Form No. 16222SL Rev F



Count on it.

Service Manual

Groundsmaster 7210

(Models with Yanmar Engine)

Revision History

| Revision | Date | Description | | | |
|----------|---------|---|--|--|--|
| A | 2016 | Initial issue. | | | |
| В | 2017 | Added Foldout Drawings. | | | |
| С | 03/2018 | Updated Engine chapter. Added Revision History and published in new format. | | | |
| D | 03/2019 | Updated Chassis chapter. | | | |
| E | 06/2020 | Updated Foldout Drawings. | | | |
| F | 06/2021 | Updated Engine chapter. | | | |
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Reader Comments

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NOTES:

Preface

The purpose of this publication is to provide the service technician with the information for troubleshooting, testing, and repair of the major systems and components of Groundsmaster 7210 machines that are powered by a Yanmar diesel engine.

Refer to the *Operator's Manuals* for operating, maintenance, and adjustment instructions. Space is provided in Chapter 2 (page 2–1) of this book to insert the *Operator's Manuals* and *Parts Catalog* for your machine. Additional copies of the *Operator's Manuals* and *Parts Catalogs* are available at www.toro.com.

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

This safety symbol means danger. When you see this symbol, carefully read the instructions that follow. Failure to obey the instructions could kill or cause serious permanent injury or disability.

WARNING

This safety symbol means warning. When you see this symbol, carefully read the instructions that follow. Failure to obey the instructions can result in serious injury.

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CAUTION

This safety symbol means caution. When you see this symbol, carefully read the instructions that follow. Failure to obey the instructions can result in minor to moderate injury.

IMPORTANT

The *Important* notice will give the important instructions which you must follow to prevent damage to the systems or components on the machine.

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

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Service Procedure Icons

The following icons appear throughout this Service Manual to bring attention to specific important details of a service procedure.



Critical Process

This icon is used to highlight:

- installing safety equipment (shields, guards, seat belts, brakes and R.O.P.S. components) that may have been removed
- dimensions or settings that must be maintained for proper machine operation
- a specific fastener tightening sequence
- · component orientation that may not be obvious



Critical Torque

This icon is used to highlight an assembly torque requirement that is different than what is recommended in the Standard Torque Tables; refer to Torque Specifications (page 2–4).



Fluid Specifications

This icon is used to highlight fluid specifications and capacities that are less common, and may not appear on the machine service decal or in the machine *Operator's Manual*.

Note: Refer to the service decal on the machine and the machine *Operator's Manual* for commonly used fluid specifications and capacities.

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Additional Reference Materials

YANMAR TNV (TIER 4) SERIES SERVICE MANUAL YANMAR TNV (TIER 4) SERIES TROUBLESHOOTING MANUAL PARKER TORQMOTOR™ SERVICE PROCEDURE (TC, TB, TE, TJ, TF, TG, TH AND TL SERIES)



Chapter 1

Safety

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Safety Instructions

The Groundsmaster 7210 machine meets or exceeds safety standard specifications as identified in the *Operator's Manuals*. Although the hazard control and accident prevention are dependent partially 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. The improper use or maintenance by the operator or owner of the machine can result in injury.

WARNING

To reduce the potential of injury or death, comply with the following safety instructions as well as information found in the *Operator's Manuals*.

Supervisor's Responsibilities

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- 1. Ensure that the operators are fully trained and familiar with the *Operator's Manuals*, *Operator's Training DVD*, and all of the operating and safety decals on the machine.
- 2. Establish your own special procedures and work rules for unusual operating conditions (e.g., slopes too steep for machine operation). Survey the mowing site completely to determine hills on which you can operate safely. When performing this site survey, always understand and take into consideration the turf condition and rollover risk. To perform a site survey, follow the procedure outlined in the *Operator's Manuals*.

Before Operating the Machine

- Review and understand the contents of the Operator's Manuals and Operator's Training DVD before starting and operating the machine. Become familiar with the controls and know how to stop the machine and engine quickly. Additional copies of the Operator's Manuals are available at www.toro.com.
- Keep all the shields, safety devices, and decals in place. If a shield, safety device, or decal is illegible or damaged, repair or replace it before operating the machine.
- Tighten any loose nuts, bolts, or screws to ensure that the machine is in safe operating condition.
- Ensure the interlock switches are adjusted correctly so that the engine does not start unless the 2 drive handles are in the NEUTRAL LOCK position, the PTO switch is in the OFF (disengaged) position, and either the seat is occupied or the parking brake is applied.
- Diesel fuel is highly flammable; handle it carefully.
 - Store fuel in containers specifically designed for storing fuel.
 - Do not remove the fuel tank cap of the machine while the engine is hot or running.
 - Do not smoke while handling fuel.
 - Fill the fuel tank outdoors and only to a level within an inch of the top of the tank, not the filler neck. Do not overfill the fuel tank.
 - Replace the fuel tank and fuel container caps securely after refuelling the machine.

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Before Operating the Machine (continued)

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

While Operating the Machine

- Sit on the seat when starting and operating the machine.
- Anytime you park the machine (short or long term), lower the cutting deck (or implement) to the ground.

IMPORTANT

When you lower the cutting deck fully to the ground, the pressure from the lift circuit releases and prevents the cutting deck from accidentally lowering.

• If you park the machine on a slope, block or chock the wheels.

Before starting the machine

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The exhaust fumes are hazardous and have the potential of injury or death.

Do not run the engine in a confined area without adequate ventilation.

- 1. Set the parking brake.
- 2. Ensure that the 2 drive handles are in the NEUTRAL LOCK position and the PTO switch is in the OFF (disengaged) position.
- 3. After you start the engine, release the parking brake and keep the 2 drive handles in the NEUTRAL LOCK position. Ensure that the machine does not move.

Note: If machine movement is evident, the traction linkage is adjusted incorrectly; therefore, shut off the engine and adjust the traction linkage until the machine does not move when the 2 drive handles are in the NEUTRAL LOCK position; refer to *Traction Unit Operator's Manual*.



Running the engine causes the engine, radiator, and exhaust system to become hot. Touching a hot engine, radiator, or exhaust system can burn you.

Do not touch the engine, radiator, or exhaust system while the engine is running or soon after you stop it.

Before stopping the machine

- 1. Ensure that the 2 drive handles are in the NEUTRAL LOCK position.
- 2. Lower and disengage the cutting deck (or implement) and wait for all moving parts to stop.
- 3. Set the parking brake.
- 4. Shut off the engine and remove the key from the key switch.

Maintenance and Service

- Before servicing or making any adjustments to the machine, lower the cutting deck (or implement), set the parking brake, shut off the engine, and remove the key from the key switch.
- Ensure that the machine is in safe operating condition by keeping all the nuts, bolts, and screws tight.
- Do not store the machine or a fuel container inside where there is an open flame, such as near a water heater or furnace.
- Ensure that all of the hydraulic line connectors are tight and that all the hydraulic hoses and lines are in good condition before applying pressure to the hydraulic system.
- Keep your body and hands away from pin-hole leaks in the hydraulic lines that eject hydraulic fluid under high pressure. Use cardboard or paper to find hydraulic leaks. The hydraulic fluid escaping under pressure can penetrate the skin and cause injury. If hydraulic fluid is accidentally injected into the skin, you must have it surgically removed within a few hours by a doctor familiar with this type of injury. Otherwise, gangrene may result.
- Before disconnecting or performing any work on the hydraulic system, release all the pressure in the system by parking the machine on a level surface, lowering the cutting deck (or implement) completely, and then shutting off the engine.
- Use eye protection when working on the hydraulic system and its components.
- If major repairs are necessary, contact your Authorized Toro Distributor.
- Use care when checking or servicing the cutting deck. Wear gloves and use caution when servicing the deck.
- To reduce potential fire hazards, keep the engine area free of excessive grease, grass, leaves, and dirt. Clean the protective screen on the machine frequently.
- If you must run the engine to perform maintenance or to make an adjustment, keep your hands, feet, clothing, and other parts of the body away from the cutting deck (implement) and other moving parts. Keep bystanders away.
- Do not overspeed the engine by changing the engine governor setting. To ensure safety and accuracy, check the maximum engine speed with a tachometer.
- Shut off the engine before checking or adding oil to the engine crankcase.
- Disconnect the batteries before servicing the machine. Disconnect the negative battery cable and then the positive cable. If battery voltage is necessary for troubleshooting or test procedures, temporarily connect the battery. Connect the positive battery cable and then the negative cable.
- Battery acid is poisonous and can cause burns. Avoid acid contact with skin, eyes, and clothing. Protect your face, eyes, and clothing when working with a battery.
- Battery gases can explode. Keep cigarettes, sparks, and flames away from the battery.

Maintenance and Service (continued)

- If welding on the machine is necessary, disconnect all the battery cables to prevent damage to the electrical system. Disconnect the negative battery cable and then the positive cable.
- Disconnect and remove the engine ECU from the machine.
- At the time of manufacture, the machine conformed to the safety standards for riding mowers. To ensure the optimum performance and continued safety certification of the machine, use genuine Toro replacement parts and accessories. The replacement parts and accessories of other manufacturers can result in non-conformance with the safety standards and can void the warranty.
- When changing the attachments, tires, or performing other service, use correct blocks, hoists, and jacks to raise and support the machine. Ensure that the machine is parked on a solid level surface, such as a concrete floor. Before you lift the machine, remove all the attachments that may interfere with the safe and correct lift of the machine. Always block the wheels with chocks. Use appropriate jack stands to support the raised machine. Failing to properly support the machine with appropriate jack stands can cause the machine to move or fall and can result in personal injury; refer to Jacking Instructions (page 1–6).

Jacking Instructions

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CAUTION

Failing to properly support the machine with appropriate jack stands can cause the machine to move or fall and can result in personal injury.

When changing the attachments, tires, or performing other services, do the following steps:

- Use correct blocks, hoists, and jacks to raise and support the machine.
- Park the machine on a solid level surface, such as a concrete floor.
- Before you lift the machine, remove all the attachments that may interfere with the safe and correct lift of the machine.
- Always block the wheels with chocks.
- Use appropriate jack stands to support the raised machine.
- Do not use the cutting deck (or implement) as a jacking point.

Raising the Front of the Machine



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Figure 2

1. Front castor wheel

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2. Front jacking point
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- 1. Set the parking brake and block the 2 rear tires with chocks to prevent the machine from moving.
- 2. Position the jack to the machine:
 - A. On machines with cutting deck, position the jack stands under the square carrier frame tube near the front castor wheel (Figure 2).
 - B. On machines with Polar Trac[™] Kit, position the jack securely under the lift arm pivot tube on the front of the machine.
- 3. Use a jack to raise the front of the machine.
- 4. After raising the front of the machine, use appropriate jack stands under the frame to support the front of the machine.

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Raising the Rear of the Machine

IMPORTANT

Do not support the machine on the wheel hubs (brake rotors).



- 1. Block the 2 front castor wheels with chocks to prevent the machine from moving.
- 2. Position the jack securely under the flat surface of the protection plate (Figure 3).
- 3. Lift the rear wheels off the ground.
- 4. Use appropriate jack stands under the frame to support the rear of the machine.

Safety and Instructional 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. Decal part numbers are listed in your *Parts Catalog*. Order replacement decals from Authorized Toro Distributor.

Chapter 2



Specifications and Maintenance

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Specifications

Insert a copy of the *Operator's Manuals* and *Parts Catalogs* for your machine at the end of this chapter. Additionally, if any optional equipment or accessories are installed to your machine, insert the *Installation Instructions*, *Operator's Manuals*, and *Parts Catalogs* for those options at the end of this chapter.

The maintenance procedures and recommended service intervals for your machine are covered in the *Operator's Manual*. Refer to this publication when performing the regular equipment maintenance.

| 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 inch | | | | 0.001 | inch = 0.02 | 54 mm | | | |

Decimal and Millimeter Equivalents

U.S. to Metric Conversions

| | To Convert | Into | Multiply By |
|--------------------|----------------|----------------------|---|
| Linear Measurement | Miles | Kilometers | 1.609 |
| | Yards | Meters | 0.914 |
| | Feet | Meters | 0.305 |
| | Feet | Centimeters | 30.48 |
| | Inches | Meters | 0.025 |
| | Inches | Centimeters | 2.54 |
| | Inches | Millimeters | 25.4 |
| Area | Square Miles | Square Kilometers | 2.59 |
| | Square Feet | Square Meters | 0.093 |
| | Square Inches | Square Centimeters | 6.452 |
| | Acre | Hectare | 0.405 |
| Volume | Cubic Yards | Cubic Meters | 0.765 |
| | Cubic Feet | Cubic Meters | 0.028 |
| | Cubic Inches | Cubic Centimeters | 16.39 |
| Weight | Tons (Short) | Metric Tons | 0.908 |
| | Pounds | Kilograms | 0.454 |
| | Ounces (Avdp.) | Grams | 28.349 |
| Pressure | Pounds/Sq. In. | Kilopascal | 6.895 |
| | Pounds/Sq. In. | Bar | 0.069 |
| Work | Foot-pounds | Newton-Meters | 1.356 |
| | Foot-pounds | Kilogram-Meters | 0.138 |
| | Inch-pounds | Kilogram-Centimeters | 1.152 |
| Liquid Volume | Quarts | Liters | 0.946 |
| | Gallons | Liters | 3.785 |
| Liquid Flow | Gallons/Minute | Liters/Minute | 3.785 |
| Temperature | Fahrenheit | Celsius | Subtract 32° Multiply by 5/9 |

Torque Specifications

The 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 the fasteners will apply to all the fasteners which do not have a specific requirement identified in this *Service Manual*. The following factors must be considered when applying the 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 head of the fastener, or similar condition which affects the installation.

As noted in the following tables, the torque values should be reduced by 25% for the lubricated fasteners to achieve the similar stress as a dry fastener. The torque values must be reduced when the fastener is threaded into the 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 checking the torque can be performed by marking a line on the fastener (head or nut) and mating part, then back off the fastener 1/4 of a turn. Measure the torque necessary to tighten the fastener until the lines match up.

Identifying the Fastener



Calculating the Torque Values When Using a Drive-Adapter Wrench



Using a drive-adapter wrench (e.g., crowfoot wrench) in any position other than 90° and 270° to the frame of the torque wrench will affect the torque value measured by the torque wrench because of the effective length (lever) of the torque wrench changes. When using a torque wrench with a drive-adapter wrench, multiply the listed torque recommendation by the calculated torque conversion factor (Figure 6) to determine proper tightening torque. When using a torque wrench with a drive-adapter wrench with a drive-adapter wrench, the calculated torque 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 457 mm (18 inches).

The measured effective length of the torque wrench with the drive-adapter wrench installed (distance from the center of the handle to the center of the drive-adapter wrench) is 483 mm (19 inches).

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

If the listed torque recommendation for a fastener is **103 to 127 N·m (76 to 94 ft-lb)**, the proper torque when using this torque wrench with a drive-adapter wrench would be **98 to 121 N·m (72 to 89 ft-lb)**.

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

| Thread Size | Grade 1, 5 and 8 with Thin Height Nuts | SAE Grade 1 Bolts, Screws, Studs, and Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts) | | Grade 1,SAE Grade 1 Bolts, Screws, Studs, and Sems withSAE Grade Studs5 and 8Studs, and Sems withStudswith ThinRegular Height NutsRegeight Nuts(SAE J995 Grade 2 or Stronger Nuts)(SAE Stronger Nuts) | | SAE Grade 5 I Studs, and Regular H (SAE J995 Stronge | Bolts, Screws, Sems with eight Nuts Grade 2 or er Nuts) | SAE Grade 8 Bolts, Screws, Studs, and Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts) | |
|------------------|---|---|------------|--|------------|--|---|---|--|
| | in-lb | in-lb | N∙cm | in-lb | N·cm | in-lb | N∙cm | | |
| # 6 - 32 UNC | 10 + 2 | 12 + 2 | 147 + 02 | 15 ± 2 | 169 ± 23 | 23 ± 3 | 262 ± 34 | | |
| # 6 - 40 UNF | 10 ± 2 | 13 ± 2 | 147 ± 23 | 17 ± 2 | 192 ± 23 | 25± 3 | 282 ± 34 | | |
| # 8 - 32 UNC | 12 + 2 | 25 + 5 | 202 + 56 | 29 ± 3 | 328 ± 34 | 41± 5 | 463 ± 56 | | |
| # 8 - 36 UNF | 13 ± 2 | 20 ± 5 | 202 ± 30 | 31 ± 4 | 350 ± 45 | 43 ± 5 | 486 ± 56 | | |
| # 10 - 24 UNC | 10 1 0 | 20 I F | 220 + 56 | 42 ± 5 | 475 ± 56 | 60 ± 6 | 678 ± 68 | | |
| # 10 - 32 UNF | 10 ± 2 | 30 ± 5 | 339 ± 30 | 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 | 1146 ± 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: The torque values must be reduced when installing the fasteners into threaded aluminum or brass. The specified torque value should be determined based on the aluminum or base material strength, fastener size, 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 \pm 10% of the nominal torque value. The thin height nuts include jam nuts.

Note: Reduce the 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 a thread sealant, such as Loctite.

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

| Thread Size | Class 8.8 Bolt Studs with Reg (Class 8 or S | s, Screws, and ular Height Nuts tronger Nuts) | Class 10.9 Bolt Studs with Regu (Class 10 or S | s, Screws, and ular Height Nuts 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: The torque values must be reduced when installing the fasteners into threaded aluminum or brass. The specified torque value should be determined based on the aluminum or base material strength, fastener size, 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 \pm 10% of the nominal torque value.

Note: Reduce the 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 a thread sealant, such as Loctite.

Other Torque Specifications

| Throad Size | Recommended Torque | | | | | |
|---------------|--------------------|----------------|--|--|--|--|
| Thread Size | 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 | | | | |

SAE Grade 8 Steel Set Screws

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 | | | |

Wheel Bolts and Lug Nuts

| Thread Size | Recommend | ded 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)

| Thread Size | Threads per Inch | | Beeeline Tergue** |
|-------------|------------------|--------|-------------------|
| | Туре А | Туре В | Baseline Torque |
| 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 |

**The hole size, material strength, material thickness, and material finish must be considered when determining the specified torque values. All the torque values are based on the non-lubricated fasteners.

Conversion Factors

in-lb X 11.2985 = N·cm

ft-lb X 1.3558 = N·m

 $N \cdot cm \ X \ 0.08851 = in-lb$ $N \cdot m \ X \ 0.7376 = ft-lb$

Shop Supplies

The procedures found in this *Service Manual* may recommend the use of commonly used shop supplies (lubricants, sealants, and adhesives). A symbol denoting the use of a shop supply may appear in figures that support a procedure. Always refer to the written procedure for specific information regarding the type and the application of a shop supply.

IMPORTANT

Always follow manufacturers instructions when using or storing shop supplies.

Anti-seize lubricant Used to prevent corrosion, galling, and seizure between metal parts. Most often applied to shafts and bores during assembly. Unless otherwise specified, high viscosity regular grade lithium-graphite based anti-seize lubricant should be used. Grease Can be used to pre-fill (pack) bearings, boots, and seals before assembly, ease installation of components during assembly, or fill cavities between moving parts through grease fittings after assembly. Unless otherwise noted, refer to the machine Operator's Manual or Installation Instructions for grease specifications. Thread locking compound (Threadlocker) Used to lock threaded fasteners in position. Available in low, medium, and high strength for various size fasteners and applications. Most thread locking compounds are applied immediately before fastener installation. Some thread locking compounds use a wicking feature, and can be applied after fastener installation. Most thread locking compounds allow the fastener to be removed with standard tools once cured. High strength thread locking compounds may require applying heat to the fastener and the surrounding area to allow fastener removal. Note: Some fasteners have a dry thread locking compound pre-applied (patch-loc) so no additional thread locking compound is necessary when installing a new fastener. These fasteners are designed to be removed and re-installed only once before applying additional thread locking compound is necessary. Retaining compound (bearings and sleeves) An adhesive used to secure bearings, bushings, and cylindrical parts into housings or onto shafts. When cured, bearing and sleeve retaining compound fills the gap between mating parts with a hard resin that increases load distribution and protects against corrosion. Adhesive Used to secure a variety of components immediately prior to assembly. May be recommended for installing new components or when reusing a component that had a pre-applied adhesive such as hood seals, mouldings, and weather-stripping. Thread sealant Used to seal threaded fittings and sensors from air, fuel, and oil pressure leaks and prevent galling and seizure between threaded parts. A thread sealant in paste firm is preferred over sealant tape. The sealant should remain semi-pliable to allow for component removal with standard tools. Some thread sealants may require the use of a cleaner or primer before use. Gasket compound Used to create a seal between mating parts. Gasket compounds may be used with or without the presence of a pre-formed gasket. Gasket compounds may be solvent or silicone based, and cure when exposed to air or designed to cure in an air-less environment (anaerobic). Most gasket compounds are designed to be applied to clean surfaces free of oil, chemical residue and previously used gaskets or gasket compounds. Silicone sealant Designed for a broad variety of sealing and bonding requirements, silicone sealants are usually room temperature vulcanizing (RTV) which form a flexible silicone rubber that bonds to a wide variety of smooth or porous materials when cured. Standard silicone sealants are designed to perform in temperatures from -51°F to 232°C (-60°F to 400°F), while high temperature variants can preform in temperatures up to 343°C (650°F).

Special Tools

You can order these special tools from your Toro Distributor. Some tools may also be available from a local tool supplier.

Hydraulic Pressure Testing Kit

Toro Part No. TOR47009

Use this kit to take various pressure readings for diagnostic tests. Quick disconnect fittings are provided to attach directly to the mating fittings on the machine test ports without the tools. A high-pressure hose is given for remote readings. Contains 1 each: 6,900 kPa (1,000 psi), 34,500 kPa (5,000 psi), and 69,000 kPa (10,000 psi) gauges.



57 LPM (15 GPM) Hydraulic Tester Kit

Toro Part No. TOR214678

Use this tester to test the hydraulic circuits and components for flow and pressure capacities. The tester flow measurement maximum is 57 LPM (15 GPM). This tester includes the following:

Inlet Hose – This hose connects the system circuit to the inlet side of the hydraulic tester.

Load Valve – Turn the valve to restrict the flow to create a simulated working load in the circuit.

Pressure Gauge – A glycerine filled pressure gauge 0 to 34,500 kPa (0 to 5,000 psi) to provide operating circuit pressure.

Flow Meter – This meter measures the actual fluid flow in the operating circuit with a gauge rated at 5 to 55 LPM (1 to 15 GPM).

Outlet Hose – A hose from the outlet side of the hydraulic tester that connects to the hydraulic system circuit.

Fittings – An assortment of hydraulic fittings are included with this kit.



150 LPM (40 GPM) Hydraulic Tester

Toro Part No. AT40002

Use this tester to test the hydraulic circuits and components for flow and pressure capacities. The tester flow measurement maximum is 151 LPM (40 GPM). This tester includes the following:

Load Valve – Turn the valve to restrict the flow to create a simulated working load in the circuit.

Pressure Gauge – A glycerine filled pressure gauge 0 to 34,500 kPa (0 to 5,000 psi) to provide operating circuit pressure.

Flow Meter – This meter measures the actual fluid flow in the operating circuit with a gauge rated at 20 to 150 LPM (4 to 40 GPM).

Note: This tester does not include any hydraulic hoses or fittings; refer to Hydraulic Hose Kit Toro Part No. TOR6007 and Hydraulic Test Fitting Kit Tor Part No. TOR4079.

Hydraulic O-Ring Kit

Toro Part No. 117-2727

This kit includes O-rings in a variety of sizes for the face seal and port seal hydraulic connections. To help prevent a hydraulic leak, replace the O-rings when you open the hydraulic connection.



Toro Part No. TOR6007

This kit includes the fittings and hoses that are used to connect high flow hydraulic filter kit (TOR6011) to the machine hydraulic traction system components.







Hydraulic Test Fitting Kit

Toro Part No. TOR4079

This kit includes a variety of O-ring face seal fittings to let you connect the test gauges into the system.

| FITTING TYPE | SIZE | PART NUMBER |
|--|--|-------------|
| | 4 ORFS (9/16–18) | TOR4079–3 |
| | 6 ORFS (11/16–16) | TOR4079-12 |
| | 8 ORFS (13–16–16) | TOR4079-4 |
| | 10 ORFS (1–14) | TOR4079–5 |
| SWIVEL NUT RUN TEE (2 each) | | |
| | 4 ORFS (9/16–18) | TOR4079–13 |
| | 6 ORFS (11/16–16) | TOR4079–14 |
| | 8 ORFS (13–16–16) | TOR4079–15 |
| PLUG (2 each) | 10 ORFS (1–14) | TOR4079–16 |
| | 4 ORFS (9/16–18) | TOR4079–17 |
| | 6 ORFS (11/16–16) | TOR4079–18 |
| | 8 ORFS (13–16–16) | TOR4079–19 |
| CAP (2 each) | 10 ORFS (1–14) | TOR4079–20 |
| | 6 ORFS (11/16–16) to 8 SAE-ORB (3/4–16) | TOR4079–8 |
| | 8 ORFS (13–16–16) to 8 SAE-ORB (3/4–16) | TOR4079–9 |
| UNION (1 each) | 10 ORFS (1–14) to 8 SAE-ORB (3/4–16) | TOR4079–2 |
| | 10 ORFS (1–14) to 8 SAE-ORB (3/4–16) | TOR4079–7 |
| | 12 ORFS (1 3/16–12) to 8 SAE-ORB (3/4–16) | TOR4079–6 |
| REDUCER (1 each) | | |
| | 4 ORFS (9/16–18) | TOR4079–10 |
| | 6 ORFS (11/16–16) | TOR4079–11 |
| | 8 ORFS (13/16–16) | TOR4079-21 |
| TEST CONNECTOR – FEMALE THREAD (2 each) | 10 ORFS (1–14) | TOR4079–1 |
| | 4 SAE-ORB (7/16–20) | TOR4079–22 |
| | 1/8 NPTF | TOR4079–23 |
| TEST CONNECTOR – MALE THREAD (2 each) | | |

High Flow Hydraulic Filter Kit

Toro Part Number: TOR6011

The high flow hydraulic filter kit is designed with large flow (150 L/minute or 40 gallons/minute) and high pressure (34,500 kPa or 5,000 psi) capabilities. This kit provides for bi-directional filtration which prevents filtered unwanted material from entering into the circuit regardless of the flow direction.

If a component failure occurs in the closed loop traction circuit, contamination from the damaged part will remain in the circuit until you remove it. Install a high flow hydraulic-fluid filter into the circuit when you connect the hydraulic test gauges in order to test the traction circuit components or after you replace a failed traction circuit component (e.g., piston pump or wheel motor). This filter removes contamination from the hydraulic fluid in the traction circuit, thereby preventing additional component damage.

Note: This kit does not include the hydraulic hoses; refer to Hydraulic Hose Kit (page 2–12).



Note: The replacement filter element is Toro Part No. TOR6012. The filter element canister tightening torque is **34** N·m (**25** ft-lb).

Remote Starter Switch

After flushing the hydraulic system or replacing a hydraulic component (e.g. gear pump, piston pump, drive motor), it is necessary to prime the hydraulic pumps. A remote starter switch can be used for this purpose. A remote starter switch can be purchased locally or fabricated as follows.

IMPORTANT: When using a remote starter switch, it is highly recommended to include a 20 amp in-line fuse between the battery and switch connector for circuit protection.

A remote stater switch can also be constructed using Toro switch #106-2027, a length of 14 gauge wire, a 20 amp in-line fuse, two (2) alligator clips and necessary connectors. Connecting the wire to switch terminals 1 and 2 will allow the momentary switch contacts to be used for the remote starter switch.

Note: For information on using the remote starter switch to prime the hydraulic pumps.





Remote Starter Switch (fabricated)

Multimeter

Obtain this tool locally

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

Note: Use a digital multimeter when testing the electrical circuits. The high impedance (internal resistance) of a digital meter in the voltage mode ensures that the excess current is not allowed through the meter. This excess current can damage the circuits that are not designed to carry it.



Battery Terminal Protector

Toro Part No. 107-0392

Use this aerosol spray on the battery terminals, ring terminals, and fork terminals to reduce corrosion problems. Apply the terminal protector to the connection after you secure the battery cable, ring terminal, or fork terminal.





Diesel Engine

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Additional Reference Materials

YANMAR TNV (TIER 4) SERIES SERVICE MANUAL YANMAR TNV (TIER 4) SERIES TROUBLESHOOTING MANUAL

Specifications

| ltem | Description |
|------------------------|---|
| Make/Designation | Yanmar Model 3TNV88C-DTR2: 4-cycle, 3 cylinder common-rail water cooled diesel with EGR and diesel-particulate filter (DPF). EPA Tier 4 Final compliant. |
| Bore | 88 mm (3.46 inches) |
| Stroke | 90 mm (3.54 inches) |
| Total displacement | 1642 cm ³ (100.2 in ³) |
| Firing order | 1 (closest to the flywheel end) - 3 - 2 |
| Direction of rotation | Counterclockwise (viewed from the flywheel) |
| Fuel | Diesel or Biodiesel fuel (up to B7) with ultra-low sulfur content |
| Fuel tank capacity | 43.5 L (11.5 US gallons) |
| Fuel injection pump | Yanmar supply pump |
| Fuel injection type | Common rail system (EPA Tier 4 certified) |
| Governor | Electronic |
| Low idle (no load) | 1,400 rpm |
| High idle (no load) | 3,000 rpm |
| Engine oil | API CJ-4 or higher |
| Engine-oil viscosity | Refer to the Traction Unit Operator's Manual |
| Crankcase-oil capacity | 4.7 L (5 qt) |
| Oil pump | Yanmar trochoid pump |
| Coolant capacity | 6.6 L (7 qt) |
| Alternator/Regulator | 12 VDC, 55 A |
| Engine weight (dry) | 188 kg (414 lb) |

General Information

This chapter gives information about specifications and repair of the Yanmar diesel engine used in the Groundsmaster 7210 machine. The general maintenance procedures are described in the *Operator's Manual*. Detailed information on engine troubleshooting, testing, disassembly, and assembly is identified in the Yanmar Service Manual and Yanmar Troubleshooting Manual.

Additionally, some engine repair procedures are described in this manual. The described adjustments and repairs require tools which are commonly available in many service shops. Special tools are described in the Yanmar Service Manual. The use of some specialized test equipment is explained. 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 the Yanmar engines are supplied through your Authorized Toro Distributor. If the parts list is not available, provide your distributor with the Toro Model and Serial Number of your machine.

Traction Unit Operator's Manual

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

Yanmar Service and Troubleshooting Manuals

The engine that powers your Groundsmaster machine is a Yanmar Model 3TNV88C (used on Groundsmaster 7210 Models 30616, 30617, 30618, 30619, 30633, and 30695), a Tier 4F compliant engine. The Yanmar Service Manual and Yanmar Troubleshooting Manual are available for these engines. Ensure that the correct engine manuals are used when servicing the engine on your machine.

Engine Electronic Control Unit (ECU)

The Yanmar engine used in the Groundsmaster 7210 machine uses an electronic control unit (ECU) for engine management and to communicate with operator InfoCenter on the machine. The engine ECU is located on the left side of the machine frame near the engine.

IMPORTANT

Do not plug or unplug the engine ECU for 30 seconds after the machine key switch is turned off. The engine ECU may remain energized even though the key switch is in the OFF position.

If you must disconnect the engine ECU for any reason, ensure that the key switch is in the OFF position with the key removed before disconnecting the engine ECU. Also, to prevent possible ECU damage when welding on the machine, disconnect and remove the engine ECU from the machine before welding.

The engine electrical components (e.g., ECU, fuel injectors, EGR, and exhaust DPF) are identified and matched in the engine ECU program. If engine electrical components are replaced, the Yanmar electronic tool must be used to update the ECU program which will ensure correct engine operation.

Engine Electronic Control Unit (ECU) (continued)

If the engine ECU identifies that an engine problem exists, the engine speed may be reduced or the engine may shut off. The Yanmar troubleshooting manual and electronic diagnosis tool and should be used to provide assistance in identifying the cause of the problem and the repairs that are necessary. Contact your Toro distributor for assistance in Yanmar engine troubleshooting.

Yanmar Engine



The engine used on your Groundsmaster is a Yanmar TNV Series, diesel engine that complies with EPA Tier 4F emission regulations. The engine features include an electronic control unit (ECU) that controls a common rail fuel injection system with direct injection, water- cooled exhaust gas recirculation (EGR), an electronic governor, an exhaust system diesel oxidation catalyst (DOC), and an exhaust diesel-particulate filter (DPF) with active regeneration. Glow plugs are used to assist starting the engine. Numerous engine sensors are used to allow the engine ECU to monitor and control the engine operation for optimum engine performance.

The engine ECU, combined with numerous engine sensors, monitor and control the engine operation for optimum performance. During the operation of the engine, if conditions warrant, the engine ECU may generate an engine fault. Use the machine InfoCenter to identify the engine fault; refer to Starting Problems (page 5–16), the Yanmar Troubleshooting Manual, or contact an Authorized Toro Distributor for assistance.

Diesel Particulate Filter (DPF)

g036118

The diesel particulate filter (DPF) used on Yanmar Tier 4F compliant engines is designed to breakdown the hazardous elements in the exhaust and prevent the discharge of unburnt fuel or oil known as particulate matter or soot. The DPF includes a Diesel Oxidation Catalyst (DOC), a Soot Filter (SF), 2 temperature sensors, and a pressure differential sensor. Additional information regarding the
Diesel Particulate Filter (DPF) can be found in the Yanmar Operation Manual -Industrial Engines TNV supplied with your machine.

Regeneration

The engine ECU monitors the exhaust pressure before and after the soot filter in the DPF to determine if soot is accumulating. If soot is accumulating during normal engine operation, the pressure differential will increase. The increase in pressure will signal the engine to begin a process called Regeneration. Regeneration increases the exhaust temperature and the length of time the engine operates at a higher than normal exhaust temperature, incinerating the built up soot and turning it into ash. The different types of regeneration used are listed in order based on the amount of particulate matter in the soot filter (least to most).

Note: The user interface and InfoCenter displays for DPF regeneration changed with machine software 122-0127E. Use the InfoCenter About screen to verify the software installed on the machine.

- For machines with software 122-0127A thru D: Complete DPF regeneration instructions can be found in the updated traction unit *Operator's Manual* for the specific machine. Visit www.toro.com to download the updated traction unit *Operator's Manual* for the machine.
- For machines with software 122-0127E and up: Complete DPF regeneration instructions can be found in the traction unit *Operator's Manual*. Visit www.toro.com to download the traction unit *Operator's Manual* with the correct DPF regeneration instructions for the machine.

| Туре | Conditions | Description |
|---------|--|--|
| Passive | Occurs during normal operation of the machine at high engine speed or high engine load | The DPF processes high heat exhaust gasses, oxidizing harmful emissions and incinerating soot to ash. |
| | | The InfoCenter does not display an icon during passive regeneration. |
| Assist | Occurs because of prolonged operation at low engine speed, low engine load, or when the engine ECU detects the soot filter is becoming obstructed. | The engine ECU adjusts the exhaust intake throttle to raise the exhaust temperature. For software 122-0127A thru D only: the InfoCenter displays the assist regeneration icon. |
| Reset | Occurs every 100 hours of engine operation Occurs after an assist regeneration if the engine ECU determines the assist regeneration did not sufficiently reduce the soot level Note: Reset regeneration may be temporarily delayed if high exhaust temperatures would create an unsafe condition (the machine is operating indoors or outdoors around trees, brush, tall grass, or other temperature-sensitive plants or materials). Refer to Setting the Inhibit Regen in the traction unit <i>Operators Manual</i> for additional information. | The engine ECU adjusts the exhaust intake throttle and the injector timing to raise the exhaust temperature. For all software revisions: the InfoCenter displays the high exhaust temperature icon. |

Types of regeneration that are performed automatically (while the machine is operating)

Regeneration (continued)

Types of regeneration that are performed manually (while the machine is stationary)

| Туре | Conditions | Description |
|----------|--|---|
| Parked | Occurs when exhaust back pressure in the DPF increases due to continued soot buildup. May be caused by prolonged operation at low engine speed, low engine load, or the use of incorrect fuel or engine oil. | Manually initiate a parked regeneration as soon as possible. A parked regeneration will take approximately 30 to 60 minutes and should not be started with less than 1/4 tank of fuel. The machine must remain stationary (cannot be operated) during the entire parked regeneration process. |
| | May occur if the InfoCenter is set to inhibit regen (preventing a Reset Regeneration) and machine operation is continued. Can be initiated when prompted by the engine ECU or after a minimum of 50 hours of engine operation. | For all software revisions: the InfoCenter displays advisory #188 and/or the stationary regeneration icon |
| | For software 122-0127E and up: if a parked regeneration is ignored, the machine mow function (PTO) will be disabled approximately 2 hours after the first notification. | |
| Recovery | Occurs when exhaust back pressure in the DPF increases due to soot buildup reaching a critical level. Can only be initiated when prompted by the engine ECU. For software 122-0127E and up: the machine mow function (PTO) will be disabled at first notification. | Manually initiate a recovery regeneration as soon as possible. A recovery regeneration will take approximately 3 hours and should not be started with less than 1/2 tank of fuel. The machine must remain stationary (cannot be operated) during the entire recovery regeneration process. Use the InfoCenter About screen to verify the software installed on the machine. Machines with software 122-0127A thru D: Recovery regeneration must be initiated by an Authorized Toro Distributor service technician using Yanmar SMARTASSIST-Direct Machines with software 122-0127E and up: Recovery regeneration can be initiated from the machine InfoCenter For software 122-0127A thru D only: the InfoCenter displays the recovery regeneration icon. For software 122-0127E and up: the InfoCenter displays advisory #190 and/or the stationary regeneration icon. Note: Verify the model and serial number of the engine installed in the machine. 3TNV88C-DTR2 engines below serial number 02254 cannot run a recovery regeneration without first reprogramming the engine ECU. Contact an Authorized Toro Distributor |

Soot Accumulation

If the types of regeneration that are performed automatically (while the machine is operating) are bypassed or not allowed to complete before shutting off the engine, soot will continue to accumulate in the soot filter. When enough soot accumulates, the engine ECU will generate an engine fault to prompt a parked or recovery regeneration. In addition to an engine fault appearing on the InfoCenter, the engine output power will be reduced.

Soot Accumulation Engine Faults

| Fault Level | Fault Code | Engine Power Rating | Recommended Action |
|-------------------------|--|---------------------|---|
| Level 1: Engine Warning | ADVISORY #179 | De-rated to 85% | Perform a parked regeneration as soon as possible. |
| Level 2: Engine Warning | Check Engine SPN: 3251 FMI: 0 Occ: 1 See Service Manual | De-rated to 50% | Perform a recovery regeneration as soon as possible |

Ash Accumulation

Ash is a result of the regeneration processes. The lighter ash is discharged through the exhaust system, while the heavier ash collects in the soot filter. When enough ash accumulates in the soot filter, the engine ECU will generate an engine fault to prompt servicing the DPF. In addition to an engine fault appearing on the InfoCenter, the engine output power and speed will be reduced.

Ash Accumulation Advisories and Engine Faults

| Fault Level | Fault Code | Engine Power Rating | Engine Speed Reduction | Recommended Action |
|---|--|------------------------|-----------------------------|---|
| System Advisory (machine software 122-0127A thru D only) | ADVISORY #179 | 100% | None | Plan to service the DPF in the near future |
| Level 1: Engine Warning | Check Engine SPN: 3251 FMI: 0 Occ: 1 See Service Manual | De-rated to 85% | None | Service the DPF; Exhaust System (page 3–10) |
| Level 2: Engine Warning | Check Engine SPN: 3251 FMI: 0 Occ: 1 See Service Manual | De-rated to 50% | None | Service the DPF; Exhaust System (page 3–10) |
| Level 3: Engine Warning | Check Engine SPN: 3251 FMI: 0 Occ: 1 See Service Manual | De-rated to 50% | Maximum torque + 200 rpm | Service the DPF; Exhaust System (page 3–10) |

Service and Repairs

Air Cleaner System



Removing the Air Cleaner System

Note: Refer to the *Traction Unit Operator's Manual* for the maintenance procedures and intervals of the air cleaner.

Removing the Air Cleaner System (continued)



- 1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
- 2. Unlatch the hood and raise it.
- 3. Remove the air cleaner components as shown in Figure 8 and Figure 9.
- 4. Examine the air cleaner housing and cover for wear or damage that could cause possible air leaks.

IMPORTANT

Leaks in the air filter system will allow dirt to enter into the engine and can cause serious engine damage. Ensure that all the air cleaner components are in good condition and are properly secured during installation.

- 5. Examine the air inlet hoses for wear or damage, replace the hose that is worn or damaged.
- 6. Inspect and replace the damaged hood seals.

Installing the Air Cleaner System

- 1. Assemble the air cleaner system as shown in Figure 8 and Figure 9.
 - A. Ensure that the vacuator valve (item 4 in Figure 9) is pointed down after installation.
 - B. Ensure that the inlet hose (item 7 in Figure 8) has clearance around it at all the points after you complete installation of air cleaner.
 - C. If the service indicator (item 1 in Figure 9) and nipple were removed from the housing, apply sealant to the threads of the nipple, torque the nipple to **3.4 N·m (30 in-lb)**, and install the service indicator onto the nipple.
- 2. Lower the hood and secure it with the latches.

Exhaust System



1. 2.

3.

4.

5.

6.

7.

8.

9.

10.

11. 12.

| Gasket | 13. | DPF gasket (2 each) | 25. | Sensor pipe assembly | 37. | Connector clip (2 each) |
|--------------------|-----|--------------------------|-----|-----------------------|-----|-------------------------|
| DPF stay | 14. | Bolt (16 each) | 26. | Sensor pipe assembly | 38. | Bolt (2 each) |
| DPF stay | 15. | DPF lifter | 27. | Exhaust hose assembly | 39. | Bolt (3 each) |
| DPF stay | 16. | DPF stiffener (5 each) | 28. | Hose clip (2 each) | 40. | Bolt (4 each) |
| DPF stay | 17. | DPF stiffener | 29. | Exhaust hose assembly | 41. | Bolt (2 each) |
| DPF unit | 18. | DPF stiffener | 30. | Hose clip (2 each) | 42. | Bolt (2 each) |
| Temperature sensor | 19. | DPF stiffener | 31. | Pressure sensor | 43. | Bolt (2 each) |
| Temperature sensor | 20. | Bolt (2 each) | 32. | Sensor bracket | 44. | Nut (2 each) |
| DPF assembly | 21. | Nut (16 each) | 33. | Bolt (2 each) | 45. | Nut (4 each) |
| Doc-case | 22. | Pressure sensor unit | 34. | Bolt (2 each) | 46. | Exhaust manifold |
| Soot-case filter | 23. | Pipe joint bolt (2 each) | 35. | Clip band | | |
| DPF silencer | 24. | Sensor gasket (4 each) | 36. | Band | | |

Figure 10

The engine that powers your Groundsmaster 7210 machine is a Yanmar model 3TNV88C with EPA Tier 4F emission regulations. The engine is equipped with an exhaust system that includes a diesel oxidation catalyst (DOC) and a diesel-particulate filter (DPF).

These exhaust components require service or component replacement at regular intervals, refer to the *Operator's Manual*.

At recommended intervals, DPF reconditioning is necessary which will require exhaust system disassembly, DPF removal, and DPF reconditioning that is done by a company that has necessary equipment. Once the DPF has gone through the reconditioning process, it can be re-installed in the exhaust system. Contact your Toro Distributor for information on reconditioning the DPF.

The diesel oxidation catalyst (DOC) has a service life expectancy and requires replacement at recommended intervals. Replacement of the DOC will require exhaust system disassembly, removal of the existing DOC and installation of the new DOC.

Additional information about the diesel-particulate filter (DPF) operation and maintenance can be found in the Yanmar Service Manual and the Yanmar Troubleshooting Manual.

Removing the Exhaust System



A hot engine and exhaust system can cause burns.

Allow the engine and the exhaust system to cool before working on or near them.

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.



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- 1. Flange nut (2 each)
- 2. Screw (2 each)
- 3. Exhaust support

- Figure 11
 - 4. Exhaust clamp (2 each)
 - 5. Exhaust tube
 - 6. Diesel-particulate filter (DPF)

Removing the Exhaust System (continued)

- 2. Unlatch the hood and raise it.
- 3. Remove the exhaust tube as shown in Figure 11.

Note: The exhaust system DPF and DOC can be removed from the exhaust system without removing the entire exhaust from the engine. Refer to the Yanmar Service Manual for complete disassembly and assembly procedures.

- 4. Disconnect all the electrical connectors from the DPF.
- 5. Remove the 2 nuts (item 44 in Figure 10) that attach the DPF to the DPF stay.
- 6. Remove the 4 nuts (item 45 in Figure 10) that attach the DPF to the exhaust manifold.
- 7. Remove the 2 bolts (item 43 in Figure 10) that attach the DPF stiffener to the DPF stay.
- 8. Remove the DPF from the engine.
- 9. Remove and discard the gasket (item 1 in Figure 10).

Installing the Exhaust System

Note: Ensure that all of the sealing surfaces of the exhaust system are free of unwanted material or damage that can prevent a tight seal.

- 1. Install new gasket on the exhaust manifold (item 46 in Figure 10).
- 2. Position the DPF on the engine.

Note: Finger tight all the fasteners to avoid stressing of exhaust system components and finally tighten the fasteners in order of exhaust system flow i.e. manifold or header to block, tube to muffler, muffler to DOC, DOC to exhaust tube.

- 3. Install the 2 nuts (item 44 in Figure 10) to attach the DPF to the DPF stay; torque the nuts to **11 to 21 N·m (8 to 15 ft-lb)**.
- 4. Install the 4 nuts (item 45 in Figure 10) to attach the DPF to the exhaust manifold; torque the nuts to **11 to 21 N·m (8 to 15 ft-lb)**.
- 5. Install the 2 bolts (item 43 in Figure 10) to attach the DPF stiffener to the DPF stay; torque the bolts to **21 to 31 N·m (15 to 23 ft-lb)**.
- 6. Connect all the electrical connectors to the DPF.
- 7. Assemble all the exhaust system components that were removed as follows:



A. If the exhaust temperature sensors (items 7 and 8 in Figure 10) were removed, tighten the sensors to **25 to 40 N**⋅**m** (**19 to 29 ft-lb**).

- B. If the sensor pipe assemblies (items 25 and 26 in Figure 10) were removed, replace the sensor gaskets on both sides of the sensor pipe assemblies. Tighten the pipe joint bolts to 45 to 55 N·m (33 to 40 ft-lb).
- C. If the DPF stiffeners (items 16, 17, 18, and 19 in Figure 10) were loosened or removed, tighten the fasteners that secure the stiffeners to 21 to 31 N·m (15 to 23 ft-lb) before you tighten the fasteners that secure the exhaust system to the DPF stays.
- 8. Install the exhaust tube as shown in Figure 11.
- 9. Lower the hood and secure it with the latches.

Radiator



Isolator mount (3 each) 4.

16.

17.

18.

19.

20.

21.

22.

Screw (2 each)

Rubber grommet

Bulkhead bracket

Flange nut (2 each)

Flange nut (4 each)

O-ring

- 5. Clip (4 each)
- 6. Hose clamp (3 each)
- Lower radiator hose 7.
- 8. Hose clamp
- 9. Bulb seal (2 each)
- 10. Screw (4 each)
- 11. Lower hydraulic tube
- 26. Overflow tank Hydraulic hose (2 each) 27. Worm clamp 28. Coolant hose 29. Bottle bracket 30. Grommet (2 each)
 - 31. Carriage screw (2 each) 42.
 - 32. Tie clip (3 each)
 - 33. Upper hydraulic tube
- 37. Radiator cap 38. O-ring 39. 90° Hydraulic fitting (2 each) 40. Flange nut (2 each) 41. Carriage screw (2 each) Bottom shroud 43. Plastic plug (2 each)

Top shroud

44.

Removing the Radiator

- 1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
- Unlatch the hood and raise it.

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DANGER

If the radiator or engine is hot, pressurized hot coolant can escape and cause burns.

Do not open the radiator cap or drain the radiator when the coolant is hot.

WARNING

Ethylene-glycol antifreeze is poisonous.

Keep coolant away from children and pets.

Keep the coolant in a labeled container.

Discard the coolant in accordance with local hazardous waste ordinances.

3. Remove the radiator cap (item 5 in Figure 13) from the radiator.



- 4. Remove the pipe plug (item 6 in Figure 13) from the bottom of the radiator and completely drain the coolant from the radiator into a suitable container.
- 5. Disconnect the following hoses from the radiator:
 - The upper radiator hose (item 35 in Figure 12) that is connected to the water pump.

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Removing the Radiator (continued)

- The lower radiator hose (item 7 in Figure 12) that is connected to the engine block.
- The coolant hose (item 28 in Figure 12) that is connected to the overflow tank.
- 6. Align a drain pan under the 90° hydraulic fitting of the oil cooler.
- Disconnect the upper and lower hydraulic tubes (items 33 and 11 in Figure 12) from the 90° hydraulic fittings in the oil cooler.
- 8. Remove the (2 each) 90° hydraulic fittings from the oil cooler.
- 9. Remove the 2 bolts (item 2 in Figure 12) and 2 flange nuts that attach the cooling bracket to the radiator frame, and remove the cooling bracket.
- 10. Remove the top shroud (item 44 in Figure 12) from the machine.
- 11. Remove the bottom shroud fasteners from the radiator.
- 12. Move the shroud away from the radiator to allow oil cooler and radiator to be removed from the machine.
- 13. Carefully remove the oil cooler and radiator from the machine.
- 14. Cover or plug the oil cooler, radiator, and the disconnected coolant and hydraulic hoses to prevent contamination.
- 15. If necessary, separate the oil cooler from the radiator (Figure 13).
- 16. Check the condition of the rubber isolator mounts (item 4 in Figure 12) and replace the mounts if damaged.
- 17. Check the condition of the bulb seals (items 9 and 36 in Figure 12) and replace the bulb seals if damaged.

Installing the Radiator

- 1. If removed, install the bottom shroud (item 42 in Figure 12).
- 2. If separated, assemble the radiator to the oil cooler (Figure 13).
- 3. Remove the covers and plugs from the oil cooler, radiator, and the disconnected coolant and hydraulic hoses that were installed during removal.
- 4. Carefully align the oil cooler and radiator with the radiator frame.
- 5. Install the top shroud (item 44 in Figure 12) to the radiator.
- 6. Ensure that equal clearance exists at all points between the fan shroud and fan.
 - A. To move the fan shroud left or right, adjust the location of the radiator in the radiator frame.
 - B. To move the fan shroud up or down, adjust the location of the shroud on the radiator.
- 7. Install the cooling bracket (item 1 in Figure 12) to the radiator frame, press the cooling bracket at the top with enough force to compress the bulb seal to a maximum thickness of 6.35 mm (0.25 inch) before tightening the fasteners.
- 8. Connect the following hoses to the radiator:
 - The upper radiator hose that is connected to the water pump.
 - The lower radiator hose that is connected to the engine block.
 - The coolant hose that is connected to the overflow tank.
- 9. Use new O-rings and lubricate the O-rings with clean hydraulic fluid before installing the 90° hydraulic fittings.
- 10. Install the (2 each) 90° hydraulic fittings into the oil cooler.

Installing the Radiator (continued)

- 11. Connect the upper and lower hydraulic tubes to the 90° hydraulic fittings in the oil cooler.
- 12. Apply thread sealant to the threads of the pipe plug (item 6 in Figure 13). Install the plug into the radiator opening.
- 13. Install the radiator cap (item 5 in Figure 13) to the radiator.
- 14. Check that no gaps exist between the radiator, radiator frame, and machine frame.
- 15. Fill the radiator with coolant; refer to the Traction Unit Operator's Manual.

Note: Ensure that the overflow tank coolant level is correct.

- 16. Add hydraulic fluid to the hydraulic reservoir as necessary to raise the hydraulic-fluid level to the operating range; refer to the *Traction Unit Operator's Manual*.
- 17. Add the fluids as necessary and run the engine to the operating temperature.
- 18. Check for leaks. Repair any leaks as required.
- 19. Once at operating temperature, check the coolant level and fill the coolant reservoir as necessary.
- 20. Lower the hood and secure it with the latches.

Fuel System



| 2. | Left-vent tube | 13. | Hinge |
|-----|--------------------|-----|-------------|
| 3. | Vent hose (2 each) | 14. | Spacer |
| 4. | Screw (6 each) | 15. | Rubber w |
| 5. | Tool box cover | 16. | Plain was |
| 6. | Instruction decal | 17. | Flat wash |
| 7. | Keps nut (3 each) | 18. | Screw |
| 8. | Fuel cap (2 each) | 19. | Fuel pum |
| 9. | Elbow fitting | 20. | Flange nu |
| 10. | Fuel return hose | 21. | Strainer fi |
| | | | |

11. Left fuel ta

| tube | 12. | Elbow fitting | 23. | Flange nut (2 each) | 34. | Hydraulic tee fitting (2 each) |
|----------|-----|---------------------------|-----|---------------------|-----|--------------------------------|
| ıbe | 13. | Hinge | 24. | Foam pad (4 each) | 35. | Fuel return hose |
| (2 each) | 14. | Spacer | 25. | Clamp (4 each) | 36. | Fuel/water separator |
| ach) | 15. | Rubber washer (2 each) | 26. | Flange nut (4 each) | 37. | Fuel return hose |
| over | 16. | Plain washer (2 each) | 27. | Fuel supply hose | 38. | Cable clamp |
| decal | 17. | Flat washer (2 each) | 28. | Right fuel tank | 39. | Screw (2 each) |
| 3 each) | 18. | Screw | 29. | Spacer | 40. | Fuel return hose |
| 2 each) | 19. | Fuel pump | 30. | Screw | 41. | Fuel supply hose |
| g | 20. | Flange nut (2 each) | 31. | Elbow fitting | 42. | Filter |
| hose | 21. | Strainer fitting (2 each) | 32. | Screw (4 each) | 43. | Elbow fitting |
| nk | 22. | Fuel supply hose | 33. | Elbow fitting | 44. | Straight fitting |
| | | | | | | |

DANGER

Diesel fuel is highly flammable and explosive. A fire or an explosion from the fuel can burn you, burn other people, and damage property.

- Use caution whenever you store or handle diesel fuel.
- Do not smoke while filling the fuel tank.
- Do not fill the fuel tank while the engine is running, while the engine is hot, or when the machine is in an enclosed area.
- Always fill the fuel tank outside and wipe up any spilled diesel fuel before starting the engine.
- Store fuel in a clean, safety-approved container and keep the cap in place.
- Use diesel fuel as an engine fuel only, not for any other purpose.

Checking the Fuel Lines and Connections

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Note: The fuel tanks of the Groundsmaster 7210 machine are connected to a hydraulic tee fitting (item 34 in Figure 14) under the operator seat. If you remove either of the fuel tanks from the machine, ensure that the fuel is removed from both the tanks before you disconnect any of the fuel hoses.

Check the fuel lines and connections at the scheduled maintenance intervals recommended in the *Traction Unit Operator's Manual*. Check the lines for deterioration, damage, leaks, or loose connections. Replace the hoses, clamps, and fittings as necessary.

Priming the Fuel System

The fuel system needs to be primed before starting the engine for the first time, after running out of fuel or after fuel system maintenance (e.g., draining the fuel/water separator, replacing a fuel hose). To prime the fuel system, ensure that the fuel tank has fuel in it. Then, turn and hold the key switch in the RUN position for 10 to 15 seconds which allows the fuel pump to prime the fuel system. Do not use the engine starter motor to crank the engine in order to prime the fuel system.

Removing the Fuel Tanks

- 1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.
- 2. Unlatch the hood and raise it.
- 3. Remove the negative battery cable from the negative post of the battery.
- 4. Allow the engine to completely cool.
- 5. Raise the operator seat.
- 6. Use a fuel transfer pump to remove the fuel from both of the fuel tanks.

Note: Label the fuel hoses if necessary to assure correct installation.

- 7. Disconnect the vent hoses from the top of each fuel tank.
- 8. Disconnect the return hoses from the back of each fuel tank.
- 9. Disconnect the supply hoses from the bottom of each fuel line.
- 10. At the right fuel tank, loosen the 2 swell latches (item 5 in Figure 15) and remove the access cover of the control panel. Position the cover away from the fuel tank.



- 1. Flange-head screw (5 each)
- 2. Control panel

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3. Locknut (2 each)

- 4. Control panel cover
- 5. Swell latch (2 each)
- 11. At the right fuel tank, remove the 5 flange-head screws (item 1 in Figure 15) that secure the control panel to the right fuel tank. Carefully position the control panel away from the fuel tank.
- 12. Loosen and remove the 2 screws, 2 clamps, and 2 flange nuts (items 32, 25, and 26 in Figure 14) that secure each fuel tank to the frame of the machine.
- 13. Loosen and remove the screws (items 18 and 30 in Figure 14), flat washers, plain washers, rubber washers, and flange nuts that secure the fuel tanks to the frame of the machine.
- 14. Lift the fuel tank from the machine.
- 15. Locate and retain the spacer (items 29 and 15 in Figure 14) from the fuel tank.

Note: For information regarding the fuel pump testing; refer to Testing the Fuel Pump (page 5–43).

Note: Refer to the *Traction Unit Operator's Manual* for the fuel/water separator and fuel filter service information.

Installing the Fuel Tanks

- 1. If the strainer fitting was removed from the fuel tank, perform the following:
 - A. Clean the threads of the fuel tank and strainer fitting.
 - B. Apply a coat of fuel resistant thread sealant to the threads of the strainer fitting.
 - C. Install the strainer fitting into the fuel tank and tighten the strainer.
- 2. If the elbow and straight fittings (items 43 and 44 in Figure 14) were removed from the fuel/water separator head, apply thread sealant to the fittings before installing.

Installing the Fuel Tanks (continued)

- 3. Assemble the fuel tanks to the frame of the machine with the screws (items 18 and 30 in Figure 14), flat washers, plain washers, rubber washers, spacer, and the flange nuts.
- 4. Align the fuel tank to the machine and secure the tank to the frame with a screw, clamp, and flange nut (items 32, 25, and 26 in Figure 14).
- 5. If the right fuel tank was removed, carefully position the control panel onto the fuel tank and secure the control panel with the 5 flange-head screws (item 1 in Figure 15).
- 6. Assemble the access cover to the control panel and secure the cover with the 2 swell latches (item 5 in Figure 15).
- 7. Install the fuel supply, return, and vent hoses to their appropriate locations and secure with the hose clamps.
- 8. Connect the negative battery cable to the negative battery post.
- 9. Add fuel to the tank and prime the fuel system; refer to Priming the Fuel System (page 3–18).
- 10. Check the fuel hoses and fittings for leaks.

Note: Repair all fuel leaks before operating the machine.

- 11. Lower the hood and secure it with the latches.
- 12. Lower the operator seat.

Engine



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Figure 16

| 1. | Dual temperature switch | 8. | Screw | 15. | Flywheel housing | 22. | Exhaust support |
|----|-------------------------|-----|-----------------------------|-----|-------------------------|-----|---------------------|
| 2. | Locknut (2 each) | 9. | Snubbing washer (2 each) | 16. | Lock washer (16 each) | 23. | Flange nut (2 each) |
| 3. | Motor mount (2 each) | 10. | Screw (2 each) | 17. | Screw (3 each) | 24. | Guide bracket |
| 4. | Lock washer (8 each) | 11. | Flange nut (4 each) | 18. | Screw (13 each) | 25. | Bolt (8 each) |
| 5. | Screw (8 each) | 12. | Engine mount (2 each) | 19. | Lock washer | 26. | Yanmar engine |
| 6. | Harness tab | 13. | Screw (4 each) | 20. | Rubber grommet (2 each) |) | |
| 7. | Lock washer | 14. | Flywheel coupling | 21. | Screw (2 each) | | |

Removing the Engine

- 1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.
- 2. Remove the hood; refer to Removing the Hood (page 6-40).



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Figure 17

1. Negative battery cable

3. Engine block

2. Positive battery cable



- Disconnect both the battery cables at the battery. Disconnect the negative battery cable (item 1 in Figure 17) and then the positive battery cable (item 2 in Figure 17); refer to Servicing the Battery (page 5–61).
- 4. Remove the ROPS assembly; refer to Removing the Rollover Protection System (page 6–33).

Removing the Engine (continued)

A

- 5. Remove the air cleaner from the engine; refer to Removing the Air Cleaner System (page 3–8).
- 6. Remove the exhaust tube from the engine (Figure 11).
- 7. Remove the radiator and oil cooler from the frame; refer to Removing the Radiator (page 3–13).
- 8. Label all the electrical connectors to assure correct assembly. Note the location of cable ties, anchors, and wire routing to assure correct assembly.
 - Disconnect the negative battery cable from the engine block (item 3 in Figure 17).
 - Separate the machine wire harness from the engine wire harness (2 connectors) (item 6 in Figure 18).
 - Disconnect the engine wire harness from the Yanmar ECU (2 connectors) (item 2 in Figure 18).
 - Disconnect the ground eye cable (bolt at the engine controller) (item 4 in Figure 18).
 - Disconnect the positive eye terminal (item 3 in Figure 18) at the clamp for the positive battery cable.
 - Disconnect the negative eye terminal (item 1 in Figure 18) at the clamp for the negative battery cable.
 - Disconnect the socket connector (item 5 in Figure 18) of the terminal receptacle at the coolant-temperature sender of the engine wire harness.
 - Disconnect the Glow, Start, and EGR Relays (items 1, 2, and 3 in Figure 20).
- 9. Disconnect the fuel supply hose (item 4 in Figure 19) and return hose from the fuel filter.
- 10. Cover or plug the fuel hoses and fuel filter fittings openings to prevent contamination.

Note: When lifting the engine using the following procedure, the flywheel housing and transmission will remain in the machine.

CAUTION

The engine is very heavy, and a hoist not rated for the weight of the engine may fail, causing possible injury and damage to the engine.

Use hoist equipment rated to lift the engine, which is approximately 188 kg (414 lb).

IMPORTANT

Do not lift the engine with the lift eyes on the DPF.

- 11. Attach a suitable lift or hoist to the lift tabs on the front and rear of the engine. Support the engine with lift or hoist to prevent the engine from shifting or moving.
- 12. Remove the 2 screws (item 18 in Figure 16) and 2 lock washers that secure the guide bracket to the flywheel housing.

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Removing the Engine (continued)

- 13. Remove the 7 screws (item 17 in Figure 16) and 7 lock washers that secure the flywheel housing to the engine.
- 14. Remove the locknut (item 2 in Figure 16), snubbing washer, and screw that secures each side of the engine to the engine mounts that are attached to the frame.

IMPORTANT

When removing the engine ensure that you do not damage the engine, flywheel housing, fuel hoses, hydraulic lines, electrical harness or other parts. Also, ensure that the transmission does not shift during engine removal.

15. Support the transmission to prevent it from moving during engine removal.

CAUTION

Use 1 person to operate the lift or hoist while the other person guides the engine from the machine.

- 16. Slide the engine backward a couple of inches to separate it from the transmission input shaft. Carefully raise the engine from the machine.
- 17. If necessary, remove the 8 bolts (item 25 in Figure 16) that secure the flywheel coupling to the engine, and remove the flywheel coupling from the engine.

Installing the Engine

IMPORTANT

Ensure that all parts removed from the engine during maintenance or overhaul are correctly installed on the engine.

- 1. Apply anti-seize lubricant to the splines of the transmission input shaft.
- If removed, install the flywheel coupling to the engine with the 8 bolts (item 25 in Figure 16), apply red gel threadlocker to the bolts, and torque the bolts to 25.8 to 29.8 N·m (19 to 22 ft-lb).
- 3. If the 2 motor mounts (item 3 in Figure 16) were removed, install the 2 motor mounts to the engine with the 8 screws and 8 lock washers; torque the screws to 32.5 to 56.9 N·m (24 to 42 ft-lb).
- 4. If the dual temperature switch was removed, apply pipe thread sealant to the switch.

CAUTION

A

The engine is very heavy, and a hoist not rated for the weight of the engine may fail, causing possible injury and damage to the engine.

Use hoist equipment rated to lift the engine, which is approximately 188 kg (414 lb).

Installing the Engine (continued)

- 5. Support the transmission to prevent it from moving during the engine installation.
- 6. Carefully lower the engine into the machine, align the engine with the transmission input shaft, and move the engine toward the flywheel housing.

IMPORTANT

When installing the engine ensure that you do not damage the engine, flywheel housing, fuel hoses, hydraulic lines, electrical harness or other parts. Also, ensure that transmission does not shift during engine installation.





1. Glow relay

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EGR relay

- 2. Start relay
- 7. Align the engine with the engine mounts that are attached to the frame with the locknut (item 2 in Figure 16), snubbing washer, and screw.
- Install the engine to the flywheel housing with the 7 screws (item 17 in Figure 16), 7 lock washers; torque the screws to 45.19 N·m (33.33 ft-lb). Follow same procedure for verifying hose fitting torque. Paint mark screws prior to final torque.
- Install the guide bracket to the flywheel housing with the 2 screws (item 18 in Figure 16) and 2 lock washers; torque the screws to 45.19 N·m (33.33 ft-lb). Follow same procedure for verifying hose fitting torque. Paint mark screws prior to final torque.
- 10. Remove all of the covers and plugs from the engine openings that you placed while removing the engine.
- 11. Connect the fuel supply hose (item 4 in Figure 19) and return hose to the fuel filter.
- 12. Use the notes that you recorded during removal and connect all the electrical connectors.
 - The machine wire harness to the engine wire harness (2 connectors) (item 6 in Figure 18).
 - The engine wire harness to the Yanmar ECU (2 connectors) (item 2 in Figure 18).
 - The ground eye cable (bolt at the engine controller) (item 4 in Figure 18).
 - The positive eye terminal (item 3 in Figure 18) at the clamp for the positive battery cable.
 - The negative eye terminal (item 1 in Figure 18) at the clamp for the negative battery cable.
 - The terminal receptacle at the coolant-temperature sender engine wire harness: Connect the 1 socket connector (item 5 in Figure 18) of the engine wire harness.
 - The Glow, Start, and EGR Relays (items 1, 2, and 3 in Figure 20).
 - The negative battery cable to the engine block (item 3 in Figure 17).
 - Torque the engine ground bolt to 34 to 42 ft-lb (47 to 56 N-m) and apply a coat of terminal protector. Torque the frame ground bolt to 14 to 19 ft-lb (19 to 26 N-m) and apply a coat of terminal protector.

Installing the Engine (continued)

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

- 13. Install the radiator to the machine; refer to Installing the Radiator (page 3–15).
- 14. Install the exhaust tube to the engine (Figure 11).
- 15. Install the air cleaner to the frame of the machine; refer to Installing the Air Cleaner System (page 3–9).
- 16. Install the ROPS assembly; refer to Installing the Rollover Protection System (page 6–34).
- 17. Lower the operator seat.
- Connect both the battery cables to the battery. Connect the positive battery cable (item 2 in Figure 17) and then the negative battery cable; refer to Servicing the Battery (page 5–61).
- 19. Install the hood; refer to Installing the Hood (page 6-41).
- 20. Ensure that all the hoses, tubes, and wires are clear of moving parts and secured to their original locations.
- 21. Operate the machine checking for coolant, hydraulic fluid or fuel leaks before returning the machine to service.



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Additional Reference Materials

PARKER TORQMOTOR™ SERVICE PROCEDURE (TC, TB, TE, TJ, TF, TG, TH AND TL SERIES)

Specifications

| Item | Description |
|---|--|
| Transmission Maximum traction pump displacement (per revolution) Traction circuit relief pressure (forward and reverse) Charge pump displacement (per revolution) Charge pressure | Kanzaki dual, variable displacement traction piston pumps with integral charge pump and multi-disc PTO clutch 18 cm ³ (1.1 in ³) 27,600 kPa (4,000 psi) 6 cm ³ (0.37 in ³) 480 to 690 kPa (70 to 100 psi) |
| Gear pump Displacement (per revolution) Implement relief pressure | Casappa single section, positive displacement gear type pump 6.7 cm³ (0.41 in³) 20,700 kPa (3,000 psi) |
| Wheel motors Displacement (per revolution) | Parker orbital rotor motor, TG Series 310 cm³ (19 in³) |
| Hydraulic filter | Spin-on cartridge type |
| Hydraulic fluid capacities (approximate) Hydraulic fluid change (hydraulic tank and transmission) Hydraulic system (all components and lines) | 10.3 L (10.9 US qt) 15.1 L (16 US qt) |
| Hydraulic fluid | Refer to the Traction Unit Operator's Manual |

General Information

A

Hydraulic Hoses

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

- A hose that is hard, cracked, cut, abraded, charred, leaking, or otherwise damaged.
- A hose that is kinked, crushed, flattened, or twisted.
- A hose cover that is blistered, soft, degraded, or loose.
- Hose fittings that are cracked, damaged, or badly corroded.

When you replace a hydraulic hose, ensure that the hose is straight (not twisted) before you tighten the fittings. Observe the imprint (layline) on the hose to do this. Using 2 wrenches, hold the hose straight with 1 wrench and tighten the hose swivel nut onto the fitting with the other wrench; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–5).

Note: If the hose has an elbow at 1 end, tighten the swivel nut on the elbow end before you tighten the nut on the straight end of the hose.

For more hydraulic hose information; refer to *Hydraulic Hose Servicing* of the Toro Basics Series Training Books (Part No. 94813SL).

WARNING

Release all pressure in the hydraulic system before performing any work on the system; refer to Releasing Pressure from the Hydraulic System (page 4–11).

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

A

Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting)

1. Ensure that all the threads, the sealing surfaces of the hose/tube, and the fitting are free of burrs, nicks, scratches, or unwanted material.



- 2. To help prevent a hydraulic leak, replace the face seal O-ring when you open the connection. Ensure that the O-ring is installed and correctly seated in the groove of the fitting. Lightly lubricate the O-ring with clean hydraulic fluid.
- 3. Align the hose/tube against the body of the fitting so that the flat face of the hose/tube sleeve fully touches the O-ring in the fitting (Figure 21).
- 4. Use your hand to thread the swivel nut onto the fitting. While you hold the hose/tube in alignment with a wrench, use a torque wrench to tighten the swivel nut to the recommended torque value within the specified range of torque values; refer to the Hose/Tube Installation Torque Table (page 4–6). This procedure to tighten the swivel nut requires a drive-adapter wrench (e.g., crowfoot wrench).

Note: It may be necessary to use a drive-adapter wrench (e.g., crowfoot wrench) to install a hydraulic fitting; refer to Calculating the Torque Values When Using a Drive-Adapter Wrench (page 2–5).

5. If a torque wrench is not available or if space at the swivel nut prevents the use of a torque wrench, use the alternative procedure Flats From Wrench Resistance (FFWR) given below (Figure 22).



- A. Use a wrench to tighten the swivel nut onto the fitting until you feel light resistance with the wrench-approximately **3.39** N·m (**30** in-lb).
- B. Put a mark on the swivel nut and body of the fitting. Hold the hose/tube in alignment with a wrench to prevent the hose/tube from turning.

Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (continued)

C. Use a second wrench to tighten the nut to the correct Flats From Wrench Resistance (FFWR); refer to the Flats From Wrench Resistance Table (page 4–6).

Note: The markings on the nut and body of the fitting show that the connection is correctly tightened.

Hose/Tube Installation Torque Table

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

Flats From Wrench Resistance Table

| Size | FFWR |
|-------------------------------------|------------|
| 4 (1/4 inch nominal hose or tubing) | 1/2 to 3/4 |
| 6 (3/8 inch) | 1/2 to 3/4 |
| 8 (1/2 inch) | 1/2 to 3/4 |
| 10 (5/8 inch) | 1/2 to 3/4 |
| 12 (3/4 inch) | 1/3 to 1/2 |
| 16 (1 inch) | 1/3 to 1/2 |

Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fitting into the Component Port)

Installing the Non-Adjustable Fittings



- 1. Ensure that all the threads, the sealing surfaces of fitting, and the component port are free of burrs, nicks, scratches, or unwanted material.
- 2. To help prevent a hydraulic leak, replace the O-ring when you open the connection.
- 3. Lightly lubricate the O-ring with clean hydraulic fluid. Ensure that the threads of the fitting are clean with no lubricant applied.

IMPORTANT

Before installing the fitting into the port, determine the material of which the port is made. Installing a fitting into an aluminum port requires a reduced installation torque.

4. Install the fitting into the port, then use a torque wrench and socket to tighten the fitting to the recommended torque value within the specified range of torque values; refer to the Fitting Installation Torque Table (page 4–7).

Note: It may be necessary to use a drive-adapter wrench (e.g., crowfoot wrench) to install a hydraulic fitting; refer to Calculating the Torque Values When Using a Drive-Adapter Wrench (page 2–5).

- If a torque wrench is not available or if space at the port prevents the use of a torque wrench, use the alternative procedure Flat From Finger Tight Table (page 4–8) given below;
 - A. Install the fitting into the port and tighten the fitting down full length until finger-tight.
 - B. If the port material is steel, tighten the fitting to the listed FFFT. If the port material is aluminum, tighten the fitting to 60% of the listed FFFT.

Fitting Installation Torque Table

| Fitting Dash Size | Fitting Port Side Thread Size (inch(es)—threads per inch) | Installation Torque Into Steel Port | Installation Torque Into Aluminum Port |
|-------------------|---|--|---|
| 4 | 7/16—20 | 21 to 25 N⋅m (15 to 19 ft-lb) | 13 to 15 N·m (9 to 11 ft-lb) |
| 5 | 1/2—20 | 25 to 29 N⋅m (18 to 22 ft-lb) | 15 to 20 N·m (11 to 15 ft-lb) |
| 6 | 9/16—18 | 47 to 56 N⋅m (34 to 42 ft-lb) | 28 to 35 N·m (20 to 26 ft-lb) |
| 8 | 3/4—16 | 79 to 97 N⋅m (58 to 72 ft-lb) | 48 to 58 N·m (35 to 43 ft-lb) |

Installing the Non-Adjustable Fittings (continued) Fitting Installation Torque Table (continued)

| 10 | 7/8—14 | 135 to 164 N⋅m (99 to 121 ft-lb) | 82 to 100 N⋅m (60 to 74 ft-lb) |
|----|-----------|-----------------------------------|-----------------------------------|
| 12 | 1–1/16—12 | 182 to 222 N·m (134 to 164 ft-lb) | 110 to 134 N·m (81 to 99 ft-lb) |
| 14 | 1–3/16—12 | 217 to 265 N·m (160 to 196 ft-lb) | 131 to 160 N·m (96 to 118 ft-lb) |
| 16 | 1–5/16—12 | 274 to 336 N·m (202 to 248 ft-lb) | 165 to 202 N·m (121 to 149 ft-lb) |
| 20 | 1–5/8—12 | 335 to 410 N·m (247 to 303 ft-lb) | 202 to 248 N·m (149 to 183 ft-lb) |

Flat From Finger Tight Table

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

Installing an Adjustable Fitting





2.



1. Ensure that all the threads, the sealing surfaces of fitting, and the component port are free of burrs, nicks, scratches, or unwanted material.

Installing an Adjustable Fitting (continued)

- 2. To help prevent a hydraulic leak, replace the O-ring when you open the connection.
- 3. Lightly lubricate the O-ring with clean hydraulic fluid. Ensure that the threads of the fitting are clean with no lubricant applied.
- 4. Turn back the locknut as far as possible. Ensure that the back-up washer is not loose and it is pushed up as far as possible (Step 1 in Figure 25).

IMPORTANT

Before installing the fitting into the port, determine the material of which the port is made. Installing a fitting into an aluminum port requires a reduced installation torque.

- 5. Install the adjustable fitting into the port by hand until the washer contacts the face of the port (Step 2 in Figure 25).
- If the adjustable fitting needs to align with another component, rotate the fitting counterclockwise until it is aligned to the desired position (Step 3 in Figure 25). Do not rotate the adjustable fitting more than 1 turn counterclockwise.
- 7. Hold the fitting in the correct alignment with a wrench and use a torque wrench and tighten the fitting to the recommended torque value within the specified range of torque values; refer to the Fitting Installation Torque Table (page 4–7). This tightening procedure requires a drive-adapter wrench (e.g., crowfoot wrench).

Note: It may be necessary to use a drive-adapter wrench (e.g., crowfoot wrench) to install a hydraulic fitting; refer to Calculating the Torque Values When Using a Drive-Adapter Wrench (page 2–5).

- If a torque wrench is not available or if space at the port prevents the use of a torque wrench, use the alternative procedure Flat From Finger Tight Table (page 4–9) given below;
 - A. Hold the fitting in the correct alignment with a wrench and, if the port material is steel, tighten the locknut with a second wrench to the listed FFFT (Step 4 in Figure 25).
 - B. If the port material is aluminum, tighten the fitting to 60% of the listed FFFT; refer to the Flat From Finger Tight Table (page 4–9).

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

Flat From Finger Tight Table

Traction Unit Operator's Manual

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

Pushing the Traction Unit

In case of emergency, push the machine for a very short distance. However, Toro does not recommend this as a standard procedure.



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Figure 26

1. Transmission

2. Bypass valve

1. Find the 2 bypass valves on the transmission (Figure 26). Loosen the 2 valves and rotate them counterclockwise 1 to 2 turns.

IMPORTANT

Pushing the machine faster than 2 mph can damage the drive system. If you must move the machine a considerable distance (more than a few feet), transport it on a truck or trailer.

2. Slowly push the machine.

IMPORTANT

Do not start the engine when the bypass valves are open.



3. Before you start the engine, tighten the 2 bypass valves to close them; torque the valves to 7 to 9 N·m (62 to 79 in-lb).

Releasing Pressure from the Hydraulic System

Release all the pressure in the hydraulic system before you work on the hydraulic system.

• Release the hydraulic pressure from the traction circuit as follows:

Note: If you park the machine on an incline or slope, the pressure in the traction circuit does not release.

- 1. Move the machine to a level surface.
- 2. Lower the cutting deck (or implement).
- 3. Shut off the engine.
- 4. Turn the key switch to the OFF position and allow the engine to stop.
- Release the hydraulic pressure from the lift circuit as follows:
 - 1. Fully lower the cutting deck (or implement) onto the solid blocks.
 - 2. Turn the key switch to the OFF position and allow the engine to stop.
 - 3. After lowering the cutting deck, ensure that the lift cylinder does not support the cutting deck (or implement).

Traction Circuit (Closed Loop) Component Failure

The traction system of the Groundsmaster 7210 machine consists of 2 identical and independent closed loop traction circuits. If a component failure occurs in 1 of these traction circuits (e.g., wheel motor or transmission piston pump), unwanted material and contamination from the damaged component will circulate throughout the traction circuit. This contamination can damage other components in the circuit, so remove the contamination to prevent additional component failure.

If a component failure occurs in 1 of these traction circuits, disassemble the entire traction circuit, drain the hydraulic fluid, and clean the traction circuit (transmission piston pump, hydraulic hoses, and wheel motor) to ensure that you remove all contamination from it. Operating the machine with contaminants in the traction circuit could cause additional damage to components of the traction circuit.

An alternative procedure to remove contamination from the traction circuit is to temporarily install a high-pressure hydraulic-fluid filter into the circuit; refer to Special Tools (page 4–23). Use a high-pressure hydraulic-fluid filter when you connect the hydraulic test gauges in order to test the traction circuit components or after you replace a failed traction circuit component (e.g., wheel motor or transmission piston pump). Using a high-pressure hydraulic-fluid filter will remove contaminates from the hydraulic fluid in the traction circuit, thereby preventing additional component damage.

After you have installed the high-pressure hydraulic-fluid filter in the traction circuit, raise and support the machine with jack stands and operate the traction circuit to allow the hydraulic fluid to the circuit. With the machine raised off the ground, the traction circuit will have maximum fluid flow at minimum pressure to minimize damage from any remaining contamination. This filter removes contaminants from the closed loop traction circuit during the circuit operation. When you are certain that the filter has removed the contaminates from the hydraulic fluid of the traction circuit, remove the filter.

IMPORTANT

When you operate the traction system with the additional high-pressure filter, ensure that the flow is always directed through the filter before it enters into a replaced component (e.g., do not move the traction levers to move the machine in the reverse direction if you installed the filter in the traction circuit for moving the machine in the forward direction). If hydraulic fluid flows in the opposite direction through the high-pressure hydraulic-fluid filter, contamination from the filter will again circulate through the traction circuit.
Hydraulic Schematics

Refer to the Hydraulic Schematic in Appendix A (page A–1)—Foldout Drawings.



Hydraulic System: Hydraulic Schematics

Traction Circuits

The traction system of the Groundsmaster consists of a transmission that is directly connected to, and driven by, the engine flywheel. The transmission provides 2 identical and independent closed loop traction circuits: one for the right wheel motor and the other for the left wheel motor. Each of these transmission circuits includes a variable displacement, slipper foot design piston pump which provides hydraulic flow for a wheel motor. The swash plate in each of these piston pumps is controlled by 1 of the operator traction levers.

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

Because hydraulic fluid flow to each rear wheel is determined by the traction lever movement and subsequent swash plate position, steering is accomplished by moving the 2 traction levers a different amount or direction.

With the engine running and the traction levers in the NEUTRAL position, the swash plates of the piston pump are held in the vertical position, providing no flow to either wheel motor and the machine remains stationary. The transmission reverse check valves include an orifice which makes it easier to locate the transmission NEUTRAL position.

Forward Direction

When a traction lever is pushed forward, the rod connected to the traction lever positions the swash plate in the piston pump to provide hydraulic fluid flow from the transmission (port A for the right side or C for the left side). This fluid flows to the wheel motor and turns the motor in the forward direction. The fluid flow from the wheel motor returns to the transmission (port B or D) and is continuously pumped while the traction lever is pushed forward.

As the traction load increases, the forward traction circuit pressure can increase to the relief-valve setting of 27,600 kPa (4,000 psi). If the circuit pressure is more than the relief-valve setting, fluid flows through the forward relief valve in the transmission to the low-pressure side of the closed loop traction circuit.

The piston pumps use a small amount of hydraulic fluid for internal lubrication. The fluid is designed to leak across the pump parts into the transmission case drain. This leakage results in the loss of hydraulic fluid from the closed loop traction circuits that must be replaced.

A charge pump in the transmission supplies hydraulic flow for maintaining 480 to 690 kPa (70 to 100 psi) to the low-pressure side of the 2 traction circuits. The charge pump also provides pressure for the transmission PTO drive system. The charge pump replenishes the closed loop traction circuits with fluid from the hydraulic tank. The charge-relief valve in the transmission maintains sufficient pressure so that the charge-pump flow is guided past check valves to the low-pressure side of each traction circuit. The charge-pump flow in excess of system requirements is released through the charge-relief valve back to the hydraulic tank.

The 2 transmission traction circuits include a flushing valve that bleeds off a small amount of hydraulic fluid for cooling of the closed loop traction circuits. The flushing valves are opened only during forward direction operation. When the flushing valves are unseated, some fluid from the low-pressure side of the traction loop is returned to the hydraulic tank. The fluid loss from the closed loop due to the flushing valve is replaced by the charge pump.

Reverse Direction

The traction circuit operates essentially the same in reverse as it does in the forward direction.

When a traction lever is pulled rearward, the rod connected to the lever positions the swash plate in the transmission-piston pump to provide hydraulic fluid flow from the transmission (port B for the right side or D for the left side). This fluid flows to the wheel motor and turns the motor in the reverse direction. The fluid flow from the wheel motor returns to the transmission (port A or C) and is continuously pumped while the traction lever is pulled rearward.

As the traction load increases, the reverse traction circuit pressure can increase to the relief-valve setting of 27,600 kPa (4,000 psi). If the circuit pressure is more than the relief-valve setting, fluid flows through the reverse relief valve in the transmission to the low-pressure side of the closed loop traction circuit.

The charge circuit functions the same in reverse as it does in the forward direction.

Reverse Direction (continued)



Lift Circuit (Raise)

A single-section gear pump is directly coupled to the transmission which is driven by the engine. This gear pump supplies hydraulic flow for raising and lowering the cutting deck (or implement). The pump takes its suction from the hydraulic tank.

During the conditions of not raising or lowering the cutting deck (or implement), flow from the gear pump is bypassed by the lift-control manifold directly to the oil cooler and then to the transmission. The flow then returns to the hydraulic tank.

Note: To raise the cutting deck, the engine must be in running condition.

Electrical Lift Control

The lift-control manifold is equipped with the 2 solenoid valves for electrical control of the lift circuit. A deck lift/lower switch on the right side traction lever is used to raise the cutting deck (or implement).

When the top of the lift/lower switch is pressed (momentary position), both the solenoid valves (A/S1 and B/S2) in the deck lift manifold are energized to cause the valves to shift. The energized solenoid valve B/S1 prevents the gear pump flow from bypassing the lift cylinder. The energized solenoid valve A/S1 allows the hydraulic flow from the gear pump to the cylinder head of the lift cylinder. The lift cylinder extends, causing the cutting deck to raise. The fluid displaced from the rod end of the lift cylinder is routed to the oil cooler, transmission, and then to the hydraulic tank. An orifice in the manifold controls the extending speed of the lift cylinder while raising the cutting deck.

The load on the lift cylinder causes the lift circuit pressure to increase. If the lift circuit pressure reaches the implement relief valve pressure 20,700 kPa (3,000 psi), the relief valve in the gear pump shifts to allow the pump flow to return to the hydraulic tank. This condition occurs in both the raise and lower modes.

When the top of the lift/lower switch is released, both the solenoid valves (A/S1 and B/S2) in the deck lift manifold are de-energized. The de-energized solenoid valve B/S2 allows the gear pump flow to bypass the lift cylinder, returning to the oil cooler, transmission, and then to the hydraulic tank. The de-energized solenoid valve A/S1 prevents the hydraulic flow to and from the lift cylinder to keep the cutting deck in the raised position.

Electrical Lift Control (continued)



Lift Circuit (Lower)

A single-section gear pump is directly coupled to the transmission which is driven by the engine. This gear pump supplies hydraulic flow for raising and lowering the cutting deck (or implement). The pump takes its suction from the hydraulic tank.

The circuit operation for lowering the cutting deck (or implement) is similar to raising it. However, the hydraulic flow is used to retract the lift cylinder and this action allows the cutting deck (or implement) to lower.

During the conditions of not raising or lowering the cutting deck (or implement), flow from the gear pump is bypassed by the lift-control manifold directly to the oil cooler and then to the transmission. The flow then returns to the hydraulic tank.

Electrical Lift Control

Note: The engine must be running to allow the cutting deck to be lowered. When the bottom of the lift/lower switch is pressed (detent position), the deck will lower fully and then enter the float position.

When the bottom of the lift/lower switch is pressed (detent position), the solenoid valve A/S1 in the deck lift manifold is energized to cause the valve to shift. The energized solenoid valve A/S1 allows a path for fluid flow from the cylinder head of the cylinder. The weight of the cutting deck causes the lift cylinder to retract, allowing the cutting deck to lower to the ground. An orifice in the manifold controls the retracting speed of the lift cylinder while lowering the cutting deck.

Cutting Deck Float

The cutting deck float allows the fully lowered cutting deck to follow ground surface contours. The deck lift manifold solenoid valve A/S1 stays energized for the deck float when the deck is fully lowered. This energized solenoid provides an oil passage to and from the lift cylinder to allow cylinder and cutting deck movement while mowing.

Cutting Deck Float (continued)



PTO Circuit

A

The transmission of the Groundsmaster 7210 machine consists of a hydraulic, multi-plate clutch that is used to engage the PTO. The hydraulic flow for the PTO clutch engagement is provided by the transmission-charge pump.

When the PTO switch is turned on, the transmission solenoid valve is energized to allow the hydraulic flow to engage the PTO clutch. As the PTO clutch engages, an integral PTO brake is released at the same time to allow the rotation of the driveshaft and cutting deck (or implement). An orifice and accumulator in the transmission prevent sudden engagement of the PTO.

WARNING

The Groundsmaster 7210 machine has a hydraulic accumulator built into the transmission that stores energy by compressing a spring.

This pressure must be released before disconnecting or doing any work on the hydraulic system; refer to Releasing Pressure from the Hydraulic System (page 4–11).

The pressure to the PTO clutch is limited by the pressure valve in the transmission. The pressure-valve setting is 1,930 to 2,340 kPa (280 to 340 psi).

When the PTO switch is turned off, the transmission solenoid valve is de-energized and the PTO clutch is disengaged. The integral PTO brake is applied to control the stopping rate of the driveshaft and cutting deck (or implement).

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Special Tools

You can order these special tools from your Toro Distributor. Some tools are also available from a local tool supplier.

Hydraulic Pressure Testing Kit



g031764

Figure 31

Toro Part No. TOR47009

Use this kit to take various pressure readings for diagnostic tests. Quick disconnect fittings are provided to attach directly to the mating fittings on the machine test ports without the tools. A high-pressure hose is given for remote readings. Contains 1 each: 6,900 kPa (1,000 psi), 34,500 kPa (5,000 psi), and 69,000 kPa (10,000 psi) gauges; refer to Testing the Hydraulic System (page 4–31).

15 GPM Hydraulic Tester Kit (Pressure and Flow)



g031765

Figure 32

Toro Part No. TOR214678

Use this tester to test the hydraulic circuits and components for flow and pressure capacities as recommended in Testing the Hydraulic System (page 4–31). This tester includes the following:

- 1. Inlet Hose: This hose connects the system circuit to the inlet side of the hydraulic tester.
- 2. Load Valve: Turn the valve to restrict the flow to create a simulated working load in the circuit.

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

- 3. Pressure Gauge: A glycerine filled pressure gauge 0 to 34,500 kPa (0 to 5,000 psi) to provide operating circuit pressure.
- 4. Flow Meter: This meter measures the actual fluid flow in the operating circuit with a gauge rated at 5 to 55 L/minute (1 to 15 gallons/minute).
- 5. Outlet Hose: A hose from the outlet side of the hydraulic tester that connects to the hydraulic system circuit.
- 6. Fittings: An assortment of hydraulic fittings are included with this kit.

Hydraulic Test Fitting Kit



Toro Part No. TOR4079

a033394

This kit includes a variety of O-ring face seal fittings to let you connect the test gauges into the system.

The kit includes: tees, unions, reducers, plugs, caps, and male test fittings.

O-Ring Kit



g033395

Figure 34

Toro Part No. 117-2727

This kit includes O-rings in a variety of sizes for the face seal and port seal hydraulic connections. To help prevent a hydraulic leak, replace the O-rings when you open the hydraulic connection.

High Flow Hydraulic Filter Kit



Toro Part Number: TOR6011

The high flow hydraulic filter kit is designed with large flow (150 L/minute or 40 gallons/minute) and high pressure (34,500 kPa or 5,000 psi) capabilities. This kit provides for bi-directional filtration which prevents filtered unwanted material from entering into the circuit regardless of the flow direction.

If a component failure occurs in the closed loop traction circuit, contamination from the damaged part will remain in the circuit until you remove it. Install a high flow hydraulic-fluid filter into the circuit when you connect the hydraulic test gauges in order to test the traction circuit components or after you replace a failed traction circuit component (e.g., piston pump or wheel motor). This filter removes contamination from the hydraulic fluid in the traction circuit, thereby preventing additional component damage.

Note: This kit does not include the hydraulic hoses; refer to Hydraulic Hose Kit (page 4–25).

Note: The replacement filter element is Toro Part No. TOR6012. The filter element canister tightening torque is **34** N·m (**25** ft-lb).

Hydraulic Hose Kit

g035152



Hydraulic Hose Kit (continued)

Toro Part No. TOR6007

This kit includes the fittings and hoses that are used to connect high flow hydraulic filter kit (TOR6011) to the machine hydraulic traction system components.

Remote Starter Switch



Remote Starter Switch (continued)



After flushing the hydraulic system or replacing a hydraulic component (e.g., gear pump, piston pump, or wheel motor), it is necessary to prime the hydraulic pumps. A remote starter switch (Figure 37) can be used for priming the hydraulic pumps. You can get this switch locally.

IMPORTANT

When using a remote starter switch, it is highly recommended to include a 20 A in-line fuse between the battery and switch connector for circuit protection.

A remote stater switch can also be constructed using the Toro switch #106-2027, a length of 14 gauge wire, a 20 A in-line fuse, 2 alligator clips, and necessary connectors. Connecting the wire to switch terminals 1 and 2 will allow the momentary switch contacts to be used for the remote starter switch (Figure 38).

Note: For information on using the remote starter switch to prime the hydraulic pumps; refer to Flushing the Hydraulic System (page 4–59).

Troubleshooting

The following chart contains information to troubleshoot hydraulic circuit problems. There can be more than 1 cause for a machine malfunction.

Refer to Testing the Hydraulic System (page 4–31) for precautions and specific hydraulic test procedures.

General Hydraulic System Problems

| Problem | Possible Causes |
|---|---|
| The hydraulic fluid is leaking from the system. | The fitting(s), hose(s), or tube(s) are loose or damaged. The O-ring(s) or seal(s) are missing or damaged. |
| The hydraulic fluid foams excessively causing fluid leakage from the hydraulic tank breather. Note: Some aeration of the hydraulic fluid on this machine is normal. | The hydraulic-fluid level in the hydraulic tank is low. The hydraulic system has a wrong type of fluid. One of the pump suction lines has an air leak. The incompatible hydraulic fluids are mixed in the system. There is water in the hydraulic system. |
| The hydraulic system operates hot. | The transmission pressure is high due to load or dragging brakes. The hydraulic-fluid level in the hydraulic tank is low or the inlet filter is loose or clogged. The hydraulic fluid is contaminated or the fluid viscosity is too light. The oil cooler is damaged or plugged. The oil cooler air flow is obstructed. The transmission bypass valve(s) is open or damaged. The gear pump relief valve is stuck open. The transmission check valve is not seating or is damaged. The charge pressure is low. The transmission or wheel motor(s) is worn or damaged. Note: If 1 traction circuit component has internal wear or damage, it is possible that the other traction components are also damaged. |

Traction Circuit Problems

| Problem | Possible Causes |
|------------------------------------|---|
| The traction response is sluggish. | The transmission bypass valve(s) is open or damaged. The brake is dragging or binding. The transmission-check valve, relief valve, and/or flushing valve is leaking. The charge pressure is low. The hydraulic fluid is very cold. The transmission or wheel motor(s) is worn or damaged. Note: If 1 traction circuit component has internal wear or the transmission or wheel motor (s) is internal wear or transmission or wheel motor (s) is internal wear or transmission or wheel motor (s) is internal wear or transmission or wheel motor (s) is internal wear or transmission or wheel motor (s) is internal wear or transmission or wheel motor (s) is internal wear or transmission or wheel motor (s) is internal wear or transmission or wheel motor (s) is internal wear or wheel motor (s) is internal wear or wheel motor (s |
| | are also damaged. |
| Neutral is difficult to find. | The external control linkage is incorrectly adjusted, disconnected, binding, or damaged. The orifice in the transmission-check valve(s) is plugged. The transmission is worn or damaged. |

Traction Circuit Problems (continued)

| | • |
|--|---|
| No traction exists in either direction. | The hydraulic-fluid level in the hydraulic tank is low. The transmission bypass valves are open. The charge pressure is low. The engine flywheel coupling is damaged. The transmission or wheel motor(s) is worn or damaged. Note: If 1 traction circuit component has internal wear or damage, it is possible that the other traction components are also damaged. |
| The wheel motor does not turn. | The transmission bypass valve(s) is open. The transmission or wheel motor is worn or damaged. Note: If 1 traction circuit component has internal wear or damage, it is possible that the other traction components are also damaged. |
| The wheel motor does not hold load in the NEUTRAL position. Note: The machine may not be completely stationary if parked on an incline without the parking brake engaged. | The make-up fluid from the charge pump is not available. The check valves in the transmission are damaged. The valve plate(s) in the transmission is worn or damaged. The wheel motor is worn or damaged. The cylinder block assembly in the transmission is worn or damaged. |
| A single-wheel motor turns while unloaded, but slows down or stops when the load is applied. | The wheel motor is worn or damaged. The transmission components (e.g., piston pump, relief valve, and check valve) for the problem wheel motor are worn or damaged. Note: If 1 traction circuit component has internal wear or damage, it is possible that the other traction components are also damaged. |
| The machine does not track straight. Note: If the machine does not track straight, look for a problem with the components that affect the weaker traction side of the machine. | The external traction control linkage is incorrectly adjusted, disconnected, binding, or damaged. The transmission bypass valve(s) is open. The brake is dragging or binding. The transmission-check valve is not seating or damaged. The transmission or wheel motor(s) is worn or damaged. |

PTO Circuit Problems

| Problem | Possible Causes |
|--|---|
| The cutting deck blades do not turn. | An electrical problem exists; refer to Chapter 5: Electrical System (page 5–1). The engine coolant temperature is high. The transmission solenoid valve is stuck. The transmission charge pump is damaged (the traction charge circuit is also affected). The transmission pressure valve is damaged. There is a problem with the cutting deck; refer to Chapter 7: Cutting Deck (page 7–1). |
| The cutting deck blade(s) turn too slowly. | The engine speed is too low. There is a problem with the cutting deck; refer to Chapter 7: Cutting Deck (page 7–1). |
| The PTO does not stop when disengaged. | An electrical problem exists; refer to Chapter 5: Electrical System (page 5–1). The transmission solenoid valve is stuck or damaged. The PTO brake friction plates are worn or damaged. |

Lift/Lower Circuit Problems

| Problem | Possible Causes |
|--|---|
| The gear pump is noisy (cavitation). | The hydraulic-fluid level in the hydraulic tank is low. The hydraulic fluid is very cold. The suction line is restricted. There are air leaks in the suction line. |
| The cutting deck (or implement) does not lift or lifts slowly. | The engine speed is too low. The lift cylinder linkage is binding or broken. The lift arm bushings are binding. The hydraulic-fluid level in the hydraulic tank is low. The gear pump pressure or flow is insufficient. The gear pump is damaged. The implement-relief valve (in the gear pump) is stuck open. The lift cylinder is leaking internally. The lift control manifold is damaged. |
| The cutting deck (or implement) raises, but does not stay up. | The lift cylinder is leaking internally.The lift control manifold is worn or damaged. |

Testing the Hydraulic System

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The most effective procedure to isolate the problems in the hydraulic system is to use hydraulic test equipment, such as pressure gauges and flow meters in the circuits during different operational checks; refer to Special Tools (page 4–23).

AWARNINGA

Opening the hydraulic system without releasing pressure from the system will cause the hydraulic fluid to escape, causing possible injury.

Before you disconnect the hydraulic components or work on the hydraulic system, release the pressure in the system; refer to Releasing Pressure from the Hydraulic System (page 4–11).

WARNING

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Hydraulic fluid escaping under pressure can penetrate skin and cause injury.

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



Failing to use gauges having the recommended pressure (kPa/psi) rating could damage the gauge and cause personal injury from contact with hot, leaking hydraulic fluid.

Use gauges with the recommended pressure rating as listed in the test procedures.

IMPORTANT

Before performing the hydraulic tests, check all obvious areas, such as fluid supply, filter, binding linkages, loose fasteners, or improper adjustments before you assume that a hydraulic component is the source of the problem.

Page 4–31

IMPORTANT

Use 2 people to perform all the tests, with 1 person in the seat and the other to read and record the test results.

1. Clean the machine fully before you disconnect or disassemble the hydraulic components.

Note: Cleanliness is required whenever you work on the hydraulic equipment. Contamination causes too much wear on hydraulic components.

- 2. When you perform tests on the hydraulic system, wear the eye protection.
- 3. Before you perform a test, check the traction control lever linkages for improper adjustment, binding, or broken parts.
- 4. Perform all the hydraulic tests with the hydraulic fluid at normal operating temperature.
- 5. Install clean metal caps or plugs on the hydraulic lines that are left open or exposed during the testing or component removal.
- 6. When you use a hydraulic tester (pressure and flow), ensure that the inlet and outlet hoses are properly connected and not reversed to prevent damaging the hydraulic tester or components.
- 7. Install the hydraulic fittings by hand and ensure that they are not cross-threaded before you tighten them with a wrench.
- 8. Position the tester hoses to prevent the rotating machine parts from contacting and damaging the hoses or tester.
- 9. After you connect the test equipment, check the hydraulic-fluid level in the hydraulic tank and ensure that the tank has the correct fluid level.
- 10. When you use a hydraulic tester (pressure and flow), open the tester load valve fully before you start the engine to reduce the possibility of damaging the components.
- 11. Ensure that the engine is in good operating condition before performing any hydraulic test.

Note: Use a phototac when you perform a hydraulic test. The engine speed can affect the accuracy of the tester readings.

- 12. If there is a traction circuit problem, perform 1 or more of the following tests: charge relief valve pressure, transmission piston pump flow, traction relief valve pressure, and/or wheel motor efficiency.
- 13. If there is a lift circuit problem, perform 1 or more of the following tests: implement relief pressure, gear pump flow, and/or lift cylinder internal leakage.
- 14. If there is a PTO circuit problem, perform the PTO pressure valve test.

Testing the Traction System Operation

Because the traction system of the Groundsmaster 7210 machine uses 2 different circuits, it is difficult to identify which circuit is causing a problem and what hydraulic tests should be performed. Use the following operation tests and suggestions before you perform the hydraulic tests described in this section.

- 1. If the machine does not track in a straight line, look for a problem with the components that affect the weaker traction side of the machine. During operation, the machine will steer toward the weaker side of the traction system. Because the swash plate of the piston pump is controlled by the traction control lever movement, if 1 lever rotates its swash plate more than the other lever, the machine will not track in a straight line.
- 2. Drive the machine up a moderate incline, shut off the engine, place the traction-control levers in the NEUTRAL LOCK position and allow the transmission to hold the machine in place (the parking brake is not applied). The machine should remain stationary on the incline or drift slowly backwards in a straight line. If 1 of the traction circuits of the transmission is damaged, the machine will roll backwards toward the weaker traction circuit.
- 3. The wheel speed should be the same on the 2 rear wheels. Ensure that the hydraulic fluid is at normal operating temperature. With the machine raised off the ground and correctly supported with jack stands, have an operator in the seat move the traction-control levers to the full forward speed. Use a phototac to check the rotational speed of the 2 rear wheels. The wheel speed should be 190 to 200 rpm for both rear wheels.
- 4. If any of these operation tests suggest a traction system problem, check the following before you perform the hydraulic tests.
 - A. The parking brake is dragging.
 - B. The traction-control lever is not adjusted correctly.
 - C. The transmission bypass valve is not seated.
 - D. Check the hydraulic-fluid level in the hydraulic tank to ensure that the fluid level is correct.



Testing the Charge Relief Valve Pressure (Using Pressure Gauge)

g187016

Figure 40

Perform the charge relief valve pressure test if you identify a traction circuit problem. This test determines if the transmission charge relief valve operates correctly.

Test Procedure

- 1. Ensure that the hydraulic fluid is at normal operating temperature.
- 2. Ensure that the traction drive is correctly adjusted for the NEUTRAL position.

WARNING

Before disconnecting or doing any work on the hydraulic system, release all the pressure in the system; refer to Releasing Pressure from the Hydraulic System (page 4–11).

- 3. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, and set the parking brake.
- 4. Read all Warning, Cautions, and precautions listed at the beginning of this section.
- 5. Clean the transmission area around the charge-pressure test port on the right side of the transmission.
- 6. Remove the plug from the charge-pressure test port.
- 7. Connect a 6,900 kPa (1000 psi) hydraulic-pressure gauge with an attached hydraulic hose to the transmission charge-pressure port.
- 8. Ensure that the traction levers are in the NEUTRAL LOCK position and the parking brake is applied.
- 9. Start the engine and run it at low-idle speed **(1,400 rpm)**. Check for hydraulic-fluid leaks from the test connections and correct before continuing the test.



- 10. Operate the engine by moving the throttle to full speed **(3,000 rpm)**. The pressure gauge reading should read from **480 to 690 kPa (70 to 100 psi)**. Record the test result.
- 11. If the charge relief pressure specification is not met, consider the following:
 - A. The transmission charge relief valve is damaged. Repair or replace the charge-relief valve; refer to Servicing the Transmission (page 4–75).
 - B. A transmission traction relief valve or flushing valve is leaking or damaged; refer to Servicing the Transmission (page 4–75).
 - C. The charge pump in the transmission is damaged (the PTO operation may also be affected); refer to Servicing the Transmission (page 4–75).
- 12. Perform a dynamic charge-pressure test by doing the following:
 - A. With the hydraulic-pressure gauge still connected, sit in the operator seat and move the traction levers forward.
 - B. While the machine is moving, monitor the charge pressure reading on the pressure gauge.
 - C. The charge pressure should not drop more than 15% from the initial test reading (Step 10) as the machine is moving (e.g., if the initial charge pressure is 690 kPa (100 psi), charge pressure while the machine is moving should be above 590 kPa (85 psi).

Test Procedure (continued)

D. A pressure drop of more than 15% indicates a traction circuit leak (e.g., a leaking transmission check valve, a worn/damaged transmission piston pump). If charge pressure is good under no load, but the pressure drops below specification when under a traction load, the transmission piston pump(s) are probably worn or damaged.

Note: When a pump is worn or damaged, the charge pump cannot keep up with internal leakage in the traction circuit.

- 13. Stop the machine and shut off the engine.
- 14. Release pressure from the hydraulic system; refer to Releasing Pressure from the Hydraulic System (page 4–11).
- 15. Remove the pressure gauge from the transmission charge-pressure test port.



16. Install the plug into the port and torque the plug to **17.7 to 21.5** N·m (13 to 15 ft-lb).

Testing the Transmission Piston Pump Flow (Using Tester with Pressure Gauges and Flow Meter)



Figure 41

Perform the transmission piston pump flow test if you identify a traction circuit problem. This test determines if hydraulic flow from a transmission piston pump is correct.

Test Procedure

A

- 1. Ensure that the hydraulic fluid is at normal operating temperature.
- 2. Ensure that the traction drive is correctly adjusted for the NEUTRAL position.

WARNING

Before disconnecting or doing any work on the hydraulic system, release all the pressure in the system; refer to Releasing Pressure from the Hydraulic System (page 4–11).

- 3. Park the machine on a level surface, lower the cutting deck (or implement), and shut off the engine.
- 4. Read all Warning, Cautions, and precautions listed at the beginning of this section.

IMPORTANT

Before lifting the machine with a jack, review and follow Jacking Instructions (page 1–6).

5. Lift and support the machine with jack stands so that the 2 rear wheels are off the ground. In this test, the rear wheels need to spin freely to allow hydraulic flow through the traction circuit.

Note: Ensure that the parking brake is not applied.

- 6. Clean the transmission area around the traction circuit hoses on the top of the transmission (Figure 41). Determine which piston pump is to be tested.
- 7. Disconnect the hydraulic hose from the transmission pump outlet fitting to test the piston pump (Figure 41):

| Piston Pump to be Tested | Pump Outlet |
|--------------------------|-------------|
| Right side pump | Port A |
| Left side pump | Port C |

- 8. Install a hydraulic tester (pressure and flow) in series between the pump outlet fitting and disconnected hose. Ensure that the tester flow arrow points from the pump outlet and toward the hose. Ensure that the flow-control valve on the tester is fully open.
- 9. Sit in the operator seat, start the engine and run it at low-idle speed **(1,400 rpm)**. Check for any hydraulic-fluid leaks from the test connections and correct before continuing the test.

IMPORTANT

Do not run the engine at full speed when performing this flow test using Toro hydraulic tester (pressure and flow) (TOR214678). The traction pump output at full engine speed can damage the hydraulic tester.

Test Procedure (continued)

- 10. Use a phototac to measure the engine speed, move the throttle so that the engine speed is **2,800 rpm** (not full speed).
- 11. Have an operator slowly push the traction lever for the pump that is being tested to fully forward position. Keep the other traction lever in the NEUTRAL position.
- 12. Slowly close the tester flow control valve until the pressure gauge reading is **6,900 kPa (1,000 psi)**.
- 13. Check the engine speed with a phototac and ensure that the engine speed is still **2,800 rpm**.
- 14. Observe the flow gauge.

Note: The tester reading should be approximately **50.3 L/minute (13.3 gallons/minute)** for a traction pump in good condition.

- 15. Open the tester flow control valve, release the traction lever to the NEUTRAL position and shut off the engine. Record the test results.
- 16. A normal traction pump flow is 50.3 L/minute (13.3 gallons/minute). A lower pump flow may result in reduced traction circuit performance. If the flow is less than 41.6 L/minute (11 gallons/minute) or a pressure of 6,900 kPa (1,000 psi) cannot be obtained:
 - A. The traction control lever may need adjustment.
 - B. If the engine speed drops excessively as the tester flow control valve is closed, the engine performance should be evaluated; refer to Chapter 3: Diesel Engine (page 3–1).
 - C. If the engine speed does not drop, the pressure and flow specifications are not met, the tested transmission piston pump needs to be inspected, repaired, or replaced as necessary.
- 17. If the transmission piston pump flow specification is met, and you identify a traction circuit problem, consider that a wheel motor is worn or damaged; refer to Test Procedure (page 4–44).
- 18. Release pressure from the hydraulic system; refer to Releasing Pressure from the Hydraulic System (page 4–11).
- 19. Disconnect the tester from the transmission fitting and hose, and connect the hydraulic hose to the transmission port fitting again.
- 20. If necessary, repeat the flow test for other transmission piston pump.

Testing the Traction Relief Valve Pressure (Using Tester with Pressure Gauges and Flow Meter)



Figure 42

Perform the traction relief valve pressure test if you identify a traction circuit problem. This test determines if a transmission relief valve operates correctly.

Test Procedure

A

- 1. Ensure that the hydraulic fluid is at normal operating temperature.
- 2. Ensure that the traction drive is correctly adjusted for the NEUTRAL position.

WARNING

A

Before disconnecting or doing any work on the hydraulic system, release all the pressure in the system; refer to Releasing Pressure from the Hydraulic System (page 4–11).

- 3. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, and do not set the parking brake.
- 4. Read all Warning, Cautions, and precautions listed at the beginning of this section.
- 5. Clean the transmission area around the traction circuit hoses on the top of the transmission (Figure 42). Determine which traction relief valve is to be tested.
- 6. Disconnect the hydraulic hose from the transmission pump outlet fitting to test the relief valve (Figure 42):

| Relief Valve to be Tested | Pump Outlet |
|---------------------------|-------------|
| Right side forward | Port A |
| Right side reverse | Port B |
| Left side forward | Port C |
| Left side reverse | Port D |

- 7. Install a hydraulic tester (pressure and flow) in series with the pump outlet and disconnected hose. Ensure that the tester flow arrow points from the pump outlet port and toward the hose for the relief valve direction that is to be tested. Ensure that the flow-control valve on the tester is fully open.
- 8. Start the engine and run it at low-idle speed **(1,400 rpm)**. Check for hydraulic-fluid leaks from the test connections and correct before continuing the test.

IMPORTANT

Do not run the engine at full speed when performing this test using Toro hydraulic tester (pressure and flow) (TOR214678). The traction pump output at full engine speed can damage the hydraulic tester.

- 9. Use a phototac to measure the engine speed, move the throttle so that the engine speed is **2,800 rpm** (not full speed).
- 10. Completely close the flow control valve on the tester.
- 11. Keep the traction-control lever in the NEUTRAL position for the transmission pump that is not tested.
- 12. Carefully monitor the tester pressure gauge, have an operator slowly push the traction lever for the pump being tested (right side or left side) in the direction being tested (forward or reverse) until the pressure gauge stabilizes indicating that the relief valve has opened.

Note: The pressure gauge reading should be approximately **27,600 kPa (4,000 psi)** as the relief valve lifts.

13. Release the traction lever to the NEUTRAL position, open the tester flow-control valve, and shut off the engine. Record the test results.

Note: The forward relief valves for the 2 transmission pump circuits are identical and thus you can interchange them. The reverse relief valves are also identical. The forward relief valves, however, are different than the reverse relief valves so do not interchange the forward and reverse relief valves.

14. If the traction relief valve pressure is not met, remove and inspect the relief valve from the transmission; refer to Servicing the Transmission (page 4–75). Clean or replace the relief valve.

Note: The relief valves are not adjustable.

- 15. Release pressure from the hydraulic system; refer to Releasing Pressure from the Hydraulic System (page 4–11).
- 16. Disconnect the tester from the pump outlet fitting and hydraulic hose, and connect the hose to the pump fitting.
- 17. If necessary, repeat the pressure test for other traction-relief valves.

Testing the Wheel Motor Efficiency (Using Tester with Pressure Gauges and Flow Meter)



Figure 43

Perform the wheel motor efficiency test if you identify a traction circuit problem. This test determines if a wheel motor has excessive internal leakage and wear.

Note: Over a period of time, a wheel motor can wear internally. A worn motor may bypass the hydraulic fluid to its case drain that reduces the motor efficiency. After sometime, sufficient fluid loss causes the wheel motor to stall under heavy load conditions. Continued operation with a worn, inefficient motor can generate excessive heat, cause damage to the seals and other components in the hydraulic system and affect overall machine performance.

Test Procedure

A

- 1. Ensure that the hydraulic fluid is at normal operating temperature.
- 2. Ensure that the traction drive is correctly adjusted for the NEUTRAL position.

WARNING

Before disconnecting or doing any work on the hydraulic system, release all the pressure in the system; refer to Releasing Pressure from the Hydraulic System (page 4–11).

- 3. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, and set the parking brake.
- 4. Read all Warning, Cautions, and precautions listed at the beginning of this section.
- 5. Attach a heavy chain to the rear of the machine frame and an immovable object to prevent the machine from moving during testing. As an alternative, raise the machine and support it with jack stands so that the 2 rear wheels are off the ground.
- 6. Disconnect the wire harness connector from the parking brake sensor; refer to the Parking Brake Sensor (page 5–33). Install a jumper wire across the harness connector terminals and set the parking brake to allow traction circuit operation.
- 7. Clean the transmission area around the traction circuit hoses on the top of the transmission (Figure 43). Determine which wheel motor is to be tested.
- 8. Disconnect the hydraulic hose from the transmission pump outlet fitting to test the wheel motor (Figure 43):

| Wheel Motor to be Tested | Pump Outlet |
|--------------------------|-------------|
| Right side motor | Port A |
| Left side motor | Port C |

- 9. Install a hydraulic tester (pressure and flow) in series between the pump outlet fitting and disconnected hose. Ensure that the tester flow arrow points from the pump outlet and toward the hose. Ensure that the flow control valve on the tester is fully open.
- 10. Start the engine and run it at low-idle speed **(1,400 rpm)**. Check for hydraulic-fluid leaks from test connections and correct before continuing the test.

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IMPORTANT

Do not run the engine at full speed when performing this test using Toro hydraulic tester (pressure and flow) (TOR214678). The traction pump output at full engine speed can damage the hydraulic tester.

11. Use a phototac to measure the engine speed, move the throttle so that the engine speed is **2,800 rpm** (not full speed). Set the parking brake to keep the wheel from rotating during test.

CAUTION

The rear wheel that you are testing will try to move the machine forward.

Use extreme caution when performing the test.

- 12. Sit in the operator seat and slowly push the traction control lever for the motor to be tested in the forward direction until the tester pressure gauge displays **6,900 kPa (1,000 psi)**.
- 13. The wheel motor internal leakage is shown on the tester flow meter in L/minute (gallons/minute).
- 14. Return the traction control lever to the NEUTRAL position. Shut off the engine and record the test results. Rotate the wheel and test it again.

Note: Testing the wheel motor leakage in 3 different wheel positions will give the most accurate test results.

- 15. The flow should be less than **5.7 L/minute (1.5 gallons/minute)** for the tested wheel motor. If the specification is not met, repair or replace the wheel motor.
- 16. Release pressure from the hydraulic system; refer to Releasing Pressure from the Hydraulic System (page 4–11).
- 17. Disconnect the tester from the pump outlet fitting and hydraulic hose, and connect the hose to the pump fitting.
- 18. If other wheel motor requires testing, complete the steps 7 to 17 for the other motor.
- 19. After you complete the test, remove the jumper wire from the parking brake harness connector. Connect the wire harness to the parking brake sensor; refer to the Parking Brake Sensor (page 5–33). Ensure that the operation of the parking brake sensor is correct before returning the machine to regular operation.

Testing the PTO Pressure Valve (Using Pressure Gauge)



Figure 44

Perform the PTO pressure valve test if you identify a PTO engagement problem. This test determines if the PTO pressure valve in the transmission is operating correctly.

Test Procedure

1. Ensure that the hydraulic fluid is at normal operating temperature.

WARNING

Before disconnecting or doing any work on the hydraulic system, release all the pressure in the system; refer to Releasing Pressure from the Hydraulic System (page 4–11).

- 2. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, and set the parking brake.
- 3. Read all Warning, Cautions, and precautions listed at the beginning of this section.
- 4. Clean the transmission area around the pressure valve test port.
- 5. Remove the plug from the pressure valve test port. Connect a 6,900 kPa (1,000 psi) hydraulic pressure gauge with a hydraulic hose that is attached to the test port.
- 6. Start the engine and run it at low-idle speed **(1,400 rpm)**. Check for hydraulic-fluid leaks from the test connections and correct before continuing the test.
- 7. With the engine running, move the throttle to full speed (3,000 rpm).

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WARNING

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Keep away from the deck (or implement) during the test to prevent personal injury.

- 8. Have an operator engage the PTO and monitor the pressure gauge.
- 9. With the engine running at full speed and PTO engaged, the pressure should be **1,930 to 2,340 kPa (280 to 340 psi)**.
- 10. Disengage the PTO and then shut off the engine. Record the test results.
- 11. If specification is not met, repair or replace the pressure valve in the transmission; refer to Servicing the Transmission (page 4–75). Also consider a worn or damaged charge pump in the transmission (the traction charge circuit will be affected as well).
- 12. Release pressure from the hydraulic system; refer to Releasing Pressure from the Hydraulic System (page 4–11).



13. Disconnect the test gauge from the pressure valve test port. Install the plug into the port and torque the plug to **19 to 20 N·m (14 to 15 ft-lb)**.

Testing the Implement Relief Pressure (Using Pressure Gauge)



Figure 45
Perform the implement relief pressure test if you identify a cutting deck (or implement) raise and lower problem. This test determines if the implement relief valve is operating correctly.

Test Procedure

- 1. Ensure that the hydraulic fluid is at normal operating temperature.
- 2. Ensure that the traction drive is correctly adjusted for the NEUTRAL position.



Before disconnecting or doing any work on the hydraulic system, release all the pressure in the system; refer to Releasing Pressure from the Hydraulic System (page 4–11).



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1. Lift control manifold

2. Hose from the gear pump

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3. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, and set the parking brake.

Test Procedure (continued)

- 4. Read all Warning, Cautions, and precautions listed at the beginning of this section.
- 5. Clean the junction of the hydraulic hose and upper fitting on the front side of the lift control manifold (Figure 46).
- 6. Disconnect the hydraulic hose from the upper fitting on the front side of the lift control manifold (Figure 46). This hose is from the gear pump outlet and provides fluid flow to the lift control manifold (Figure 47).
- 7. Install a T-connector with a 34,500 kPa (5,000 psi) hydraulic pressure gauge in series with the lift control manifold fitting and disconnected hose.
- 8. Start the engine and run it at low-idle speed **(1,400 rpm)**. Check for hydraulic-fluid leaks from the test connections and correct before continuing the test.
- 9. With the engine running, move the throttle to full speed (3,000 rpm).

IMPORTANT

Press the lift switch to the RAISE position only until you get a system pressure reading. Holding the lift switch in the RAISE position for an extended period may damage the lift control manifold.

- Monitor the pressure gauge carefully while you press the lift switch to the RAISE position. The system pressure should be approximately 20,700 kPa (3,000 psi) as the implement relief valve lifts.
- 11. Return the lift switch to the NEUTRAL position, shut off the engine, and record the test results.
- 12. If specification is not met, repair or replace the implement relief valve in the gear pump; refer to Servicing the Gear Pump (page 4–109). Also, consider a leaking lift cylinder, damaged lift control manifold, or worn gear pump.

Note: The implement relief valve pressure can also be tested with a hydraulic tester (pressure and flow) in series with the gear pump fitting and disconnected hose. Use the pressure gauges on the hydraulic tester and follow Testing the Implement Relief Pressure (Using Pressure Gauge) (page 4–48).

- 13. Release pressure from the hydraulic system; refer to Releasing Pressure from the Hydraulic System (page 4–11).
- 14. Disconnect the T-connector with test gauge from the lift control manifold fitting and hydraulic hose, and connect the hydraulic hose to the lift control manifold fitting again.

Testing the Gear Pump Flow (Using Tester with Pressure Gauges and Flow Meter)





Perform the gear pump flow test if you identify a cutting deck (or implement) raise and lower problem. This test determines if the hydraulic flow from the gear pump is correct.

Test Procedure

Note: Over a period of time, the gears and wear plates in the gear pump can wear. A worn pump may bypass the hydraulic fluid and make the pump less efficient. After some time, sufficient fluid loss might occur and cause the cutting deck lift cylinder to operate slowly. Optional hydraulic cylinders and motor, if equipped, will also lose efficiency. Continued operation with a worn, inefficient pump can generate excessive heat, cause damage to the seals and other components in the hydraulic system.

- 1. Ensure that the hydraulic fluid is at normal operating temperature.
- 2. Ensure that the traction drive is correctly adjusted for the NEUTRAL position.



Before disconnecting or doing any work on the hydraulic system, release all the pressure in the system; refer to Releasing Pressure from the Hydraulic System (page 4–11).



g033408

Figure 49

1. Lift control manifold

2. Hose from the gear pump

- 3. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, and set the parking brake.
- 4. Read all Warning, Cautions, and precautions listed at the beginning of this section.
- 5. Clean the junction of the hydraulic hose and upper fitting on the front of the lift control manifold.
- 6. Disconnect the hydraulic hose from the upper fitting on the front of the lift control manifold (Figure 49). This hose is from the gear pump outlet and provides fluid flow to the lift control manifold.
- 7. Install a hydraulic tester (pressure and flow) in series with the gear pump fitting and disconnected hose. Ensure that the tester flow arrow points from the pump outlet port and toward the disconnected hose. Ensure that the flow-control valve on the tester is fully open.

Test Procedure (continued)

- 8. Start the engine and run it at low-idle speed **(1,400 rpm)**. Check for hydraulic-fluid leaks from the test connections and correct before continuing the test.
- 9. With the engine running, move the throttle to full speed (3,000 rpm).
- 10. Monitor the tester pressure gauge carefully while you slowly close the flow control valve until you get **6,900 kPa (1,000 psi)**. Do not close the tester load valve fully.
- 11. Check with a phototac that the engine speed remains **3,000 rpm** while maintaining **6,900 kPa (1,000 psi)** on the tester pressure gauge.
- 12. Monitor the flow gauge. The flow indication for a pump in good condition is **18.9 L/minute (5.0 gallons/minute)**.
- 13. Open the tester load valve and then shut off the engine. Record the test results.
- 14. A normal pump flow is 18.9 L/minute (5.0 gallons/minute). A lower pump flow may result in reduced circuit performance. If the flow is less than 17.0 L/minute (4.5 gallons/minute) or a pressure of 6,900 kPa (1,000 psi) cannot be obtained, check for restriction in the pump inlet line. If the inlet line is not restricted, remove the gear pump and repair or replace as necessary.

Note: The implement relief valve pressure can also be tested with a hydraulic tester (pressure and flow) in series with the gear pump fitting and disconnected hose. Use the pressure gauges on the hydraulic tester and follow Testing the Implement Relief Pressure (Using Pressure Gauge) (page 4–48).

- 15. Release pressure from the hydraulic system; refer to Releasing Pressure from the Hydraulic System (page 4–11).
- 16. Disconnect the tester from the lift control manifold fitting and hydraulic hose, and connect the hose to the lift control manifold fitting again.

Testing the Lift Cylinder for Internal Leakage



Figure 50

Perform the lift cylinder internal leakage test if you identify a cutting deck (or implement) raise and lower problem. This test determines if the lift cylinder is damaged.

Note: The raise/lower circuit operation can be affected by the lift cylinder binding, extra weight on the cutting deck (or implement), and/or binding of the lift components. Ensure that these items are checked before continuing with the lift cylinder internal leakage test.

Test Procedure

1. Park the machine on a level surface with the PTO switch off. Position the cutting deck (or implement) in a partially raised position and shut off the engine. Set the parking brake.



g033410

Figure 51

1. Lift cylinder

- 2. Barrel end hose
- 2. Under both sides of the cutting deck (or implement), use a jack to raise the cutting deck (or implement) slightly. This removes the load from the lift cylinder and releases the lift cylinder hydraulic pressure.
- 3. Support both sides of the cutting deck (or implement) with jack stands to prevent the lift cylinder from retracting.
- 4. Clean the area around the hydraulic hose end at the barrel end of the lift cylinder. Disconnect the hydraulic hose from the lift cylinder barrel end fitting (Figure 51).

IMPORTANT

When capping the lift cylinder fitting and hydraulic hose end, use a steel cap and plug to ensure that there is no fluid leakage. The plastic plugs cannot hold the hydraulic pressure that is developed during this test procedure.

5. Install 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.



1. Lift cylinder collar

- 2. Tape
- 6. Remove the jack stands from under the cutting deck (or implement).

Note: The cutting deck (or implement) should settle slightly and then be supported by the capped lift cylinder.

- 7. Place a piece of tape on the lift cylinder rod near the rod end (Figure 52). Measure and record the distance from the lift cylinder collar to the tape location.
- 8. Keep the machine parked for 4 hours and monitor the lift cylinder. The weight of the cutting deck (or implement) can cause the lift cylinder to gradually retract. Use the change in distance from the lift cylinder collar to the location of the tape to determine the lift cylinder rod movement.
 - A. If the cutting deck (or implement) is still suspended after 4 hours and lift cylinder rod movement is less than 6.4 mm (1/4 inch), consider that the lift cylinder is in good condition.

Note: A lift cylinder in good, usable condition will show minimal rod movement.

- B. If the rod movement is more than 6.4 mm (1/4 inch) after 4 hours, indicates a lift cylinder with internal seal damage or excessive internal wear. Replace or repair the lift cylinder; refer to Lift Cylinder (page 4–124) and Servicing the Lift Cylinder (page 4–126).
- 9. Once the lift cylinder condition is determined, use a jack to raise both sides of the cutting deck (or implement) slightly which removes the load from the lift cylinder.
- 10. Support both sides of the cutting deck (or implement) with jack stands.
- 11. Remove the cap from the cylinder fitting and the plug from the hydraulic hose.
- 12. Connect the hydraulic hose to the lift cylinder fitting.
- 13. Remove the tape from the lift cylinder rod.
- 14. Remove the jack stands from the cutting deck (or implement).
- 15. Start the engine and operate the lift cylinder through several raise and lower cycles. Shut off the engine and check for any leakage.
- 16. Check the hydraulic-fluid level in the hydraulic reservoir.

Service and Repairs

General Precautions for Removing and Installing the Hydraulic System Components

Before Repairing or Replacing the Components

- 1. Before removing any parts from the hydraulic system, park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.
- 2. Clean the machine before you disconnect, remove, or disassemble the hydraulic components.

Note: Cleanliness is necessary whenever you work on the hydraulic equipment. Ensure that you clean the hydraulic components, hoses, connections, and fittings.

- 3. Label all the disconnected hydraulic lines and hoses for proper installation after repairs are completed.
- 4. Note the position of the hydraulic fittings (especially elbow fittings) on the hydraulic components before removal.

Note: Mark the parts, if necessary before removal and ensure that they are aligned properly when installing the hydraulic fittings, hoses, and tubes.

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Before disconnecting or doing any work on the hydraulic system, release all the pressure in the system; refer to Releasing Pressure from the Hydraulic System (page 4–11).

- 5. The hydraulic fluid may be hot. Be careful when you loosen and remove the hydraulic system components.
- 6. Install clean caps or plugs on the hydraulic lines, hydraulic fittings, and components that are left open or exposed to prevent hydraulic system contamination. Cap the opening as soon as the line or port is exposed.

After Repairing or Replacing the Components

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1. Check the hydraulic-fluid level in the hydraulic reservoir and add correct quantity of fluid if necessary. Use the hydraulic fluids that are specified in the *Traction Unit Operator's Manual*.

IMPORTANT

Drain and fill the hydraulic-system reservoir and change the oil filter if the component failure is severe or the system is contaminated; refer to Flushing the Hydraulic System (page 4–59).

- 2. Lubricate the O-rings and seals with clean hydraulic fluid before installing the hydraulic components.
- 3. Remove all the caps or plugs from the hydraulic tubes, hydraulic fittings, and components before connecting them again.
- 4. Use proper tightening procedures when installing the hydraulic hoses and fittings; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal

After Repairing or Replacing the Components (continued)

Fitting) (page 4–5) and Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fitting into the Component Port) (page 4–7).

- 5. After you complete the repairs, check the control linkages or cables for proper adjustment, binding, or broken parts.
- 6. After you disconnect or replace any hydraulic components, operate the machine functions slowly until the air is out of the system; refer to Charging the Hydraulic System (page 4–61).
- 7. Check for hydraulic-fluid leaks. Shut off the engine and repair leaks if necessary.

Checking the Hydraulic Lines and Hoses

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WARNING

Hydraulic fluid escaping under pressure can penetrate skin and cause injury.

- Ensure that all hydraulic-fluid hoses and lines are in good condition and all hydraulic connections and fittings are tight before applying pressure to the hydraulic system.
- Keep your body and hands away from pinhole leaks or nozzles that eject high-pressure hydraulic fluid.
- Use a piece of cardboard or paper to find hydraulic leaks.
- Release all pressure in the hydraulic system before performing any work on the system.
- Seek immediate medical attention if hydraulic fluid is injected into your skin.

IMPORTANT

Check the hydraulic lines and hoses daily for leaks, kinked lines, loose mounting supports, wear, loose fittings, weather deterioration, and chemical deterioration. Repair the damaged hydraulic equipment before operating the machine.

Priming the Hydraulic Pumps

When the hydraulic system is flushed, the hydraulic system is charged, or the hydraulic components are installed, it is important to properly prime the hydraulic pumps. The hydraulic pump priming ensures that the gear pump and piston (traction) pump have sufficient fluid during initial start-up and running. The pumps can be primed by using a remote starter switch (refer to Special Tools (page 4–23)) to crank the engine which allows the pumps to prime.

Use the following procedure to prime the hydraulic pumps:

- 1. Ensure that the key switch is in the OFF position and the key is removed from the key switch.
- 2. Check the hydraulic-fluid level in the hydraulic reservoir and add correct quantity of fluid if necessary; refer to the *Traction Unit Operator's Manual*.

Priming the Hydraulic Pumps (continued)



2. Starter solenoid

Note: A blue wire connects to the starter motor solenoid B+ terminal (Figure 53). It is not necessary to remove this blue wire from the solenoid terminal for hydraulic pump priming.

- 3. Connect the remote starter switch electrical leads to the starter motor solenoid B+ terminal and positive post of the battery.
- 4. Engage the remote starter switch and crank the starter for 30 seconds to prime the hydraulic pumps. Wait for 30 seconds to allow the starter motor and starter solenoid to cool. Repeat the cranking procedure for the second time.
- 5. Disconnect the remote starter switch leads from the starter motor solenoid terminal and positive post of the battery.

Flushing the Hydraulic System

IMPORTANT

Flush the hydraulic system whenever there is a severe component failure or the system is contaminated (for example, the fluid appears milky, black, or contains metal particles).

IMPORTANT

If a component failure occurs in the traction circuit; refer to the Traction Circuit (Closed Loop) Component Failure (page 4–12) for information regarding the importance of removing contamination from the traction circuit.

1. Ensure that the hydraulic fluid is at normal operating temperature by operating the machine for at least 20 minutes.

Flushing the Hydraulic System (continued)

WARNING

Before disconnecting or doing any work on the hydraulic system, release all the pressure in the system; refer to Releasing Pressure from the Hydraulic System (page 4–11).

2. Park machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.

Note: Ensure that you clean all the hydraulic connections that are disconnected for draining.

- 3. Drain the hydraulic fluid from the hydraulic tank and transmission.
- 4. Drain the complete hydraulic system. Drain all the hoses, tubes, and components while the system is warm.
- 5. Remove and replace the hydraulic-fluid filter.
- 6. Inspect and clean the hydraulic-fluid tank; refer to Inspecting the Hydraulic Tank (page 4–64).

IMPORTANT

Follow all local codes and regulations when recycling or disposing the hydraulic fluid and filters.

 Connect all the hydraulic hoses, tubes, and components that were disconnected while draining the system; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–5).

IMPORTANT

Using other hydraulic fluids could damage the hydraulic system. Use the hydraulic fluids that are specified in the *Traction Unit Operator's Manual*.

- 8. Fill the hydraulic tank with the correct quantity of new hydraulic fluid.
- 9. Prime the hydraulic pumps; refer to Priming the Hydraulic Pumps (page 4–58).
- 10. Start the engine and operate it at low-idle speed **(1,400 rpm)** for a minimum of 2 minutes. Increase the engine speed to high idle **(3,000 rpm)** for a minimum of 1 minute under no load.
- 11. Raise and lower the cutting deck (or implement) several times.
- 12. Shut off the engine and check for hydraulic-fluid leaks.

Note: Check the hydraulic-fluid level in the hydraulic tank and add correct quantity of fluid if necessary; refer to the *Traction Unit Operator's Manual*.

- 13. Operate the machine for 2 hours under normal operating conditions.
- 14. Check the condition of hydraulic fluid. If new fluid shows any signs of contamination, repeat steps 1 through 13 again until the fluid is clean.
- 15. Assume the normal operation and follow the recommended maintenance intervals.

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Charging the Hydraulic System

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Note: When initially starting the hydraulic system with new or rebuilt components such as wheel motors, gear pump, or lift cylinder, it is important that the hydraulic system is charged properly. Remove the air from the system and its components to reduce the chance of damage.

IMPORTANT

Change the hydraulic-fluid filter when you repair or replace the hydraulic components.

- 1. Park the machine on a level surface and shut off the engine.
- 2. Ensure that all of the hydraulic connections, lines, and components are secured tightly.

Note: Flush and fill the hydraulic system and reservoir whenever there is a severe component failure or the system is contaminated; refer to Flushing the Hydraulic System (page 4–59).

- 3. Ensure that the hydraulic reservoir is full. Add correct quantity of hydraulic fluid if necessary; refer to the *Traction Unit Operator's Manual*.
- 4. Check the traction control components for proper adjustment, binding, or damaged parts.
- 5. Prime the hydraulic pumps; refer to Priming the Hydraulic Pumps (page 4–58).

IMPORTANT

Before lifting the machine with a jack, review and follow Jacking Instructions (page 1–6).

6. Raise the 2 drive wheels off the ground and place the jack stands under the frame to support the machine.

CAUTION

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Ensure that the machine is safely supported so that it does not move or accidentally fall and prevent injuring anyone under the machine.

7. Start the engine and run it at low-idle speed (1,400 rpm).

Note: The charge and gear pumps must pick up the hydraulic fluid and fill the hydraulic system. If there is no indication of fill in 30 seconds, shut off the engine and find the cause.

- 8. After the hydraulic system starts to show the signs of fill, actuate a lift switch until the lift cylinder rod moves in and out several times.
- 9. If the lift cylinder does not move after 3 to 5 seconds or if the pump emits abnormal sounds, shut off the engine immediately, and find the cause or problem. Inspect for the following:
 - A. The oil filter or suction lines that are loose.
 - B. An incorrect hose routing.
 - C. The suction line that is blocked.
 - D. The implement relief valve that is damaged.

Charging the Hydraulic System (continued)

- E. The gear pump that is damaged.
- 10. After the lift cylinder moves normally, proceed to step 11.
- 11. Operate the traction control levers in the forward and reverse directions. The drive wheels should rotate in the proper direction. If the wheels rotate in the wrong direction, shut off the engine, inspect the wheel motor location and hydraulic lines to the wheel motors; refer to Installing the Transmission (page 4–73).
- 12. Adjust the traction control levers to the NEUTRAL position; refer to the *Traction Unit Operator's Manual.*
- 13. Lower the machine to the ground.
- 14. If the transmission or a wheel motor was replaced or rebuilt, operate the traction circuit on a level ground so that the 2 drive wheels rotate slowly for 10 minutes.
- 15. Operate the machine by gradually increasing its work load to full over a 10 minute period.
- 16. Stop the machine. Check the hydraulic-fluid level in the hydraulic reservoir and add correct quantity of fluid if necessary; refer to the *Traction Unit Operator's Manual*.
- 17. Check the hydraulic components for leaks and tighten any loose connections.

Hydraulic Tank



Removing the Hydraulic Tank

- 1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.
- 2. Remove the operator seat and seat base; refer to Removing the Operator Seat (page 6–35).

Removing the Hydraulic Tank (continued)

- 3. Remove the brake handle from the machine to allow removal of the hydraulic tank; refer to Parking Brake Assembly (page 6–15).
- 4. Drain the hydraulic fluid from the hydraulic tank.
- 5. Clean the hydraulic hose ends and fittings on the hydraulic tank to prevent contaminants from entering into the hydraulic system.
- 6. For assembly purposes, label all the hydraulic hoses and fittings. Remove the hydraulic hoses from the fittings on the hydraulic tank and drain the hoses into a suitable container.
- 7. Install clean caps or plugs on the hydraulic hoses and fittings to prevent system contamination.
- 8. Remove the 2 washer-head screws and tank support that retain the hydraulic tank to the frame.
- 9. Remove the hydraulic tank toward the front of the machine.
- 10. Inspect the foam strips under the hydraulic tank.

Note: Replace the strips if they are damaged.

11. Remove the fittings from the hydraulic tank as shown in Figure 54. Discard and replace the O-rings.

Inspecting the Hydraulic Tank

- 1. Clean the hydraulic tank and suction strainer with solvent.
- 2. Inspect the hydraulic tank for leaks, cracks, or other damage.

Installing the Hydraulic Tank



- 1. If the suction strainer was removed from the hydraulic tank, install a new, lubricated O-ring on the strainer. Thread the strainer into the tank and torque the strainer to 82 to 90 N·m (60 to 66 ft-lb).
- Install the fittings that were removed with new lubricated O-rings to the hydraulic tank (Figure 54). Refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fitting into the Component Port) (page 4–7). Tighten the fittings to 90 to 94 N·m (66 to 70 ft-lb)
- 3. Install the hydraulic tank to the machine and secure the tank to the frame with the tank support and 2 washer-head screws.
- 4. Remove the caps or plugs that were installed to the hydraulic hoses and fittings during the removal process.
- 5. Use the labels that you attached during tank removal to correctly connect the hydraulic hoses to the fittings on the hydraulic tank; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–5).
- Install the brake handle to the machine; refer to Parking Brake Assembly (page 6–15). Ensure that the operation of the parking brake sensor is correct after you install the brake handle.
- 7. Fill the hydraulic tank with the correct quantity of new hydraulic fluid.
- 8. Install the operator seat and seat base; refer to Installing the Operator Seat (page 6–36).
- 9. Operate the machine. Check the hydraulic-fluid level and adjust if necessary.
- 10. Check the hydraulic components for leaks. Tighten any loose connections.

Wheel Motors



Removing the Wheel Motor



1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.

IMPORTANT

Before lifting the machine with a jack, review and follow Jacking Instructions (page 1–6).

- 2. Lift the machine with a jack and remove the drive wheel, support the machine with jack stands; refer to Removing the Rear Wheel (page 6–4).
- 3. Remove the brake assembly from the machine; refer to Removing the Parking Brakes (page 6–9).

IMPORTANT

Do not hit the wheel hub, wheel-hub puller, or wheel motor with a hammer while removing or installing. Hammering can damage the wheel motor.

- 4. Use an appropriate puller to loosen the wheel hub from the wheel motor.
- 5. Loosen, but do not remove the locknut that secures the wheel hub to the wheel motor.
- 6. Remove the locknut and wheel hub that is loosened from the motor shaft.
- 7. Locate and retrieve the woodruff key from the wheel motor shaft.



Figure 56

 1. Hydraulic tank
 3. Right wheel motor

g033416

- 2. Transmission 4. Left wheel motor
- 8. Clean the hydraulic hose ends and fittings on the wheel motor to prevent contaminants from entering into the hydraulic system.
- 9. For assembly purposes, label all the hydraulic hoses and fittings (Figure 56). Remove the hydraulic hoses from the fittings on the wheel motor. Allow the hoses to drain into a suitable container.
- 10. Put a mark on the hydraulic fitting orientation for correct assembly and remove the hydraulic fittings from the wheel motor.
- 11. Remove and discard the O-rings from the fittings.
- 12. Install clean caps or plugs on the hydraulic hoses and wheel motor ports to prevent system contamination.
- 13. Support the wheel motor to prevent it from falling during removal.

Removing the Wheel Motor (continued)

- 14. Remove the 4 socket-head screws that secure the wheel motor to the machine.
- 15. Remove the wheel motor from the frame.

Installing the Wheel Motor

IMPORTANT

Because of the internal differences in the wheel motors, do not interchange the wheel motors on the machine (e.g., do not put the right motor on the left side of the machine). If necessary, use the *Parts Catalog* and Part Number on the wheel motor to identify the right and left motors, there is also a yellow dot on the left motor.

- 1. Clean the threads in the frame and on the 4 socket-head screws.
- 2. Position the wheel motor to the frame with ports facing up.
- 3. Apply the Loctite #271 (or equivalent) to the threads of the socket-head screws. Secure the wheel motor to the frame with the 4 socket-head screws.
- 4. Remove the caps or plugs from the hydraulic hoses and wheel motor ports.
- 5. Lubricate and install new O-rings to the hydraulic fittings. Install the fittings into the wheel motor ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fitting into the Component Port) (page 4–7). Ensure that the fittings are orientated correctly.
- 6. Use the labels that you attached during the removal process to correctly connect the hydraulic hoses to the wheel motor fittings; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–5).
- 7. Ensure that the tapers of the wheel motor shaft and wheel hub are clean.
- 8. Insert the woodruff key into the key slot in the wheel motor shaft.
- 9. Assemble the wheel hub to the motor shaft with the locknut.
- 10. Install the brake assembly and wheel assembly to the machine; refer to Installing the Rear Wheel (page 6–5) and Installing the Parking Brakes (page 6–11). Ensure that the clearance between the brake assembly and wheel hub rotor is 0.8 to 1.7 mm (0.030 to 0.070 inch).



- 11. Lower the machine to the ground. Torque the locknut (item 1 in Figure 55) to 407 to 542 N⋅m (300 to 400 ft-lb).
- 12. Fill the reservoir with the correct quantity of new hydraulic fluid.

Servicing the Wheel Motor



Note: The 2 wheel motors of the Groundsmaster 7210 machine have the same basic construction. The left wheel motor has a yellow sticker on the port side of the stator. The right wheel motor has a reverse timed manifold.

IMPORTANT

Do not interchange the wheel motors on the machine (e.g., do not put the right motor on the left side of the machine). If necessary, use the *Parts Catalog* and Part Number on the wheel motor to identify the right and left motors.

Note: For the wheel motor repair procedures; refer to 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 fails; refer to the Traction Circuit (Closed Loop) Component Failure (page 4–12) for information regarding the importance of removing contamination from the traction circuit.

Transmission



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- 1. Transmission
- 2. Coupler
- 3. O-ring
- 4. Gear pump
- 5. Bolt (40 mm long)
- 6. Lock washer (7 each)
- 7. Bolt (50 mm long) (6 each)
- 8. Tube
- 9. Flywheel housing
- 10. Dowel pin (2 each)
- 11. Hydraulic fitting
- 12. O-ring
- 13. Hydraulic hose
- 14. Bolt (2 each)
- 15. Lock washer (2 each)

Figure 58

- 16. Hydraulic tube
- 17. O-ring
- 18. Hydraulic fitting
- 19. 90° hydraulic fitting
- 20. Hydraulic fitting
- 21. Hose clamp
- 22. Hydraulic hose
- 23. O-ring
- 24. O-ring
- 25. Hex nut
- 26. Clip
- 27. Bolt
- 28. O-ring
- 29. Hydraulic fitting
- 30. O-ring

- 31. O-ring
- 32. Hydraulic hose
- 33. Hose clamp
- 34. 90° hydraulic fitting
- 35. 90° hydraulic fitting
- 36. Hydraulic hose
- 37. Hydraulic hose (2 each)
- 38. Hydraulic hose (2 each)
- 39. O-ring
- 40. Hydraulic fitting
- 41. O-ring
- 42. Hydraulic hose
- 43. Hydraulic fitting (4 each)
- 44. O-ring

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WARNING

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Before disconnecting or doing any work on the hydraulic system, release all the pressure in the system; refer to Releasing Pressure from the Hydraulic System (page 4-11).

- 1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.
- 2. Remove the operator seat and seat base; refer to Removing the Operator Seat (page 6-35).



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Figure 59

4.

- 1. Transmission
- 2. Pump control rod

- Bolt 5.
- Traction control hub 3
- 6. Retaining ring

Locknut

3. On both sides of the machine, remove the bolt and locknut that secures the pump control rod to the traction control hub (Figure 59).

Note: The bolt is installed from the outside toward the center of the machine.

- Disconnect the wire harness electrical connector from the transmission solenoid valve coil. Position the wire harness away from the transmission.
- 5. Drain the hydraulic fluid from the hydraulic tank and transmission.
- 6. Clean the hydraulic hose ends and fittings on the transmission, gear pump, and hydraulic tank to prevent contaminants from entering into the hydraulic system.
- 7. For assembly purposes, label all the hydraulic hoses and fittings. Remove the hydraulic hoses from the fittings on the transmission, gear pump, and hydraulic tank. Allow the hoses to drain into a suitable container.
- 8. Install clean caps or plugs in the hose and fitting openings to prevent system contamination.
- 9. Remove the hydraulic tank; refer to Removing the Hydraulic Tank (page 4-63).

Removing the Transmission (continued)

10. Remove the oil filter from the transmission and discard the filter. If necessary, remove the gear pump from the transmission; refer to Removing the Gear Pump (page 4–106).



6. Transmission

Note: Two 8 mm eyebolts can be installed into the threaded bosses in the top of the transmission to allow the use of a lift or hoist to remove the transmission (Figure 60).



Support the transmission assembly when you remove it from the flywheel housing to prevent it from falling and causing personal injury.

11. Remove the 7 bolts and 7 lock washers that secure the transmission to the flywheel housing. Note the location of the shorter bolt for assembly purposes.

IMPORTANT

Ensure that you do not damage the transmission, flywheel housing, hydraulic lines, electrical harness, or other parts while removing the transmission.

12. Move the transmission assembly toward the front of the machine and away from the flywheel housing and coupler on the engine flywheel. Lift the transmission from the machine.

Removing the Transmission (continued)

- 13. Locate and note the location of the 2 dowel pins from the transmission and flywheel housing.
- 14. On both sides of the transmission, remove the retaining ring that secures the pump control rod end onto the transmission control arm (Figure 59). Slide the control rod from the control arm.
- 15. If the hydraulic fittings are to be removed from the transmission, put a mark on the fitting orientation for correct assembly. Remove the hydraulic fittings from the transmission as necessary. Discard the fitting O-rings.
- 16. Inspect the flywheel housing and coupler on the engine flywheel for wear or damage.

Installing the Transmission

- 1. Ensure that the flywheel coupler and flywheel housing are secure on the engine; refer to Chapter 3: Diesel Engine (page 3–1).
- 2. If the hydraulic fittings were removed from the transmission, lubricate and install new O-rings onto the fittings. Install the fittings into the transmission ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fitting into the Component Port) (page 4–7). Tighten the fittings to the torque values identified in Figure 61.
- 3. If the gear pump was removed from the transmission, install the gear pump; refer to Installing the Gear Pump (page 4–107).



4. Slide both the pump control rods onto the transmission control arms and attach them with retaining rings (Figure 59).



Installing the Transmission (continued)

A

- 5. Apply a generous amount of anti-seize lubricant to the splines of the transmission input shaft and flywheel coupler.
- 6. Place the 2 dowel pins in the flywheel housing.

IMPORTANT

Ensure that you do not damage the transmission, flywheel housing, hydraulic lines, electrical harness, or other parts while installing the transmission.

CAUTION

A

Support the transmission assembly when you install it to the flywheel housing to prevent it from falling and causing personal injury.

7. Lower the transmission into the machine. Align the transmission input shaft with the flywheel coupler and slide the transmission to the flywheel housing. Support the transmission to prevent it from shifting.



- 8. Assemble the transmission to the flywheel housing with the 7 bolts and 7 lock washers. Ensure that the shorter (40 mm) bolt (item 5 in Figure 58) is properly positioned. Torque the bolts to **45 N**⋅**m** (400 in-lb).
- 9. Install the hydraulic tank to the machine; refer to Installing the Hydraulic Tank (page 4–64).
- 10. On both sides of the machine, attach the pump control rod to the traction control hub with the bolt and locknut (Figure 59).

Note: The bolt is installed from the outside toward the center of the machine.

- 11. Remove the caps or plugs that were installed to the hydraulic hoses and fittings during the removal process.
- 12. Use the labels that you attached during the removal process to correctly connect the hydraulic hoses to the transmission, gear pump, and hydraulic tank fittings; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–5).
- 13. Lubricate the gasket of new oil filter and install the filter on the transmission.

Note: Ensure that the drain plugs are properly installed in the hydraulic tank and transmission.

- 14. Fill the hydraulic tank with the correct quantity of new hydraulic fluid.
- 15. Install the operator seat and seat base; refer to Installing the Operator Seat (page 6–36).
- 16. Connect the wire harness electrical connectors to the solenoid valve coil and seat switch. Secure the harness to the frame.
- 17. Check the operation of the parking brake and parking brake sensor.
- 18. Adjust the traction drive for neutral.

Servicing the Transmission



Figure 62 (continued)

| 1. | Solenoid assembly | 27. | Seal (4 each) | 53. | Valve plate (2 each) |
|-----|------------------------------|-----|--------------------------------------|-----|----------------------------------|
| 2. | Solenoid valve assembly | 28. | O-ring (2 each) | 54. | Cylinder block assembly (2 each) |
| 3. | Bolt (3 each) | 29. | Washer (2 each) | 55. | Thrust plate (2 each) |
| 4. | Bolt (2 each) | 30. | Bearing (5 each) | 56. | Swash plate (2 each) |
| 5. | Hex plug (2 each) | 31. | Bearing (2 each) | 57. | Pin (4 each) |
| 6. | O-ring | 32. | Side cover (2 each) | 58. | Gasket |
| 7. | Pump body | 33. | Socket-head screw (3 each per cover) | 59. | Pump housing |
| 8. | Pin (2 each) | 34. | Nut (2 each) | 60. | PTO brake assembly |
| 9. | O-ring | 35. | Control arm (2 each) | 61. | Push rod (3 each) |
| 10. | Charge pump assembly | 36. | Socket-head screw (2 each) | 62. | PTO shaft |
| 11. | Key | 37. | Bearing (3 each) | 63. | Seal ring (4 each) |
| 12. | O-ring (5 each) | 38. | O-ring (2 each) | 64. | Right pump shaft |
| 13. | Piston | 39. | Socket head plug (2 each) | 65. | Left pump shaft |
| 14. | Spring | 40. | O-ring (8 each) | 66. | Pump gear (2 each) |
| 15. | Collar | 41. | Hex plug (8 each) | 67. | Gasket |
| 16. | Bolt and washer (2 each) | 42. | Pipe assembly | 68. | Gear case housing |
| 17. | Accumulator cover | 43. | Seal (2 each) | 69. | Flange-head screw (13 each) |
| 18. | Gasket | 44. | Washer (2 each) | 70. | Pipe assembly |
| 19. | Filter bypass valve assembly | 45. | Left flushing valve | 71. | Spacer |
| 20. | Hex drain plug | 46. | Reverse relief valve (2 each) | 72. | Input gear |
| 21. | Charge relief valve assembly | 47. | Forward relief valve (2 each) | 73. | PTO gear |
| 22. | Pressure valve assembly | 48. | Socket-head screw (8 each) | 74. | Input shaft |
| 23. | Socket head plug (4 each) | 49. | Right flushing valve | 75. | Retaining ring |
| 24. | Filter adapter | 50. | Bypass valve (2 each) | 76. | Clutch assembly |
| 25. | Oil filter | 51. | Center case | 77. | O-ring |
| 26. | Retaining ring (4 each) | 52. | Pin (4 each) | 78. | Key |

IMPORTANT

If a transmission fails; refer to the Traction Circuit (Closed Loop) Component Failure (page 4–12) for information regarding the importance of removing contamination from the traction circuit.



g033423

Figure 63

- 1. Solenoid coil
- 2. Solenoid valve stem
- 3. Pin

- 4. Spool
- 5. Sleeve
- 1. Clean the exterior of the transmission.
- 2. Remove the nut, lock washer, washer, O-ring, solenoid coil, and O-ring from the solenoid valve stem.
- 3. For assembly purposes, note that the "KANZAKI" molded into the coil has the "I" nearest the location of the nut as coil direction is important for proper solenoid operation.
- 4. Remove the solenoid valve stem from the transmission pump body.
- 5. Remove the pin from the spool, and remove the spool, sleeve, and solenoid valve spring from the transmission pump body.
- 6. For assembly purposes, note that the step in the spool is toward the spring location and that the sleeve is installed so that the holes are closest to the spring location.



g033424



1. Filter bypass plug

- Bypass valve
- 7. Remove the filter bypass plug, spring, and valve from the transmission pump body.
- 8. Remove and discard the O-ring from the plug.

a033425



- 1. Pressure valve plug
 2. Charge relief plug
- 9. Remove the pressure valve plug, spring, and valve from the transmission pump body.
- 10. Remove and discard the O-ring from the pressure valve plug.
- 11. Remove the charge relief plug, spring, and valve from the transmission pump body.
- 12. Remove and discard the O-ring from the charge relief plug.



g033426

Figure 66

- 1. Accumulator cover 3. Piston
- 2. Collar
- 13. Remove the 2 bolts that attach the accumulator cover to the transmission pump body.
- 14. Remove the cover, gasket, collar, spring, and piston from the pump body. For assembly purposes, note that the hole in the collar is toward the outside of the pump body. Discard the gasket.

1.



- 15. Remove the 2 hex plugs from the pump body.
- 16. Remove and discard the O-rings from the plugs.
- 17. Remove the 4 socket head plugs from the pump body.



18. Remove the 3 shorter (45 mm) and 2 longer (95 mm) flange-head screws that attach the pump body to the center case, and remove the pump body from the center case.



- 1. Pin2. Pump body
- 19. Remove the 2 pins that locate the pump body.
- 20. Remove and discard the O-rings.



g033430

1. Right pump shaft

3. Inner pump rotor

- 2. Outer pump rotor
- 21. Slide the outer and inner charge pump rotors from the right pump shaft, and remove the key from the key slot in the pump shaft.

Disassembling the Transmission (continued)







- 1. Center case



2. Pump housing



1.



- 2. Reverse relief cartridge
- 22. Remove the 8 socket-head screws that attach the center case to the transmission pump housing.
- 23. Carefully remove the center case assembly from the transmission pump housing.
- 24. Remove the 2 pins from the transmission pump housing bores.
- 25. Remove and discard the gasket.
- 26. Remove the bypass valves from the center case.
- 27. Remove and discard the O-rings and back-up rings from the bypass valves.

IMPORTANT

The forward and reverse relief cartridges are different. For assembly purposes, label all the relief cartridges.

28. Remove the forward and reverse relief valve cartridges from the center case and note the location of the relief cartridge for assembly purposes.

Note: You can identify the reverse relief valve cartridges by the groove in the hex head (Figure 73).

29. Remove the valve plates from the center case. Mark the positions of the valve plates so that you can assemble them in the same position.



g033434

Figure 74

Hex plug (6 each)
 Left flushing valve
 Right flushing valve
 Center case

30. Remove the 6 hex plugs from the center case.

Disassembling the Transmission (continued)

g033435

a033436

- 31. Remove and discard the O-rings from the plugs.
- 32. Remove the right and left flushing valve plugs, springs, and valves from the center case. Note the differences in the flushing valves and their locations for assembly purposes.
- 33. Remove and discard the O-rings from the plugs.



- Cylinder block assembly 2. Pipe 1.
- 34. Slide the 2 cylinder block assemblies from the pump shafts. Mark the positions of the cylinder blocks so that you can assemble them in the same position.

Note: Ensure that you do not drop the pistons from the cylinder block.

- 35. Slide the pipe assembly from the bore of the transmission pump housing.
- 36. Remove and discard the O-rings from the grooves in the pipe.



- 1. Oil seal Thrust plate Control arm 2. 4.
- 37. Remove the retaining ring that secures the PTO shaft oil seal into the housing bore, and remove the spacer and oil seal from the housing.

Note: Ensure that you do not damage the housing bore.

Disassembling the Transmission (continued)

- 38. Remove the thrust plate from each swash plate. For assembly purposes, note that the beveled sides of the thrust plates are against the swash plate surfaces.
- 39. Remove the socket-head screw and nut that secures the control arm onto each trunnion shaft. Slide the control arm from each trunnion shaft.



1. Hex plug

- 2. Socket head plug
- 40. Remove the 2 hex plugs and 1 socket head plug from the gear case housing.41. Remove and discard the O-rings from the plugs.



- 1. Gear case housing
- 3. Pin (2 each)

- 2. Pump housing
- 42. Remove the 15 flange-head screws that attach the gear case housing to the transmission pump housing.
- 43. Carefully remove the gear case housing from the pump housing.
- 44. Locate and retrieve the 2 pins from the gear case housing holes.
- 45. Remove and discard the gasket.
46. Remove the retaining ring that secures the input shaft oil seal into the gear case housing bore, and remove the spacer and oil seal from the housing. Discard the seal.



Note: Ensure that you do not damage the seal bore in the housing.

- 47. Remove the input shaft, right pump shaft, and left pump shaft assemblies from transmission pump housing.
- 48. Slide the pipe assembly from the bore of the pump housing.
- 49. Remove and discard the 2 O-rings from the grooves in the pipe.

1.

2.



- 50. If the pump shaft bearing replacement is necessary, remove and discard the seal ring from the right and left pump shafts.
- 51. Use a bearing puller to remove the bearings from the pump shaft.
- 52. Discard the bearings that were removed, and remove the gear from the pump shaft.
- 53. If the input shaft bearing replacement is necessary, use a bearing puller to remove the bearings from the input shaft.
- 54. Discard the bearings that were removed, and remove the gear from the input shaft.





1.

PTO shaft assembly



2. Pump housing

55. Remove the PTO shaft assembly from the transmission pump housing.



- 1. Friction plate 2. Pump housing
- 56. Remove the final friction plate from the transmission pump housing.

Note: This friction plate may have been removed with the PTO shaft assembly.



g033443

- 1. Bearing
- 2. PTO shaft
- 3. Spacer

- Figure 83
 - 4. Gear
 - 5. Clutch assembly
 - 6. Key



- 1.
- 2. PTO shaft **B**-plate 3.

- 6. Friction plate (3 each)
- 7. Bearing

- C-plate 4.
- 57. Disassemble the PTO shaft assembly as follows:
 - A. Use a bearing puller to remove the bearing from the PTO shaft. Discard the bearing.
 - B. Remove the spacer from the PTO shaft.
 - C. Slide the gear and clutch assembly from the PTO shaft.
 - D. Remove the key from the PTO shaft slot.
 - E. Remove the 2 seal rings from the PTO shaft grooves. Discard the seal rings.
 - F. Remove the B-plate, C-plate, 3 A-plates, and 3 friction plates from the PTO shaft.
 - G. Use a bearing puller to remove the bearing from the PTO shaft. Discard the bearing.



Figure 85

3.

PTO gear assembly

Rod (3 each) 1.

g033445

- Clutch assembly 2.
- 58. Slide the 3 rods from the holes in the clutch assembly.
- 59. Slide the PTO gear assembly from the clutch assembly.

Note: Because the individual clutch components are not available, disassembly of the clutch assembly is not necessary.



- 60. If necessary, remove the 2 bearings from the PTO gear and discard the bearings that were removed.
- 61. Remove the retaining ring from the groove in the PTO gear bore.



- 62. Remove the socket head plug and hex plug from the transmission pump housing.
- 63. Remove and discard the O-rings from the plugs.

1.

2.

3.



- 64. Remove the 3 socket-head screws that attach the 2 side covers to the transmission pump housing.
- 65. Carefully slide the side covers from the trunnion shafts and housing.
- 66. Remove and discard the O-rings from the side covers.
- 67. Remove the retaining rings that attach the oil seals into the 2 side covers.
- 68. Remove and discard the oil seals from the side covers.



1. Swash plate (2 each)



- 2. Washer
- 69. Carefully remove the swash plates from the transmission pump housing, and remove the washer from each swash plate.
- 70. Clean and inspect all the transmission components.



Note: When assembling the transmission, lubricate all the transmission components with clean hydraulic fluid.

- 1. Ensure that all the transmission components are clean before you assemble the transmission.
- 2. Apply clean hydraulic fluid to the washers and surfaces of the swash plate. Install the washer onto each swash plate and carefully install the swash plates into the transmission pump housing.



g033451



- Side cover 1.
- 2. O-ring

- Retaining ring 4.
- 5. Oil seal

- 3. Pump housing
- 3. Press the oil seal into the 2 side covers and secure the seal with the retaining ring. Lubricate new O-rings and install them onto the side covers.
- 4. Carefully slide the side covers over the trunnion shaft.

Note: Ensure that you do not damage the seals.



Install the 2 side covers to the transmission pump housing with the 3 5. socket-head screws; torque the screws to 8.8 to 10.8 N·m (78 to 95 in-lb).



Hex plug 2.

1.

g033452



6. Lubricate new O-rings and install the O-rings onto the socket head plug and hex plug. Install both the plugs into the transmission pump housing; torque the plugs to 23 to 26 N·m (17 to 19 ft-lb).



2. PTO gear

1.

7. Install the retaining ring into the groove in the PTO gear bore. Press both the bearings into the PTO gear until each bearing contacts the retaining ring that is installed.



Clutch assembly 2.

- 3. PTO gear assembly
- 8. Slide the 3 rods into the holes in the clutch assembly.
- 9. Slide the PTO gear assembly into the clutch assembly.



10. Assemble the PTO shaft assembly as follows:

- A. Press new bearing onto the PTO shaft so that the bearing is flush with the shaft shoulder.
- B. Alternately place the 3 A-plates and 3 friction plates onto the PTO shaft.
- C. Place the C-plate and then the B-plate onto the shaft.
- D. Carefully install the 2 seal rings into the grooves of the PTO shaft.

1.

2.



- 3. Spacer 6. Key
- 11. Install the clutch assembly and gear onto the PTO shaft:
 - A. Install the key into the PTO shaft slot.

Note: Ensure that the rounded ends of the key are aligned with the rounded ends of the shaft slot.

B. Slide the clutch assembly and gear onto the PTO shaft. Also, align the rods in the clutch with the holes in the B-plate.

Note: Ensure that the slot in the clutch is aligned with the key in the shaft.

- C. Place the spacer onto the PTO shaft.
- D. Press the bearing onto the PTO shaft so that the bearing is flush with the shaft shoulder.



Figure 97

1. Friction plate

g033457

2. Pump housing

12. Apply clean hydraulic fluid to the friction plate and place it in the transmission pump housing.

Note: Ensure that the tabs on the friction plates are placed in the housing grooves.



- PTO shaft assembly 1.
- 2. Pump housing

1.

- 3. Friction plate tabs
- Housing groove 4.
- 13. Install the PTO shaft assembly into the transmission pump housing.

Note: Ensure that the tabs on the friction plates are placed in the housing grooves.



14. If the shafts were disassembled, install the gear and 2 bearings onto the input shaft, right pump shaft and/or left pump shaft.

Note: Ensure that the bearings are pressed fully to the shaft shoulder.

15. Lubricate the seal rings and install the seal ring onto the right and left pump shafts.



Figure 100

1. Input shaft

Right pump shaft

g033460

2.

- Left pump shaft
 Pipe assembly
- 16. Install the right and left pump shaft assemblies into the transmission pump housing, and install the input shaft into the pump housing.

Note: Ensure that the gear teeth of the input shaft is aligned with the gears on the PTO and pump shafts.

17. Lubricate the 2 new O-rings and install the O-rings into the grooves in the pipe. Slide the pipe assembly into the bore of the transmission pump housing.



Figure 101

1. Gear case housing

3. Pin (2 each)

2. Pump housing

g033461

18. Install the 2 pins into the transmission pump housing holes. Align new gasket to the housing.

19. Carefully place the gear case housing onto the pump housing and align the pins, pipe, and shaft bearings.



- 20. Assemble the gear case housing to the pump housing with the 15 flange-head screws. Tighten the screws evenly in a crossing pattern and then torque the screws to **23 to 26 N·m (17 to 19 ft-lb)**.
- 21. Install the oil seal into the gear case housing bore.

Note: Ensure that you do not damage the input shaft oil seal.

22. Place the spacer on the oil seal and secure the seal with the retaining ring.



1. Hex plug

a033462

2. Socket head plug



Lubricate new O-rings and install the O-rings onto the 3 plugs. Install the plugs into the transmission assembly; torque the hex plugs to 19 to 20 N·m (14 to 15 ft-lb) and socket head plug to 23 to 26 N·m (17 to 19 ft-lb).



g033463

Figure 103

- 1. Oil seal
- 2. Thrust plate

- 3. Thrust plate bevel
- 4. Control arm
- 24. Install the oil seal into the bore of the pump housing at the PTO shaft.

Note: Ensure that you do not damage the PTO oil seal.

- 25. Place the spacer on the oil seal and secure the seal with the retaining ring.
- 26. Lubricate the both sides of the thrust plates with clean hydraulic fluid. Place the thrust plate onto each swash plate.

Note: Ensure that you position the beveled side of the thrust plates against the swash plate surface.



27. Slide the control arm onto each trunnion shaft and secure the control arm with the socket-head screw and nut; torque the nut to 27 to 31 N·m (20 to 23 ft-lb).



g033464

Figure 104 2.

Pipe

- Cylinder block assembly 1.
- 28. Lubricate all components of the cylinder blocks with a thick layer of clean hydraulic fluid.

Note: Ensure that all the pistons are placed in the cylinder blocks. Ensure that you do not drop the pistons from the cylinder block.

- 29. Slide the 2 cylinder block assemblies onto the pump shafts.
- 30. Lubricate the 2 new O-rings and install the O-rings into the grooves in the pipe. Slide the pipe assembly into the bore of the transmission pump housing.



4.

Figure 105

Hex plug (6 each) 1.

g033465

3. Left flushing valve Center case

Right flushing valve 2.



- 31. Lubricate new O-rings and install the O-rings onto the 6 hex plugs. Install the plugs into the center case; torque the plugs to **19 to 20 N·m (14 to 15 ft-lb)**.
- 32. Lubricate the flushing valves with clean hydraulic fluid and place them in the center case bores.

Note: Ensure that you place the right and left flushing valves in the correct location.

 Lubricate new O-rings and install the O-rings onto the 2 flushing valve plugs. Install the springs and plugs to secure the flushing valves; torque the plugs to 23 to 26 N·m (17 to 19 ft-lb).



g033466

Figure 106

- 1. Bypass valve
- 2. Center case
- 3. Reverse relief cartridge

- 4. Forward relief cartridge
- 5. Valve plate



2. Reverse relief cartridge



- 34. Lubricate the O-rings and back-up rings for bypass valves. Position the rings on the bypass valves and install the valves into the center case; torque the valves to **7 to 9 N·m (62 to 79 in-lb)**.
- 35. Lubricate the sealing washers and install them onto the forward and reverse relief valve cartridges.

IMPORTANT

The forward and reverse relief cartridges are different. Use the labels that you attached during disassembly to correctly install the relief cartridges.

36. Thread the relief cartridges into the correct center case ports and torque the cartridges to **32 to 37 N·m (24 to 27 ft-lb)**.

Note: You can identify the reverse relief valve cartridges by the groove in the hex head (Figure 107).

37. Apply clean grease to the mating surfaces of the center case and valve plates to hold the valve plates in position during assembly. Install the valve plates to the dowel pins in the center plate.



g033468

Figure 108

1. Center case

3. Pin (2 each)

- 2. Pump housing
- 38. Install the 2 pins into the transmission pump housing bores. Align new gasket to the pump housing.
- 39. Position the center case assembly to the transmission pump housing and ensure that the valve plates remain in position.



40. Assemble the center case to the transmission pump housing with the 8 socket-head screws. Tighten the screws evenly in a crossing pattern and then torque the screws to **23 to 26 N·m (17 to 19 ft-lb)**.



1. Right pump shaft

a033469

g033470

3. Inner pump rotor

- 2. Outer pump rotor
- 41. Install the key into the key slot in the right pump shaft. Lubricate the inner and outer charge pump rotors with clean hydraulic fluid. Slide the inner pump rotor onto the pump shaft and align the pump rotor with the key. Place the outer pump rotor onto the inner pump rotor.
- 42. Install the 2 pins into the bores of the pump body.
- 43. Apply clean grease to the pump body O-rings to hold them in position during assembly. Place the O-rings in the pump body locations.



1. Pin2. Pump body

1.





44. Place the pump body onto the center case and ensure that the O-rings remain in position. Install the 3 shorter and 2 longer flange-head screws to attach the pump body to the center case; torque the screws to 23 to 26 N·m (17 to 19 ft-lb) in a crossing pattern.



Hex plug (2 each) 2. Socket plug (4 each)



1.

- 45. Lubricate new O-rings and install the O-rings onto the 2 hex plugs. Install the plugs into the pump body; torque the plugs to 19 to 20 N·m (14 to 15 ft-lb).
- 46. Apply sealant to the threads of the 4 socket-head plugs and install them into the pump body; torque the plugs to 8.8 to 10.8 N·m (78 to 95 in-lb).



Figure 113

- Accumulator piston 1.
- 2. Accumulator collar

- 3. Collar hole
- 4 Accumulator cover
- 47. Lubricate the accumulator components with clean hydraulic fluid. Install the piston, spring, and collar into the pump body.

Note: Ensure that the hole in the collar is toward the outside of the pump body.



48. Align new gasket to the accumulator cover and secure the cover to the pump body with the 2 bolts; torque the bolts to 23 to 26 N·m (17 to 19 ft-lb).



g033474

2.



1. Charge relief valve Pressure valve

- 3. Charge relief plug
- Pressure valve plug 4.
- 49. Lubricate the charge relief valve and spring with clean hydraulic fluid and install them into the pump body.
- 50. Lubricate the pressure valve and spring with clean hydraulic fluid and install them into the pump body.



51. Lubricate new O-rings and install the O-rings onto the charge relief plug and pressure valve plug. Install the plugs into the pump body; torque the plugs to 23 to 26 N·m (17 to 19 ft-lb).



Figure 115

- 1. Filter bypass valve 2. Filter bypass plug
- 52. Lubricate the filter bypass valve and spring with clean hydraulic fluid and install them into the pump body.



53. Lubricate new O-ring and install the O-ring onto the plug. Install the plug into the pump body; torque the plug to **23 to 26 N⋅m (17 to 19 ft-lb)**.



g033476

Figure 116

- 1. Sleeve
- 2. Spool
- 3. Pin
- 4. Sleeve holes

- 5. Spool step
- 6. Solenoid valve stem
- 7. Solenoid coil
- 54. Lubricate the solenoid valve spring, sleeve, and spool with clean hydraulic fluid and install the solenoid valve spring, sleeve, and spool into the pump body.

Note: Ensure that the sleeve is installed so that the holes are closest to the spring location and that the step in the spool is also toward the spring location.

55. Place the pin in the spool.



- 56. Install the solenoid valve stem into the pump body and torque the solenoid valve stem to **21 to 22 N·m (186 to 195 in-lb)**.
- 57. Install the O-ring, solenoid coil, O-ring, washer, lock washer, and nut onto the solenoid valve stem; torque the nut to **5.9 to 7.8 N·m (52 to 69 in-lb)**.

Note: The coil should be installed so that the "KANZAKI" molded into the coil has the "I" nearest the nut location.

Gear Pump



1. Transmission assembly

2. Coupler

- 3. O-ring
- 4. O-ring
- 5. Hydraulic fitting
- 6. O-ring

- 7. Hydraulic hose (output)
- 8. Bolt (2 each)
- 9. Lock washer (2 each)
- 10. O-ring
- 11. Hydraulic fitting
- 12. Hose clamp

- 13. Hydraulic hose
- 14. Hydraulic hose (suction)
- 15. O-ring
- 16. Hydraulic fitting
- 17. O-ring
- 18. Gear pump

Removing the Gear Pump

Â

WARNING

Before disconnecting or doing any work on the hydraulic system, release all the pressure in the system; refer to Releasing Pressure from the Hydraulic System (page 4–11).

- 1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.
- 2. Remove the operator seat and seat base; refer to Removing the Operator Seat (page 6–35).
- 3. Drain the hydraulic fluid from the hydraulic tank.
- 4. Clean the hydraulic hose ends and fittings on the gear pump and hydraulic tank to prevent contaminants from entering into the system.
- 5. For assembly purposes, label all the hydraulic hoses and fittings.

A

Removing the Gear Pump (continued)



- 3. Gear pump
- 6. Disconnect the hydraulic hoses from the fittings on the hydraulic tank and gear pump (Figure 118). Allow the hoses to drain into a suitable container.
- 7. Install clean caps or plugs in the hose and fitting openings to prevent system contamination.
- 8. Remove the parking brake handle from the machine to position the hydraulic tank; refer to Disassembling the Parking Brake Assembly (page 6–15).
- 9. Remove the reservoir support that secures the hydraulic tank to the machine; refer to Removing the Hydraulic Tank (page 4–63).
- 10. Move the hydraulic tank toward the front of the machine to allow clearance for the gear pump removal.
- 11. Support the gear pump to prevent it from falling during removal.
- 12. Remove the 2 bolts and 2 lock washers that secure the gear pump to the transmission, and remove the gear pump from the transmission.
- 13. Remove and discard the O-ring (item 3 in Figure 117).
- 14. Locate and remove the coupler from the transmission or gear pump shaft.
- 15. If necessary, remove the hydraulic fittings from the pump.
- 16. Remove and discard the O-rings from the fittings.

Installing the Gear Pump

- 1. If the hydraulic fittings were removed from the pump, lubricate and install new O-rings onto the fittings. Tighten the fittings to the torque specifications identified in Figure 117; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fitting into the Component Port) (page 4–7).
- 2. Slide the coupler onto the transmission shaft. Lubricate the O-ring (item 3 in Figure 117) with grease and install the O-ring onto the flange of the gear pump.

IMPORTANT

Position the gear pump to the transmission so that the gear pump suction port is facing up.

Installing the Gear Pump (continued)

- 3. Position the gear pump to the transmission and secure the pump with the 2 bolts and 2 lock washers.
- 4. Move the hydraulic tank toward the rear of the machine to its proper position and assemble the tank to the reservoir support; refer to Installing the Hydraulic Tank (page 4–64).
- 5. Install the parking brake handle to the machine; refer to Assembling the Parking Brake Assembly (page 6–16). Ensure that the operation of the parking brake sensor is correct after you install the brake handle.
- 6. Remove the caps or plugs that were installed to the hydraulic hoses and fittings during the removal process.
- Use the labels that you attached during the removal process to correctly connect the hydraulic hoses to the fittings on the gear pump and hydraulic tank; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–5).
- 8. Fill the hydraulic tank with the correct quantity of new hydraulic fluid.
- 9. Install the operator seat and seat base; refer to Installing the Operator Seat (page 6–36).

Servicing the Gear Pump



- 3. Front back-up ring
- 4. Drive gear
- 5. Rear back-up ring
- 6. Rear pressure seal
- 9. Socket-head screw (4 each)
- 10. Lock washer (4 each)
- 11. Back plate
- 12. Body

- 15. Idler gear
- 16. Front bearing block
- 17. Front plate
- 18. Retaining ring

Disassembling the Gear Pump

1. Install clean plugs in the pump ports and clean the outer surface of the pump. After cleaning, remove the plugs and drain the hydraulic fluid out of the pump.



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Disassembling the Gear Pump (continued)

2. Use a marker to make a "V" across the front plate, body, and back plate for assembly purposes (Figure 120).

IMPORTANT

Clamping the pump body in a vise could damage the pump. When you clamp the pump in a vise, clamp the mounting flange only.

- 3. Clamp the mounting flange of the pump in a vise with the shaft end down.
- 4. Loosen the 4 socket-head screws that attach the back plate and front plate together.
- 5. Remove the pump from the vise, and remove the 4 socket-head screws and 4 lock washers.
- 6. Remove the front plate from the body and then remove the back plate.
- 7. Locate and remove the 2 dowel pins from the body.

IMPORTANT

Mark the relative positions of the gear teeth and bearing blocks so that you can assemble them in the same position. Do not touch the gear surfaces as residue on hands may be corrosive to gear finish.

8. Place the pump on its side and push on the rear bearing block to remove the bearing blocks and gear set from the pump body.

Note: The pressure seals and back-up rings fit in the grooves machined into the bearing blocks. The O-rings fit in the grooves machined in the pump body.

9. Carefully remove and discard the O-rings, pressure seals, and back-up rings from the pump body and bearing blocks.

Note: Do not damage the machined grooves during the removal process.

10. Turn the front plate over, with seal side up, and remove the retaining ring.

IMPORTANT

Ensure that you do not damage the counterbore when removing the shaft seal from the front plate.

- 11. Carefully remove the shaft seal from the front plate.
- 12. If necessary, remove the implement relief valve from the back plate.
- 13. Remove and discard the sealing washers.

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Use eye protection such as goggles when using compressed air.

- 1. Clean all the pump parts with solvent and dry them with compressed air.
- 2. Inspect the drive gear, idler gear, and bearing blocks for the following. If damage is found, the pump replacement is necessary.



a033481

Figure 121

3.

- Gear shaft spline 1.
- 2. Gear shaft
- Gear teeth 4 Gear face edge
- A. Gear shafts must be free from rough surfaces and excessive wear at the bushing points and sealing areas. Replace the gears if you find any scoring, rough surfaces, or wear on the gear shafts.
- B. Gear teeth must be free from excessive scoring and wear. Replace the gears if you find broken or nicked gear teeth.
- C. Gear face edge must be free from sharpness. The sharp edges of gears will mill into the bearing blocks. Replace the gears if you find any sharp gear face edge.
- D. Bearing areas of the bearing blocks must not have excessive wear or scoring.
- E. Face of the bearing blocks that are in contact with the gears must be free of wear, roughness, or scoring.
- 3. Inspect the front plate and back plate for damage or wear. If the plates are damaged or worn, replace the pump.

Assembling the Gear Pump

Note: When assembling the pump, check the V-shaped marker line made during disassembly to ensure that the components are properly aligned.

- 1. Lubricate new O-rings, pressure seals, and back-up gaskets with a thin coat of petroleum jelly, and lubricate all internal pump parts freely with clean hydraulic fluid.
- 2. Install new shaft seal in the front plate.

Note: The seal should be pressed into place until it reaches the bottom of the bore.

3. Install the retaining ring into the groove of the front plate.

Assembling the Gear Pump (continued)

- 4. Lubricate and install the O-rings into the body.
- 5. Lubricate and install the pressure seals into the machined grooves of the bearing blocks and carefully place the back-up rings into the grooves.
- 6. Lubricate the gear faces and bearing surfaces of the drive gear, idler gear, and bearing blocks with clean hydraulic fluid.
- 7. Use the identification marks that you made during disassembly and carefully assemble the bearing blocks and gears.
- 8. Position the pump body on its side.
- 9. Use the identification marks that you made during disassembly and carefully slide the bearing block and gear assembly into the body cavity.
- 10. Remove excess lubrication from the mating surfaces of the body, back plate, and front plate. Ensure that these surfaces are clean and dry.
- 11. Install the 2 dowel pins into the body.

IMPORTANT

Do not dislodge the O-rings, pressure seals, or back-up rings during final assembly.

- 12. Use the marker lines for proper location, gently slide the back plate onto the assembly, and engage the dowel pins with firm hand pressure.
- 13. Place a thin sleeve or tape on the pump shaft splines to prevent seal damage.
- 14. Position the pump with back plate downwards.
- 15. Use the marker lines for proper location and carefully slide the front plate onto the assembly.

Note: Do not damage the seal during the front plate installation.

- 16. Remove the sleeve or tape from the shaft splines.
- 17. Install the 4 socket-head screws with the 4 lock washers and tighten them by hand.

IMPORTANT

Clamping the pump body in a vise could damage the pump. When you clamp the pump in a vise, clamp the mounting flange only.

18. Clamp the mounting flange of the pump in a vise with the shaft end down.



- 19. Alternately torque the 4 socket-head screws to 25 N·m (220 in-lb).
- 20. If the implement relief valve was removed from the back plate, install the relief valve to the back plate; torque the relief valve to **25** N·m (**220** in-lb).
- 21. Put a small amount of hydraulic fluid in the inlet port of the pump and rotate the input shaft for 1 revolution. Place the coupler on the input shaft, use pliers on the coupler and rotate the pump shaft. If the input shaft binds, disassemble the pump and repeat the assembly process.
- 22. Remove the pump from the vise.

Lift Control Manifold



Removing the Lift Control Manifold



Before disconnecting or doing any work on the hydraulic system, release all the pressure in the system. Refer to Releasing Pressure from the Hydraulic System (page 4–11)

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.

WARNING

If the cutting deck is in the raised position while the manifold components are loosened, the deck may drop unexpectedly.

Ensure that the cutting deck is fully lowered and supported before loosening the hydraulic lines, cartridge valves, or plugs from the lift control manifold.

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Removing the Lift Control Manifold (continued)

- 2. Clean the hydraulic hose ends and fittings on the lift control manifold to prevent contaminants from entering into the hydraulic system.
- 3. For assembly purposes, label all the hydraulic hoses and electrical connections.
- 4. Disconnect the hydraulic hoses from the fittings on the lift control manifold and drain the hoses into a suitable container.
- 5. Install clean caps or plugs on the hydraulic hoses and fittings to prevent system contamination.
- 6. Disconnect the wire harness connectors from the solenoid coils on the manifold.
- 7. Support the manifold to prevent it from falling.
- 8. Remove the 2 bolts (item 17 in Figure 122) and 2 lock washers that secure the manifold to the machine, and remove the manifold from the machine.
- 9. If the hydraulic fittings are to be removed from the lift control manifold, put a mark on the fitting orientation for correct assembly.
- 10. Remove the fittings from the manifold and discard the O-rings.

Installing the Lift Control Manifold

- 1. If the hydraulic fittings were removed from the lift control manifold, lubricate the new O-rings with clean hydraulic fluid, position the O-rings to the fittings, and install the fittings into the manifold ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fitting into the Component Port) (page 4–7).
- 2. Position the lift control manifold to the machine and secure the manifold with the 2 bolts and 2 lock washers.
- 3. Remove the caps and plugs from the hydraulic hoses and fittings.
- 4. Lubricate and install the new O-rings onto the control manifold fittings.
- 5. Use the labels that you attached during the manifold removal to correctly connect the hydraulic hoses to the lift control manifold; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–5).
- 6. Connect the wire harness connectors to the solenoid coils on the manifold.
- 7. Check the hydraulic-fluid level in the hydraulic reservoir and add correct quantity of fluid if necessary; refer to the *Traction Unit Operator's Manual*.

Servicing the Lift Control Manifold



The lift control manifold on the machines with a serial number from 313000001 to 314999999 is different than the manifold used on the machines with a serial number above 315000000. Both the manifolds are shown in Figure 123. Service for the manifold valves, solenoid coils, and plugs are similar on either manifold.

Note: The ports on the lift control manifold are marked for easy identification of the components. Refer to the Hydraulic Schematic in Appendix A (page A-1)—Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each of the manifold port.

Note: The lift control manifold used on the machines with a serial number from 313000001 to 314999999 has an expander plug (item 9 in Figure 123) installed in the manifold port 4. This plug is not a serviceable part and is used to prevent hydraulic flow from the manifold port 1 to port 4.

CAUTION

Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to Releasing Pressure from the Hydraulic System (page 4–11).

WARNING

If the lift control manifold is attached to the machine, ensure that the cutting deck is fully lowered and supported before loosening the hydraulic lines, and cartridge valves, or plugs from the lift manifold.

If the cutting deck is in the raised position while the manifold components are loosened, the deck may drop unexpectedly.

IMPORTANT

The 2 solenoid valves in the lift control manifold are different. Label the valves before removal so that the valves can be correctly installed into the manifold.

- 1. Ensure that the lift control manifold is clean before you remove the cartridge valve from the manifold.
- 2. Remove the nut that secure the solenoid coil to the cartridge valve. Carefully slide the coil off the valve.

IMPORTANT

Carefully handle the cartridge valve. Slight bending or distortion of the stem tube can cause binding and malfunction. When removing the cartridge valve from the manifold, ensure that the deep well socket fully engages the valve base.

- 3. Use a deep socket wrench to remove the cartridge valve from the manifold. Note the correct location of the O-rings, sealing rings, and back-up rings.
- 4. Remove and discard the seal kit from the cartridge valve.
- 5. Visually examine the port in the manifold for damaged sealing surfaces, damaged threads, and contamination.
- 6. Visually inspect the cartridge valve for damaged sealing surfaces and contamination.
 - A. Contamination can cause the valves to stick or hang up. Contamination can accumulate in small valve orifices or seal areas and cause malfunction.
 - B. If the sealing surfaces of the valve are pitted or damaged, the hydraulic system can be too hot or there can be water in the system.

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CAUTION

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Use eye protection such as goggles when using compressed air.



Sudden movement of the internal spools can release the stored fluid suddenly.

7. Use clean-mineral spirits to clean the cartridge valve. Put the valve in clean-mineral spirits to flush out contamination.

IMPORTANT

Particles as fine as talcum powder can affect the operation of high-pressure hydraulic valves.

If the cartridge design allows, use a wood or plastic probe to press the internal spool in and out for 20 to 30 times to flush out contamination.

Ensure that you do not damage the cartridge. Use compressed air for cleaning.

- 8. Install the cartridge valve into the manifold as follows:
 - A. Lubricate the new seal kit components with clean hydraulic fluid and install the components onto the valve.
 - B. Install the O-rings, sealing rings, and back-up rings correctly on the cartridge valve for proper operation and sealing.
 - C. Put the assembled cartridge into the clean hydraulic fluid.

IMPORTANT

Carefully handle the cartridge valve. Slight bending or distortion of the stem tube can cause binding and malfunction. When installing the cartridge valve into the manifold, ensure that the deep well socket fully engages the valve base.

- D. Turn the cartridge valve carefully into the manifold port until it reach the top of the O-ring. The valve should go into the manifold port easily without binding.
- E. Use a deep socket wrench and torque the cartridge valve as shown in Figure 123.



- 9. Carefully install the solenoid coil into the cartridge valve and secure the coil to the valve with the nut; torque the nut to **6.7 N·m (60 in-lb)**.
- 10. If the problems still exist after manifold assembly, remove the cartridge valve and clean the valve again or replace the cartridge valve.

Polar Trac Hydraulic Control Valve



g033626

- 1. Grease fitting (2 each)
- 2. Pin assembly
- 3. Flange bearing
- 4. Right pedal assembly
- 5. Flange bearing
- 6. Left pedal assembly
- 7. Regulatory decal
- 8. Serial plate
- 9. Decal
- 10. Pop rivet (2 each)
- 11. Hose cover
- 12. Control valve
- 13. O-ring
- 14. Straight fitting
- 15. O-ring (2 each)

Figure 124

- 16. 45° hydraulic fitting (2 each)
- 17. O-ring
- 18. 45° hydraulic fitting
- 19. O-ring
- 20. Cable tie
- 21. O-ring
- 22. Hydraulic fitting
- 23. O-ring (2 each)
- 24. Hydraulic cap
- 25. O-ring
- 26. O-ring
- 27. 90° hydraulic fitting
- 28. Cable tie
- 29. O-ring
- 30. 90° hydraulic fitting

- 31. O-ring
- 32. O-ring
- 33. Hydraulic tube
- 34. Flange nut (2 each)
- 35. Hairpin (2 each)
- 36. Lever valve link (2 each)
- 37. O-ring
- 38. Washer (2 each)
- 39. Bulkhead nut
- 40. Hydraulic plug
- 41. O-ring
- 42. Retainer nut (4 each)
- 43. Carriage screw (2 each)
- 44. Ear pivot
- 45. Screw (4 each)

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WARNING

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Before disconnecting or doing any work on the hydraulic system, release all the pressure in the system; refer to Releasing Pressure from the Hydraulic System (page 4–11).

- 1. Park the machine on a level surface, lower the implement, shut off the engine, set the parking brake, and remove the key from the key switch.
- 2. Clean the hydraulic hose ends and fittings on the control valve to prevent contaminants from entering into the hydraulic system.
- 3. For assembly purposes, label all the hydraulic hoses and fittings.



g033627

Figure 125

1. Control valve

3. Lever valve link

- 2. Hairpin
- 4. Disconnect the hydraulic hoses that are connected to the hydraulic fittings on the control valve. Allow the hoses to drain into a suitable container.
- 5. Install clean caps or plugs in the hose openings to prevent system contamination.
- 6. Remove the 2 hairpins that attach the lever valve links to the control valve spools (Figure 125). Slide the links from the spools.
- 7. Support the control valve to prevent it from falling during removal.
- 8. Remove the 2 carriage screws (item 43 in Figure 124) and 2 flange nuts that attach the control valve to the machine, and remove the control valve from the machine.
- 9. If necessary, remove the hydraulic fittings from the control valve. Note the orientation of the fittings for assembly purposes.
- 10. Remove and discard the O-rings from the fittings.

Installing the Polar Trac Hydraulic Control Valve

1. If the hydraulic fittings were removed from the control valve, lubricate and install new O-rings to the fittings. Install the fittings into the valve ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fitting into the Component Port) (page 4–7). Use the notes that you recorded during removal to orientate the fittings.

Installing the Polar Trac Hydraulic Control Valve (continued)

- 2. Position the control valve to the frame of the machine and attach the control valve to the frame with the 2 carriage screws and 2 flange nuts.
- 3. Attach the lift lever valve links to the control valve spools with the 2 hairpins (Figure 125).
- 4. Remove the caps or plugs that were installed to the hydraulic hoses during the removal process.
- 5. Use the labels that you attached during the removal process to correctly connect the hydraulic hoses to the fittings on the control valve; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–5).
- 6. Ensure that the hydraulic tank is full. Add correct quantity of fluid if necessary; refer to the *Traction Unit Operator's Manual*.
Servicing the Polar Trac Hydraulic Control Valve



Disassembling the Polar Trac Hydraulic Control Valve

1. Plug all the ports and clean the outer surface of the valve.

IMPORTANT

Match-mark spools to their associated bores before disassembly. The spools must be installed again to the bore from which they were removed.

- 2. Remove the 2 spool caps (item 10 in Figure 126) and slide the spool assemblies from their bores.
- 3. Remove the O-ring (item 12 in Figure 126) and bushing from each spool assembly.
- 4. Remove the wiper seals (item 20 in Figure 126) and O-rings from the spool bore ends that are opposite to the spool caps.

Note: Disassemble the spool assemblies only if the retaining ring (item 13 in Figure 126), spacer, spool spring, or washer needs replacement.

- 5. Remove the seat retaining plugs (items 7 and 15 in Figure 126), back-up washers, O-rings, and check spring from the valve body.
- 6. Remove the check poppet (item 1 in Figure 126), seats, O-rings, and plungers from the valve body.
- 7. Remove the solid plug (item 6 in Figure 126), back-up washer, and O-ring from the opposite end of the plunger.
- 8. Remove the detent plug (item 19 in Figure 126) and O-ring from the valve body, and remove the disc, spring, and detent plunger from the body.

Inspecting the Polar Trac Hydraulic Control Valve

- 1. Inspect the spools and spool bores for wear. If wear is excessive, replace the control valve with new one.
- 2. Inspect the springs and replace as necessary.
- 3. Inspect the plunger and detent plunger for wear. Replace as necessary.
- 4. Inspect the caps and plugs for damaged threads and inspect the O-ring sealing surfaces. Replace as necessary.

Assembling the Polar Trac Hydraulic Control Valve

IMPORTANT

Do not wipe the control valve parts dry with paper towels or a cloth. They let lint accumulate in the hydraulic system, which will damage it.

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CAUTION

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Use eye protection such as goggles when using compressed air.

- 1. Clean all the metal parts with solvent and blow dry with compressed air.
- 2. Replace the check poppet (item 1 in Figure 126), O-rings, and back-up washers with new ones.
- 3. Install new O-rings (item 12 in Figure 126) into the valve body.

Assembling the Polar Trac Hydraulic Control Valve (continued)

- 4. If a spool was disassembled, install the washer (item 14 in Figure 126), spool spring, spacer, and retaining ring to the spool.
- 5. Slide the bushings (item 8 in Figure 126) and new O-rings over the spools.
- 6. Lubricate the spools with a thick layer of clean hydraulic fluid and carefully install the spools into their proper bores.



- 7. Install the spool caps (item 10 in Figure 126) into the valve body; torque the caps to 27 to 33 N·m (20 to 25 ft-lb).
- 8. Lubricate the detent plunger (item 2 in Figure 126) and plunger with a thick layer of clean hydraulic fluid and install the plungers into their proper bores.
- 9. Install new O-rings, seats (item 5 in Figure 126), check poppet, and check spring into the plunger bores.



- Install the O-rings, back-up washers, and seat retaining plugs (items 7 and 15 in Figure 126) into their plunger bores; torque the plugs to 41 to 47 N·m (30 to 35 ft-lb).
- Install new O-ring, back-up washer, and solid plug (item 6 in Figure 126) into the bore with the detent plunger; torque the plug to 41 to 47 N·m (30 to 35 ft-lb).
- 12. Lubricate the detent plunger (item 22 in Figure 126), spring, and disc with a thick layer of clean hydraulic fluid and install them into the valve body bore.
- 13. Install the O-ring and detent plug (item 19 in Figure 126) into the valve body; torque the plug to **5.4 to 6.8 N·m (4 to 5 ft-lb)**.

Lift Cylinder



Removing the Lift Cylinder



key switch.Clean the hydraulic hose ends and fittings on the lift cylinder to prevent contaminants from entering into the hydraulic system.

Removing the Lift Cylinder (continued)

3. For assembly purposes, label the hydraulic hoses. Also, label the orientation of the hydraulic hose at the cylinder head for correct assembly.



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Figure 128

- 1. Lift cylinder
- 2. Pivot pin

- 3. Flange-head screw
- 4. Disconnect the hydraulic hoses that are connected to the hydraulic fittings on the lift cylinder.
- 5. Install clean caps or plugs in the hose openings to prevent system contamination.
- 6. Remove the retaining ring (item 2 in Figure 127) that secures the cylinder head to the pin on the carrier frame.
- 7. Remove the locknut, flange-head screw, and pivot pin that attach the lift cylinder rod end to the right lift arm (Figure 128).
- 8. Remove the lift cylinder from the machine.
- 9. If necessary, remove the hydraulic fittings from the lift cylinder.
- 10. Remove and discard the O-rings from the fittings.

Installing the Lift Cylinder



- 1. If the hydraulic fittings were removed from the lift cylinder, lubricate and install new O-rings to the fittings. Install the fittings into the lift cylinder ports and torque the fittings to **20 to 25 N·m (15 to 19 ft-lb)**.
- 2. Position the lift cylinder to the machine.
- 3. Assemble the cylinder head to the pin on the carrier frame with the retaining ring.
- 4. Attach the lift cylinder rod end to the right lift arm with the pivot pin, flange-head screw, and locknut (Figure 128).
- 5. Remove the caps or plugs that were installed to the hydraulic hoses during the removal process.
- 6. Use the labels that you attached during the lift cylinder removal to correctly connect the hydraulic hoses to the lift cylinder fittings; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–5).
- 7. Lubricate the grease fittings on the lift cylinder and pivot pin.

Installing the Lift Cylinder (continued)

8. Ensure that the hydraulic tank is full. Add correct quantity of fluid if necessary; refer to the *Traction Unit Operator's Manual*.



Servicing the Lift Cylinder

Disassembling the Lift Cylinder

1. Slowly pump the cylinder shaft to remove the hydraulic fluid from the lift cylinder into a drain pan. Plug both the ports and clean the outer surface of the cylinder.

IMPORTANT

When you clamp the hydraulic cylinder in a vise, clamp the clevis only to prevent damage.

- 2. Mount the lift cylinder in a vise. Use a vise equipped with soft jaws.
- 3. Carefully remove the collar with a pipe wrench.
- 4. Remove the plugs from the ports. Carefully twist and pull the shaft and remove the shaft with head and piston.

IMPORTANT

Clamping the vise jaws against the shaft surface could damage the shaft. When securing the shaft in a vise, clamp the shaft clevis only.

- 5. Mount the shaft correctly in a vise by clamping on the clevis of the shaft. Remove the nut and piston from the shaft. Slide the head off the shaft.
- 6. Remove the piston seal and O-ring from the piston, and remove the O-ring, back-up ring, rod seal, and dust seal from the head.

Assembling the Lift Cylinder

- 1. Ensure that all the parts are clean before assembly.
- 2. Put a coating of clean hydraulic fluid on new O-rings, piston seal, rod seal, back-up ring, and dust seal, and do the following steps:
 - A. Install the piston seal and O-ring to the piston.
 - B. Install the dust seal, O-ring, back-up ring, and dust seal to the head.

IMPORTANT

Clamping the vise jaws against the shaft surface could damage the shaft. When securing the shaft in a vise, clamp the shaft clevis only.

- 3. Mount the shaft correctly in a vise by clamping on the clevis of the shaft, and do the following steps:
 - A. Put a coating of clean hydraulic fluid on the shaft.
 - B. Slide the head onto the shaft. Install the rod seal onto the shaft and into the head.

Note: Ensure that you do not damage the seals.

- C. Install the piston onto the shaft and attach the piston with the nut.
- D. Remove the shaft from the vise.

IMPORTANT

When you clamp the cylinder head of the cylinder in a vise, clamp the clevis end of the cylinder head only to prevent damage.

4. Mount the cylinder head in a vise.

Assembling the Lift Cylinder (continued)

5. Put a light coating of clean hydraulic fluid on all internal parts. Carefully slide the piston, shaft, and head assembly into the cylinder head.

Note: Do not damage the seals.

6. Use a pipe wrench to install the collar and secure the head in the cylinder head.

Polar Trac Lift Cylinder



- 1. Pin assembly
- 2. Flange bearing (2 each)
- 3. Grease fitting (4 each)
- 4. Locknut (2 each)
- 5. Locknut
- 6. Lift cylinder
- 7. O-ring (2 each)
- 8. 90° hydraulic fitting (2 each)
- 9. O-ring (2 each)
- 10. Hydraulic hose assembly
- 11. Lift arm assembly
- 12. Locknut (3 each)
- 13. O-ring

- Bulkhead fitting (2 each)
- 15. O-ring

14.

- 16. Quick disconnect nipple
- 17. Dust cap
- 18. Dust plug
- 19. Quick disconnect coupler
- 20. O-ring
- 21. 90° hydraulic fitting
- 22. Hydraulic hose assembly
- 23. Hydraulic hose
- 24. Lock pin
- 25. Slotted roll pin
- 26. Hairpin

- 27. Flange bushing
- 28. Retaining ring (2 each)
- 29. Shaft
- 30. Rubber grommet (4 each)
- 31. Screw
- 32. Locknut (2 each)
- 33. Flange-head screw (2 each)
- 34. 45° lube fitting
- 35. Bolt (2 each)
- 36. Pivot pin (2 each)
- 37. Hydraulic hose



Fitting into the Component Port) (page 4–7). Use the notes that you recorded

3. Attach the cylinder head of the cylinder to the carrier frame with the pivot

5. Remove the caps or plugs that were installed to the hydraulic hoses during

6. Use the labels that you attached during the lift cylinder removal to correctly connect the hydraulic hoses to the lift cylinder fittings; refer to Installing the

8. Ensure that the hydraulic tank is full. Add correct quantity of fluid if necessary;

Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–5).

4. Attach the cylinder rod end to the lift arm assembly with the pivot pin,

7. Lubricate the grease fittings on the cylinder pivot pins.

refer to the Traction Unit Operator's Manual.

during removal to orientate the fittings.2. Position the lift cylinder to the machine.

pin, flange-head screw, and locknut.

flange-head screw, and locknut.

the removal process.

Servicing the Polar Trac Lift Cylinder



Disassembling the Polar Trac Lift Cylinder

1. Slowly pump the cylinder rod and remove the hydraulic fluid from the lift cylinder into a drain pan. Plug the 2 ports and clean the outer surface of the cylinder.

IMPORTANT

When you clamp the lift cylinder in a vise, clamp the clevis end of the cylinder head only to prevent damage.

- 2. Mount the lift cylinder correctly in a vise by clamping the clevis end of the cylinder head. Use a vise equipped with soft jaws.
- 3. Use a spanner wrench, rotate the head clockwise until the edge of the retaining ring appears in the cylinder head opening. Insert a screwdriver under the beveled edge of the retaining ring to start the retaining ring through the opening. Rotate the head counterclockwise to remove the retaining ring from the cylinder head (item 2 in Figure 131) and head.
- 4. Remove the plugs from the ports. Carefully twist and pull the shaft and remove the shaft with head and piston.

IMPORTANT

Clamping the vise jaws against the rod surface could damage the rod. When securing the rod in a vise, clamp the rod clevis only.

- 5. Mount the rod correctly in a vise by clamping on the clevis of the rod. Remove the locknut and piston from the rod. Carefully slide the head off the shaft.
- 6. Remove the cap seal and O-ring from the piston. If necessary, remove the wear ring from the piston.

Note: Do not scratch or damage the piston.

7. Remove the O-ring, back-up ring, wiper, and seal from the head.

Note: Do not scratch or damage the head.

Inspecting the Polar Trac Lift Cylinder



Use eye protection such as goggles when using compressed air.

- 1. Wash all the lift cylinder components in clean solvent and dry them with compressed air.
- 2. Inspect the internal surface of the cylinder head for deep scratches, out-of-roundness, and bending.

Note: Replace the cylinder head if it is worn or damaged.

3. Inspect the head, shaft, and piston for excessive pitting, scoring, and wear.

Note: Replace the parts if they are worn or damaged.

Assembling the Polar Trac Lift Cylinder

- 1. Ensure that all the lift cylinder parts are clean before assembly.
- 2. Put a coating of clean hydraulic fluid on new O-rings, back-up ring, and other seals, and do the following steps:
 - A. Carefully install the cap seal and O-ring to the piston. If removed, install the wear ring on the piston.

Assembling the Polar Trac Lift Cylinder (continued)

B. Carefully install the back-up ring, O-ring, seal, and wiper to the head.

IMPORTANT

Clamping the vise jaws against the rod surface could damage the rod. When securing the rod in a vise, clamp the rod clevis only.

- 3. Mount the rod correctly in a vise by clamping on the clevis of the rod, and do the following steps:
 - A. Put a coating of clean hydraulic fluid on the rod.
 - B. Slide the head onto the rod.



C. Install the piston onto the rod and attach the piston with the locknut; torque the locknut to **339 to 406 N·m (250 to 300 ft-lb)**.

D. Remove the shaft assembly from the vise.

IMPORTANT

When you clamp the hydraulic cylinder in a vise, clamp the clevis end of the cylinder head only to prevent damage.

4. Mount the cylinder head correctly in a vise by clamping on the clevis end of the cylinder head.

IMPORTANT

When installing the head into the cylinder head, pay careful attention to the retaining ring slot in the cylinder head to ensure that the piston and head seals do not lodge in the slot.

5. Put a light coating of clean hydraulic fluid on all internal parts. Slide the piston, shaft, and head assembly into the cylinder head.

Note: Do not damage the seals.

6. Install the retaining ring and insert the head in the cylinder head. Align the retaining ring hole in the head with the access slot in the cylinder head. Insert the retaining ring hook into the hole and rotate the head clockwise until the retaining ring is completely pulled into the cylinder head and the ring ends are covered.

Oil Cooler

Removing the Oil Cooler

A

A

- 1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.
- 2. Unlatch the hood and raise it.



A hot radiator and oil cooler can cause burns.

Allow the engine and cooling systems to cool before working on or near them.

- 3. Remove the radiator and oil cooler from the machine; refer to Removing the Radiator (page 3–13).
- 4. Remove the 3 screws (item 1 in Figure 132), 6 flat washers, 3 lock washers, and 3 nuts that attach the oil cooler to the radiator.
- 5. Separate the oil cooler from the radiator.

Inspecting the Oil Cooler

1. Back flush the oil cooler with cleaning solvent. After cleaning the cooler, ensure that all the solvent is drained from the cooler.

CAUTION

Use eye protection such as goggles when using compressed air to dry the oil cooler.

A

A



1. Screw (3 each)

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- 2. Flat washer (6 each)
- 3. Lock washer (3 each)
- 4. Nut (3 each)

- Figure 132
 - 5. Radiator cap
 - 6. Pipe plug
 - 7. Radiator
 - 8. Oil cooler
- 2. Use compressed air in the opposite direction of the fluid flow and dry the interiors of the oil cooler.
- 3. Install clean plugs on the oil cooler ports. Clean the outer surface of the cooler.

Note: The oil cooler must be free from corrosion, cracked tubes, or excessive pitting of tubes.

Installing the Oil Cooler

- 1. Install the oil cooler to the radiator with the 3 screws (item 1 in Figure 132), 6 flat washers, 3 lock washers, and 3 nuts.
- 2. Install the radiator and oil cooler to the machine; refer to Installing the Radiator (page 3–15).
- 3. Lower the hood and secure it with the latches.
- 4. Start the engine and check for leaks.



Chapter 5

Electrical System

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General Information

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

Standard Control Module



- 2. Standard Control Module (SCM)
- 3. Screw

1.

The Groundsmaster 7210 machine is equipped with a Standard Control Module (SCM) to monitor and control the electrical components required for safe operation. The SCM is attached to the control panel cover (Figure 133).

5.

Latch

The SCM monitors the inputs from the key, neutral, parking brake, PTO, seat, and dual temperature switch. The SCM provides a Run and Start signal for the Engine Controller to use.

Use the SCM to check the operation of the machine switches by monitoring the SCM LEDs. If a SCM LED does not illuminate (e.g., the In seat input LED does not illuminate when the seat is occupied and the key switch is in the ON position), you must test the switch, fuses, and circuit wiring.

The SCM does not connect to an external computer or hand held device, cannot be re-programmed, and does not record intermittent fault data.

SCM Inputs

The power input LED should be illuminated when the key switch is in the ON position. The power input LED should also be illuminated when the key switch is in the START position.

The start input LED should be illuminated when the key switch is in the START position.

The neutral input LED should be illuminated when the 2 traction control levers are in the NEUTRAL LOCK position.

The parking brake off input LED should be illuminated when you do not set the parking brake.

SCM Inputs (continued)

The PTO switch input LED should be illuminated when the PTO switch is ON (pulled out).

The In seat input LED should be illuminated when the operator is sitting in the seat.

The high-temperature shutdown input LED should be illuminated when the engine dual temperature switch closes due to engine coolant temperature of approximately 115°C (240°F).

The high-temperature warning input LED should be illuminated when the engine dual temperature switch closes due to engine coolant temperature of approximately 105°C (220°F).

The backlap input LED is not used on the Groundsmaster 7210 machine.

SCM Outputs



The start output LED should be illuminated when the key switch is in the START position with the 2 traction control levers in the NEUTRAL LOCK position, the PTO switch OFF, and either the seat is occupied or parking brake is set.

The run output LED should be illuminated when the key switch is in the ON position and inputs from the neutral, parking brake, PTO, seat, and engine coolant temperature switches indicate safe engine operation (e.g., the seat is occupied and the parking brake is disengaged when you move the traction control levers from the NEUTRAL LOCK position).

The PTO output LED should be illuminated when the key switch is in the ON position and the PTO switch is ON (pulled out).

Note: If the SCM high-temperature warning input LED is illuminated, the PTO output LED does not illuminate, and the PTO disengages regardless of the PTO switch position.

2.

4

5. 6

Standard Control Module Logic Chart

Each line of the following chart (Figure 135) identifies the necessary component position (inputs) in order for the SCM to energize the appropriate outputs for operating the machine.

Example: To start the engine with an operator in the seat, when the key is in the START position, the 2 traction control levers in the NEUTRAL LOCK position, and the parking brake is not set, the engine components and engine starter is energized.

IMPORTANT

During the operation of the machine, if the PTO shuts down and the console temperature warning light illuminates, avoid shutting off the engine. Under this condition, push the PTO knob down, slowly drive to a safe flat area, move the throttle lever to the SLOW position, move the traction control levers into the NEUTRAL LOCK position, and set the parking brake. Allow the engine to be idle for several minutes while it cools to a safe level, and check the cooling system before returning the machine to service.

Standard Control Module Logic Chart (continued)

| SLINGN MACHINE FUNCTION | Power | Start | Neutral | Parking brake Off | PTO Switch | In Seat | High Temperature Warning | High Temperature Shutdown | Backup | OUTPUTS | Engine Run | Engine Start | PTO |
|--|-------|-------|---------|-------------------|------------|---------|--------------------------|---------------------------|--------|---------|------------|--------------|---------|
| Engine Start (operator in seat) | Θ | Ŧ | Θ | Θ | 0 | Θ | 0 | 0 | NA | | Θ | Ξ | 0 |
| Engine Start (no operator in seat) | Θ | + | Θ | 0 | 0 | 0 | 0 | 0 | NA | | Θ | Ξ | 0 |
| Engine Run (operator in seat) | Θ | 0 | 0 | Θ | 0 | Θ | 0 | 0 | NA | | Θ | 0 | 0 |
| Engine Run (no operator in seat) | Θ | 0 | Θ | 0 | 0 | 0 | 0 | 0 | NA | | Θ | 0 | 0 |
| Mow | Θ | 0 | 0 | Θ | Θ | Θ | 0 | 0 | NA | | Θ | 0 | Ð |
| High Temperature Warning | Θ | 0 | | | | | Ð | 0 | NA | | Θ | Θ | 0 |
| High Temperature Shutdown | Θ | 0 | | | | | | Ð | NA | | 0 | 0 | 0 |
| High Temperature Shutdown KEY TO CHART LED ON- Circuit closed to ground LED ON- Circuit is energized LED OFF- Circuit is open to ground or circuit is de-energized Circuit is not involved with this machine function (LED OFF) NA Backlap Input is not used on the Groundsmaster 7210 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | G034737 |

Figure 135

Yanmar Engine Electronic Control Unit (ECU)



2. Electronic Control Unit (ECU)

The Yanmar engine that powers the Groundsmaster 7210 machine uses an electronic control unit (ECU) for engine management and to communicate with the InfoCenter display on the machine. If you must disconnect the engine ECU for any reason, ensure that the key switch is in the OFF position with the key removed for a minimum of 30 seconds before disconnecting the engine ECU. Refer to Chapter 3: Diesel Engine (page 3-1).

Yanmar Engine Electrical Components

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1.

When servicing or troubleshooting the engine electrical components use the Engine Service Manual and Troubleshooting Manual. Contact your Toro distributor for additional engine troubleshooting assistance.

CAN-bus Communications

The ECU and InfoCenter display used on the Groundsmaster 7210 machine communicate with each other on a CAN bus system. This system allows the traction unit to fully integrate all the different electrical components of the tractor and bring them together as one. The CAN bus system reduces the number of electrical components and connections that are used on the machine and allows the number of wires in the wire harness to be significantly reduced. The integration of the electrical functions also allows the InfoCenter display to assist with the electrical system diagnostics.

The CAN identifies the controller area network that is used between the controllers on the machine. The 2 specially designed, twisted cables form the bus. These wires provide the data pathways between the controller (ECU) and InfoCenter display used on the machine. The engineering term for these cables are the CAN High and CAN Low. At the ends of the twisted pair of bus cables are the 120-ohm terminator resistors.

CAN-bus Communications (continued)

The CAN bus link controls each of the components that requires only 4 wires to operate and communicate to the system: CAN High, CAN Low, B+ (power), and ground.

Electrical Schematics and Diagrams

Refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1)—Foldout Drawings.

Special Tools

You can order these special tools from your Authorized Toro Distributor. Some tools are also available from a local supplier.

Multimeter



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

Note: Use a digital multimeter when testing the electrical circuits. The high impedance (internal resistance) of a digital meter in the voltage mode ensures that the excess current is not allowed through the meter. This excess current can damage the circuits that are not designed to carry it.

Battery Terminal Protector

g033636

| 1 | | ļ | |
|---|---|---|--|
| : : : : : : : : : : : : : : : : : : : | ० एस अः हार्राहर क्रम्बर | N | |
| | FLEXIBL NON-TACH PROTECTI COATIN | | |
| | CHLORI |) | |

g033638

Figure 138

Use this aerosol spray on the battery terminals, ring terminals, and fork terminals to reduce corrosion problems. Apply the terminal protector to the connection after you secure the battery cable, ring terminal, or fork terminal.

Toro Part No. 107-0392

Battery Hydrometer



Use the battery hydrometer when measuring the specific gravity of the battery electrolyte. You can get this tool locally.

Dielectric Gel



g033639

Figure 140

Use the dielectric gel to prevent corrosion of unsealed connection terminals. To ensure complete coating of the terminals, liberally apply the gel to the component and wire harness connector, plug the connector into the component, unplug the connector, apply the gel to both surfaces again, and connect the harness connector to the component again. The connectors must be fully packed with gel for effective results.

Note: Do not use the dielectric gel on the sealed connection terminals as the gel can unseat the connector seals during assembly.

Toro Part No. 107-0342

InfoCenter Display

The InfoCenter Display used on your Groundsmaster is a LCD device that is located on the console. The InfoCenter provides information to the operator during the operation of the machine, provides the electrical system diagnostic assistance for the technicians, and allows inputs for the adjustable machine settings.

The power for the InfoCenter is available when the main power relay is energized (key switch in the RUN or START position). A CAN bus system involving the Yanmar engine electronic control unit and the InfoCenter provides necessary machine communication for the InfoCenter operation.

Splash Screen



The InfoCenter splash screen (Figure 141) is displayed when the key switch is initially turned to the RUN or START position. The splash screen allows basic machine information to be reviewed by the operator. Once the splash screen has been on the InfoCenter for several seconds, the main information screen will be displayed on the InfoCenter.

The splash screen can be used to identify the machine battery voltage, hour meter reading, engine coolant temperature, and engine status.

Main Information Screen



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- Figure 142
- 1. Engine coolant temperature
- 2. Battery voltage
- 3. Hour meter

- 4. Right button
- 5. Down button
- 6. Menu/back button



The 2 InfoCenter main information screens (Figure 142 and Figure 143) are displayed after the initial splash screen has been displayed for several seconds. During the normal operation of the machine, the main information screens

Main Information Screen (continued)

provide machine information to the operator. Toggling between the main information screens is done by pressing the right button on the InfoCenter.

The main information screens can be used to monitor the engine coolant temperature, battery voltage, and engine RPM.

If an electrical engine fault occurs during the operation of the machine, the fault will be displayed on the InfoCenter to notify the operator. The engine fault will be retained in the engine ECU and can be viewed using the engine diagnostic tool.

The main menu and additional information screens can be accessed from the InfoCenter main information screen by pressing and releasing the menu/back button (left button) on the display. For information on the main menu and menu item screens; refer to the Main Menu Screen (page 5-13).

Main Menu Screen

3.



The main menu screen can be accessed from the InfoCenter main information or splash screen by pressing and releasing the menu/back button (left button) on the display. Once to the main menu screen (Figure 144), navigation to the 3 different menu items can occur. Pressing the move to menu item button (center button) allows a different menu item to be highlighted. Selection of the highlighted item is completed by pressing the choose item button (right button).

The main menu items include service, settings, and about. These menu items are described below

To return to the main information screen from the main menu screen, press the back button (left button).

Service Screen

The service screen contains operational information of the machine including hours and counts. The values listed for these service menu items cannot be changed. If the machine PIN has been entered to get access to the protected menu items in the settings screen, the protected service menu items will be listed and available in the service screen.

Note: If the protected menu items are available, the PIN is shown in the upper right corner of the InfoCenter display.

The options listed for hours include the following:

- Key On identifies the number of hours that the key switch has been in the RUN position.
- **DPF Regeneration** provides the necessary procedure for stationary regeneration for the exhaust system DPF (diesel-particulate filter) on the machines with a Tier 4 engines (Models 30616, 30617, 30618, 30619, 30633, and 30695). If the engine ECU identifies that a stationary DPF regeneration is necessary, an advisory will occur on the InfoCenter and necessary steps will be listed in the service screen menu.

Settings Screen



2. Change menu item

g035032

1.

- Settings items 5.
- 3 Move to menu items

The settings screen (Figure 145) identifies the InfoCenter language and units (English or Metric). The settings screen also allows the operator to customize the backlight (brightness) and contrast settings for the InfoCenter display.

If either the backlight (brightness) or contrast items are selected, the center button or right button can be used to change the display settings.

Protected menus allows the machine PIN to be entered so that the hidden machine service screen items can be viewed and modified. The protected service items include the exhaust system DPF regeneration (Tier 4 engines).

Settings Screen (continued)

To get access to the protected menu items, enter the 4 digit pin PIN using the center and right InfoCenter buttons. After the PIN has been entered, a check mark should be visible above the center InfoCenter button. Press the center button and the InfoCenter display screen should indicate "PIN" in the upper right hand corner if the correct PIN number was entered. Use the back button to return to the settings menu. The protected menu items should be available in the service menu and can be changed as long as the key switch remains in the RUN position.

Note: The initial PIN will either be 1234 or 0000. If the PIN has been changed and is forgotten, you can obtain a temporary PIN from your Toro distributor.

About Screen



The about screen (Figure 146) identifies the machine model number, serial number, and software revision number. The about screen also lists the CAN-bus status. Additional information is identified if the about screen is accessed after the protected menus have been accessed by entering the PIN.

To return to the main menu screen from the about screen, press the back button (left button).

Troubleshooting

A

CAUTION

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

For the effective troubleshooting and repairs, you must have a good understanding of the electrical circuits and components that are used on this machine; refer to the Electrical Schematics in Appendix A (page A–1)—Foldout Drawings.

If the machine has any interlock switches that are bypassed, connect the switches for the correct troubleshooting and safety.

Note: Use the Standard Control Module input and output LED's when troubleshooting an electrical problem of the Groundsmaster 7210 machine.

Starting Problems

| Problem | Possible Causes |
|--|---|
| All the electrical power is dead, including the InfoCenter display. | The batteries are discharged. The battery cables are loose or corroded. The fuse F1 (15 A) to the key switch is damaged. The ground connection is loose or corroded. The key switch or circuit wiring is damaged. |
| The starter solenoid clicks, but the starter does not crank. Note: If the starter solenoid clicks, the problem is not in the interlock circuit. | The battery charge is low. The batteries are discharged. The battery cables are loose or corroded. The ground connection is loose or corroded. The wiring at the starter motor is damaged. The starter solenoid or starter motor is damaged. |

A

Starting Problems (continued)

| Nothing happens when you attempt to start the engine. The InfoCenter display operates with the key switch in the RUN position. | The traction levers are not in the NEUTRAL LOCK position. The operator seat is unoccupied or the parking brake is not applied. The traction neutral switch(es) is(are) damaged or out of adjustment. The PTO switch is in the ON (up) position or it is damaged. The engine coolant temperature is excessive or the engine dual temperature switch is damaged. The battery is discharged. The fuse F1, F2, F3, and/or F4 are/is damaged. The fusible link harness at the engine starter motor is damaged. The wiring in the engine crank circuit is loose, corroded, or damaged. The key switch is damaged. The starter solenoid wiring is loose, corroded, or damaged. The starter solenoid is damaged. The starter solenoid is damaged. |
|--|---|
| The engine cranks, but does not start. | The fuel tank is empty. The wiring in the engine crank circuit is loose, corroded, or damaged; refer to the Electrical Schematics in Appendix A (page A-1)—Foldout Drawings. The fuel filter is plugged. The engine and/or fuel can be too cold. The engine fuel pump or circuit wiring is damaged. The engine glow circuit does not operate properly. The engine or fuel system is malfunctioning; refer to Chapter 3: Diesel Engine (page 3-1). |
| The glow plug circuit does not operate properly. | The wiring in the engine glow circuit is loose, corroded, or damaged; refer to the Electrical Schematics in Appendix A (page A-1)—Foldout Drawings. The engine glow plug(s) is(are) damaged. The glow relay is damaged. The fusible link harness at the engine starter motor is damaged. The fuses F1, F2, F3, and/or F4 are/is damaged. |
| The engine cranks, but should not, when the PTO switch is in the ON (up) position. | The PTO switch or circuit wiring is damaged. The Standard Control Module is damaged. |
| The engine starts, but stops when the key switch is released from the START position. | The circuit wiring is damaged.The key switch is damaged. |

General Run and Transport Problems

| Problem | Possible Causes |
|--|---|
| The engine continues to run, but should not, when the key switch is turned to the OFF position. | The batteries are discharged. The battery cables are loose or corroded. The fuse F1 (15 A) to the key switch is damaged. The key switch or circuit wiring is damaged. |
| The engine shuts off during the operation, but it is able to start again. Note: If the excessive coolant temperature causes the engine to shutdown, the operator can start the engine by moving the machine to a short distance. After starting the engine in this condition, the engine runs for approximately 10 seconds before it shuts off again. | The parking brake is engaged. The operator is raising from the seat (the seat switch not fully pressed). The seat switch or circuit wiring is damaged. The key switch or circuit wiring is damaged. The machine is operated on a slope with a low fuel level. The parking brake sensor or circuit wiring is damaged. |
| The engine shuts off during the operation (the operator sitting on the seat). | The operator is not in the center of the seat (the seat switch is not pressed). The engine temperature is excessive (above 115°C/240°F). The engine dual temperature switch is damaged. The machine is operated on a slope with a low fuel level. The parking brake is engaged or the parking brake sensor is damaged. The seat switch is damaged. The fuses F1, F3, and/or F4 are/is damaged. The fuel pump is damaged. |
| The battery does not charge. | A loose, corroded, or broken wire(s) exist in the charging circuit; refer to the Electrical Schematics in Appendix A (page A-1)—Foldout Drawings. The engine alternator belt is loose or damaged. The alternator is damaged. The battery is damaged. The fusible link harness at the engine starter motor is damaged. |

Cutting Deck Operating Problems

Note: To engage the mow circuit, the operator must be in the operator seat, the PTO switch must be on.

| Problem | Possible Causes |
|---|--|
| The cutting deck remains engaged, but should not, with no operator in the seat. | The seat switch or circuit wiring is damaged. A hydraulic problem in the mow circuit exists; refer to Chapter 4: Hydraulic System (page 4–1). |

Cutting Deck Operating Problems (continued)

| The cutting deck run, but should not, with the PTO switch in the OFF (disengage) position. | The PTO switch or circuit wiring is damaged. A hydraulic problem in the mow circuit exists; refer to Chapter 4: Hydraulic System (page 4–1). |
|--|---|
| The cutting deck does not operate with the PTO switch in the ON (up) position. | The operator seat is unoccupied. The hydraulic-fluid level in the hydraulic tank is low. The seat switch or circuit wiring is damaged. The wiring to the transmission PTO solenoid valve coil is loose, corroded, or damaged; refer to the Electrical Schematics in Appendix A (page A-1)—Foldout Drawings. The transmission PTO solenoid valve coil is damaged. The PTO switch is damaged. The engine temperature is excessive (above 105°C/220°F). The dual temperature switch or circuit wiring is damaged. The Standard Control Module is damaged. The transmission hydraulic solenoid valve is damaged; refer to Chapter 4: Hydraulic System (page 4–1). The transmission pressure valve or charge pump is damaged; refer to Chapter 4: Hydraulic System (page 4–1). |

Cutting Deck Lift/Lower Problems

| Problem | Possible Causes |
|-----------------------------------|---|
| The cutting deck does not lower. | The operator is not fully pressing the seat switch. The seat switch or circuit wiring is damaged. The lift control manifold solenoid coil S1 or circuit wiring is damaged. A hydraulic problem in the lift/lower circuit exists; refer to the Troubleshooting (page 4–28). |
| None of the cutting units raises. | The lift control manifold solenoid coil S1 or circuit wiring is damaged. A hydraulic problem in the lift/lower circuit exists; refer to the Troubleshooting (page 4–28). |

Electrical System Quick Checks

Testing the Battery (Open Circuit Test)

Use a multimeter to measure the voltage between the battery terminals; refer to Battery Test Table (page 5–20).

Set the multimeter to the DC volts settings. The battery must be at a temperature of 16° C to 38° C (60° F to 100° F). Ensure that the key is in the OFF position and all the accessories are turned off.

Connect the positive (+) meter lead to the positive battery post and negative (-) meter lead to the negative battery post.

Measure and record the battery voltage. Use the Battery Test Table (page 5–20) to determine charge level of the battery.

Note: This test provides a relative condition of the battery. The load testing of the battery provides additional and more accurate information; refer to Servicing the Battery (page 5–61).

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

Battery Test Table

Testing the Charging System

This is a simple test that determines if a charging system is functioning. It tells you if the charging system has an output, but not its capacity.

Tool required: Digital multimeter to set the DC volts.

Test instructions: Connect the positive (+) multimeter lead to the positive battery post and negative (-) multimeter lead to the negative battery post. Keep the test leads connected to the battery posts and record the battery voltage.

Note: When starting the engine, the battery voltage drops and then must increase once the engine is running.

Note: Depending upon the condition of the battery charge and battery temperature, the battery voltage increases at different rates as the battery charges.

Start the engine and run it at high-idle speed **(3,000 rpm)**. Allow the battery to charge for a minimum time of 3 minutes. Record the battery voltage.

Note: After running the engine for a minimum time of 3 minutes, the battery voltage must be minimum 0.50 V higher than that of the initial battery voltage.

Refer to the Battery Voltage Table (page 5–21) for an example of a charging system that is functioning.
Testing the Charging System (continued)

Battery Voltage Table

| At least 0.50 V over the initial battery voltage. | | |
|---|-----------|--|
| Initial battery voltage | = 12.30 V | |
| Battery voltage after 3 minutes charge | = 12.85 V | |
| Difference | = +0.55 V | |

Testing the Glow Plug System

A

This is a fast, simple test that helps to determine the integrity and operation of the Groundsmaster glow plug system. Perform this test when you find hard starting (cold engine) on a diesel engine equipped with a glow plug system.

Tool(s) required: Digital multimeter and/or inductive Ammeter (AC/DC Current Transducer).

Test instructions: Properly connect the ammeter to the digital multimeter (refer to the manufacturer's instructions). Set the multimeter to the correct scale. With the key 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 and record the multimeter results.

The glow plug system of the Groundsmaster 7210 machine should have a reading of approximately 21 A.

Checking the Operation of the Interlock Switches

CAUTION

Check the operation of the interlock switches daily for proper operation.

Replace any malfunctioning switches before operating the machine.

The Groundsmaster 7210 machine is equipped with a Standard Control Module (SCM) which monitors the interlock switch operation. The information on the SCM is described in Testing the Electrical Components (page 5–23). Testing of the individual interlock switches is included in the Testing the Electrical Components (page 5–23).

Note: The machine is equipped with an interlock switch on the parking brake. The engine shuts off if the traction control levers are moved from the NEUTRAL LOCK position with the parking brake engaged.

- 1. Ensure that all the bystanders are away from the area of operation. Keep your hands and feet away from the cutting deck (or implement).
- 2. With the operator in the seat, the engine must not start with either the PTO switch in the ON position or the traction control levers moved from the NEUTRAL LOCK position. Correct the problem if the machine is not operating properly.

Checking the Operation of the Interlock Switches (continued)

3. With the operator in the seat, the traction control levers in the NEUTRAL LOCK position, the parking brake off and the PTO switch in the OFF position, the engine must start. Lift off the seat and slowly move the traction control levers from the NEUTRAL LOCK position, the engine must stop in 1 to 3 seconds. Correct the problem if the machine is not operating properly.

Testing the Electrical Components

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

Note: For the engine component testing information; refer to the Yanmar Engine Service Manual.

IMPORTANT

When testing the electrical components for continuity with a multimeter (ohms setting), ensure that you disconnect the power to the circuit.

Key Switch



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Figure 147

1. Key switch





The key switch (item 1 in Figure 147) has 3 positions (OFF, ON/PREHEAT, and START) (Figure 148). The key switch terminals are identified as shown in Figure 149.

The Standard Control Module (SCM) monitors the operation of the key switch. When the key switch is in the ON position, the SCM power input LED must be illuminated.

Testing the Key Switch

- Before you disconnect the key switch for testing, ensure that you test the switch and its circuit wiring as a SCM input; refer to Standard Control Module (page 5–3).
- 2. If the SCM verifies that the key switch and circuit wiring are functioning correctly, no further switch testing is necessary.
- 3. If the SCM determines that the key switch and circuit wiring are not functioning correctly, then test the key switch as follows:
 - A. Ensure that the key switch is in the OFF position. Disconnect the wire harness connector from the key switch.
 - B. The circuitry of the key switch is shown in the Circuit Logic Table (page 5–24). With the use of a multimeter (ohms setting), test the switch functions to determine if the continuity exists between the various terminals for each switch position. Check the continuity between the switch terminals.
 - C. Replace the key switch if necessary.
 - D. If the key switch testing is correct and the circuit problem still exists, check the wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1)—Foldout Drawings.
 - E. Connect the machine wire harness connector to the key switch.

Circuit Logic Table

| Switch Position | Normal Circuits | Other Circuits |
|-----------------|-----------------|----------------|
| Off | None | None |
| ON/PREHEAT | B+A+I | X+Y |
| Start | B+S+I | None |

PTO Switch



The PTO switch is located on the control panel (Figure 150). Pull up the PTO switch to engage the PTO (cutting deck or implement).

The Standard Control Module (SCM) monitors the position of the PTO switch (up or down). Using the inputs from the PTO switch and other switches in the interlock system, the SCM controls the energizing of the transmission solenoid valve and thus, the PTO. If the key switch is in the ON position and the PTO switch is engaged, the SCM PTO switch input LED should be illuminated.

IMPORTANT

During the operation of the machine, if the PTO shuts down and the console temperature warning light is illuminated because of excessive engine coolant temperature, avoid shutting off the engine. Under this condition, push the PTO knob down, slowly drive to a safe flat area, move the throttle lever to the SLOW position, move the traction control levers into the NEUTRAL LOCK position, and set the parking brake. Allow the engine to be idle for several minutes while it cools to a safe level, and check the cooling system before returning the machine to service.

Testing the PTO Switch

- Before you disconnect the PTO switch for testing, ensure that you test the switch and its circuit wiring as a SCM input; refer to Standard Control Module (page 5–3).
- 2. If the SCM verifies that the PTO switch and circuit wiring are functioning correctly, then no more switch testing is necessary.
- 3. If the SCM determines that the PTO switch and circuit wiring are not functioning correctly, then test the PTO switch as follows:
 - A. Ensure that the key switch is in the OFF position and locate the PTO switch for testing.
 - B. Disconnect the machine wire harness electrical connector from the PTO switch.
 - C. The PTO switch terminals are identified as shown in Figure 151. The circuitry of the PTO switch is shown in the Circuit Logic Table (page 5–26). With the use of a multimeter (ohms setting), test the switch functions to determine if the continuity exists between the various terminals for each switch position. Check the continuity between the switch terminals.
 - D. Replace the PTO switch if necessary.
 - E. If the PTO switch testing is correct and the circuit problem still exists, check the wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1)—Foldout Drawings.
 - F. Connect the machine wire harness connector to the PTO switch. Check the operation of the PTO switch.

| Switch Position | Closed Circuits | Open Circuits |
|-----------------|------------------------------|------------------------------|
| Off (Down) | COM B + NC B COM C + NC C | COM B + NO B COM C + NO C |
| On (Up) | COM B + NO B COM C + NO C | COM B + NC B COM C + NC C |

Circuit Logic Table

Neutral Switches



The Groundsmaster 7210 machine uses 2 identical neutral switches. These neutral switches are normally open and close when the traction levers are in the NEUTRAL LOCK position. The neutral switches are located under the left cover and right cover below the operator seat (Figure 152 and Figure 153).

The Standard Control Module (SCM) monitors the status of the neutral switches. If the key switch is in the ON position and the 2 traction levers are in the NEUTRAL LOCK position, the SCM Neutral input LED should be illuminated. The switches are connected in series so that the 2 switches must be closed for the neutral input to be completed for the SCM.

Testing the Neutral Switches

 Before you disconnect a neutral switch for testing, ensure that you test the switch and its circuit wiring as a SCM input; refer to Standard Control Module (page 5–3).

Testing the Neutral Switches (continued)

- 2. If the SCM verifies that the neutral switches and circuit wiring are functioning correctly, then no more switch testing is necessary.
- 3. If the SCM determines that the neutral switch and circuit wiring are not functioning correctly, then test each neutral switch as follows:
 - A. Ensure that the key switch is in the OFF position and locate the neutral switches for testing.
 - B. Disconnect the machine wire harness electrical connector from the neutral switch.
 - C. Connect a multimeter (ohms setting) across the connector terminals to check the continuity of the switch.
 - D. When the switch plunger is extended, ensure that there is no continuity (open) between the switch terminals.
 - E. When the switch plunger is pressed, ensure that there is a continuity (closed) between the switch terminals.



- 1. Traction lever
- 2. Neutral switch

F. Replace the switch if necessary.

G. If the neutral switch testing is correct and the circuit problem still exists, check the wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1)—Foldout Drawings.

3. Screw

H. Connect the machine wire harness connector to the neutral switch. Check the operation of the neutral switch.

Seat Switch

The seat switch is normally open and closes when the operator is on the seat. If the traction system or PTO switch is engaged when the operator raises out of the seat, the engine shuts off. The seat switch and its electrical connector are located directly under the seat (Figure 155).

The Standard Control Module (SCM) monitors the status of the seat switch. If the key switch is in the ON position and the seat is occupied, the SCM In seat input LED should be illuminated.

Testing the Seat Switch

- 1. Before you disconnect the seat switch for testing, ensure that you test the switch and its circuit wiring as a SCM input; refer to Standard Control Module (page 5–3).
- 2. If the SCM verifies that the seat switch and circuit wiring are functioning correctly, then no more switch testing is necessary.
- 3. If the SCM determines that the seat switch and circuit wiring are not functioning correctly, then test the seat switch as follows:
 - A. Ensure that the key switch is in the OFF position. Tilt the seat assembly up to get access to the seat switch electrical connections.



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1.Seat harness connector2.Machine wire harness

Note: There is a short wire harness that is used to connect the seat switch to the main wire harness of the machine. This seat switch harness is between the seat and the seat plate.

- B. Disconnect the machine wire harness electrical connector from the seat switch harness electrical lead under the operator seat (Figure 155).
- C. Connect a multimeter (ohms setting) across the seat switch harness connector terminals to check the continuity of the seat switch.
- D. With no pressure on the seat, ensure that there is no continuity between the harness terminals of the seat switch.
- E. Press directly onto the seat switch through the seat cushion. Ensure that there is continuity between the harness terminals of the seat switch as the seat cushion approaches the bottom of its travel indicating that the seat switch is functioning.

A

WARNING

To prevent injury, do not attempt to reach the switch through openings in the seat plate.

If seat switch service is necessary, remove the seat from the seat plate to access the switch.

- F. If the continuity test is incorrect, remove the seat; refer to the Operator Seat (page 6–35). Check the seat switch and/or seat switch harness for continuity. Repair or replace the components as necessary.
- G. If the seat switch testing is correct and the circuit problem still exists, check the machine wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1)—Foldout Drawings.
- H. After you complete the seat switch testing, connect the machine wire harness connector to the seat switch electrical lead. Lower the seat assembly. Check the operation of the seat switch.

A

Engine Oil Pressure Switch



The engine oil pressure switch is located on the engine near the oil filter (Figure 156). The oil pressure switch is a normally closed switch that opens with oil pressure.

The oil pressure switch opens from 40 to 60 kPa (5.8 to 8.8 psi).

The oil pressure switch is connected to the engine controller. If the switch closes while the engine is running (indicating low oil pressure) the ECU will shut down the engine. If the oil pressure switch failure is detected by the ECU, the engine will transmit a fault and the fault will be displayed on the InfoCenter display.

Testing the Engine Oil Pressure Switch

Note: Refer to the Yanmar engine service manual for information regarding the engine lubrication system and testing.

- 1. Park the machine on a level surface, lower the cutting deck, set the parking brake, and shut off the engine.
- 2. Ensure that the key switch is in the OFF position.
- 3. Locate the engine oil pressure switch on the engine and disconnect the wire harness connector from the switch.
- 4. Connect a multimeter (ohms setting) across the switch harness connector terminals to check the continuity of the switch:
 - A. With the engine shut off, there should be no continuity between the switch harness terminals.
 - B. With the engine running, there should be continuity between the switch harness terminals.
- 5. If the testing determines that the oil pressure switch is not operating correctly, check the pressure switch and/or pressure switch harness for continuity. Repair or replace the components as necessary.
- If the switch testing is correct and the circuit problem still exists, check the machine wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1)—Foldout Drawings.

Testing the Engine Oil Pressure Switch (continued)

7. After you complete the oil pressure switch testing, connect the ECU wire harness connector to the oil pressure switch.

Parking Brake Sensor



The parking brake sensor is a normally open proximity sensor that is mounted below the parking brake shaft (Figure 157). The sensing plate for the brake sensor is the tab that is on the brake shaft.

When the parking brake is not set (the brake latch is not engaged), the tab is positioned near the target end of the parking brake sensor so that the sensor is closed. The tab is moved away from the sensor when the parking brake is set (the brake latch is engaged) causing the sensor to open.

The Standard Control Module (SCM) monitors the operation of the parking brake sensor. If the key switch is in the RUN position and the parking brake is released (the brake latch is not engaged), the SCM parking brake sensor input LED should be illuminated. Test the parking brake sensor and circuit wiring as a SCM input before you perform the following testing procedure.

Testing the Parking Brake Sensor

3. 4.

- 1. Park the machine on a level surface, lower the cutting deck, and shut off the engine.
- 2. Before you disconnect the parking brake sensor for testing, ensure that you test the sensor and its circuit wiring as a SCM input; refer to Standard Control Module (page 5–3).
- 3. If the SCM verifies that the brake sensor and circuit wiring are functioning correctly, then no more brake sensor testing is necessary.
- If the SCM determines that the brake sensor and circuit wiring are not functioning correctly, proceed with the following parking brake sensor testing procedure.
- 5. Remove the left cover.
- Locate the parking brake sensor (Figure 157).

Note: Ensure that the parking brake is not set.

Testing the Parking Brake Sensor (continued)

- 7. Turn the key switch to the RUN position (do not start the engine) and check the LED on the cable end of the parking brake sensor. The LED should be illuminated when the parking brake is not set (the brake latch is not engaged).
- 8. With the key switch is still in the RUN position (do not start the engine), set the parking brake (the brake latch engaged) and check the LED on the cable end of the parking brake sensor. The LED should not be illuminated when the parking brake is set (the brake latch engaged).
- 9. If the brake sensor LED did not function correctly, do the following:
 - A. Ensure that the parking brake sensor is properly adjusted; refer to Parking Brake Sensor (page 5–54). If necessary, adjust the sensor and return to step 7.
 - B. Ensure that the key switch is in the OFF position and disconnect the parking brake sensor connector from the machine wire harness.
 - C. Use a multimeter, check that the machine wire harness connector terminal for the black wire is closed (continuity) to the ground.
 - D. Turn the key switch to the RUN position (do not start the engine) and check with a multimeter that the machine wire harness connector terminal for pink wire has system voltage (12 VDC) present.
 - E. If the black wire is closed to the ground, the pink wire has system voltage present, and the sensor LED did not function, replace the parking brake sensor. Adjust the sensor after installation; refer to Parking Brake Sensor (page 5–54).
- 10. After you complete the brake sensor testing, ensure that the sensor connector is plugged into the machine wire harness.

PTO Solenoid Valve Coil



The hydraulic system of the Groundsmaster 7210 machine uses a solenoid valve coil on the front of the transmission (Figure 158). When the solenoid valve coil is energized, hydraulic flow is directed to operate the PTO system.

The Standard Control Module (SCM) provides current to the solenoid valve coil based on the position of several inputs. The PTO LED on the SCM is illuminated when the solenoid valve coil is energized.

Testing the PTO Solenoid Valve Coil

1.

2

Note: Do not remove the solenoid from the cartridge valve for testing.

1. Ensure that the key switch is in the OFF position. Unplug the wire harness electrical connector from the solenoid valve coil.

Note: Before taking the small resistance readings with a digital multimeter, short the multimeter test leads together. The multimeter displays a small resistance value (usually 0.5 ohms or less). This resistance is because of the internal resistance of the multimeter and test leads. Subtract this value from the measured value of the component that you are testing.

2. Measure the resistance between the 2 connector terminals of the solenoid coil.

Note: The resistance of the solenoid coil must be approximately 7.5 ohms.

- 3. Connect the wire harness connector to the solenoid coil.
- If the solenoid coil requires replacement; refer to PTO Solenoid Valve Coil (page 5–35).

Fusible Link Harness



Figure 159

1. Fusible link harness

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The Groundsmaster 7210 machine uses 3 fusible links for the circuit protection. These fusible links are located in a harness that connects the starter B+ terminal to the main wire harness. If any of these links fail, current to the protected circuit stops; refer to the Electrical Schematics in Appendix A (page A–1)—Foldout Drawings.

Ensure that the key switch is in the OFF position, disconnect the negative battery cable from the battery terminal, and then disconnect the positive cable from the battery; refer to Servicing the Battery (page 5–61). Locate and unplug the fusible link connector P1 from the machine wire harness. Use a multimeter to ensure that the continuity exists between each terminal pin in the connector P1 and connector J1 at the starter (Figure 160). If any of the fusible links are open, replace the fusible link harness.

Note: Ensure any conditions that may have damaged the fusible links have been identified and repaired.

After you complete the testing, ensure that the fusible link harness connectors are correctly attached to the starter and machine wire harness. Connect the positive battery cable to the battery terminal and then connect the negative cable to the battery.

Diode Assemblies

Several identical diodes are used on the Groundsmaster 7210 machines. The maximum current allowed through any of the diodes is 6 A. The diode assemblies can be identified by a black color, diode symbol, and Toro Part Number on the end of the diode assembly body (Figure 161).

A diode assembly is used for circuit protection from the voltage spikes that occur when the engine starter solenoid is de-energized. This diode plugs into the engine wire harness near the fuel water separator; refer to the Engine Wire Harness Drawing in Appendix A (page A-1)—Foldout Drawings.

A diode assembly is used to protect the engine ECU from reverse polarity in the EGR relay circuit. This diode plugs into the engine wire harness near the Yanmar engine ECU; refer to the Engine Wire Harness Drawing in Appendix A (page A–1)—Foldout Drawings.

A diode assembly is used to protect the engine ECU from reverse polarity in the alternator circuit. This diode plugs into the engine wire harness near the Yanmar engine ECU; refer to the Engine Wire Harness Drawing in Appendix A (page A–1)—Foldout Drawings.

A diode assembly is used to protect the PTO circuit from the voltage spikes that occur when the PTO switch is engaged. This diode plugs into the machine wire harness below the operator seat; refer to the Platform Wire Harness Drawing in Appendix A (page A–1)—Foldout Drawings.

A diode in the raise/lower circuit is used for circuit logic. When the lift switch is pressed to raise, this diode allows both lift manifold solenoids to be energized. When the lift switch is pressed to lower, this diode prevents the solenoid marked B in the schematic from being energized. This diode plugs into the machine wire harness below the operator seat; refer to the Platform Wire Harness Drawing in Appendix A (page A–1)—Foldout Drawings.

In the optional rear lift kit, 4 diodes are used for circuit logic.

In the optional debris blower kit, a diode is used to prevent voltage spikes when the hydraulic solenoid valve in the kit is de-energized.

Testing the Diode Assembly



- 1. End of the diode body
- 2. Diode assembly

- 3. Male terminal
 - 4. Female terminal

The diode shown in Figure 161 can be tested by using a digital multimeter (diode test or ohms setting); refer to Diode Test Table (page 5–38).

Testing the Diode Assembly (continued)

Diode Test Table

| Multimeter Red Lead (+) on Terminal | Multimeter Black Lead (-) on Terminal | Continuity |
|--|--|------------|
| Female | Male | Yes |
| Male | Female | No |

Resistor Assembly

The resistor assembly is used in all the engine wire harnesses for GM7210 machines that is necessary for operating the key switch. The resistor plugs into the wiring harness near the alternator; refer to the Engine Wire Harness Drawing in Appendix A (page A–1)—Foldout Drawings

The resistor assembly can be identified by its gray color and resistor symbol on the end of the resistor assembly body.



Testing the Resistor Assembly

The resistor can be tested using a digital multimeter (ohms setting).

Note: The resistance across the resistor terminals should be 1600 ohms.

Glow Relay



1. Glow relay



The glow relay of the Groundsmaster 7210 machine has 4 terminals and allows electrical current to the engine glow plugs when energized. The glow relay is attached to the ECU bracket that is located above the battery.

The ECU energizes the glow relay when you initially turn the key switch to the ON/PREHEAT position and also to the START position.

Testing the Glow Relay

- 1. Unlatch the hood and raise it.
- 2. Ensure that the key switch is in the OFF position. Disconnect the wire harness electrical connector from the glow relay.

Note: Before taking the small resistance readings with a digital multimeter, short the multimeter test leads together. The meter displays a small resistance value (usually 0.5 ohms or less). This resistance is because of the internal resistance of the multimeter and test leads. Subtract this value from the measured value of the component that you are testing.

Testing the Glow Relay (continued)

3. Check the coil resistance between the terminals 85 and 86 with a multimeter (ohms setting).

Note: The resistance must be approximately 72 ohms.

- 4. Connect the multimeter (ohms setting) leads to the relay terminals 30 and 87. Then ground terminal 85 and apply +12 VDC to terminal 86. The relay must break the continuity between the terminals 30 and 87 as +12 VDC is set and removed from terminal 86.
- 5. Disconnect the voltage and leads from the relay terminals.
- 6. Connect the wire harness electrical connector to the glow relay after you complete the testing.
- 7. Close the hood and secure it with the latches.

Start and EGR Relays



The Groundsmaster 7210 machine uses 2 identical relays that have 5 terminals to control power to the starter motor solenoid and EGR valve of the engine. The relays are attached to the ECU bracket above the battery (Figure 165).

The start relay supplies power to the engine starter motor solenoid when energized by the engine ECU.

The EGR relay supplies power to the engine EGR valve when energized by the engine ECU.

Testing the Start or EGR Relays

- 1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
- 2. Unlatch the hood and raise it.
- 3. Ensure that the machine operation does not occur unexpectedly, disconnect the negative (-) cable from the battery and then disconnect the positive (+) cable from the battery; refer to Servicing the Battery (page 5–61).
- 4. Locate the relay that you are testing.
- 5. Disconnect the wire harness connector from the relay, and remove the relay from the mounting bracket for testing.

Testing the Start or EGR Relays (continued)

6. Use a multimeter (ohms setting), measure the coil resistance between the terminals 85 and 86.

Note: The resistance should be 71 to 88 ohms.

- Connect the multimeter (ohms setting) leads to the relay terminals 30 and 87. Then ground terminal 86 and apply +12 VDC to terminal 85. The relay should make and break continuity between the terminals 30 and 87 as +12 VDC is set and removed from terminal 85.
- 8. Disconnect the voltage from terminal 85 and multimeter lead from terminal 87.
- 9. Connect the multimeter (ohms setting) leads to the relay terminals 30 and 87A and apply +12 VDC to the terminal 85. The relay should make and break continuity between the terminals 30 and 87A as +12 VDC is set and removed from the terminal 85.
- 10. After testing, disconnect the voltage and multimeter test leads from the relay terminals.
- 11. Attach the relay to the mounting bracket and connect the wire harness connector to the relay.
- 12. Connect the positive (+) cable to the battery and then connect the negative (-) cable to battery; refer to Servicing the Battery (page 5–61).
- 13. Lower the hood and secure it with the latches.

Fuel Pump



The fuel pump is attached to the ROPS tube near the left fuel tank (Figure 167).

The Standard Control Module Run output LED illuminates when the fuel pump is energized.

Testing the Fuel Pump

- 1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, and set the parking brake. Ensure that the key switch is in the OFF position.
- 2. Unlatch the operator seat and raise it to get access to the fuel pump.
- 3. Remove the 3 swell latches that attach the rear panel to the crossmember of the machine, and remove the rear panel and position it away from the machine.
- 4. Unlatch the hood and raise it.
- 5. Disconnect the fuel supply hose (pump discharge) from the inlet fitting on the fuel filter.
- 6. Ensure that the fuel hoses attached to the fuel pump are free of obstructions.
- 7. Place the disconnected fuel supply hose (pump discharge) into a large, graduated cylinder sufficient enough to collect 0.9 L (32 fl oz).

IMPORTANT

When testing the fuel pump, do not turn the key switch to the START position.

 Turn the key switch to the ON position and collect the fuel in the graduated cylinder. Allow the pump to run for 30 seconds and then return the switch to the OFF position.

Testing the Fuel Pump (continued)

Note: The amount of fuel pumped in 30 seconds must be approximately 350 ml (11.8 fl oz).

9. Replace the fuel pump as necessary. Connect the fuel hose to the fuel filter.

10. Prime the fuel system; refer to Priming the Fuel System (page 3–18).

Fuel Pump Specifications

| Pump Capacity | 700 ml/minute (23.5 fl oz/minute) |
|----------------------|-----------------------------------|
| Pressure | 21.5 to 37.3 kPa (3.1 to 5.4 psi) |
| Maximum Current Draw | 0.9 A |

11. Lower the operator seat.

12. Lower the hood and secure it with the latches.

Dual Temperature Switch



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Figure 168

1. Dual temperature switch



2. Shutdown circuit

The dual temperature switch includes 2 normally open circuits that are used to monitor the engine coolant temperature. These switch circuits are the high-temperature warning circuit and high-temperature shutdown circuit. The dual temperature switch is attached to the engine water pump housing (Figure 168).

When the engine coolant temperature rises to approximately 105°C (220°F), the high-temperature warning circuit closes. This closed circuit provides an input to the Standard Control Module (SCM). This input causes the SCM high-temperature warning LED to illuminate and the PTO implement to shut down.

If the engine coolant temperature rises to approximately 115°C (240°F), the high-temperature shutdown circuit closes and provides an input to the Standard Control Module (SCM). This input causes the SCM high-temperature shutdown LED to illuminate and the engine to shut down.

The Standard Control Module (SCM) monitors the operation of the dual temperature switch. If excessive coolant temperature causes either the switch circuit to close, the appropriate LED on the SCM illuminates. Test the switch

and its circuit wiring using the SCM before you perform the following testing procedure.

Testing the Dual Temperature Switch

1. Park the machine on a level surface, lower the implement, shut off the engine, set the parking brake, and remove the key from the key switch. Open the hood to get access to the engine.



If the radiator or engine is hot, pressurized hot coolant can escape and cause burns.

Do not open the radiator cap or drain the radiator when the coolant is hot. Ensure that the engine is cool before removing the dual temperature switch from the engine.

- 2. Lower the coolant level in the engine and remove the dual temperature switch from the engine.
- 3. Put the end of the switch in a container of oil with a thermometer and then slowly heat the oil (Figure 170).



The oil is hot and could cause personal injury or fire.

Handle the hot oil with extreme care.



Figure 170

- 4. Check the resistance of the switch with a multimeter (ohms setting) as the oil temperature increases.
 - A. The high-temperature warning circuit is normally open and closes at 101° to 108°C (214° to 226°F).
 - B. The high-temperature shutdown circuit is normally open and closes at 112° to 119°C (234° to 246°F).
- 5. If the switch does not meet either of the specifications, replace the switch.
- 6. After you complete the testing, install the temperature switch to the engine housing, do the following steps:
 - A. Clean the threads of the housing and switch. Apply thread sealant to the threads of the switch.

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Testing the Dual Temperature Switch (continued)



- B. Thread the switch into the housing; torque the switch to 29.4 to 39.2 N·m (22 to 28 ft-lb).
- C. Connect the harness wires to the temperature switch.
- 7. Fill the engine cooling system.
- 8. Lower the hood and secure it with the latches.

Fuses



The fuse block is located under the controller cover next to the operator seat.

In addition to the fuses in the fuse block, a 25 A fuse is included in the engine wire harness to protect the power circuit to the ECU. This fuse is located near the ECU (Figure 172).

Identification and Function

Refer to Figure 171 to identify each individual fuse and its correct amperage in the fuse block. The fuses have the following functions.

The fuse F1 (15 A) protects power supply for the key switch circuits and optional light kit.

The fuse F2 (10 A) protects the SCM start circuit.

The fuse F3 (10 A) protects the SCM power, hour meter, InfoCenter, and parking brake sensor.

The fuse F4 (2 A) protects power supply for the SCM logic.

Testing the Fuses

Turn the key switch to the RUN position (do not start the engine). With the fuse installed in the fuse block, use a multimeter to check that 12 VDC exists at both of the terminal test points on the fuse. If 12 VDC exists at 1 of the fuse test points but not at the other, the fuse is damaged.

If the fuse removal is necessary, ensure that the key switch is in the OFF position and the key is removed from the key switch. Remove the fuse from the fuse block and check that the fuse has continuity across the fuse terminals.

CAN-bus Terminator Resistor



The system communication between the electrical components on the Groundsmaster 7210 machine is accomplished on a CAN-bus communication system. The 2 specially designed, twisted wires form the bus for the network are used on your machine. These wires provide the data pathways between the machine components. At the end of the twisted pair of bus wires near the InfoCenter display is a 120 ohm CAN-bus terminator resistor.

The CAN-bus terminator resistor plugs into the platform wire harness in the control arm. The resistor can be accessed by removing the cover plate on the right side of the control arm.

The second CAN-bus terminator resistor plugs into the platform wire harness below the fuel pump near the left fuel tank. The resistor can be accessed by removing the operator seat and rear panel.

Note: The insulator wedge in the terminator resistor is blue for identification purposes. There also is a center keyway to prevent the terminator resistor from plugging into the wrong wire harness connector.

Note: Refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1)—Foldout Drawings for additional information on the location of the terminator resistor and wire connections.

Testing the CAN-bus Terminator Resistor

Test the terminator resistor (Figure 173) using a digital multimeter (ohms setting). The resistance between the terminals A and B of the terminator resistor should be 120 ohms. The terminal C is not used on the Groundsmaster 7210 machine.

Deck Lift/Lower Switch

1.



The deck lift/lower switch is used to raise and lower the cutting deck of your machine. The switch is attached to the right traction lever (Figure 174). The lift/lower switch is connected to the switch wire harness that runs through the right traction lever and connects to the main wire harness below the control panel.

When the top of the lift/lower switch is pressed (momentary position), both of the solenoid valve coils (S1 and S2) on the hydraulic lift control manifold are energized causing the valves to shift and the lift cylinder to extend to raise the cutting deck. When the bottom of the lift/lower switch is pressed (detent position), solenoid valve coil S1 on the hydraulic lift control manifold is energized causing the valve to shift and the lift cylinder to retract to lower the cutting deck.



1. Switch cap

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- Switch wire harness
- 3. Deck lift/lower switch

- Screw (2 used)
 Right traction lever
- 1. Ensure that the key switch is in the OFF position and the key is removed from the key switch.
- Move the right traction lever out of the NEUTRAL position and remove the 2 screws that secure the switch cap to the right motion control handle (Figure 175). Carefully slide the switch cap with the deck lift/lower switch and the attached wire harness from the control handle.
- 3. Disconnect the wire harness connectors from the lift/lower switch.
- 4. Connect a multimeter (ohms setting) across the lift/lower switch connector terminals to check the continuity of the switch.
- 5. With the switch is its normal, centered position, there should be no continuity (open circuit) between any of the switch terminals.
- 6. With the top of the switch pressed (momentary position), there should be continuity (closed circuit) between the bottom and center switch terminals and no continuity (open circuit) between the top and center switch terminals.
- 7. With the bottom of the switch pressed (detent position), there should be continuity (closed circuit) between the top and center switch terminals and no continuity (open circuit) between the bottom and center switch terminals.
- 8. If the testing determines that the deck lift/lower switch is damaged, replace the lift/lower switch.
- 9. After you complete the testing, secure the wire harness connectors to the deck lift/lower switch.

Note: Ensure that the connectors are attached to the switch terminals as shown in Figure 175. The top switch terminal should have the green wire connected to it for proper lift operation.

10. Carefully slide the switch cap with the lift/lower switch and the attached wire harness into the right control handle and secure the switch cap with the 2 screws.

Lift Control Manifold Solenoid Valve Coil





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2. Deck lift manifold



The hydraulic lift control manifold valve is located on the right side of the machine, near the rear left wheel. When the solenoid coils are energized, the valve shift occurs to control the hydraulic fluid flow. The electrical testing of the coils can be done with the coil installed on the hydraulic valve.

Testing the Lift Control Manifold Solenoid Valve Coil

- 1. Ensure that the key switch is in the OFF position.
- 2. Disconnect the wire harness electrical connector from the solenoid valve coil that is to be tested (Figure 176).
- 3. Identify the coil resistance specification by measuring the coil diameter and coil height (Figure 177).

Note: Before taking the small resistance readings with a digital multimeter, short the multimeter test leads together. The multimeter displays a small resistance value (usually 0.5 ohms or less). This resistance is because of the internal resistance of the multimeter and test leads. Subtract this value from the measured value of the component that you are testing.

- Use a multimeter (ohms setting), measure the resistance between the 2 connector terminals on the solenoid valve coil. The correct resistance for the solenoid coil is identified in the Solenoid Valve Coil Specifications Table (page 5–53).
- 5. If the solenoid coil resistance is incorrect, replace the solenoid coil; refer to the Lift Control Manifold Solenoid Valve Coils (page 5–58).
- 6. After testing the coils, connect the wire harness electrical connector to the solenoid valve coil.

Solenoid Valve Coil Specifications Table

| Coil Diameter | Coil Height | Coil Resistance |
|---------------------|---------------------|-----------------|
| 46.7 mm (1.84 inch) | 49.9 mm (1.96 inch) | 7.1 ohm |
| 35.8 mm (1.41 inch) | 36.3 mm (1.43 inch) | 8.8 ohm |

Adjustments

Parking Brake Sensor



The parking brake sensor acts as an input for the SCM controller to determine when the parking brake is set (the brake latch engaged). The brake sensor is a normally open proximity sensor that is installed to the bracket located below the brake shaft (Figure 178).

4.

Gap

2.

Tab

When the parking brake is not set (the brake latch not engaged), the parking brake tab is positioned near the target end of the parking brake sensor so that the sensor is closed. The parking brake tab is moved away from the sensor when the parking brake is set (the brake latch engaged) causing the sensor to open.

Adjusting the Parking Brake Sensor

1. When the parking brake is not set (the brake latch is not engaged), the gap between the parking brake sensor and the tab on the parking brake should be 2.8 to 3.8 mm (0.110 to 0.150 inches).



- 2. If the gap is incorrect, loosen the jam nuts that secure the sensor to the brake lever. Position the sensor with the jam nuts to allow correct gap between the sensor and the tab. Tighten the jam nuts to secure the adjustment. Tighten the jam nuts to 18.4 to 22.4 N·m (162 to 198 in-Ib). After you tighten the jam nuts, ensure that the clearance between the head of the parking brake sensor and the tab on the parking brake is not changed.
- 3. Check that the LED on the cable end of the parking brake sensor is illuminated when the parking brake is not set (the brake latch is not engaged). The LED should not be illuminated when the parking brake is set (the brake latch is engaged).
- 4. After adjusting the parking brake sensor, use the SCM to check that the parking brake sensor and circuit wiring are functioning correctly; refer to Parking Brake Sensor (page 5–33).

Service and Repairs

Note: For the engine electrical component repair information; refer to Chapter 3: Diesel Engine (page 3–1).

PTO Solenoid Valve Coil



1. Transmission



2. Solenoid valve and coil



You can replace the PTO solenoid valve coil on the transmission without opening the hydraulic system (Figure 180).

1.

2.

3.
Removing the PTO Solenoid Valve Coil

- 1. Park the machine on a level surface, lower the cutting deck (or implement), set the parking brake, shut off the engine, and remove the key from the key switch.
- 2. Raise the operator seat to get access to the PTO solenoid valve coil.
- 3. Disconnect the wire harness electrical connector from the PTO solenoid valve coil connector.
- 4. Remove the nut from the spool assembly.
- 5. Slide the coil assembly from the solenoid valve stem (Figure 181).
- 6. Clean any corrosion or dirt from the valve stem.

Installing the PTO Solenoid Valve Coil

1. Slide the new coil assembly, seals, and washers onto the solenoid valve stem. Ensure that you correctly position the seals and washers (Figure 181).

IMPORTANT

When securing the solenoid valve coil to the solenoid, do not overtighten the hex nut.



- Install the hex nut onto the spool assembly and torque the nut to 5.9 to 7.8 N·m (53 to 69 in-lb).
- 3. Connect the wire harness electrical connector to the solenoid valve coil connector.
- 4. Lower and secure the operator seat.

Lift Control Manifold Solenoid Valve Coils



You can replace a hydraulic solenoid valve coil on the deck lift manifold (Figure 182) without opening the hydraulic system.

Removing the Lift Control Manifold Solenoid Valve Coils

1.

2.

3. 4

- 1. Park the machine on a level surface, lower the cutting deck, set the parking brake, shut off the engine, and remove the key from the key switch.
- 2. Locate the solenoid valve coil that you replace.
- Raise the operator seat to get access to the deck lift manifold (Figure 182) for the location of solenoid coils on the deck lift manifold.
- 4. Disconnect the wire harness electrical connector from the solenoid valve coil that you replace.
- 5. Remove the nut from the hydraulic valve.
- 6. Slide the solenoid coil from the valve.
- 7. Clean any corrosion or dirt from the valve.

Installing the Lift Control Manifold Solenoid Valve Coils

1. Slide the coil assembly onto the hydraulic valve.



2. Install the nut onto the valve and torque the nut to **6.8** N·m (5 ft-lb).

Note: Do not overtighten the nut.

- 3. Connect the machine wire harness connector to the solenoid coil.
- 4. Lower and secure the seat.

Battery Storage

If you store the machine for more than 30 days:

- 1. Ensure that the key switch is in the OFF position. Remove the battery and charge it fully; refer to Servicing the Battery (page 5–61).
- 2. Either store the battery on a shelf or on the machine.
- 3. Disconnect the cables if the battery is kept on the machine.
- 4. Store the battery in a cool atmosphere to avoid quick deterioration of the battery charge.
- 5. To prevent the battery from freezing during storage, ensure that you charge it fully; refer to Servicing the Battery (page 5–61).

Battery Care

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1. The 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 the temperatures are extremely high, the battery will discharge more rapidly than if the machine is stored in a location where the temperatures are cool.

WARNING

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The gases are explosive; also, they can cause nausea.

- Wear safety goggles and rubber gloves when working with electrolyte. Charge the battery in a well ventilated place so that the gasses produced while charging can dissipate.
- Keep open flames and electrical sparks away from the battery; do not smoke.
- Disconnect the charger from the electrical outlet before connecting or disconnecting charger leads to or from the battery posts.
- 2. Clean the top of the battery by washing at the intervals with a brush dipped in ammonia or bicarbonate of soda solution. Flush the top surface with water after cleaning.

IMPORTANT

Do not remove fill caps while cleaning.

- 3. Tighten the battery cables on the battery terminals to provide a good electrical contact.
 - WARNING

Connecting the cables to the wrong battery post could result in personal injury and/or damage to the electrical system.

Ensure that the cables are properly connected to the correct battery posts before operating the machine.

- 4. If corrosion occurs at the battery terminals, disconnect the cables. Always disconnect the negative (-) cable first. Clean the cable clamps and terminals separately. Connect the cables with the positive (+) cable first. Apply a layer of battery terminal protector (Toro Part No. 107-0392) or a light coat of grease to the terminals to reduce corrosion after you make the connections.
- 5. Check the battery-electrolyte level every 25 operating hours and every 30 days if machine is in storage.
- 6. Maintain the cell level with the distilled or demineralized water.

Note: Do not fill the cells above the fill line.

Servicing the Battery

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The battery is the heart of the electrical system. With the regular and correct service, the battery life can be extended. Additionally, the battery and electrical component failure can be prevented.

Battery-electrolyte is corrosive and can burn skin and eyes and damage clothing.

While working with the batteries, use extreme caution to avoid splashing or spilling of the electrolyte. Always wear the safety goggles and a face shield while working with batteries.

Battery Specifications

| Battery-electrolyte specific gravity | Fully Charged: 1.265 corrected to 26.7°C (80°F) Discharged: less than 1.240 |
|--|--|
| Battery specifications | BCI Group Size 26: 540 CCA at -17.8°C (0°F) Reserve Capacity of 80 minutes at 26.7°C (80°F) |
| Battery dimensions (including terminal posts and caps) | Length 20.8 cm (8.2 inches) Width 17.3 cm (6.8 inches) Height 20.3 cm (8.0 inches) |

Removing the Battery



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Figure 183

- 1. Negative cable
- 2. Battery
- 3. Battery tray
- 4. Flange nut

- 5. Flat washer
- 6. Battery retainer
- 7. Carriage screw
- 8. Positive cable

IMPORTANT

Be careful when removing the battery cables and ensure that you do not damage the terminal posts or cable connectors.

- 1. Unlatch, raise the hood and support it. Loosen the battery retainer that secures the side of the battery to the frame.
- 2. Loosen the nut on the ground cable (-) first and remove the ground cable from the battery. This must prevent the short circuiting the battery, other components, or the operator's hands.
- 3. After you disconnect the negative cable from the battery, loosen the nut on the positive cable (+) and remove the positive cable from the battery.
- 4. Ensure that the battery vent caps are tight.
- 5. Remove the battery from the battery compartment to a service area to allow better access for service.

Inspecting, Maintaining, and Testing the Battery

- 1. Do the following inspections and maintenance:
 - A. Check for cracks. Replace the battery if cracked or leaking.
 - B. Check the battery terminal posts for corrosion. Use the wire brush to clean corrosion from the posts.

IMPORTANT

Before cleaning the battery, tape or block the vent holes of the filler caps and ensure that the caps are tight.

- C. Check for the 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 the 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 the cells with distilled water between the minimum and maximum fill lines. Charge at 15 to 25 A for 15 minutes to allow sufficient mixing of the electrolyte.
- 2. Perform the hydrometer test of the battery-electrolyte.

IMPORTANT

Ensure that the area around the cells is clean before opening the battery caps.

A. Use a hydrometer to measure the specific gravity of each cell. Pull the electrolyte in and out of the hydrometer barrel before taking a reading to warm-up the hydrometer. At the same time, take the temperature of the cell.

Inspecting, Maintaining, and Testing the Battery (continued)

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B. Temperature correct each cell reading. For each 5.5°C (10°F) above 26.7°C (80°F) add 0.004 to the specific gravity reading. For each 5.5°C (10°F) below 26.7°C (80°F) subtract 0.004 from the specific gravity reading; refer to the Cell Specific Gravity Example (page 5–63).

Cell Specific Gravity Example

| Cell Temperature | 100°F |
|---|-------|
| Cell Specific Gravity | 1.245 |
| 37.7°C minus 26.7°C equals 11.0°C (100°F minus 80°F equals 20°F) | |
| 11°C multiply by 0.004/5.5°C equals 0.008 (20°F multiply by 0.004/10°F equals 0.008) | |
| ADD (conversion above) | 0.008 |
| Correction to 26.7°C (80°F) | 1.253 |

- C. If the difference between the highest and lowest cell specific gravity is 0.050 or more or the lowest cell specific gravity is less than 1.225, charge the battery.
- D. Charge at the rate and time given in Charging the Battery (page 5–65) or until all cells specific gravity is 1.225 or greater with the difference in specific gravity between the highest and lowest cell is less than 0.050. If you can not meet these charging conditions, replace the battery.
- 3. Do a high-discharge test with an adjustable load tester. This is 1 of the most reliable means of testing a battery as it simulates the cold-cranking test. A commercial battery load tester is required to do this test.

CAUTION

Follow the manufacturer's instructions when using a battery load tester.

- A. Check the voltage across the battery terminals before testing the battery. If the voltage is less than 12.4 VDC, charge the battery before continuing the test.
- B. If you charge the battery, apply a 150 A load for 15 seconds to remove the surface charge. Use a battery load tester following the manufacturer's instructions.
- C. Ensure that the battery terminals are free of corrosion.
- D. Measure the electrolyte temperature of the center cell.
- E. Connect a battery load tester to the battery terminals following the manufacturer's instructions. Connect a digital multimeter to the battery terminals
- F. Apply a test load of 1/2 the cranking performance rating of the battery for 15 seconds; refer to Battery Specifications (page 5–61).
- G. Take a test voltage reading at 15 seconds, then remove the load.

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Inspecting, Maintaining, and Testing the Battery (continued)

H. Use the Minimum Voltage Table (page 5–64), determine the minimum voltage for the center cell electrolyte temperature reading.

Minimum Voltage Table

| Minimum Voltage | Battery-Electrolyte Temperature | | |
|-----------------|---------------------------------|-----------------|--|
| 9.6 | 70°F (and up) | 21.1°C (and up) | |
| 9.5 | 60°F | 15.6°C | |
| 9.4 | 50°F | 10.0°C | |
| 9.3 | 40°F | 4.4°C | |
| 9.1 | 30°F | -1.1°C | |
| 8.9 | 20°F | -6.7°C | |
| 8.7 | 10°F | -12.2°C | |
| 8.5 | 0°F | -17.8°C | |

I. If the test voltage is below the minimum, replace the battery. If the test voltage is at or above the minimum, return the battery to service.

Installing the Battery

IMPORTANT

To prevent possible electrical problems, install only a fully charged battery.

- 1. Ensure that the key switch and all accessories are in the OFF position.
- 2. Ensure that the battery compartment is clean and paint it if necessary. Place the battery tray in position.
- 3. Ensure that all the battery cables, battery retainer, and electrical connections are in good condition.
- Place the battery in its compartment. Ensure that the battery is level and flat. Connect the positive (+) cable connector onto the positive (+) battery post. Use 2 wrenches to attach the cable bolt and locknut.
- 5. Attach the battery retainer with the flat washer and flange nut.

Note: Do not overtighten the nut to prevent cracking or distorting the battery case.

- 6. Connect a digital multimeter (set to A) between the negative (-) battery post and the negative (-) cable connector. Ensure that the reading is less than 0.1 A. A reading of more than 0.1 A usually indicates a damaged switch, a shorted circuit, or grounded wire. Identify and repair the electrical faults before returning the machine to service.
- 7. Connect the negative (-) cable connector to the negative (-) battery post. Use the 2 wrenches to attach the cable bolt and locknut.
- 8. After you make the connections, apply battery terminal protector (Toro Part No. 107-0392) or a light layer of grease on all the battery posts and cable connectors to reduce corrosion.

To minimize damage to the battery and allow the battery to charge fully, do the following slow charging procedure. You can do this charging procedure with a constant current battery charger that is locally available.

IMPORTANT

Follow the manufacturer's instructions when using a battery charger.

Note: Using specific gravity of the battery cells is the most accurate procedure of determining the 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 manufacturer's battery charger instructions or the following Battery Charge Level Table (page 5–65).

| Battery | Charge | Level | Table |
|---------|--------|-------|-------|
|---------|--------|-------|-------|

| Battery | / Battery Charge Level (Percent of Fully Charged) | | arged) | |
|----------------------------------|---|----------|----------|--------|
| Reserve Capacity (Minutes) | 75% | 50% | 25% | 0% |
| 80 or less | 3.8 hrs | 7.5 hrs | 11.3hrs | 15 hrs |
| | @ | @ | @ | @ |
| | 3 A | 3 A | 3 A | 3 A |
| 81 to 125 | 5.3 hrs | 10.5 hrs | 15.8 hrs | 21 hrs |
| | @ | @ | @ | @ |
| | 4 A | 4 A | 4 A | 4 A |
| 126 to 170 | 5.5 hrs | 11 hrs | 16.5 hrs | 22 hrs |
| | @ | @ | @ | @ |
| | 5 A | 5 A | 5 A | 5 A |
| 171 to 250 | 5.8 hrs | 11.5 hrs | 17.3 hrs | 23 hrs |
| | @ | @ | @ | @ |
| | 6 A | 6 A | 6 A | 6 A |
| above 250 | 6 hrs | 12 hrs | 18 hrs | 24 hrs |
| | @ | @ | @ | @ |
| | 10 A | 10 A | 10 A | 10 A |

CAUTION

Charging a frozen battery can cause explosion and can cause personal injury. Let the battery warm to 15.5°C (60°F) before connecting to a charger.

- Charge the battery in a well-ventilated place to dissipate the gases produced from the charging.
- These gases are explosive; keep open flame and electrical spark away from the battery. Do not smoke.
- Inhaling the battery gases can cause nausea.
- Unplug the charger from the electrical outlet before connecting or disconnecting the charger leads from the battery posts.
- 3. Follow the battery charger manufacturer's instructions, connect the charger cables to the battery posts. Ensure that you make a good connection
- 4. Charge the battery following the manufacturer's instructions.
- 5. Occasionally check the temperature of the battery-electrolyte. If the temperature is more than 51.6°C (125°F) or the electrolyte is violently gassing or spewing, lower and temporarily stop the charging rate.
- 6. Three hours before the end of the charging, measure the specific gravity of a battery cell once per hour.

Note: 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 3 consecutive readings.

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Chapter 6

Chassis

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Specifications

| Item | Description |
|---|-----------------------------------|
| Rear tire pressure | 124 kPa (18 psi) |
| Castor wheel (front) tire pressure | 172 kPa (25 psi) |
| Tire pressure (machines with Polar Trac) | 241 kPa (35 psi) |
| Rear wheel lug nut torque | 102 to 115 N·m (75 to 85 ft-lb) |
| Wheel lug nut torque (machines with Polar Trac) | 88 to 115 N·m (65 to 85 ft-lb) |
| Rear wheel hub locknut torque | 407 to 542 N·m (300 to 400 ft-lb) |

General Information

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

Service and Repairs

Rear Wheels



Removing the Rear Wheel

1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, and remove the key from the key switch.

Note: If the machine is equipped with the Polar Trac Kit; refer to Polar Trac Wheels (page 6–6) for information regarding the wheel removal.

2. Loosen, but do not remove the 5 wheel-lug nuts that attach the rear wheel to the wheel hub.

IMPORTANT

Before lifting the machine with a jack, review and follow Jacking Instructions (page 1–6). Do not support the machine on the rear wheel hubs (brake rotors).

- 3. Lift the rear wheel with a jack and use appropriate jack stands to support the machine.
- 4. Remove the 5 wheel-lug nuts and 5 wheel studs that attach the rear wheel to the wheel hub, and remove the rear wheel.

Installing the Rear Wheel

1. Install the wheel to the machine with the 5 wheel-lug nuts and 5 wheel studs.



 Lower the wheel to the ground and torque the wheel-lug nuts to 102 to 115 N·m (75 to 85 ft-lb) in a star-like pattern. **Polar Trac Wheels**



- 5. Wheel assembly (6 each)
- 6. Wheel lug nut (5 each per wheel)
- Parking brake (left)
 Screw (4 each per motor)
- 17. Wheel stud (5 each per hub)

Removing the Polar Trac Wheels

Note: Refer to the *Polar Trac Operator's Manual* for additional information regarding the drive track and wheel removal.

1. Park the machine on a level surface, lower the implement, shut off the engine, and remove the key from the key switch.

Note: When removing the wheels from a Polar Trac equipped machine, remove the center wheel first to allow track clearance for the front or rear wheels.

Removing the Polar Trac Wheels (continued)

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- Side access cover 2.
- 2. Loosen, but do not remove the wheel-lug nuts that attach the wheels to the machine.

Locknut and flat washer

- 3. Position the 2 jack stands under the rear bumper tube at a height so that they contact or nearly contact the bumper.
- 4. On the side of the machine that is to have the wheel(s) removed (Figure 186):
 - A. Remove the 2 screws that attach the side access cover to the machine, and remove the access cover.
 - B. Remove the locknut and flat washer that secures the bogie pivot to the front frame.
- 5. Position a suitable floor jack under the center of the lift arm pivot tube.
- 6. Lift the front of the machine with the jack until you support the rear of the machine on the jack stands and the center tire swings back and nearly contacts the rear tire. Support the front of the machine with jack stands.

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CAUTION

The track guides have many pinch points.

Carefully hold the rubber track on the outer edges outboard of the steel guides when moving the tracks.

- 7. Have a second person to lift the center of the track to remove the center wheel.
- 8. Remove the 5 wheel-lug nuts that attach the center wheel to the machine, and carefully remove the center wheel from the track.
- 9. Once you remove the center wheel, have a second person to lift the track from other wheel(s) as necessary to remove the additional wheel(s) from the machine.

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Installing the Polar Trac Wheels

1. If the track was removed from the machine, position the track to the wheel location.

Note: Ensure that the direction arrow on the track is correctly orientated.

Note: When installing the wheels to a Polar Trac equipped machine, install the center wheel last to allow track clearance for the front and rear wheels.

- 2. Have a second person to lift the track to install the front and/or rear wheel to the machine.
- 3. Install the wheel(s) to the machine with the 5 wheel-lug nuts.
- 4. After you install the front and rear wheels on the machine, have a second person to lift the center of the track to install the center wheel.
- 5. Install the center wheel to the machine with the 5 wheel-lug nuts.
- 6. Lower the front of the machine to the ground.

Note: When you attach the bogie pivot to the front frame, raise the rear of the machine to install the flat washer and locknut.



- 7. Insert the stud of the bogie pivot through the hole in front frame and secure with the flat washer (item 14 in Figure 185) and locknut; torque the locknut to **102 N·m (75 ft-lb)**.
- 8. Position the side access cover to the frame and attach with the 2 screws.
- 9. Fully lower the machine to the ground and torque all the wheel-lug nuts to **88** to **115** N·m (65 to 85 ft-lb) in a crossing pattern.

Parking Brakes



Removing the Parking Brakes

1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, and remove the key from the key switch.

Note: The installation torque of the locknut used to attach the wheel hub to the wheel motor is **407 to 542** N·m (**300 to 400 ft-lb**). If the hub removal is necessary, use an impact wrench to loosen the locknut.

- 2. If the wheel hub requires removal, loosen, but do not remove the locknut that secures the wheel hub to the wheel motor.
- 3. Remove the rear wheel; refer to Removing the Rear Wheel (page 6-4).

Note: Ensure that the machine is correctly supported with jack stands.



- 4. Remove the retaining ring and flat washer that retains the brake rod assembly to the parking brake lever. Separate the brake rod from the brake lever.
- 5. Remove the 4 bolts and 4 flange nuts that attach the brake support to the frame.
- 6. Slide the brake support (with the parking brake assembly attached) from the wheel hub disc and frame.
- 7. Remove the 2 locknuts that secure the parking brake assembly to the brake support, and remove the brake from the support.
- 8. Locate and retrieve the 2 hardened washers from the parking brake and brake support (Figure 188 and Figure 189).

IMPORTANT

If you must remove the wheel hub, do not hit the wheel hub or hub puller with a hammer while removing. Hammering can damage the hydraulic wheel motor or wheel hub.

- 9. If necessary, use a wheel-hub puller to loosen the wheel hub from the wheel motor shaft.
- 10. Remove the locknut that is loosened, remove the wheel hub from the wheel motor, and remove the woodruff key from the shaft.

Installing the Parking Brakes

- 1. If the wheel hub was removed, do the following steps:
 - A. Ensure that you clean the wheel hub and wheel motor shaft.
 - B. Install the woodruff key into the slot on the wheel motor shaft and slide the wheel hub onto the shaft.
 - C. Install the wheel hub to the motor shaft with the locknut.
- 2. Place the 2 hardened washers on the brake mounting screws (Figure 188 and Figure 189).

IMPORTANT

When installing the brake to the brake support, ensure that you do not get Loctite on the brake pad surface.

3. Apply the Loctite #271 (or equivalent) to the threads of the brake mounting screws.



- 4. Install the parking brake to the brake support with the 2 locknuts; torque the locknuts to **48 to 54 N·m (35 to 40 ft-lb)**.
- 5. Assemble the brake support (with the parking brake assembly attached) to the wheel hub disc and frame.

Note: Ensure that the disc is between the 2 stators (brake pads) in the brake assembly.

6. Install the 4 bolts and 4 flange nuts in the mounting holes of the brake support and frame, but do not fully tighten.



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Figure 190

- 1. Brake swivel
- 2. Caliper brake lever
- 3. Wheel hub disc

- 4. Hardened washer
- 5. Clearance
- Adjust the position of the brake support so that the clearance between the wheel hub disc and the 2 springs in the parking brake is 0.8 to 1.7 mm (0.030 to 0.070 inch). When the clearance is correct, fully tighten the 4 bolts and 4 flange nuts (Figure 190).
- 8. Install the brake rod assembly to the parking brake lever with the flat washer and retaining ring.
- 9. Install the wheel to the machine with the 5 wheel-lug nuts.



10. Lower the wheel to the ground and torque the 5 wheel-lug nuts to **102 to 115 N·m (75 to 85 ft-lb)** in a crossing pattern.

- 11. If the wheel hub was removed, set the parking brake and torque the locknut (item 1 in Figure 187) to 407 to 542 N·m (300 to 400 ft-lb). Release the parking brake.
- 12. Check the operation of the parking brake and parking brake sensor.

Servicing the Parking Brake



Mounting screw (2 each)

Note: If the parking brake wear or damage occurs, brake replacement is necessary. Individual brake components are not available.

Disassembling the Parking Brake

14.

Stationary actuator

- 1. Loosen and remove the 2 hex bolts (item 4 in Figure 191), 2 socket-head screws, and 4 hex nuts.
- 2. Slide the inner and outer stators from the sleeves and stationary actuator.
- 3. Inspect the parking brake components. Replace the complete brake assembly, if you find excessive wear or damage to any component.

Assembling the Parking Brake

- 1. Position the stationary actuator on the level work surface.
- 2. Assemble the brake components in order (Figure 191).

7.

Assembling the Parking Brake (continued)



Secure the brake assembly with the 2 hex bolts (item 4 in Figure 191), 2 socket-head screws, and 4 hex nuts; torque the hex bolts to 41 to 54 N·m (30 to 40 ft-lb) and socket-head screws to 24 to 31 N·m (18 to 23 ft-lb).

Parking Brake Assembly



Disassembling the Parking Brake Assembly

1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, and remove the key from the key switch.

Disassembling the Parking Brake Assembly (continued)

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- 1. Left cover2. Bolt (2 each)
- 2. Remove the 2 bolts (item 2 in Figure 193) that attach the left cover to the machine, and remove the left cover.
- 3. If necessary, remove the brake handle (item 1 in Figure 192) as follows:
 - A. On both sides of the machine, remove the hairpin cotter and clevis pin from the brake linkage yoke.
 - B. Support the brake handle to prevent it from shifting or falling.
 - C. Remove the 4 screws and 4 nuts that attach the flange bearings to the frame.
 - D. Remove the brake handle and flange bearings from the machine.
- 4. Remove the additional parking brake components as shown in Figure 192.

Assembling the Parking Brake Assembly



1. Front brake rod

3. Brake linkage yoke

- 2. Hex nut
- 1. Assemble the parking brake components as shown in Figure 192.
 - A. If the brake linkage yoke was removed from the front brake rod, install the yoke onto the rod so that the center-to-center length is 21.1 to 21.2 cm (8.290 to 8.350 inches) (Figure 194).
 - B. Ensure that the screws (item 10 in Figure 192) that are used to attach the flange bearings to the frame are installed from the outside of the frame to the inside.

Assembling the Parking Brake Assembly (continued)



1. Rear brake rod

4. Rear hex nut (2 each)

2. Compression spring

- 5. Swivel
- 3. Flat washer (2 each)
- 6. Front hex nut (2 each)
- 2. After you assemble the brake system, set the parking brake and check the length of the compression spring on the rear brake rod.

Note: Ensure that the length of the spring with the brake applied is 7.4 to 7.6 cm (2.880 to 3.000 inch). If necessary, adjust the length of the spring with the front hex nuts (item 6 in Figure 195) on the rear brake rod.

- 3. Check the operation of the parking brake and parking brake sensor.
- 4. Install the left cover to the machine with the 2 bolts (Figure 193).

Front Castor Wheels



- 2. Carrier frame assembly
- 3. Retainer pin (2 each)
- Taptite screw (2 each) 4.
- 5. Grease fitting (2 each)
- Castor arm assembly 6.
- Screw (3 each) 7.

- 9. Bearing cup
- Locknut (3 each) 10.
- Bolt (2 each) 11.
- 12. Castor wheel assembly (2 each)
- 13. Locknut (2 each)
- Castor fork (2 each) 14.

- Bearing cone (4 each) 16.
- 17. Belleville washer (6 each)
- Locknut (2 each) 18.
- 19. Grease cap (2 each)

Disassembling the Front Castor Wheels

Note: The left castor wheel has 2 adjustable positions, 1 is for 60/62 inch deck and the other is for 72 inch deck.

Disassembling the Front Castor Wheels (continued)



1. Locknut

Upper bearing cone 3.

2. Belleville washer



- 1.
- 2. Seal 3. Bearing cone

- 5. Castor wheel
- Castor spacer 6.
- 1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.

IMPORTANT

Before lifting the machine with a jack, review and follow Jacking Instructions (page 1–6).

- 2. Block the wheels with chocks. Use a jack to lift the front of the machine so that the castor wheel can be removed.
- 3. Support raised machine with appropriate jack stands.
- 4. Remove the bolt (item 11 in Figure 196) and locknut that attach the castor wheel to the castor fork, and remove the castor wheel assembly from the machine.
- 5. Remove the grease cap (item 19 in Figure 196) from the carrier frame, and discard the cap.

Disassembling the Front Castor Wheels (continued)

- 6. Support the castor fork to prevent it from falling. Remove the locknut (item 18 in Figure 196) from the castor fork and slide the castor fork from the machine.
- 7. Remove the 3 belleville washers and upper bearing cone from the carrier frame. Note the orientation of the washers while removing them (Figure 197).

Note: The belleville washer orientation is critical for proper movement of the castor wheel.

- 8. Remove and discard the seal (item 15 in Figure 196) from the carrier frame
- 9. Remove the lower bearing cone from the frame.
- 10. Inspect the bearing cups in the carrier frame for wear or damage. If the bearing cups are damaged, remove the bearing cups from the frame and replace them.
- 11. If necessary, remove the spacers, seals, and bearings from the castor wheel (Figure 198).
- 12. Inspect the wheel components and replace all the components that are worn or damaged.

Assembling the Front Castor Wheels

- 1. If the components were removed from the castor wheel, assemble the castor wheel (Figure 198) as follows:
 - A. Press the bearing cups into the castor wheel until they are flush with the shoulder in the wheel
 - B. Install the grease packed bearing cone into the wheel.
 - C. Install the seals into the wheel.
 - D. Carefully install the bearing spacers and then the castor spacer into the wheel.
- 2. If the bearing cups were removed from the carrier frame, press new cups into the carrier frame until they are flush with shoulder in the frame.
- 3. Pack the 2 bearing cones with new grease. Place the grease packed bearing cone into the lower bearing cup of the carrier frame.

Note: Ensure that you do not damage the seal.

- 4. Install new seal. Slide the castor fork up through the carrier frame.
- 5. Position the grease packed bearing cone onto the castor fork. Place the 3 belleville washers onto the castor fork and note the orientation as shown in Figure 197.

IMPORTANT

After you correctly tighten the locknut that secures the castor fork to the carrier frame, it should take 7.3 to 8.5 N·m (65 to 75 in-lb) to rotate the castor fork.



- 6. Install the locknut onto the castor fork and tighten the locknut until the castor fork requires **7.3 to 8.5 N·m (65 to 75 in-lb)** to rotate.
- 7. Remove the plug (item 8 in Figure 196) from the carrier frame. Use the grease gun through the plug hole in the frame, fill the area surrounding the castor fork shaft with grease. Allow grease to fill the cavities below the lower bearing, between the bearings, and above the upper bearing. Install the plug again into the frame.

Assembling the Front Castor Wheels (continued)

Note: Periodic greasing of the castor fork bearing area is not necessary. Do not replace the plug (item 8 in Figure 196) with a grease fitting. The grease cap (item 19 in Figure 196) will loosen if the castor fork has excessive grease installed.

8. Install new grease cap (item 19 in Figure 196) so that the cap shoulder is flush with the top of the carrier frame.

Note: There should be no evidence that the cap is indented by the top of the castor fork.

- 9. Position the castor wheel to the castor fork and secure the wheel with the bolt and locknut.
- 10. Lower the machine to the ground.

Servicing the Polar Trac Wheel Hub



Disassembling the Polar Trac Wheel Hub

Note: Refer to the *Polar Trac Operator's Manual* for additional information regarding the drive track and wheel removal.

Disassembling the Polar Trac Wheel Hub (continued)



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Figure 200

- 1. Dust cap
- 2. Cotter pin
- 3. Slotted hex nut
- 4. Bearing cone

- 5. Bearing cup
- 6. Wheel hub
- 7. Wheel stud (5 each)
- 8. Seal
- 1. Park the machine on a level surface, lower the implement, shut off the engine, set the parking brake, and remove the key from the key switch.
- Remove the wheels as necessary to get access to the wheel hub(s); refer to Removing the Polar Trac Wheels (page 6–6).
- 3. Support the machine with jack stands.
- 4. Remove the dust cap from the wheel hub.
- 5. Remove the cotter pin and slotted hex nut. Slide the wheel hub with bearings from the spindle shaft.
- 6. Remove the seal from the wheel hub and discard the seal.
- 7. Remove the bearing cones from both sides of the wheel hub.
- 8. Clean the bearings in solvent, and clean the inside of the wheel hub.

Note: Ensure that the bearings are in good operating condition.

9. Inspect the bearing cups for wear, pitting, or other damage. Replace all the parts that are worn or damaged.

Assembling the Polar Trac Wheel Hub

- 1. If the bearing cups were removed from the wheel hub, press new cups into the hub until they seat against the shoulder of the hub.
- 2. Pack the 2 bearings with grease and install 1 bearing into the bearing cup on the inboard side of the wheel hub.

IMPORTANT

The lip of the seal must be toward the bearing. Press the seal into the wheel hub so that it is flush with the end of the wheel hub.

Assembling the Polar Trac Wheel Hub (continued)

- 3. Lubricate the inside of a new seal and press the seal into the wheel hub with the seal lip toward the bearing.
- 4. Fill the wheel hub cavity between the bearings with approximately 50% full of grease. Position the remaining bearing into the outer bearing cup.
- 5. Slide the wheel hub assembly onto the spindle shaft and thread the slotted hex nut onto the shaft. Do not fully tighten the nut or install the cotter pin.



- While you turn the wheel hub by hand, torque the slotted hex nut to 8.5 to 11.3 N·m (75 to 100 in-lb) to set the bearings and then loosen the nut until the hub has end-play.
- While you turn the wheel hub by hand, torque the slotted hex nut to 1.7 to 2.3 N·m (15 to 20 in-lb). Also, align the hex nut slot with the shaft hole.

Note: After you tighten the hex nut, ensure that the wheel hub does not have any free-play.

- 8. Install the cotter pin and install the dust cap.
- 9. Install the drive track and wheels to the machine; refer to Installing the Polar Trac Wheels (page 6–8).

Note: Ensure that the drive track is installed in the correct direction of rotation.



10. Lower the machine to the ground and torque all the wheel-lug nuts to **88 to 115 N·m (65 to 85 ft-lb)** in a crossing pattern.

PTO Driveshaft



Removing the PTO Driveshaft

Note: The PTO driveshaft removal is easier if the machine is positioned on a hoist.

- 1. Park the machine on a level surface, lower the cutting deck (or implement) to the lowest setting, shut off the engine, set the parking brake, and remove the key from the key switch.
- 2. Remove the fuse F1 (15 A) from the fuse block to prevent the PTO clutch from engaging accidentally.
- 3. Disconnect the end yoke of the PTO driveshaft from the PTO shaft of the transmission as follows:
 - A. Remove the roll pin from the end yoke and PTO shaft.
 - B. Loosen the 2 bolts and 2 locknuts.
 - C. Slide the driveshaft end yoke from the PTO shaft.
- 4. Disconnect the end yoke of the PTO driveshaft from the cutting deck gearbox shaft as follows:
 - A. Remove the roll pin from the end yoke and gearbox shaft.

Removing the PTO Driveshaft (continued)

- B. Loosen the 2 bolts and 2 locknuts.
- C. Slide the driveshaft end yoke from the gearbox shaft.
- D. Remove the PTO driveshaft from the machine.

Installing the PTO Driveshaft

1. Position the PTO driveshaft to the machine.



Note: Ensure that the driveshaft yoke and slip tube (item 6 in Figure 202) is toward the cutting deck gearbox input shaft.

- 2. Align the splines and roll pin holes of the driveshaft yokes with the transmission and gearbox shafts.
- 3. Slide the PTO driveshaft end yokes onto the transmission PTO shaft and gearbox shaft.
- 4. Install the end yokes of the PTO driveshaft as follows:
 - A. Install the 2 roll pins to the end yokes and shafts.



- B. Install the 4 bolts and 4 locknuts that attach the end yokes to the gearbox shaft and PTO shaft; torque the locknuts to 20 to 25 N·m (175 to 225 in-lb).
- 5. Lubricate the PTO driveshaft grease fittings.
- 6. Install the fuse F1 (15 A) into the fuse block.
Servicing the PTO Driveshaft Cross and Bearing

1. Remove the PTO driveshaft from the machine; refer to Removing the PTO Driveshaft (page 6–25).

IMPORTANT

When you place the yoke in a vise, clamp lightly on the solid part of the yoke to prevent damage. Use a vise equipped with soft jaws.

2. Lightly clamp the yoke in a vise. Use the 2 screwdrivers to remove the 4 snap rings that attach the bearings at the inside of each yoke. Remove the yoke from the vise.

IMPORTANT

Support the yokes when removing and installing the bearings to prevent damage.

- 3. Use a press to remove the cross and bearings from the yokes, do the following steps:
 - A. Place a small socket against 1 bearing and a large socket against the yoke on the opposite side.
 - B. While you support the large socket, apply pressure on small socket to partially push the opposite bearing into the large socket.
 - C. Remove the yoke from the press, hold the partially removed bearing and tap on the yoke to completely remove the bearing.
 - D. Repeat the process for the remaining bearings.
 - E. Clean and inspect all the components.



- 4. Install new cross and bearings as follows:
 - A. Apply a coat of grease to the bearing bores of the end yoke and shaft yoke. Also, apply grease to the bearings and seal of the bearing assembly.

1.

2.

Servicing the PTO Driveshaft Cross and Bearing (continued)

Note: Ensure that all the bearing rollers are correctly seated in the bearing cage.

B. Press 1 bearing partially into the yoke.

IMPORTANT

When installing the cross into the bearing, ensure that you do not damage the bearing seal.

- C. Carefully insert the cross into the bearing and yoke.
- D. Hold the cross to align and press the bearing in until it hits the yoke.
- E. Carefully position the second bearing into the yoke bore and onto the cross shaft. Press the bearing into the yoke.
- F. Install the 4 snap rings to the bearings to secure the bearings in place.
- G. Repeat the procedure for the other yoke.
- H. Apply grease to the cross until it comes out of all the 4 bearing cups.
- 5. Lightly rap the yoke plugs with a soft-faced hammer to remove slight binding. If the binding continues, disassemble the joint to identify the source of binding.

Note: Ensure that the assembled joint moves without any binding.

6. Install the PTO driveshaft to the machine; refer to Installing the PTO Driveshaft (page 6–26).

Cutting Deck Lift Arms



Disassembling the Cutting Deck Lift Arms

1. Park the machine on a level surface with the cutting deck in fully raised position. Shut off the engine, set the parking brake, and remove the key from the key switch.

Disassembling the Cutting Deck Lift Arms (continued)



- 2. Note the location of the HOC pin in the HOC bracket for assembly purposes, and remove the HOC pin from the HOC bracket (Figure 205).
- 3. Start the engine and fully lower the cutting deck. Shut off the engine, and remove the key from the key switch.
- 4. Remove the lift arm components as shown in Figure 204 and Figure 206.





1. Check the flange bushings in the carrier frame for wear or damage (Figure 207).

Note: Replace the flange bushings if necessary.

- 2. Install the lift arm components as shown in Figure 204 and Figure 206.
 - A. If the ball joints were removed from the link (item 4 in Figure 204), install the ball joints equally on both ends of the link. Adjust the center-to-center length of the link assembly to 45.9 to 46.1 cm (18.070 to 18.180 inches). Tighten the jam nuts to secure the ball joints to the link (Figure 208).

Note: Ensure that the ball joints stay in-line when you tighten the jam nuts.

Note: Do not change the link assembly length to adjust the height-of-cut or for any other reason.

Note: When properly installed, the flange nuts (item 9 in Figure 204) should have the flange surface against the lift arm and not against the chain.



B. If the bolt (item 10 in Figure 204) was removed from the deck lift chain, insert the bolt into the upper link of chain and thread the flange nut onto the bolt with the flange away from the link; torque the flange nut to 67 N·m (50 ft-lb). When you fasten the chain to the front lift arm; torque the second flange nut to 67 N·m (50 ft-lb). When you install the chain to the rear lift arm; torque the bolts to 67 N·m (50 ft-lb).

- 3. Lubricate all the lift arm grease fittings after assembly.
- 4. Start the engine and fully raise the cutting deck. Shut off the engine and remove the key from the key switch.

Assembling the Cutting Deck Lift Arms (continued)

5. Install the HOC pin into the HOC bracket to allow desired height-of-cut (Figure 205).

Rollover Protection System



Removing the Rollover Protection System

- 1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.
- 2. Raise the operator seat.

Removing the Rollover Protection System (continued)



- 3. Remove the 2 double loop hairpin cotters (item 10 in Figure 209) from the 2 fold pins and pull the fold pins from the ROPS support plate.
- 4. Remove the 2 screws (item 7 in Figure 209) and 2 nuts from the ROPS support plate, and remove the ROPS tube.
- 5. Remove the 3 swell latches (item 2 in Figure 209) that secure the rear panel to the cross-member assembly, and remove the rear panel.
- 6. Disconnect the vent hose (item 1 in Figure 210) from the top of each fuel tank.
- 7. Disconnect the oil breather (item 2 in Figure 210) from the hydraulic hose.
- 8. Remove the 4 screws (item 3 in Figure 209) and 4 flange nuts that secure the cross-member assembly to the ROPS tubes, and remove the cross-member assembly.

Installing the Rollover Protection System

1.

- 1. Install the cross-member assembly (item 14 in Figure 209) to the ROPS tube with the 4 screws and 4 flange nuts.
- 2. Connect the vent hose (item 1 in Figure 210) at the top of each fuel tank.
- 3. Install the oil breather (item 2 in Figure 210) to the hydraulic hose.
- 4. Install the rear panel (item 1 in Figure 209) to the cross-member assembly with the 3 swell latches.
- 5. Install the ROPS support plate and ROPS tube with the 2 screws (item 7 in Figure 209) and 2 nuts.
- 6. Insert the 2 fold pins (item 6 in Figure 209) into the ROPS support plate and insert the 2 double loop hairpin cotters.
- 7. Lower the operator seat.

Operator Seat



- 2. Flat washer (2 each)
- 3. Retractable seat belt
- 4. Flat washer (2 each)
- 5. Screw (2 each)
- 6. Carriage bolt (4 each)
- 7. Seat support
- 8. Nut (2 each)
- 9. Rubber bumper (2 each)
- 10. Shoulder screw (2 each)
- 11. Hairpin (2 each)

- 13. Brake lever grip
- 14. Clevis pin
- 15. Seat lever
- 16. Torsion spring
- 17. Flange nut (8 each)
- 18. Seat prop
- 19. Left cover
- 20. Clevis pin (2 each)
- 21. Seat plate assembly
- 22. Safety decal

- 24. Bolt (2 each)
- 25. Top console decal
- 26. Carriage screw
- 27. Housing cap
- 28. R-clamp (2 each)
- 29. Manual tube
- 30. Grommet
- 31. Flange nut (4 each)

Removing the Operator Seat

1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.

Removing the Operator Seat (continued)

A

2. Unlatch the operator seat and raise it.

WARNING

To prevent injury, do not attempt to reach the seat switch through the openings in the seat plate.

If seat switch service is necessary, remove the seat from the seat plate to access the switch.



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Figure 212

1. Harness connector



- 2. Latch angle
- 3. Disconnect the machine wire harness electrical connector from the seat switch harness connector (Figure 212).
- 4. Support the seat and latch angles to prevent them from shifting during seat removal.
- 5. Remove the 4 flange nuts that attach the seat and latch angles to the seat plate, and remove the seat from the machine.
- 6. Remove the seat parts as shown in Figure 211.

Installing the Operator Seat

- 1. Install all the removed seat parts (Figure 211).
- 2. Align the seat and latch angles to the seat plate. Secure the assembly with the 4 flange nuts.
- Connect the wire harness electrical connector to the seat switch harness (Figure 212).
- 4. Lower the seat and latch it.
- 5. Check the operation of the operator seat switch.

Servicing the Operator Seat



- 4. Right armrest mount assembly
- 5. Back panel
- 6. Left armrest mount assembly
- 7. Seat frame assembly
- 8. Lumbar support knob
- 9. Label

- 13. Spring saddle
- 14. Bearing shaft
- 15. Hex nut
- 16. Cable (2 each)
- 17. Weight adjust bar
- 18. Label

- 22. Back rest knob
- 23. Label
- 24. Seat switch
- 25. Seat adjuster
- 26. Seat adjuster (slave)
- 27. Seat boot

Disassembling the Operator Seat

- 1. Remove the operator seat from the machine; refer to Removing the Operator Seat (page 6-35).
- 2. Remove the armrest assemblies and then the back panel from the back of the seat.



Figure 214

1. Back rest knob

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- 3. Lumbar support knob
- 2. Seat suspension knob
- 4. Seat position lever
- 3. Carefully peel the label from the back rest knob, and remove the nut and knob from the seat frame (Figure 214).
- 4. Remove the 6 push clips that attach the back cushion to the seat frame, and remove the back cushion.
- 5. Remove the 2 bolts that attach the bottom cushion to the seat frame, and remove the bottom cushion.
- 6. Remove the hex nut that secures the weight adjustment knob to the weight adjust bar. Remove the adjustment knob from the weight adjust bar to remove the tension of the cable. Remove the cables from the spring saddle.
- 7. Remove the 18 push clips from the seat frame and separate the seat boot from the frame.
- 8. Remove the 2 roll pins that attach the bearing shafts to the seat frame, and remove the bearing shafts and split nylon bushings from the frame.
- 9. Lift the seat frame from the suspension base.
- 10. Remove the nut and bolt that attach the top of the shock absorber to the suspension base, and remove the shock absorber.
- 11. Slide the spring saddle from the spring arm while you disengage the springs at top of the suspension base.
- 12. Remove the springs from the spring saddle. Note the orientation of the springs and spring saddle for assembly purposes.
- 13. Remove the nut and bolt that attach the bottom of the shock absorber to the spring saddle, and remove the shock absorber.

Assembling the Operator Seat

- 1. Attach the bottom of the shock absorber to the spring saddle with the nut and bolt.
- 2. Install the springs to the spring saddle in the same orientation that you noted during removal.

Assembling the Operator Seat (continued)

- 3. Position the spring saddle on the spring arm and slide the saddle down. Hook the spring ends on the top of the suspension base.
- 4. Use the suspension base as a pry point, place a prybar on the top of the spring saddle and push the saddle down to elongate the springs to install the bolt to the top of the shock absorber and suspension base. Align the bolt in position with the nut.
- 5. Position the seat frame to the suspension base.
- 6. Align the bearing blocks on the frame with receivers on the suspension base and guide frame into the place.
- 7. Insert the 2 bearing shafts and split nylon bushings to the suspension base and frame, and install the bearing shafts with the 2 roll pins.
- 8. Position the cables under the seat frame bars and on the top of the suspension base and insert the cable ends in the spring saddle slots.
- 9. Pass the weight adjustment knob shaft through the weight indicator, washer, and seat frame hole.
- 10. Turn the knob shaft into the weight adjust bar and install the hex nut on the knob shaft.
- 11. Position the seat boot to the seat frame and attach with the 18 push clips.
- 12. Position the bottom cushion to the seat frame and attach with the 2 bolts.
- 13. Position the back cushion to the seat frame and attach with the 6 push clips.
- 14. Assemble the back rest knob to the seat and attach with the nut. Attach the label to the knob.
- 15. Assemble the back panel and then the armrest assemblies to the seat.
- 16. Install the operator seat on the machine; refer to Installing the Operator Seat (page 6–36).

Hood



Figure 215

| 1. | Hood |
|----|------|
| ~ | ~ |

- 2. Screw (2 each)
- 3. Nut (11 each)
- 4. Intake screen
- 5. Plastic plug (26 each)
- 6. Hood decal (2 each)
- 7. Screw (4 each)
- 8. Catch latch (2 each)

Seal plate

10. Bulb seal

9.

- 11. Hood support
- 12. Locknut (4 each)
- 13. Flat washer (3 each)
- 14. Hood prop
- 15. Screw (5 each)
- 16. Rubber latch (2 each)

- 17. Hairpin cotter (2 each)
- 18. Carriage screw (7 each)
- 19. Foam seal (2 each)
- 20. Bulb seal
- 21. Air shield
- 22. Clip (3 each)

Removing the Hood

- 1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.
- 2. Unlatch the hood and raise it.
- 3. Remove the hairpin cotter (item 17 in Figure 215) from the left side frame rod.
- 4. Slide the hood to the left side of the machine to free the hood support from the frame rods.
- 5. Remove the hood from the machine.
- 6. If necessary, remove the hood components (Figure 215).

Installing the Hood

1. Install all the hood components that were removed (Figure 215).

Note: If the intake screen was removed from the hood, ensure that the hood support, seal plate are attached to the hood before you install the screen.

- 2. Attach the screen to the hood with the 26 plastic plugs.
- 3. Check the condition of all the seals on the frame and hood. Replace the damaged or missing seals.
- 4. Check that no gaps exist between the hood components and the machine frame.

Note: If necessary, seal the gaps with silicone sealant.

- 5. Position the hood to the machine and slide the hood support onto the frame rods.
- 6. Secure the hood to the frame rods with the hairpin cotter (item 17 in Figure 215).
- 7. Close the hood and latch it.



Cutting Deck

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General Information

Specifications

Several cutting decks are available for Groundsmaster 7210 machine. Refer to the *Cutting Deck Operator's Manual* for specifications and optional accessories for the cutting deck used on your machine.

Note: This chapter gives information about troubleshooting and repair of 60, 62, and 72 inch cutting decks. The 100 inch cutting deck information is not covered in this chapter.

Cutting Deck 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 machine. Refer to the *Cutting Deck Operator's Manual* for additional information when servicing the cutting deck.

Factors That Can Affect Cutting Performance

There are a number of factors that can contribute to unsatisfactory quality of cut, some of which may be turf conditions. The turf conditions such as the excessive thatch, sponginess, 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 the cutting deck weight and turf conditions.

| Factor | Possible Problem/Correction |
|--|--|
| 1. Maximum governed engine speed | Check that the engine is running at the correct high-idle speed; refer to Chapter 3: Diesel Engine (page 3–1). Always mow at high engine speed. |
| 2. Blade speed | All the cutting deck blades should rotate at the same speed. |
| 3. Tire pressure | Check the air pressure of all the tires including the castor tires. Adjust to the pressures specified in the <i>Traction Unit Operator's Manual</i> . |
| 4. Blade condition | Sharpen the blades if their cutting edges are dull or nicked. Inspect the blade sail for wear or damage. Replace the blade if necessary. |
| 5. Mower housing condition | Ensure that the cutting chamber is in good condition. Keep the underside of the deck clean. The unwanted material buildup can reduce the cutting performance. |
| 6. Height-of-cut | Adjust the deck as specified in the <i>Cutting Deck</i> <i>Operator's Manual</i> . The effective (actual) height-of-cut may be different than the bench set height-of-cut. |
| 7. Cutting deck alignment and ground following | Check the lift arms for wear, damage, or binding. Also, inspect for bent or damaged pivot shafts. |
| 8. Anti-scalp roller condition | All anti-scalp rollers should rotate freely. Replace the rollers or roller shafts if they are worn or damaged. |
| 9. Grass conditions | Mow when the grass is dry for best cutting results. Also, remove only 2.5 cm (1 inch) or 1/3 of the grass blade when cutting. |
| 10. Machine traction speed | Mowing at too fast of a traction speed will result in poor after cut appearance and missed patches of grass. |

Service and Repairs

A

A

WARNING

Do not start the engine and engage the PTO switch when the PTO driveshaft is disconnected from the cutting deck (or implement). If you start the engine and the PTO shaft is allowed to rotate, serious personal injury and machine damage could result.

Before disconnecting the PTO driveshaft from the cutting deck (or implement), remove the fuse F1 (15 A) from the fuse block to prevent the PTO clutch from engaging accidentally.

CAUTION

Do not work on the cutting deck with the engine running.

Always shut off the engine and remove the key from the key switch before working on the cutting deck.



Before servicing the cutting deck, remove the fuse F1 (15 A) from the fuse block (Figure 216). Power to the PTO switch will be disconnected after removing the fuse F1 which will prevent the PTO clutch from engaging accidentally. Plug the fuse back into the fuse block after servicing the cutting deck.

Blade Stopping Time

The blades of the cutting deck should come to a complete stop in less than 7 seconds after you disengage the PTO switch.

Note: When checking the blade stopping time, ensure that the deck is lowered onto a clean section of turf or hard surface to prevent dust and unwanted material.

To check the blade stopping time, instruct a second person to stay away from the machine at a safe distance and monitor the blades on the cutting deck.

A

Blade Stopping Time (continued)

When the machine operator disengages the cutting deck, record the time that it takes for the blades to come to a complete stop. If this time is more than 7 seconds, inspect the PTO brake assembly in the transmission; refer to PTO Circuit Problems (page 4–29).

Cutting Deck

Refer to specific *Cutting Deck Operator's Manual* for cutting deck removal and installation procedure.

Idler Assembly



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- 1. Cutting deck
- 2. Flat washer
- 3. Left spindle assembly
- 4. Drive belt
- 5. Snap ring (2 each)
- 6. Flange bushing
- 7. Torsion spring (2 each)
- 8. Washer (2 each)
- 9. Grease fitting (2 each)

- Figure 217
- 10. Drive belt
- 11. Idler pulley
- 12. Idler pulley
- 13. Center spindle assembly
- 14. Right spindle assembly
- 15. Socket-head screw (2 each)
- 16. Locknut (2 each)
- 17. Right idler arm
- 18. Drive pulley

- 19. Idler spacer (2 each)
- 20. Left idler arm
- 21. Stop bolt
- 22. Jam nut (2 each)
- 23. Doubler ring (3 each)
- 24. Flange nut (24 each)
- 25. Ribbed neck bolt (24 each)

- **Removing the Idler Assembly**
 - 1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.
 - 2. Lift the footrest to get access to the top of the cutting deck and support the footrest with the prop rod.
 - 3. Remove the deck covers from the top of the cutting deck.

Removing the Idler Assembly (continued)

- 4. Loosen the 2 jam nuts (item 22 in Figure 217) that attach the idler stop bolt to the cutting deck to allow clearance between the idler arm and stop bolt.
- 5. Remove the drive belt from the deck pulleys.
- 6. Insert a nut driver or small piece of pipe onto the torsion spring end of the idler arm.



The spring is under heavy load and can cause personal injury.

Be careful when removing the tension from the torsion spring of the idler arm.

- 7. Carefully push the torsion spring end down and away from the idler arm to unhook the spring from the arm.
- 8. Remove the snap ring that retains the idler arm assembly to the cutting deck.
- 9. Remove the idler components as shown in Figure 217.

Installing the Idler Assembly

- 1. Install the idler components that were removed, and secure the idler arm assembly to the cutting deck with the snap ring (Figure 217).
- 2. Insert a nut driver or small piece of pipe onto the torsion spring end of the idler arm.



CAUTION

A

A

The spring is under heavy load and can cause personal injury.

Be careful when applying the tension to the torsion spring of the idler arm.



Installing the Idler Assembly (continued)

- 3. Carefully push down on the torsion spring end to get the spring under the idler arm mounting plate. Then release the spring slowly to lock it in place.
- 4. Install the drive belt onto the pulleys.
- 5. If the idler arm on the right side of cutting deck was removed, check that the clearance between the idler arm and stop bolt is **2.5 to 4.0 mm (0.100 to 0.160 inch)** (Figure 218).

Note: If necessary, adjust the location of the jam nuts on the stop bolt to allow proper clearance.

- 6. Install the deck covers to the cutting deck.
- 7. Lower the footrest.

Blade Spindle



- 5. Idler pulley
- 10. Anti-scalp cup (3 each)
- 15. Drive pulley



Removing the Blade Spindle





3. 3/8 inch square drive

- 2. 1/2 inch square drive
- 1. Park the machine on a level surface, raise the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch. Support the cutting deck so that it cannot fall accidentally.
- 2. Lift the footrest to get access to the top of the cutting deck and support the footrest with the prop rod.
- 3. Remove the belt covers from the top of the cutting deck.

Note: When removing the deck drive belt, use the breaker bar in the idler arm square drive holes to rotate the idler pulley away from the belt (Figure 221).

Removing the Blade Spindle (continued)

- 4. Remove the drive belt from the deck pulleys; refer to the *Cutting Deck Operator's Manual.*
- 5. Remove the cutting blade, anti-scalp cup, and blade bolt from the spindle (Figure 219).
- 6. Remove the 8 ribbed neck bolts and 8 flange nuts that attach the spindle assembly to the deck, and remove the spindle assembly from the deck.

Installing the Blade Spindle

1. Position the spindle on the cutting deck and note the orientation of the grease fitting (Figure 220). Attach the spindle assembly to the deck with the 8 ribbed neck bolts and 8 flange nuts.



- 2. Install the cutting blade, anti-scalp cup, and blade bolt (Figure 219); torque the blade bolt to **119 to 146 N·m (88 to 108 ft-lb)**.
- 3. Slowly rotate the cutting blades to check that the blades do not contact any deck component(s).
- 4. Install the drive belt to the deck pulleys.
- 5. Lubricate the spindle grease fittings.
- 6. Install the belt covers to the cutting deck.
- 7. Lower the footrest.

Servicing the Blade Spindle

Disassembling the Blade Spindle



- 1. Remove the locknut from the top of the spindle shaft.
- 2. Remove the special hardened washer and pulley from the shaft.
- 3. Use an arbor press to remove the spindle shaft from the spindle housing.

Note: Ensure that the spindle shaft spacer remains on the spindle shaft while removing the shaft.

- 4. Remove the oil seals from the spindle housing.
- 5. Remove the bearing cones, O-ring, inner bearing spacer, and spacer ring from the spindle housing.
- 6. Use an arbor press to remove the 2 bearing cups and outer bearing spacer from the housing.

Note: The large snap ring can remain inside the spindle housing. Removing the large snap ring is very difficult.

Assembling the Blade Spindle

Note: A replacement spindle bearing set contains 2 bearings, a spacer ring, and a large snap ring (items 1, 2, and 3 in Figure 223). You cannot purchase these parts separately. Also, do not mix the bearing set components from one deck spindle to the another.

Assembling the Blade Spindle (continued)

Note: A replacement bearing spacer set includes the inner spacer and outer spacer (items 4 and 5 in Figure 223). Do not mix the bearing spacers from one deck spindle to the another.

IMPORTANT

If new bearings are installed into a used spindle housing, it is not necessary to replace the original large snap ring. If the original snap ring is in good condition with no sign of damage (e.g., spun bearing), leave the snap ring in the housing and discard the snap ring that comes with the new bearings. If the large snap ring is damaged, replace the snap ring.



1. Bearing

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- 2. Spacer ring
- Large snap ring 3.

- Figure 223
 - 4. Inner spacer
 - 5. Outer spacer



g033719

- 1. Bearing cup
- 2. Large snap ring
- Outer spacer 3.

4. Arbor press

Figure 224

- 5.
- Support
- Arbor press base 6.

Assembling the Blade Spindle (continued)

1. If the large snap ring was removed from the spindle housing, install the snap ring into the housing groove.

Note: Ensure that the snap ring is fully seated in the housing groove.

2. Install the outer spacer into the top of the spindle housing.

Note: Ensure that the outer spacer fits against the snap ring.

3. Use an arbor press to push the bearing cups into the top and bottom of the spindle housing.

Note: The top bearing cup must contact the outer spacer that was previously installed, and the bottom bearing cup must contact the snap ring.

Note: Ensure that the assembly is correct by supporting the first bearing cup and pressing the second bearing cup against it (Figure 224).

- 4. Pack the bearing cones with grease. Apply a film of grease on the lips of the oil seals and O-ring.
- 5. Install the lower bearing cone and oil seal into the bottom of the spindle housing.

Note: The bottom seal must have the lip facing out (down). This seal installation allows grease to purge from the spindle during the lubrication process (Figure 225).

IMPORTANT

If you are replacing the bearings, ensure that you use the spacer ring that is included with a new bearing set (Figure 223).



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Figure 225

- 1. Bottom seal installation
 - 2. Upper seal installation
- 6. Slide the spacer ring and inner bearing spacer into the spindle housing, then install the upper bearing cone and oil seal into the top of the housing.

Note: The upper seal must have the lip facing in (down). Also, install upper seal so it is flush to **2.0 mm (0.080 inch)** recessed to the housing surface (Figure 225).

Assembling the Blade Spindle (continued)

- 7. Examine the spindle shaft and shaft spacer to ensure that there are no burrs or nicks that could damage the oil seals. Lubricate the shaft and spacer with grease.
- 8. Install the spindle shaft spacer onto the shaft. Place a thin sleeve or tape on the spindle shaft splines to prevent damage of the seal during the installation of the shaft.
- 9. Carefully slide the spindle shaft with the spacer up through the spindle housing.

Note: The bottom oil seal and spindle spacer fit together when the spindle is fully installed.

10. Install the O-ring to the top of the spindle shaft (Figure 226).



 Install the pulley (hub down), special hardened washer, and locknut to the spindle shaft (Figure 226); torque the locknut to 176 to 203 N⋅m (130 to 150 ft-lb).

IMPORTANT

A pneumatic grease gun can produce high pressure inside the spindle housing that can damage the spindle seals. Thus, do not use a pneumatic grease gun for greasing of the spindle housings.



1. Upper seal

3. Hardened washer

2. O-ring

- 4. Locknut
- 12. Attach a hand pump grease gun to the grease fitting on the housing and fill the housing cavity with grease until the grease starts to come out of the lower seal.
- 13. Rotate the spindle shaft to ensure that it turns freely.

Gearbox



- Washer (3 each) 2.
- Left gearbox bracket 3.
- Mount (3 each) 4.
- Carriage screw (3 each) 5.
- 6. Gearbox

- 8. Taper lock bushing
- 9. Right gearbox bracket
- 10. Bolt (4 each)
- Lock washer (4 each) 11.
- Woodruff key 12.

- Deck drive pulley 13.
- 14. Right deck cover
- 15. Left deck cover
- Knob (2 each) 16.
- 17. Set screw (2 each)
- 18. Retainer nut (2 each)



Set screw installation position 2. Set screw removal position 1.



- 1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.
- 2. Lift the footrest to get access to the top of the cutting deck.
- 3. Support the raised footrest with the prop rod.
- 4. Remove the deck covers from the top of the cutting deck.
- 5. Remove the drive belt from the deck pulleys.
- 6. Disconnect the PTO driveshaft from the gearbox; refer to Removing the PTO Driveshaft (page 6-25).

1.

2.

4.

Removing the Gearbox (continued)

- 7. Remove the 4 bolts (item 10 in Figure 227) and 4 lock washers that attach the gearbox assembly to the gearbox brackets.
- 8. Remove the 3 carriage screws, 3 flange nuts, 3 washers, and 3 mounts that attach the left and right gearbox brackets (items 3 and 9 in Figure 227) to the deck mounting plate, and remove the brackets from the deck.
- 9. Remove the gearbox assembly (with the drive pulley attached) from the deck. Drain the lubricant from the gearbox.
- 10. Remove the 2 set screws that attach the taper lock bushing to the drive pulley on the gearbox shaft.
- 11. Install 1 of the removed set screws into the threaded hole of the bushing. Tighten the set screw to loosen the bushing from the pulley hub (Figure 228).
- 12. Slide the bushing and pulley from the gearbox shaft.
- 13. Locate and retrieve the woodruff key.
- 14. If necessary, remove and replace the oil seals and oil caps in the gearbox (Figure 229).

Note: If internal gearbox wear or damage occurs, gearbox replacement is necessary. The internal gearbox components are not available.

Installing the Gearbox

- 1. If oil seals or oil caps were removed from the gearbox, install new seals and caps to the gearbox.
- 2. Clean the gearbox output shaft, pulley ID (inner diameter), and taper lock bushing.
- 3. Position the woodruff key, pulley, and then the taper lock bushing to the gearbox output shaft. Slide the bushing to the shoulder on the shaft. Align the threaded holes of the pulley with the non-threaded holes of the bushing.



- 4. Apply oil to the threads of the set screws and install the screws into the threads of the pulley (Figure 228). Alternately and evenly torque the set screws to **20 to 28 N·m (180 to 250 in-lb)**.
- 5. Fill the allen recess in the set screws and bushing threads with grease to prevent dirt from packing into the crevices.
- 6. Position the gearbox assembly (with the drive pulley attached) to the deck.
- 7. Position and attach the left and right gearbox brackets (items 3 and 9 in Figure 227) to the deck mounting plate with the 3 carriage screws, 3 flange nuts, 3 washers, and 3 mounts.
- 8. Secure the gearbox assembly to the gearbox brackets with the 4 bolts (item 10 in Figure 227) and 4 lock washers.
- 9. Connect the PTO driveshaft to the gearbox; refer to Installing the PTO Driveshaft (page 6–26).
- 10. Install the drive belt and deck covers to the cutting deck.



- 11. Torque the plug in the gearbox to **19.8 N⋅m (175 in-lb)**. Fill the gearbox with approximately 355 ml (12 fl oz) of SAE 80W90 gear lubricant.
- 12. Lower the footrest.

Cutting Deck Pull Links



Disassembling the Cutting Deck Pull Links

1. Remove the cutting deck from the machine; refer to the *Cutting Deck Operator's Manual*.



The pull link torsion springs can cause some rotation of the pull links during the removal process, causing personal injury.

Be careful when removing the pull links from the cutting deck.

Disassembling the Cutting Deck Pull Links (continued)



Figure 231

4.

5.

Clevis yoke

Retainer pin

- 1. Pull link (raised)
- 2. Bolt

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- 3. Torsion spring end
- 2. Remove the clevis yoke from the deck so that the retainer pin (item 5 in Figure 231) can be accessed.
 - A. Remove the flange nut (item 12 in Figure 230) that secures the clevis yoke to the deck.
 - B. Remove the clevis yoke from the deck.
- 3. Remove the bolt and locknut that secure the retainer pin (item 15 in Figure 230) to the deck.
- 4. Slide the retainer pin (item 15 in Figure 230) from the deck and pull link.
- 5. Remove the pull link with the torsion spring (item 17 in Figure 230) and plain spacer from the deck.
- 6. Inspect all the bushings (items 4 and 18 in Figure 230) in the pull link.

Note: Replace the bushings if they are worn or damaged.

Assembling the Cutting Deck Pull Links

Note: For 62 inch cutting decks, the torsion spring (item 17 in Figure 230) is painted red. The torsion spring on 72 inch decks is painted black.

- 1. Place the plain spacer (item 5 in Figure 230) inside the torsion spring and then fit the spring and spacer into the pull link. Ensure that the torsion spring end is below the bolt in the pull link.
- 2. Position the pull link to the cutting deck.
- 3. Slide the retainer pin (item 15 in Figure 230) through the cutting deck, pull link, and spacer.
- 4. Ensure that the torsion spring end is below the bolt. Secure the retainer pin to the deck with the bolt and locknut.
- 5. Secure the clevis yoke to the deck with the flange nut.
- 6. Install the cutting deck to the machine; refer to the *Cutting Deck Operator's Manual*.
- 7. Lubricate the pull link grease fittings.
- 8. Check the cutting deck mismatch and pitch. Adjust the cutting deck if necessary.




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Electrical Drawing Designations

Note: A splice used in a wire harness will be identified on the wire harness diagram by SP. The manufacturing number of the splice is also identified on the wire harness diagram (e.g., SP01 is splice number 1).

Wire Color

The following abbreviations are used for wire harness colors on the electrical schematics and wire harness drawings in this chapter.

| ABBREVIATION | COLOR | |
|--------------|--------|--|
| ВК | BLACK | |
| BR or BN | BROWN | |
| BU | BLUE | |
| GN | GREEN | |
| GY | GRAY | |
| OR | ORANGE | |
| РК | PINK | |
| R or RD | RED | |
| Т | TAN | |
| VIO | VIOLET | |
| W or WH | WHITE | |
| Y or YE | YELLOW | |

Numerous harness wires used on the Toro machines include a line with an alternate color. These wires are identified with the wire color and line color with either a / or _ separating the color abbreviations listed above (e.g., R/BK is a red wire with a black line, OR_BK is an orange wire with a black line).

Wire Size

The individual wires of the electrical harness diagrams in this chapter identify both the wire color and the wire size.

Examples:

- 16 BK = 16 AWG (American Wire Gauge) wire that has a black insulator
- 050 R = 0.5 mm metric wire that has a red insulator (AWG equivalents for metric wire appear in the following table)

| AWG Equivalents for Metric Wire | | | |
|---------------------------------|-------------|----------------|--|
| Diagram Label | Metric Size | AWG Equivalent | |
| 050 | 0.5 mm | 20 GA | |
| 175 | 0.75 mm | 18 GA | |
| 100 | 1.0 mm | 16 GA | |
| 150 | 1.5 mm | 14 GA | |

Hydraulic Schematic





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Electrical Schematic - Platform (For machine serial number above 403430001)



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Electrical Schematic - Engine







Electrical Schematic - Cab (1 of 2)

Electrical Schematic - Cab (2 of 2)





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Wire Harness Drawing - Platform (2 of 2) (For machine serial number below 403430000)



Wire Harness Drawing - Platform (1 of 2) (For machine serial number above 403430001)



Wire Harness Drawing - Platform (2 of 2) (For machine serial number above 403430001)



Wire Harness Drawing - Engine (1 of 2)

Wire Harness Drawing - Engine (2 of 2)





Wire Harness Drawing - Cab Power

Wire Harness Drawing - Cab Headliner





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Wire Harness Diagram - Cab Headliner

Wire Harness Drawing - Cab Power Point Kit



Wire Harness Drawing - Auxiliary Power Model 30382



Wire Harness Drawing - Light Kit Model 30374





Count on it.