## Revision History

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10/2018</td>
<td>Initial Release</td>
</tr>
<tr>
<td>B</td>
<td>11/2018</td>
<td>Parker hydraulic valve service information</td>
</tr>
<tr>
<td>C</td>
<td>9/2020</td>
<td>TEC connector torque, 3–point hitch position sensor alignment procedure</td>
</tr>
</tbody>
</table>
Reader Comments

The Toro Company Technical Assistance Center maintains a continuous effort to improve the quality and usefulness of its publications. To do this effectively, we encourage user feedback. Please comment on the completeness, accuracy, organization, usability, and readability of this manual by an e-mail to servicemanuals@toro.com

or Mail to:

Technical Publication Manager, Commercial
The Toro Company
8111 Lyndale Avenue South
Bloomington, MN 55420-1196
Phone: +1 952-887-8495
The purpose of this publication is to provide the service technician with information for troubleshooting, testing, and repairing the major systems and components of the Outcross 9060 traction unit (Model No. 07511AA, 07511BA, 07511CA, and 07511DA).


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

---

**DANGER**

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.

---

**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 provide additional information about the correct operation, maintenance, service, testing, or repair of the machine.
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 Standard Torque for Dry, Zinc Plated, and Steel Fasteners (Inch Series) (page 2–9) or Standard Torque for Dry, Zinc Plated, and Steel Fasteners (Metric Fasteners) (page 2–10).

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 or accessory Installation Instructions.

Note: Refer to the service decals on the machine and the machine Operator’s Manual and accessory Installation Instructions 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
Danfoss H1 Closed Circuit Axial Piston Pumps Service Manual
Danfoss H1 Closed Circuit Axial Piston Pumps Repair Instructions
Danfoss K and L Frame Variable Motors Service Manual
Danfoss Steering Unit Type OSPB, OSPC and OSPF Service Manual
Gresen/Parker Hydraulics Model V10 Sectional Body Directional Control Valve Service Manual
Carraro DriveTech Model 26.09M Axle Repair Manual
Sanden SD Compressor Service Guide
Chapter 1

Safety

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The Outcross 9060 machine is tested and certified by Toro for compliance with existing safety standards and specifications. Although hazard control and accident prevention are partially dependent upon the design and configuration of the machine, hazard control and accident prevention are also dependent upon the awareness, concern and proper training of the personnel involved in the operation, transport, maintenance and storage of the machine. Improper use or maintenance of the machine can result in injury or death. To reduce the potential for injury or death, comply with the following safety instructions.

**WARNING**

To reduce the potential of injury or death, comply with the following safety instructions as well as information found in the traction unit *Operator’s Manual*, accessory *Installation Instructions*, and the *Operator and Safety Training Videos* found on [www.toro.com](http://www.toro.com).

**Supervisor’s Responsibilities**

1. Ensure that the machine operators are fully trained and familiar with the traction unit *Operator’s Manual*, all of the operating and safety decals on the machine, and any operation information found in the *Installation Instructions* for accessories that are installed 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 work 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.
Before Operating the Machine

- Review and understand the contents of the traction unit *Operator’s Manual*, all of the operating and safety decals on the machine, and any operation information found in the *Installation Instructions* for accessories that are installed on the machine. Additional copies of the traction unit *Operator’s Manual* and accessory *Installation Instructions* are available at [www.toro.com](http://www.toro.com).

- View and understand the *Operator and Safety Training Videos* found at [www.toro.com](http://www.toro.com).

- Never allow children to operate the machine. Never allow adults to operate the machine without proper instructions.

- Become familiar with the controls and know how to stop the machine and engine quickly.

- 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.

- Always wear substantial shoes. Do not operate machine while wearing sandals, tennis shoes or sneakers. Do not wear loose fitting clothing which could get caught in moving parts and cause personal injury.

- Wearing safety glasses, safety shoes, long pants and a helmet is advisable and required by some local safety and insurance regulations.

- Make sure work area is clear of objects which might be picked up and thrown by the attachments.

- Keep everyone, especially children and pets, away from the area of operation.

- Ensure the safety interlocks are functioning properly. Adjust or replace any malfunctioning switches or interlock mechanisms before operating the machine. Refer to Checking the Operation of the Interlock Switches (page 6–13) for additional information.

- 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.
  - 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.
The exhaust fumes are hazardous and have the potential of causing injury or death.
Do not run the engine in a confined area without adequate ventilation.

Note: Operator advisories are automatically displayed by the InfoCenter when a machine function is prevented and additional action is required. Typically, an advisory can be eliminated with a change in machine controls by the operator. Refer to Operator Advisories (page 3–3) for additional information.

1. Sit on the operator seat when starting the machine.
2. To start the engine:
   A. Disengage the PTO (switch in down position)
   B. Move the transmission shift lever to the NEUTRAL position.
   C. Ensure that the auxiliary hydraulic lever is in the center position.
   D. Set the ignition key to the RUN position.
   E. Engage the parking brake (switch illuminated).
   F. Keep your foot off the accelerator pedal.
   G. Turn the ignition key to the START position and hold until the engine starts (no longer than 20 seconds).
3. Using the machine demands operator attention. To prevent loss of machine control:
   A. Operate machine attachments only in daylight or when there is good artificial light.
   B. Watch for holes or other hidden hazards.
   C. Do not drive close to sand traps, ditches, creeks or other hazards.
   D. Traverse slopes carefully. Do not start or stop suddenly when traveling uphill or downhill.
   E. Reduce speed when making sharp turns. Avoid sudden stops and starts.
   F. Before backing up, look to the rear to be sure no one is behind the machine.
   G. Watch out for traffic when near or crossing roads. Always yield the right-of-way.
   H. Depress the decelerator pedal when going downhill to keep forward speed slow and to maintain control of the machine.
4. Keep hands, feet and clothing away from moving parts and the discharge area of an attachment.
5. Raise the attachments when driving from one work area to another.
6. Do not touch the engine, muffler or exhaust pipe while the engine is running or soon after it is stopped because these areas could be hot enough to cause burns.
7. If an attachment strikes a solid object or vibrates abnormally, stop immediately, turn the engine off, wait for all motion to stop and inspect for damage. A damaged attachment must be repaired or replaced before operation is continued.
8. DON’T TAKE AN INJURY RISK! When a person or pet appears unexpectedly in or near the area while operating an attachment, STOP.
Operating the Machine (continued)

Careless operation, combined with terrain angles, ricochets or improperly positioned guards can lead to thrown object injuries. Do not resume operation until the area is cleared.

9. Before getting off the seat:
   A. Make sure any attachments are disengaged.

   IMPORTANT

   When an attachment is lowered to the ground, the pressure in the hydraulic lift circuit is released and accidentally lowering the attachment is avoided.

   B. Lower any attachments to the ground.
   C. Set the parking brake if the engine will be left running, or, stop the engine and remove the key from key switch.

10. When using the optional InchMode feature:
    A. Keep bystanders away from the machine.
    B. Use the InchMode feature only on a level surface.
    C. While moving the machine, do not stand in front of or behind the machine.
Maintenance and Service

The maintenance procedures and recommended service intervals for your machine are covered in the traction unit Operator’s Manual and accessory Installation Instructions. Refer to this publication when performing regular equipment maintenance. Several maintenance procedures have break-in intervals identified in the traction unit Operator’s Manual and accessory Installation Instructions. Refer to the Engine Operator’s Manual for additional engine specific maintenance procedures.

• Before servicing or making any adjustments to the machine, lower any attachments, 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.
• 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.
• Use eye protection when working on the hydraulic system and its components.
• 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.
• 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.
• Check all fuel lines for tightness and wear on a regular basis. Tighten or repair fuel lines as needed.
• 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 any attachments and other moving parts. Keep bystanders away.
• Shut off the engine before checking or adding oil to the engine crankcase.
• Disconnect the battery 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.
• If it is necessary to lift the machine to perform a service procedure; refer to Jacking Instructions (page 1–8).
• Before performing any welding on the machine, turn the key switch to the OFF position. To prevent damage to the machine electrical system, disconnect the ground (-) cable to the frame when welding on the frame, or disconnect the ground (-) cable to the operator platform when welding on the operator platform.
• If major repairs are necessary, contact your Authorized Toro Distributor.
Maintenance and Service (continued)

- Ensure to dispose of potentially harmful waste (e.g., fuel, oil, engine coolant, filters, battery) in an environmentally safe manner. Follow all local codes and regulations when recycling or disposing of waste.

- At the time of manufacture, the machine conformed to Machinery Directive 2006/42/EC, Electromagnetic Compatibility (EMC) Directive 2014/30/EU, and ISO standards for power, mass, vibration, and sound. 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.
Jacking Instructions

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.

Approximate weights:
- Base model = 2,340 kg (5,160 lbs)
- Cab model = 2,640 kg (5,820 lbs)

When changing the attachments, tires, or performing other service:
- Before you lift the machine, remove all the attachments that may interfere with the safe and correct lift of the machine. Remove the front loader attachment and counterweight if equipped.
- Park the machine on a solid level surface, such as a concrete floor.
- Always block the wheels with chocks.
- Use the correct blocks, hoists, and jacks to lift the machine.
- Use the appropriate jack stands to support the raised machine.
- Do Not use an attachment as a jacking point.

Raising the Front of the Machine

1. Front jack point (frame channel behind side plate)
2. Front jack stand point (frame channel behind side plate)

1. Block the 2 rear wheels with chocks to prevent the machine from moving.
2. Position the jack securely under the desired front jacking point.
3. After raising the front of the machine, use an appropriate jack stand under the vehicle frame to support the machine.
Raising the Rear of the Machine

1. Block the 2 front wheels with chocks to prevent the machine from moving.
2. Position the jack securely under the desired rear jacking point.
3. After raising the rear of the machine, use an appropriate jack stand under the vehicle frame to support the machine.

Safety and Instructional Decals

Numerous safety and instruction decals are affixed to the traction unit and attachments of your Outcross 9060 machine. If any decal becomes illegible or damaged, install a new decal. Decal part numbers are listed in the Parts Catalog, traction unit Operator’s Manual, and accessory Installation Instructions. Order replacement decals from an Authorized Toro Distributor.
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Specifications

Overall Dimensions

Figure 3
Outcross 9060
### Traction Unit

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Weight</td>
<td></td>
</tr>
<tr>
<td>Model 07511AA (base model)</td>
<td>2,340 kg (5,160 lb)</td>
</tr>
<tr>
<td>Model 07511BA (base model with front loader*)</td>
<td>2,680 kg (5,910 lb)</td>
</tr>
<tr>
<td>Model 07511CA (cab model)</td>
<td>2,640 kg (5,820 lb)</td>
</tr>
<tr>
<td>Model 07511DA (cab model with front loader*)</td>
<td>2,980 kg (6,570 lb)</td>
</tr>
</tbody>
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*Front loader attachment (bucket) and rear counterweight not included

### Engine

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Make/Designation</td>
<td>Yanmar 4TNV86CT-DTR2: 4-Cycle, 4 Cylinder, Water Cooled, Turbocharged, EPA Tier 4 compliant Diesel</td>
</tr>
<tr>
<td>Bore</td>
<td>86 mm (3.38 inches)</td>
</tr>
<tr>
<td>Stroke</td>
<td>90 mm (3.54 inches)</td>
</tr>
<tr>
<td>Total displacement</td>
<td>2,090 cm³ (127.5 in³)</td>
</tr>
<tr>
<td>Firing order</td>
<td>1 (closest to the flywheel end) - 3 - 4 (farthest from flywheel) - 2</td>
</tr>
<tr>
<td>Direction of rotation</td>
<td>Counterclockwise (viewed from the flywheel)</td>
</tr>
<tr>
<td>Fuel</td>
<td>Diesel or Biodiesel fuel (up to B20) with ultra-low sulfur content</td>
</tr>
<tr>
<td>Fuel tank capacity</td>
<td>53.4 L (14.1 US gallons)</td>
</tr>
<tr>
<td>Fuel pump</td>
<td>Yanmar electric supply pump</td>
</tr>
<tr>
<td>Fuel injection type</td>
<td>Common rail system (EPA Tier 4 certified)</td>
</tr>
<tr>
<td>Governor</td>
<td>Electronic All Speed</td>
</tr>
<tr>
<td>Low idle (no load)</td>
<td>1,200 +/- 100 rpm</td>
</tr>
<tr>
<td>ECO mode (no load)</td>
<td>2,300 +/- 100 rpm</td>
</tr>
<tr>
<td>High idle (no load)</td>
<td>3,000 +/- 100 rpm</td>
</tr>
<tr>
<td>Engine oil</td>
<td>API CJ-4, ACEA E-6, JASO DH-2</td>
</tr>
<tr>
<td>Engine-oil viscosity</td>
<td>Refer to the Operator’s Manual</td>
</tr>
<tr>
<td>Crankcase-oil capacity</td>
<td>5.7 L (6 US qt)</td>
</tr>
<tr>
<td>Oil pump</td>
<td>Yanmar trochoid pump</td>
</tr>
<tr>
<td>Coolant capacity</td>
<td>Refer to the Operator’s Manual</td>
</tr>
<tr>
<td></td>
<td>without Operator cab 7.6 L (8 US qt)</td>
</tr>
<tr>
<td></td>
<td>with Operator cab 8.5 L (9 US qt)</td>
</tr>
<tr>
<td>Alternator/Regulator</td>
<td>12 VDC, 55 A</td>
</tr>
<tr>
<td>Engine weight (dry)</td>
<td>225 kg (496 lb)</td>
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Hydraulic System

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
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<tbody>
<tr>
<td>Piston (traction) pump (P1) and (P2)</td>
<td>Danfoss tandem variable displacement axial piston pump</td>
</tr>
<tr>
<td>Maximum pump displacement (per pump)</td>
<td>37.8 cc (2.31 in³/rev) per revolution</td>
</tr>
<tr>
<td>Gear pump</td>
<td>Casappa 2 section, positive displacement gear type pump</td>
</tr>
<tr>
<td>Front section (P3) displacement</td>
<td>16.9 cc (1.03 in³) per revolution</td>
</tr>
<tr>
<td>Rear Section (P4) displacement</td>
<td>11 cc (0.67 in³) per revolution</td>
</tr>
<tr>
<td>Drive axle motors</td>
<td>Danfoss positive displacement, 2 position, axial piston motor with loop flushing valve</td>
</tr>
<tr>
<td>Displacement (per revolution)</td>
<td>38 cc (2.32 in³) maximum / 18.5 cc (1.13 in³) minimum</td>
</tr>
<tr>
<td>Steering valve</td>
<td>Danfoss Steering Unit Type OSPC load sensing distributor valve with rotary meter</td>
</tr>
<tr>
<td>Relief Pressures</td>
<td></td>
</tr>
<tr>
<td>Traction circuit</td>
<td>Forward = 33,095 kPa (4,800 psi)</td>
</tr>
<tr>
<td></td>
<td>Reverse = 33,095 kPa (4,800 psi)</td>
</tr>
<tr>
<td>Charge circuit</td>
<td>1,999 kPa (290 psi)</td>
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<tr>
<td>Steering (RV1)</td>
<td>20,684 kPa (3,000 psi)</td>
</tr>
<tr>
<td>Hitch lift (RV2)</td>
<td>20,684 kPa (3,000 psi)</td>
</tr>
<tr>
<td>Auxiliary load valve</td>
<td>20,684 kPa (3,000 psi)</td>
</tr>
<tr>
<td>Hydraulic filter</td>
<td>Spin-on cartridge type</td>
</tr>
<tr>
<td>Hydraulic fluid</td>
<td>Refer to the traction unit Operator's Manual</td>
</tr>
<tr>
<td>Hydraulic tank capacity</td>
<td>48 L (12.75 gallons)</td>
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Specifications and Maintenance: Specifications

Outcross 9060
18234SL Rev C

Traction and PTO Drive

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Tires</td>
<td></td>
</tr>
<tr>
<td>Front</td>
<td>Turf Tread 29 x 12.5–15, 6 ply @ 151 to 165 kPa (22 to 24 psi)</td>
</tr>
<tr>
<td></td>
<td>Turf Tread 29 x 12.5–15, 12 ply @ 413 to 448 kPa (60 to 65 psi)</td>
</tr>
<tr>
<td>Rear</td>
<td>Turf Tread 32 x 16–15, 6 ply @ 151 to 165 kPa (22 to 24 psi)</td>
</tr>
<tr>
<td>Wheel lug nut torque</td>
<td>380 to 434 N·m (280 to 320 ft-lb)</td>
</tr>
<tr>
<td>Drive axle fluid capacity</td>
<td></td>
</tr>
<tr>
<td>Wheel hub</td>
<td>0.4 L (0.4 US qt) Mobil 424® multipurpose tractor lubricant</td>
</tr>
<tr>
<td>Axle</td>
<td>9 L (9.5 US qt) Mobil 424® multipurpose tractor lubricant</td>
</tr>
<tr>
<td>Rear PTO gear box fluid capacity</td>
<td>1.4 L (1.5 US qt) Mobil 424® multipurpose tractor lubricant or equivalent</td>
</tr>
<tr>
<td>Brake Assembly fluid capacity</td>
<td>160 ml (5.4 ounces) Mobil 424® multipurpose tractor lubricant</td>
</tr>
</tbody>
</table>
## Chassis

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bed capacity/volume</td>
<td></td>
</tr>
<tr>
<td>Standard bed</td>
<td>453 kg (1,000 lb), 0.6 cubic meters (0.8 cubic yards)</td>
</tr>
<tr>
<td>Cargo bed (optional)</td>
<td>2,041 kg (4,500 lb), 1 cubic meters (1.3 cubic yards)</td>
</tr>
</tbody>
</table>
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 lubricated fasteners or fasteners with a wet thread locking compound applied 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.
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 4) to determine proper tightening torque. When using a torque 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)**.
Identifying the Fastener

**Figure 5**
Metric Bolts and Screws

1. Class 8.8  
2. Class 10.9

**Figure 6**
Inch Series Bolts and Screws

1. Grade 1  
2. Grade 5  
3. Grade 8

Fasteners with a Locking Feature

**IMPORTANT**

If a fastener with a locking feature or previously applied thread locking compound is reused, clean the fastener threads and apply new thread locker to the fastener during installation.

Locking features are designed to create friction and prevent a fastener from loosening. Locking features can be found on externally or internally threaded fasteners. Common examples are plastic inserts incorporated into the fastener and pre-applied “dry” thread locking compound. Keep in mind, a fastener with a locking feature usually means there will be friction during initial installation and during removal.

Toro recommends replacing fasteners with a locking feature once they have been removed because the effectiveness of the locking feature diminishes with each reuse. If it is necessary to reuse a fastener with a locking feature; apply a thread locking compound (Loctite for example) to the fastener during installation. Use the appropriate strength and type of thread locking compound based on application, fastener size or information found in the product *Operators Manual, Service Manual* or *Installation Instructions*. 

Specifications and Maintenance: Torque Specifications  
Outcross 9060  
18234SL Rev C
### Standard Torque for Dry, Zinc Plated, and Steel Fasteners (Inch Series)

<table>
<thead>
<tr>
<th>Thread Size</th>
<th>Grade 1, 5 and 8 with Thin Height Nuts</th>
<th>SAE Grade 1 Bolts, Screws, Studs, and Sems with Regular Height Nuts(SAE J995 Grade 2 or Stronger Nuts)</th>
<th>SAE Grade 5 Bolts, Screws, Studs, and Sems with Regular Height Nuts(SAE J995 Grade 2 or Stronger Nuts)</th>
<th>SAE Grade 8 Bolts, Screws, Studs, and Sems with Regular Height Nuts(SAE J995 Grade 2 or Stronger Nuts)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in-lb</td>
<td>in-lb</td>
<td>N-cm</td>
<td>in-lb</td>
</tr>
<tr>
<td>#6 - 32 UNC</td>
<td>10 ± 2</td>
<td>13 ± 2</td>
<td>147 ± 23</td>
<td>15 ± 2</td>
</tr>
<tr>
<td>#6 - 40 UNF</td>
<td>17 ± 2</td>
<td>192 ± 23</td>
<td>25 ± 3</td>
<td>282 ± 34</td>
</tr>
<tr>
<td>8 - 32 UNC</td>
<td>13 ± 2</td>
<td>25 ± 5</td>
<td>282 ± 56</td>
<td>29 ± 3</td>
</tr>
<tr>
<td>8 - 36 UNF</td>
<td>25 ± 1 ± 4</td>
<td>350 ± 45</td>
<td>43 ± 5</td>
<td>486 ± 56</td>
</tr>
<tr>
<td>#10 - 24 UNC</td>
<td>18 ± 2</td>
<td>30 ± 5</td>
<td>339 ± 56</td>
<td>42 ± 5</td>
</tr>
<tr>
<td>1/4 - 20 UNC</td>
<td>48 ± 5</td>
<td>542 ± 56</td>
<td>68 ± 7</td>
<td>768 ± 79</td>
</tr>
<tr>
<td>1/4 - 28 UNF</td>
<td>53 ± 7</td>
<td>65 ± 10</td>
<td>734 ± 113</td>
<td>115 ± 12</td>
</tr>
<tr>
<td>5/16 - 18 UNC</td>
<td>115 ± 15</td>
<td>105 ± 15</td>
<td>1186 ± 169</td>
<td>200 ± 25</td>
</tr>
<tr>
<td>5/16 - 24 UNC</td>
<td>138 ± 17</td>
<td>128 ± 17</td>
<td>1146 ± 192</td>
<td>225 ± 25</td>
</tr>
<tr>
<td>3/8 - 16 UNC</td>
<td>16 ± 2</td>
<td>16 ± 2</td>
<td>22 ± 3</td>
<td>30 ± 3</td>
</tr>
<tr>
<td>3/8 - 24 UNF</td>
<td>17 ± 2</td>
<td>18 ± 2</td>
<td>24 ± 3</td>
<td>35 ± 4</td>
</tr>
<tr>
<td>7/16 - 14 UNC</td>
<td>27 ± 3</td>
<td>27 ± 3</td>
<td>37 ± 4</td>
<td>50 ± 5</td>
</tr>
<tr>
<td>7/16 - 20 UNF</td>
<td>29 ± 3</td>
<td>29 ± 3</td>
<td>39 ± 4</td>
<td>55 ± 6</td>
</tr>
<tr>
<td>1/2 - 13 UNC</td>
<td>30 ± 3</td>
<td>48 ± 7</td>
<td>65 ± 9</td>
<td>75 ± 8</td>
</tr>
<tr>
<td>1/2 - 20 UNF</td>
<td>32 ± 4</td>
<td>53 ± 7</td>
<td>72 ± 9</td>
<td>85 ± 9</td>
</tr>
<tr>
<td>5/8 - 11 UNC</td>
<td>65 ± 10</td>
<td>88 ± 12</td>
<td>119 ± 16</td>
<td>150 ± 15</td>
</tr>
<tr>
<td>5/8 - 18 UNF</td>
<td>75 ± 10</td>
<td>95 ± 15</td>
<td>129 ± 20</td>
<td>170 ± 18</td>
</tr>
<tr>
<td>3/4 - 10 UNC</td>
<td>93 ± 12</td>
<td>140 ± 20</td>
<td>190 ± 27</td>
<td>265 ± 27</td>
</tr>
<tr>
<td>3/4 - 16 UNF</td>
<td>115 ± 15</td>
<td>165 ± 25</td>
<td>224 ± 34</td>
<td>300 ± 30</td>
</tr>
<tr>
<td>7/8 - 9 UNC</td>
<td>140 ± 20</td>
<td>225 ± 25</td>
<td>305 ± 34</td>
<td>430 ± 45</td>
</tr>
<tr>
<td>7/8 - 14 UNC</td>
<td>155 ± 25</td>
<td>260 ± 30</td>
<td>353 ± 41</td>
<td>475 ± 48</td>
</tr>
</tbody>
</table>

**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.

**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 ±10% of the nominal torque value. The thin height nuts include jam nuts.
Standard Torque for Dry, Zinc Plated, and Steel Fasteners (Metric Fasteners)

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

**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.

**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 ± 10% of the nominal torque value.
# Other Torque Specifications

## SAE Grade 8 Steel Set Screws

<table>
<thead>
<tr>
<th>Thread Size</th>
<th>Recommended Torque (Square Head)</th>
<th>Recommended Torque (Hex Socket)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4 - 20 UNC</td>
<td>140 ± 20 in-lb</td>
<td>73 ± 12 in-lb</td>
</tr>
<tr>
<td>5/16 - 18 UNC</td>
<td>215 ± 35 in-lb</td>
<td>145 ± 20 in-lb</td>
</tr>
<tr>
<td>3/8 - 16 UNC</td>
<td>35 ± 10 ft-lb</td>
<td>18 ± 3 ft-lb</td>
</tr>
<tr>
<td>1/2 - 13 UNC</td>
<td>75 ± 15 ft-lb</td>
<td>50 ± 10 ft-lb</td>
</tr>
</tbody>
</table>

## Thread Cutting Screws (Zinc Plated Steel)

### Type 1, Type 23 or Type F

<table>
<thead>
<tr>
<th>Thread Size</th>
<th>Baseline Torque**</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 6 - 32 UNC</td>
<td>20 ± 5 in-lb</td>
</tr>
<tr>
<td>No. 8 - 32 UNC</td>
<td>30 ± 5 in-lb</td>
</tr>
<tr>
<td>No. 10 - 24 UNC</td>
<td>38 ± 7 in-lb</td>
</tr>
<tr>
<td>1/4 - 20 UNC</td>
<td>85 ± 15 in-lb</td>
</tr>
<tr>
<td>5/16 - 18 UNC</td>
<td>110 ± 20 in-lb</td>
</tr>
<tr>
<td>3/8 - 16 UNC</td>
<td>200 ± 100 in-lb</td>
</tr>
</tbody>
</table>

## Wheel Bolts and Lug Nuts

<table>
<thead>
<tr>
<th>Thread Size</th>
<th>Recommended Torque*</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/16 - 20 UNF Grade 5</td>
<td>65 ± 10 ft-lb</td>
</tr>
<tr>
<td>1/2 - 20 UNF Grade 5</td>
<td>80 ± 10 ft-lb</td>
</tr>
<tr>
<td>M12 X 1.25 Class 8.8</td>
<td>80 ± 10 ft-lb</td>
</tr>
<tr>
<td>M12 X 1.5 Class 8.8</td>
<td>80 ± 10 ft-lb</td>
</tr>
<tr>
<td></td>
<td>88 ± 14 N·m</td>
</tr>
<tr>
<td></td>
<td>108 ± 14 N·m</td>
</tr>
<tr>
<td></td>
<td>108 ± 14 N·m</td>
</tr>
</tbody>
</table>

*For steel wheels and non-lubricated fasteners

## Thread Cutting Screws (Zinc Plated Steel)

<table>
<thead>
<tr>
<th>Thread Size</th>
<th>Threads per Inch</th>
<th>Baseline Torque**</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 6</td>
<td>18 Type A, 20 Type B</td>
<td>20 ± 5 in-lb</td>
</tr>
<tr>
<td>No. 8</td>
<td>15 Type A, 18 Type B</td>
<td>30 ± 5 in-lb</td>
</tr>
<tr>
<td>No. 10</td>
<td>12 Type A, 16 Type B</td>
<td>38 ± 7 in-lb</td>
</tr>
<tr>
<td>No. 12</td>
<td>11 Type A, 14 Type B</td>
<td>85 ± 15 in-lb</td>
</tr>
</tbody>
</table>

**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
- N·cm X 0.08851 = in-lb
- ft-lb X 1.3558 = N·m
- N·m X 0.7376 = ft-lb
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.**

### Shop Supplies

<table>
<thead>
<tr>
<th><strong>ANTI-SEIZE LUBRICANT</strong></th>
<th>![Image of Anti-Seize Lubricant]</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>GREASE</strong></th>
<th>![Image of Grease]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can be used to pre-fill (pack) bearings, boots and seals prior to 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.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>THREAD LOCKING COMPOUND (thread Locker)</strong></th>
<th>![Image of Thread Locker]</th>
</tr>
</thead>
<tbody>
<tr>
<td>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 prior to 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. <strong>Note:</strong> 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.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>RETAINING COMPOUND (bearings and sleeves)</strong></th>
<th>![Image of Retaining Compound]</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>ADHESIVE</strong></th>
<th>![Image of Adhesive]</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>THREAD SEALANT</strong></th>
<th>![Image of Thread Sealant]</th>
</tr>
</thead>
<tbody>
<tr>
<td>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 form 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 prior to use.</td>
<td></td>
</tr>
</tbody>
</table>
**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.

Hydraulic Hose Kit

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.

<table>
<thead>
<tr>
<th>FITTING TYPE</th>
<th>SIZE</th>
<th>PART NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWIVEL NUT RUN TEE (2 each)</td>
<td>4 ORFS (9/16–18)</td>
<td>TOR4079–3</td>
</tr>
<tr>
<td></td>
<td>6 ORFS (11/16–16)</td>
<td>TOR4079–12</td>
</tr>
<tr>
<td></td>
<td>8 ORFS (13–16–16)</td>
<td>TOR4079–4</td>
</tr>
<tr>
<td></td>
<td>10 ORFS (1–14)</td>
<td>TOR4079–5</td>
</tr>
<tr>
<td>PLUG (2 each)</td>
<td>4 ORFS (9/16–18)</td>
<td>TOR4079–13</td>
</tr>
<tr>
<td></td>
<td>6 ORFS (11/16–16)</td>
<td>TOR4079–14</td>
</tr>
<tr>
<td></td>
<td>8 ORFS (13–16–16)</td>
<td>TOR4079–15</td>
</tr>
<tr>
<td></td>
<td>10 ORFS (1–14)</td>
<td>TOR4079–16</td>
</tr>
<tr>
<td>CAP (2 each)</td>
<td>4 ORFS (9/16–18)</td>
<td>TOR4079–17</td>
</tr>
<tr>
<td></td>
<td>6 ORFS (11/16–16)</td>
<td>TOR4079–18</td>
</tr>
<tr>
<td></td>
<td>8 ORFS (13–16–16)</td>
<td>TOR4079–19</td>
</tr>
<tr>
<td></td>
<td>10 ORFS (1–14)</td>
<td>TOR4079–20</td>
</tr>
<tr>
<td>UNION (1 each)</td>
<td>6 ORFS (11/16–16)</td>
<td>TOR4079–8</td>
</tr>
<tr>
<td></td>
<td>8 SAE-ORB (3/4–16)</td>
<td>TOR4079–9</td>
</tr>
<tr>
<td></td>
<td>8 ORFS (13–16–16)</td>
<td>TOR4079–2</td>
</tr>
<tr>
<td></td>
<td>10 ORFS (1–14)</td>
<td>TOR4079–2</td>
</tr>
<tr>
<td></td>
<td>8 SAE-ORB (3/4–16)</td>
<td>TOR4079–2</td>
</tr>
<tr>
<td>REDUCER (1 each)</td>
<td>10 ORFS (1–14)</td>
<td>TOR4079–7</td>
</tr>
<tr>
<td></td>
<td>8 SAE-ORB (3/4–16)</td>
<td>TOR4079–6</td>
</tr>
<tr>
<td></td>
<td>12 ORFS (1 3/16–12)</td>
<td>TOR4079–6</td>
</tr>
<tr>
<td></td>
<td>8 SAE-ORB (3/4–16)</td>
<td>TOR4079–6</td>
</tr>
<tr>
<td>TEST CONNECTOR – FEMALE THREAD (2 each)</td>
<td>4 ORFS (9/16–18)</td>
<td>TOR4079–10</td>
</tr>
<tr>
<td></td>
<td>6 ORFS (11/16–16)</td>
<td>TOR4079–11</td>
</tr>
<tr>
<td></td>
<td>8 ORFS (13/16–16)</td>
<td>TOR4079–21</td>
</tr>
<tr>
<td></td>
<td>10 ORFS (1–14)</td>
<td>TOR4079–1</td>
</tr>
<tr>
<td>TEST CONNECTOR – MALE THREAD (2 each)</td>
<td>4 SAE-ORB (7/16–20)</td>
<td>TOR4079–22</td>
</tr>
<tr>
<td></td>
<td>1/8 NPTF</td>
<td>TOR4079–23</td>
</tr>
</tbody>
</table>
High Flow Hydraulic Filter Kit

Toro Part Number: TOR6011

The high flow hydraulic filter kit is designed with large flow (150 LPM or 40 GPM) and high pressure (34,500 kPa or 5,000 psi) capabilities. This kit provides for bidirectional 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. Refer to Filtering the Closed-Loop Traction Circuit (page 5–54) for additional information.

Note: This kit does not include the hydraulic hoses; refer to Hydraulic Hose Kit (page 2–15).

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 starter 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; refer to Priming the Hydraulic Pumps (page 5–58).
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.

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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.

---

Dielectric Gel

**Toro Part No. 107-0342**

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.
Spring Compression Tool

Toro Part No. 138–3968

Use with a press to relieve PTO clutch piston spring load during PTO clutch service.
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The information in this chapter is intended to help troubleshoot machine operation issues. Keep in mind there can be more than one cause for a machine malfunction.
GEARS – The Systematic Approach to Defining, Diagnosing and Solving Problems

Gather Information

- Information reported by the customer
- Information observed by you
- Establish the what, where and when of the issue

Evaluate Potential Causes

- Consider possible causes of the problem to develop a hypothesis
- Narrow down the focus of the problem

Assess Performance

- Ensure you have all the necessary tools for testing
- Test all potential causes of the failure
- Reevaluate and create a new hypothesis if necessary

Repair

- Return the unit to service by repairing, rebuilding or replacing

Solution Confirmation

- Did the issue go away
- Was the root cause of the issue correctly repaired
- Are there any other new symptoms
Operator Advisories

Operator advisories are automatically displayed by the InfoCenter when a machine function is prevented and additional action is required. Typically, an advisory can be eliminated with a change in machine controls by the operator. For example; if the operator attempts to start the engine when the traction pedal is depressed, an advisory is identified on the InfoCenter Display that the traction pedal needs to be in neutral. An advisory will not be logged into any fault log. The following table lists each advisory in detail.

**Operator Advisories**

<table>
<thead>
<tr>
<th>Advisory Number</th>
<th>Advisory Name</th>
<th>Qualifiers</th>
<th>Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>B2003</td>
<td>START DENIED</td>
<td>Transmission not In Neutral</td>
<td>To start</td>
</tr>
<tr>
<td>B2004</td>
<td>START DENIED</td>
<td>PTO Switch Engaged</td>
<td>To start</td>
</tr>
<tr>
<td>B2005</td>
<td>START DENIED</td>
<td>Not In Seat AND Parking Brake not ON</td>
<td>To start</td>
</tr>
<tr>
<td>B2008</td>
<td>START DENIED</td>
<td>Traction Pedal Engaged</td>
<td>To start</td>
</tr>
<tr>
<td>B200A</td>
<td>START DENIED</td>
<td>Starter has been active for 30 seconds</td>
<td>30 second starter time out</td>
</tr>
<tr>
<td>B2013</td>
<td>START DENIED</td>
<td>Fault Active</td>
<td>To start</td>
</tr>
<tr>
<td>B2016</td>
<td>START DENIED</td>
<td>Auxiliary Hydraulic Switch Closed</td>
<td>To start</td>
</tr>
<tr>
<td>B2017</td>
<td>START DENIED</td>
<td>Three Point Raise or Lower Switch Closed</td>
<td>To start</td>
</tr>
<tr>
<td>B2018</td>
<td>START DENIED</td>
<td>Inch Mode Switches Closed</td>
<td>To start</td>
</tr>
<tr>
<td>B2026</td>
<td>ENGINE ADVISORY</td>
<td>Speed restricted: Hydraulic oil too cold</td>
<td>Engine RPM Restricted</td>
</tr>
<tr>
<td>B2027</td>
<td>ENGINE ADVISORY</td>
<td>Engine shutdown due to high temp</td>
<td>Engine</td>
</tr>
<tr>
<td>B2028</td>
<td>ENGINE ADVISORY</td>
<td>Engine derate due to high temp</td>
<td>Engine</td>
</tr>
<tr>
<td>B2155</td>
<td>TRACTION DISABLED</td>
<td>Parking brake ON</td>
<td>For traction</td>
</tr>
<tr>
<td>B2159</td>
<td>TRACTION DISABLED</td>
<td>Out of seat</td>
<td>For traction</td>
</tr>
<tr>
<td>B2176</td>
<td>GROUND SPEED LIMITED</td>
<td>Hydraulic oil Hot</td>
<td>Ground speed limited</td>
</tr>
<tr>
<td>B2177</td>
<td>GROUND SPEED LIMITED</td>
<td>Engine Hot</td>
<td>Ground speed limited</td>
</tr>
<tr>
<td>B2186</td>
<td>DIFFERENTIAL LOCK DENIED</td>
<td>Traction Engaged</td>
<td>To engage differential lock</td>
</tr>
<tr>
<td>B2484</td>
<td>MODE CHANGE DENIED</td>
<td>PTO Switch Engaged</td>
<td>For Mode change</td>
</tr>
<tr>
<td>Advisory Number</td>
<td>Advisory Name</td>
<td>Qualifiers</td>
<td>Instructions</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>B2486</td>
<td>MODE CHANGE DENIED</td>
<td>Traction Engaged</td>
<td>For Mode change</td>
</tr>
<tr>
<td>B2487</td>
<td>MODE CHANGE DENIED</td>
<td>Traction Pedal Engaged</td>
<td>For Mode change</td>
</tr>
<tr>
<td>B248A</td>
<td>MODE CHANGE DENIED</td>
<td>Auxiliary Hydraulic Switch Closed</td>
<td>For Mode change</td>
</tr>
<tr>
<td>B24B2</td>
<td>INCH MODE DENIED</td>
<td>Fault Active</td>
<td>For Inch mode</td>
</tr>
<tr>
<td>B24B3</td>
<td>INCH MODE DENIED</td>
<td>Not in Neutral</td>
<td>For Inch mode</td>
</tr>
<tr>
<td>B24B4</td>
<td>INCH MODE DENIED</td>
<td>PTO Switch Closed</td>
<td>For Inch mode</td>
</tr>
<tr>
<td>B24B5</td>
<td>INCH MODE DENIED</td>
<td>Parking Brake Engaged</td>
<td>For Inch mode</td>
</tr>
<tr>
<td>B24B7</td>
<td>INCH MODE DENIED</td>
<td>Traction Pedal Engaged</td>
<td>For Inch mode</td>
</tr>
<tr>
<td>B24BA</td>
<td>INCH MODE DENIED</td>
<td>Auxiliary Hydraulic Switch Closed</td>
<td>For Inch mode</td>
</tr>
<tr>
<td>B24BE</td>
<td>INCH MODE DENIED</td>
<td>Three Point Raise or Lower Switch Closed</td>
<td>For Inch mode</td>
</tr>
<tr>
<td>B24C4</td>
<td>ATTACHMENT CHANGE DENIED</td>
<td>PTO Switch Closed</td>
<td>For attachment change</td>
</tr>
<tr>
<td>B24CA</td>
<td>ATTACHMENT CHANGE DENIED</td>
<td>Auxiliary Hydraulic Switch Closed</td>
<td>For attachment change</td>
</tr>
<tr>
<td>B24DA</td>
<td>ATTACHMENT ADVISORY</td>
<td>Increase ground speed</td>
<td>Attachment</td>
</tr>
<tr>
<td>B24EA</td>
<td>ATTACHMENT MODE DENIED</td>
<td>Controller Mismatch</td>
<td>Attachment Mode Denied</td>
</tr>
<tr>
<td>B2503</td>
<td>PTO DENIED</td>
<td>Fault Active</td>
<td>To engage PTO</td>
</tr>
<tr>
<td>B2505</td>
<td>PTO DENIED</td>
<td>Not In Seat OR Parking Brake not ON</td>
<td>To engage PTO</td>
</tr>
<tr>
<td>B2506</td>
<td>PTO DENIED</td>
<td>Traction Disengaged</td>
<td>To engage PTO</td>
</tr>
<tr>
<td>B2507</td>
<td>PTO DENIED</td>
<td>Engine Hot</td>
<td>To engage PTO</td>
</tr>
<tr>
<td>B250C</td>
<td>PTO DENIED</td>
<td>Attachment Not Present</td>
<td>To engage PTO</td>
</tr>
<tr>
<td>B250E</td>
<td>PTO DENIED</td>
<td>Below Minimum Work Height</td>
<td>To engage PTO</td>
</tr>
<tr>
<td>B250F</td>
<td>PTO DENIED</td>
<td>Above Maximum Work Height</td>
<td>To engage PTO</td>
</tr>
<tr>
<td>B2523</td>
<td>AUXILIARY HYDRAULICS DENIED</td>
<td>Fault Active</td>
<td>For auxiliary hydraulics</td>
</tr>
<tr>
<td>B2525</td>
<td>AUXILIARY HYDRAULICS DENIED</td>
<td>Neither In Seat Nor Parking Brake Applied</td>
<td>For auxiliary hydraulics</td>
</tr>
<tr>
<td>Advisory Number</td>
<td>Advisory Name</td>
<td>Qualifiers</td>
<td>Instructions</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------------------</td>
<td>---------------------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>B2526</td>
<td>AUXILIARY HYDRAULICS DENIED</td>
<td>Traction Disengaged</td>
<td>For auxiliary hydraulics</td>
</tr>
<tr>
<td>B2527</td>
<td>AUXILIARY HYDRAULICS DENIED</td>
<td>Engine Hot</td>
<td>For auxiliary hydraulics</td>
</tr>
<tr>
<td>B252E</td>
<td>AUXILIARY HYDRAULICS DENIED</td>
<td>Below Minimum Work Height</td>
<td>For auxiliary hydraulics</td>
</tr>
<tr>
<td>B252F</td>
<td>AUXILIARY HYDRAULICS DENIED</td>
<td>Above Maximum Work Height</td>
<td>For auxiliary hydraulics</td>
</tr>
<tr>
<td>B262A</td>
<td>FUEL LEVEL</td>
<td>Fuel Level Low</td>
<td>Fuel level low</td>
</tr>
<tr>
<td>B2703</td>
<td>MACHINE UNATTENDED</td>
<td>Not in neutral &amp; Out of Seat</td>
<td>Operator must be seated OR Return transmission to Neutral</td>
</tr>
<tr>
<td>B2800</td>
<td>REGEN STATUS</td>
<td>Regeneration complete</td>
<td>Regeneration Complete</td>
</tr>
<tr>
<td>B2801</td>
<td>REGEN STATUS</td>
<td>Regen Inhibited</td>
<td>Regeneration Required</td>
</tr>
<tr>
<td>B2802</td>
<td>REGEN STATUS</td>
<td>Regeneration Required - Low EGT</td>
<td>Set engine to full throttle. Regeneration Required</td>
</tr>
<tr>
<td>B2804</td>
<td>REGEN STATUS</td>
<td>Parked Regeneration Required</td>
<td>Parked Regeneration Required</td>
</tr>
<tr>
<td>B2805</td>
<td>REGEN STATUS</td>
<td>Parked Regeneration Required - No PTO</td>
<td>Parked Regeneration Required</td>
</tr>
<tr>
<td>B2806</td>
<td>REGEN STATUS</td>
<td>Recovery Regeneration Required</td>
<td>Recovery Regeneration Required</td>
</tr>
<tr>
<td>B2807</td>
<td>REGEN STATUS</td>
<td>Recovery Regeneration Required - No PTO</td>
<td>Recovery Regeneration Required</td>
</tr>
<tr>
<td>B280A</td>
<td>REGEN STATUS</td>
<td>Regeneration failed</td>
<td>Regeneration Failed</td>
</tr>
<tr>
<td>B2810</td>
<td>REGEN DENIED</td>
<td>&lt;50Hrs since last Regeneration</td>
<td>Less than 50 hrs since last regeneration.</td>
</tr>
<tr>
<td>B2811</td>
<td>REGEN DENIED</td>
<td>Engine Rejected Request</td>
<td>Request rejected by Engine</td>
</tr>
<tr>
<td>B2812</td>
<td>REGEN DENIED</td>
<td>Active Fault</td>
<td>Diagnostic trouble code active</td>
</tr>
<tr>
<td>B2813</td>
<td>REGEN DENIED</td>
<td>Low Engine Temperature</td>
<td>Engine not warm enough</td>
</tr>
<tr>
<td>B2814</td>
<td>REGEN DENIED</td>
<td>Engine Off</td>
<td>Start Engine</td>
</tr>
<tr>
<td>B2815</td>
<td>REGEN DENIED</td>
<td>Not at low idle</td>
<td>Lower engine RPM</td>
</tr>
</tbody>
</table>

**Note:** If “Unknown Cause” appears as an advisory description, a controller software issue may exist. If you are unable to clear this type of advisory, contact your Authorized Toro Distributor.
Machine and Engine Faults

Machine faults are generated by the Toro Electronic Controller (TEC) to identify an electrical system malfunction (fault) that occurs during machine operation. Engine faults are generated by the Yanmar engine Electronic Control Unit (ECU) to identify an electrical system malfunction (fault) pertaining to the engine during operation. The fault IDs conform to SAE J2012 standards. When a fault occurs, an audible alarm will sound, a red warning light will illuminate, and a code for the active fault will appear along the bottom of the status display. If more than one fault is active, their codes will scroll across the bottom of the status display one-by-one. Depending on the severity of the fault, a STOP icon may also be displayed.

Recent faults can be viewed and cleared via the InfoCenter Service – Fault Viewer screen. A code appears after each fault indicating which controller generated the fault. For example: P0227:T1 is a traction pedal fault generated by the T1: TEC, and P1455:EN is a DPF pressure sensor fault generated by the Yanmar engine ECU. Refer to the Yanmar TNV (Tier 4) Series Troubleshooting Manual for engine fault information.

### Machine Faults

<table>
<thead>
<tr>
<th>Fault ID</th>
<th>Fault Title</th>
<th>Fault Description</th>
<th>Controller Action</th>
<th>Recommended Service Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>P0225</td>
<td>Traction Pedal Analog Sensor APS1 - Open Circuit</td>
<td>Traction pedal analog sensor APS1 is reading a voltage outside the range it was designed to operate, indicating an open circuit</td>
<td>Traction is disabled until ignition key is cycled</td>
<td>1. Use the InfoCenter to verify sensor movement (TRACTION INPUTS–TR. PEDAL SIGNAL 1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. If no voltage reading is displayed:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A. Check the traction pedal wiring and connector</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B. Test the sensor wiring</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3. Test the traction pedal assembly if possible and replace if necessary</td>
</tr>
<tr>
<td>P0227</td>
<td>Traction Pedal Analog Sensor APS1 - Short to Ground</td>
<td>Traction pedal analog sensor APS1 is reading a voltage outside the range it was designed to operate, indicating a short to ground.</td>
<td>Traction is disabled until ignition key is cycled</td>
<td>1. Use the InfoCenter to verify sensor movement (TRACTION INPUTS–TR. PEDAL SIGNAL 1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. If no voltage reading is displayed:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A. Check the traction pedal wiring and connector</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B. Test the sensor wiring</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3. Test the traction pedal assembly if possible and replace if necessary</td>
</tr>
<tr>
<td>P0460</td>
<td>Fuel level Sender - Open Circuit</td>
<td>Open circuit detected on fuel level sender</td>
<td></td>
<td>1. Check sender wiring and connector</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Test fuel sender and replace if necessary</td>
</tr>
<tr>
<td>P0461</td>
<td>Fuel level Sender - Short to Ground</td>
<td>Short to ground detected on fuel level sender</td>
<td></td>
<td>1. Check sender wiring and connector</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Test fuel sender and replace if necessary</td>
</tr>
<tr>
<td>P0575</td>
<td>Cruise Control Switch Correlation Fault</td>
<td>Cruise engage (SET) input is active but the cruise enable (ON) input is off.</td>
<td>Cruise is not enabled</td>
<td>1. Check switch wiring and connector</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Test the cruise control OFF/ON/SET switch and replace if necessary</td>
</tr>
</tbody>
</table>
## Machine Faults (continued)

<table>
<thead>
<tr>
<th>Fault ID</th>
<th>Fault Title</th>
<th>Fault Description</th>
<th>Controller Action</th>
<th>Recommended Service Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>P057C</td>
<td>Decelerator Pedal Position Sensor - Analog Short to Ground</td>
<td>Short to ground detected on decelerator pedal position sensor – analog</td>
<td>Traction is disabled until ignition key is cycled</td>
<td>1. Use the InfoCenter to verify sensor operation (TRACTION INPUTS–BRAKE PEDAL SIGNAL)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. If no voltage reading is displayed:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A. Check the decelerator pedal position sensor wiring and connector</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B. Test the sensor wiring</td>
</tr>
<tr>
<td>P057D</td>
<td>Decelerator Pedal Position Sensor - Analog Open Circuit</td>
<td>Open circuit detected on decelerator pedal position sensor – analog</td>
<td>Traction is disabled until ignition key is cycled</td>
<td>1. Use the InfoCenter to verify sensor operation (TRACTION INPUTS–BRAKE PEDAL SIGNAL)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. If no voltage reading is displayed:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A. Check the decelerator pedal position sensor wiring and connector</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>B. Test the sensor wiring</td>
</tr>
<tr>
<td>P05E0</td>
<td>Decelerator Pedal Position Sensor - Analog to Decelerator Pedal Neutral Switch – Digital Correlation Fault</td>
<td>The analog and digital inputs for the decelerator pedal do not match</td>
<td>Traction is disabled until ignition key is cycled</td>
<td>1. Make sure the decelerator pedal moves freely to its full rest (up) position</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>2. Use the InfoCenter to verify neutral switch operation (TRACTION INPUTS–BRAKE NEUTRAL ON)</td>
</tr>
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<td>3. Use the InfoCenter to verify position sensor operation (TRACTION INPUTS–BRAKE PEDAL SIGNAL)</td>
</tr>
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<td>4. If no voltage reading is displayed:</td>
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<td></td>
<td>A. Check the decelerator pedal position sensor wiring and connector</td>
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<td></td>
<td>B. Test the position sensor wiring</td>
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<td>7. Test the decelerator pedal neutral switch and replace if necessary</td>
</tr>
<tr>
<td>P0615</td>
<td>Start Output - Open Circuit</td>
<td>Open circuit detected on engine start output</td>
<td></td>
<td>1. Check the engine start output circuit wiring and all of the output circuit connectors</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>2. Test the engine start output circuit wiring between T1: TEC and Engine ECU</td>
</tr>
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<td>3. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>P0616</td>
<td>Start Output – Overcurrent</td>
<td>Overcurrent detected on engine start output. Indicates a short to ground</td>
<td></td>
<td>1. Check the engine start output circuit wiring and all of the output circuit connectors</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Test the engine start output circuit wiring between T1: TEC and Engine ECU</td>
</tr>
<tr>
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<td>3. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>Fault ID</td>
<td>Fault Title</td>
<td>Fault Description</td>
<td>Controller Action</td>
<td>Recommended Service Actions</td>
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</tr>
<tr>
<td>P0617</td>
<td>Engine Start Output - Short to Battery</td>
<td>Low current detected on engine start output. Indicates a short to battery</td>
<td>1. Check the engine start output circuit wiring and all of the output circuit connectors 2. Test the engine start output circuit wiring between T1: TEC and Engine ECU 3. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
<td></td>
</tr>
<tr>
<td>P06E9</td>
<td>Starter Time-out</td>
<td>Starter has been engaged continuously for more than 30 seconds</td>
<td>Starter output is disabled</td>
<td>1. Check key switch is not stuck in start position 2. Test key switch and replace if necessary 3. Test start relay and replace if necessary</td>
</tr>
<tr>
<td>P0939</td>
<td>Hydraulic Fluid Temperature Sender - Short to Ground</td>
<td>Short to ground detected on hydraulic temperature sender</td>
<td>1. Check temperature sender wiring and connector 2. Test temperature sender and replace if necessary</td>
<td></td>
</tr>
<tr>
<td>P0940</td>
<td>Hydraulic Fluid Temperature Sender - Open Circuit</td>
<td>Open circuit detected on hydraulic temperature sender</td>
<td>1. Check temperature sender wiring and connector 2. Test temperature sender and replace if necessary</td>
<td></td>
</tr>
<tr>
<td>P100C</td>
<td>Engine Coolant Temperature Above Threshold - PTO Disabled</td>
<td>Engine coolant temperature has exceeded 105° C (221° F)</td>
<td>PTO is disabled</td>
<td>1. Allow engine to cool 2. Check fan condition and operation 3. Clear air flow passages 4. Check coolant level and condition, adjust and replace as necessary 5. Check temperature sender wiring and connector 6. Test temperature sender and replace if necessary</td>
</tr>
<tr>
<td>P100D</td>
<td>Engine Coolant Temperature Above Threshold - Engine Shut Down</td>
<td>Engine coolant temperature has exceeded 115° C (239° F)</td>
<td>Engine is shut down</td>
<td>1. Allow engine to cool 2. Check fan condition and operation 3. Clear air flow passages 4. Check coolant level and condition, adjust and replace as necessary 5. Check temperature sender wiring and connector 6. Test temperature sender and replace if necessary</td>
</tr>
<tr>
<td>P1104</td>
<td>Traction Coil (front pump forward valve - C1) Overcurrent</td>
<td>Overcurrent detected. Indicates a short to ground.</td>
<td>1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–FRONT FWD HYDRO) 2. If no amperage reading is displayed: A. Check the traction coil wiring and connector B. Test the traction coil wiring 3. Test the traction coil and replace if necessary 4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
<td></td>
</tr>
</tbody>
</table>
### Machine Faults (continued)

<table>
<thead>
<tr>
<th>Fault ID</th>
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<th>Fault Description</th>
<th>Controller Action</th>
<th>Recommended Service Actions</th>
</tr>
</thead>
</table>
| P110C    | Traction Coil (front pump forward valve - C1) Validation Failure - Current Converge | A current monitor which validates the intended traction coil current is indicating an unexpected variance between the desired level of current to the traction coil and the actual level of current to the traction coil. | Traction is disabled until ignition key is cycled. | 1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–FRONT FWD HYDRO)  
2. If no amperage reading is displayed:  
   A. Check the traction coil wiring and connector  
   B. Test the traction coil wiring  
3. Test the traction coil and replace if necessary  
4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance) |
| P110D    | Traction Coil (front pump forward valve - C1) Validation Failure - PWM Converge | PWM convergence is checking 2 fault conditions. The first check is to confirm that the PWM duty cycle across the coil is decreasing when the desired current to the coil is 0. The second check is to verify that the PWM duty cycle across the coil is not greater than the max allowed limit. | Traction is disabled until ignition key is cycled. | 1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–FRONT FWD HYDRO)  
2. If no amperage reading is displayed:  
   A. Check the traction coil wiring and connector  
   B. Test the traction coil wiring  
3. Test the traction coil and replace if necessary  
4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance) |
| P1114    | Traction Coil (front pump reverse valve - C2) Overcurrent | Overcurrent detected. Indicates a short to ground. |  | 1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–FRONT REV HYDRO)  
2. If no amperage reading is displayed:  
   A. Check the traction coil wiring and connector  
   B. Test the traction coil wiring  
3. Test the traction coil and replace if necessary  
4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance) |
| P111C    | Traction Coil (front pump reverse valve - C2) Validation Failure - Current Converge | A current monitor which validates the intended traction coil current is indicating an unexpected variance between the desired level of current to the traction coil and the actual level of current to the traction coil. | Traction is disabled until ignition key is cycled. | 1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–FRONT REV HYDRO)  
2. If no amperage reading is displayed:  
   A. Check the traction coil wiring and connector  
   B. Test the traction coil wiring  
3. Test the traction coil and replace if necessary  
4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance) |
<table>
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<tr>
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<th>Controller Action</th>
<th>Recommended Service Actions</th>
</tr>
</thead>
</table>
| P111D    | Traction Coil (front pump reverse valve - C2) Validation Failure - PWM Converge | PWM convergence is checking 2 fault conditions. The first check is to confirm that the PWM duty cycle across the coil is decreasing when the desired current to the coil is 0. The second check is to verify that the PWM duty cycle across the coil is not greater than the max allowed limit. | Traction is disabled until ignition key is cycled | 1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–FRONT REV HYDRO)  
2. If no amperage reading is displayed:  
   A. Check the traction coil wiring and connector  
   B. Test the traction coil wiring  
3. Test the traction coil and replace if necessary  
4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance) |
| P1124    | Traction Coil (rear pump forward valve -C1) Overcurrent | Overcurrent detected. Indicates a short to ground. | | 1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–REAR FWD HYDRO)  
2. If no amperage reading is displayed:  
   A. Check the traction coil wiring and connector  
   B. Test the traction coil wiring  
3. Test the traction coil and replace if necessary  
4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance) |
| P112C    | Traction Coil (rear pump forward valve -C1) Validation Failure - Current Converge | A current monitor which validates the intended traction coil current is indicating an unexpected variance between the desired level of current to the traction coil and the actual level of current to the traction coil. | Traction is disabled until ignition key is cycled. | 1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–REAR FWD HYDRO)  
2. If no amperage reading is displayed:  
   A. Check the traction coil wiring and connector  
   B. Test the traction coil wiring  
3. Test the traction coil and replace if necessary  
4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance) |
| P112D    | Traction Coil (rear pump forward valve -C1) Validation Failure - PWM Converge | PWM convergence is checking 2 fault conditions. The first check is to confirm that the PWM duty cycle across the coil is decreasing when the desired current to the coil is 0. The second check is to verify that the PWM duty cycle across the coil is not greater than the max allowed limit. | Traction is disabled until ignition key is cycled | 1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–REAR FWD HYDRO)  
2. If no amperage reading is displayed:  
   A. Check the traction coil wiring and connector  
   B. Test the traction coil wiring  
3. Test the traction coil and replace if necessary  
4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance) |
<table>
<thead>
<tr>
<th>Fault ID</th>
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<th>Controller Action</th>
<th>Recommended Service Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1134</td>
<td>Traction Coil (rear pump reverse valve - C2) Overcurrent</td>
<td>Overcurrent detected. Indicates a short to ground.</td>
<td>1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–REAR REV HYDRO)</td>
<td>1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–REAR REV HYDRO)</td>
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<td>2. If no amperage reading is displayed:</td>
<td>2. If no amperage reading is displayed:</td>
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<td></td>
<td>A. Check the traction coil wiring and connector</td>
<td>A. Check the traction coil wiring and connector</td>
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<td>B. Test the traction coil wiring</td>
<td>B. Test the traction coil wiring</td>
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<td></td>
<td>3. Test the traction coil and replace if necessary</td>
<td>3. Test the traction coil and replace if necessary</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
<td>4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>P113C</td>
<td>Traction Coil (rear pump reverse valve - C2) Validation Failure - Current Converge</td>
<td>A current monitor which validates the intended traction coil current is indicating an unexpected variance between the desired level of current to the traction coil and the actual level of current to the traction coil.</td>
<td>Traction is disabled until ignition key is cycled.</td>
<td>1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–REAR REV HYDRO)</td>
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<td></td>
<td></td>
<td></td>
<td>2. If no amperage reading is displayed:</td>
<td>2. If no amperage reading is displayed:</td>
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<tr>
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<td></td>
<td></td>
<td>A. Check the traction coil wiring and connector</td>
<td>A. Check the traction coil wiring and connector</td>
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<td>B. Test the traction coil wiring</td>
<td>B. Test the traction coil wiring</td>
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<td></td>
<td>3. Test the traction coil and replace if necessary</td>
<td>3. Test the traction coil and replace if necessary</td>
</tr>
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<td></td>
<td>4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
<td>4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>P113D</td>
<td>Traction Coil (rear pump reverse valve - C2) Validation Failure - PWM Converge</td>
<td>PWM convergence is checking 2 fault conditions. The first check is to confirm that the PWM duty cycle across the coil is decreasing when the desired current to the coil is 0. The second check is to verify that the PWM duty cycle across the coil is not greater than the max allowed limit.</td>
<td>Traction is disabled until ignition key is cycled</td>
<td>1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–REAR REV HYDRO)</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>2. If no amperage reading is displayed:</td>
<td>2. If no amperage reading is displayed:</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>A. Check the traction coil wiring and connector</td>
<td>A. Check the traction coil wiring and connector</td>
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<td></td>
<td></td>
<td>B. Test the traction coil wiring</td>
<td>B. Test the traction coil wiring</td>
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<td></td>
<td>3. Test the traction coil and replace if necessary</td>
<td>3. Test the traction coil and replace if necessary</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
<td>4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>Fault ID</td>
<td>Fault Title</td>
<td>Fault Description</td>
<td>Controller Action</td>
<td>Recommended Service Actions</td>
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</tr>
<tr>
<td>P114C</td>
<td>Front Traction Hydraulic Circuit - Charge</td>
<td>Charge pressure in front traction circuit is less than 1103 kPa (160 psi)</td>
<td>1. Use the InfoCenter to verify pressure sensor reading (TRACTION INPUTS–FRONT Traction)</td>
<td>2. If no pressure reading is displayed:</td>
</tr>
<tr>
<td></td>
<td>Pressure Low</td>
<td></td>
<td></td>
<td>A. Check front pressure sensor (left side of traction pump) wiring and connector</td>
</tr>
<tr>
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<td></td>
<td>B. Test the pressure sensor wiring</td>
</tr>
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<td>C. Test the pressure sensor if possible and replace if necessary</td>
</tr>
<tr>
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<td></td>
<td>3. Perform front traction pump (P1) flow and relief valve test</td>
</tr>
<tr>
<td>P114D</td>
<td>Hydraulic Fluid Temperature – Over Temp</td>
<td>Hydraulic fluid temperature has exceeded 95° C (203° F)</td>
<td>1. Make sure the auxiliary load valve joystick is not stuck in an enable position</td>
<td>2. Reduce traction speed</td>
</tr>
<tr>
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<td></td>
<td>3. Allow hydraulic fluid to cool below 90° C (194° F)</td>
</tr>
<tr>
<td>P115C</td>
<td>Rear Traction Hydraulic Circuit - Charge</td>
<td>Charge pressure in rear traction circuit is less than 1103 kPa (160 psi)</td>
<td>1. Use the InfoCenter to verify pressure sensor reading (TRACTION INPUTS–REAR Traction)</td>
<td>2. If no pressure reading is displayed:</td>
</tr>
<tr>
<td></td>
<td>Pressure Low</td>
<td></td>
<td></td>
<td>A. Check rear pressure sensor (right side of traction pump) wiring and connector</td>
</tr>
<tr>
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<td></td>
<td>B. Test the pressure sensor wiring</td>
</tr>
<tr>
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<td></td>
<td>C. Test the pressure sensor if possible and replace if necessary</td>
</tr>
<tr>
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<td></td>
<td>3. Perform rear traction pump (P2) flow and relief valve test</td>
</tr>
</tbody>
</table>
### Machine Faults (continued)

<table>
<thead>
<tr>
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<th>Controller Action</th>
<th>Recommended Service Actions</th>
</tr>
</thead>
</table>
| P210E    | Traction Pedal Sensor/Switch Analog vs Analog conflict | The traction pedal has 2 position sensors (APS1 and APS2), each producing its own analog signal. The analog signals independently indicate a pedal position relative to neutral (rest). The two signals are reporting differing positions outside of an expected variance. | Traction is disabled until pedal position is returned to neutral (rest) | 1. Use the InfoCenter to verify sensor movement (TRACTION INPUTS–TR. PEDAL SIGNAL 1 and TRACTION INPUTS–TR. PEDAL SIGNAL 2)  
2. If one or both voltage readings are not displayed:  
   A. Check the traction pedal wiring and connector  
   B. Test the sensor wiring  
3. Test the traction pedal assembly if possible and replace if necessary |
| P2130    | Traction Pedal Analog Sensor APS2 - Short To Ground | Traction pedal analog sensor APS2 is reading a voltage outside the range it was designed to operate, indicating a short to ground. | Traction is disabled until ignition key is cycled | 1. Use the InfoCenter to verify sensor movement (TRACTION INPUTS–TR. PEDAL SIGNAL 2)  
2. If no voltage reading is displayed:  
   A. Check the traction pedal wiring and connector  
   B. Test the sensor wiring  
3. Test the traction pedal assembly if possible and replace if necessary |
| P2132    | Traction Pedal Analog Sensor APS2 - Open Circuit | Traction pedal analog sensor APS2 is reading a voltage outside the range it was designed to operate, indicating an open circuit | Traction is disabled until ignition key is cycled | 1. Use the InfoCenter to verify sensor movement (TRACTION INPUTS–TR. PEDAL SIGNAL 2)  
2. If no voltage reading is displayed:  
   A. Check the traction pedal wiring and connector  
   B. Test the sensor wiring  
3. Test the traction pedal assembly if possible and replace if necessary |
| P2152    | Wheel Speed Sensor Failure | One of the speed sensors has failed to report to the T1: TEC | PTO is disabled and machine enters limp mode after the machine comes to a stop | 1. Use the InfoCenter to verify sensor readings (TRACTION INPUTS–FRONT GROUND and TRACTION INPUTS–REAR GROUND while the machine is in motion)  
2. If no speed reading is displayed:  
   A. Check the speed sensor wiring and connector  
   B. Test the sensor wiring  
3. Replace the speed sensor if necessary |
| P2503    | System Voltage - Too Low | The system voltage is less than 8.8 VDC. |  | 1. Use the Status Display to verify system voltage  
2. Check and clean battery connections.  
3. Test and charge battery  
4. Check alternator belt condition and adjust if necessary  
5. Check alternator wiring and connectors  
6. Test the alternator wiring  
7. Test the alternator; refer to the Yanmar TNV (Tier 4) Series Service Manual |
## Machine Faults (continued)

<table>
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</tr>
</thead>
</table>
| P2504    | System Voltage - Too High | The system voltage is more than 16.3 VDC. | 1. Use the Status Display to verify system voltage with engine operating at 2300 RPM min.  
2. Test the alternator; refer to the Yanmar TNV (Tier 4) Series Service Manual | |
| P2530 Key Start/Run Correlation Fault | Key start input is active but the key run input is inactive | Machine will shut down since key run input is inactive | 1. Use the InfoCenter to verify the run and start circuit inputs (ENGINE RUN INPUTS–KEY RUN OFF and ENGINE RUN INPUTS–KEY START ON)  
2. Check the key switch circuit wiring and connectors at the key switch and the T1: TEC  
3. Test the key switch circuit wiring between the key switch and the T1: TEC  
4. Test the key switch and replace if necessary | |
| C1013 Engine Run/Fuel Pump Output - Short to Battery | Low current detected on engine run/fuel pump output. Indicates a short to battery | 1. Check the engine run/fuel pump output circuit wiring and all of the output circuit connectors  
2. Test the engine run/fuel pump output circuit wiring  
3. Test the electric fuel pump  
4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance) | |
| C1014 Engine Run/Fuel Pump Output - Overcurrent | Overcurrent detected in engine run/fuel pump output. Indicates a short to ground | 1. Check the engine run/fuel pump output circuit wiring and all of the output circuit connectors  
2. Test the engine run/fuel pump output circuit wiring  
3. Test the electric fuel pump  
4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance) | |
| C1015 Engine Run/Fuel Pump Output - Open Circuit | Open circuit detected on engine run/fuel pump output | 1. Check the engine run/fuel pump output circuit wiring and all of the output circuit connectors  
2. Test the engine run/fuel pump output circuit wiring  
3. Test the electric fuel pump  
4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance) | |
<p>| C1020 Parking Brake Disengage Output - Fault Undetermined | The fault type is undetermined due to hardware restrictions. Cycling the output will allow the software to determine whether the fault is because of a short to battery, short to ground/overcurrent, or an open circuit. | Cycle the parking brake switch ON and OFF (key switch in RUN position) to allow the software to determine the fault type | |</p>
<table>
<thead>
<tr>
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<th>Controller Action</th>
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</tr>
</thead>
<tbody>
<tr>
<td>C1023</td>
<td>Parking Brake Disengage Output - Short to Battery</td>
<td>Low current detected on parking brake disengage output. Indicates a short to battery.</td>
<td>1. Check the parking brake disengage output circuit wiring and all of the output circuit connectors 2. Test the parking brake disengage output circuit wiring 3. Test the hydraulic solenoid valve SV2 coil 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
<td>1. Check the parking brake disengage output circuit wiring and all of the output circuit connectors 2. Test the parking brake disengage output circuit wiring 3. Test the hydraulic solenoid valve SV2 coil 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>C1024</td>
<td>Parking Brake Disengage Output - Overcurrent</td>
<td>Overcurrent detected on parking brake disengage output. Indicates short to ground.</td>
<td>1. Check the parking brake disengage output circuit wiring and all of the output circuit connectors 2. Test the parking brake disengage output circuit wiring 3. Test the hydraulic solenoid valve SV2 coil 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
<td>1. Check the parking brake disengage output circuit wiring and all of the output circuit connectors 2. Test the parking brake disengage output circuit wiring 3. Test the hydraulic solenoid valve SV2 coil 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>C1025</td>
<td>Parking Brake Disengage Output - Open Circuit</td>
<td>Open circuit detected on parking brake disengage output</td>
<td>1. Check the parking brake disengage output circuit wiring and all of the output circuit connectors 2. Test the parking brake disengage output circuit wiring 3. Test the hydraulic solenoid valve SV2 coil 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
<td>1. Check the parking brake disengage output circuit wiring and all of the output circuit connectors 2. Test the parking brake disengage output circuit wiring 3. Test the hydraulic solenoid valve SV2 coil 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>C1093</td>
<td>Warning Buzzer Output - Short to Battery</td>
<td>Low current detected on warning buzzer output. Indicates a short to battery</td>
<td>1. Check the warning buzzer output circuit wiring and all of the output circuit connectors 2. Test the warning buzzer output circuit wiring 3. Test the warning buzzer 4. Replace the T2: TDM (contact your Authorized Toro Distributor for assistance)</td>
<td>1. Check the warning buzzer output circuit wiring and all of the output circuit connectors 2. Test the warning buzzer output circuit wiring 3. Test the warning buzzer 4. Replace the T2: TDM (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>C1094</td>
<td>Warning Buzzer Output - Overcurrent</td>
<td>Overcurrent detected on warning buzzer output. Indicates short to ground.</td>
<td>1. Check the warning buzzer output circuit wiring and all of the output circuit connectors 2. Test the warning buzzer output circuit wiring 3. Test the warning buzzer 4. Replace the T2: TDM (contact your Authorized Toro Distributor for assistance)</td>
<td>1. Check the warning buzzer output circuit wiring and all of the output circuit connectors 2. Test the warning buzzer output circuit wiring 3. Test the warning buzzer 4. Replace the T2: TDM (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>C1095</td>
<td>Warning Buzzer Output - Open Circuit</td>
<td>Open circuit detected on warning buzzer output.</td>
<td>1. Check the warning buzzer output circuit wiring and all of the output circuit connectors 2. Test the warning buzzer output circuit wiring 3. Test the warning buzzer 4. Replace the T2: TDM (contact your Authorized Toro Distributor for assistance)</td>
<td>1. Check the warning buzzer output circuit wiring and all of the output circuit connectors 2. Test the warning buzzer output circuit wiring 3. Test the warning buzzer 4. Replace the T2: TDM (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>C10A3</td>
<td>Parking Brake Light Output - Short to Battery</td>
<td>Low current detected on parking brake light output. Indicates a short to battery</td>
<td>1. Check the parking brake light output circuit wiring and all of the output circuit connectors 2. Test the parking brake light output circuit wiring 3. Test the parking brake light 4. Replace the T2: TDM (contact your Authorized Toro Distributor for assistance)</td>
<td>1. Check the parking brake light output circuit wiring and all of the output circuit connectors 2. Test the parking brake light output circuit wiring 3. Test the parking brake light 4. Replace the T2: TDM (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
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<td>Recommended Service Actions</td>
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</tbody>
</table>
| C10A4    | Parking Brake Light Output - Overcurrent         | Overcurrent detected on parking brake light output. Indicates short to ground.          | 1. Check the parking brake light output circuit wiring and all of the output circuit connectors  
2. Test the parking brake light output circuit wiring  
3. Test the parking brake light  
4. Replace the T2: TDM (contact your Authorized Toro Distributor for assistance) |                                                                                                                                                           |
| C10A5    | Parking Brake Light Output - Open Circuit        | Open circuit detected on parking indicator brake light output.                          | 1. Check the parking brake indicator light output circuit wiring and all of the output circuit connectors  
2. Test the parking brake indicator light  
3. Test the parking brake indicator light output circuit wiring  
4. Replace the T2: TDM (contact your Authorized Toro Distributor for assistance) |                                                                                                                                                           |
| C10B3    | Optional Brake Controller Output - Short to Battery | Low current detected on optional brake controller output. Indicates a short to battery | 1. Check the optional brake controller output circuit wiring and all of the output circuit connectors  
2. Test the optional brake controller output circuit wiring  
3. Test the optional brake controller if possible; refer to manufacturer documentation supplier with brake controller  
4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance) |                                                                                                                                                           |
| C10B4    | Optional Brake Controller Output - Overcurrent   | Overcurrent detected on optional brake controller output. Indicates short to ground.    | 1. Check the optional brake controller output circuit wiring and all of the output circuit connectors  
2. Test the optional brake controller output circuit wiring  
3. Test the optional brake controller if possible; refer to manufacturer documentation supplier with brake controller  
4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance) |                                                                                                                                                           |
| C1314    | 3-Point Hitch Raise Output - Overcurrent         | Overcurrent detected on 3-point hitch raise output. Indicates short to ground.          | 1. Check the 3-point hitch raise output circuit wiring and all of the output circuit connectors  
2. Test the 3-point hitch raise output circuit wiring  
3. Test the hydraulic solenoid valve SP1 coil  
4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance) |                                                                                                                                                           |
| C1315    | 3-Point Hitch Raise Output - Open Circuit        | Open Circuit detected on 3-point hitch raise output.                                   | 1. Check the 3-point hitch raise output circuit wiring and all of the output circuit connectors  
2. Test the 3-point hitch raise output circuit wiring  
3. Test the hydraulic solenoid valve SP1 coil  
4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance) |                                                                                                                                                           |
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<tr>
<td>C1324</td>
<td>3-Point Hitch Lower Output - Overcurrent</td>
<td>Overcurrent detected on 3-point hitch lower output. Indicates short to ground.</td>
<td>1. Check the 3-point hitch lower output circuit wiring and all of the output circuit connectors&lt;br&gt;2. Test the 3-point hitch lower output circuit wiring&lt;br&gt;3. Test the hydraulic solenoid valve SP2 coil&lt;br&gt;4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
<td>Lipo the 40-Point hitch lower output circuit wiring and all of the output circuit connectors &lt;br&gt;2. Test the 3-point hitch lower output circuit wiring&lt;br&gt;3. Test the hydraulic solenoid valve SP2 coil&lt;br&gt;4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>C1325</td>
<td>3-Point Hitch Lower Output - Open Circuit</td>
<td>Open Circuit detected on 3-point hitch lower output.</td>
<td>1. Check the 3-point hitch lower output circuit wiring and all of the output circuit connectors&lt;br&gt;2. Test the 3-point hitch lower output circuit wiring&lt;br&gt;3. Test the hydraulic solenoid valve SP2 coil&lt;br&gt;4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
<td>Lipo the 40-Point hitch lower output circuit wiring and all of the output circuit connectors &lt;br&gt;2. Test the 3-point hitch lower output circuit wiring&lt;br&gt;3. Test the hydraulic solenoid valve SP2 coil&lt;br&gt;4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>C1450</td>
<td>Differential Lock Output - Fault Undetermined</td>
<td>The fault type is undetermined due to hardware restrictions. Cycling the output will allow the software to determine whether the fault is because of a short to battery, short to ground/overcurrent, or an open circuit.</td>
<td>Cycle the parking brake switch ON and OFF (key switch in RUN position) to allow the software to determine the fault type</td>
<td>Cycle the parking brake switch ON and OFF (key switch in RUN position) to allow the software to determine the fault type</td>
</tr>
<tr>
<td>C1453</td>
<td>Differential Lock Output - Short to Battery</td>
<td>Low current detected on differential lock output. Indicates a short to battery.</td>
<td>1. Check the differential lock output circuit wiring and all of the output circuit connectors&lt;br&gt;2. Test the differential lock output circuit wiring&lt;br&gt;3. Test the hydraulic solenoid valve SV3 coil&lt;br&gt;4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
<td>Lipo the 40-Point differential lock output circuit wiring and all of the output circuit connectors &lt;br&gt;2. Test the differential lock output circuit wiring&lt;br&gt;3. Test the hydraulic solenoid valve SV3 coil&lt;br&gt;4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>C1454</td>
<td>Differential Lock Output - Overcurrent</td>
<td>Overcurrent detected on differential lock output. Indicates short to ground.</td>
<td>1. Check the differential lock output circuit wiring and all of the output circuit connectors&lt;br&gt;2. Test the differential lock output circuit wiring&lt;br&gt;3. Test the hydraulic solenoid valve SV3 coil&lt;br&gt;4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
<td>Lipo the 40-Point differential lock output circuit wiring and all of the output circuit connectors &lt;br&gt;2. Test the differential lock output circuit wiring&lt;br&gt;3. Test the hydraulic solenoid valve SV3 coil&lt;br&gt;4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>C1455</td>
<td>Differential Lock Output - Open Circuit</td>
<td>Open Circuit detected on differential lock output.</td>
<td>1. Check the differential lock output circuit wiring and all of the output circuit connectors&lt;br&gt;2. Test the differential lock output circuit wiring&lt;br&gt;3. Test the hydraulic solenoid valve SV3 coil&lt;br&gt;4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
<td>Lipo the 40-Point differential lock output circuit wiring and all of the output circuit connectors &lt;br&gt;2. Test the differential lock output circuit wiring&lt;br&gt;3. Test the hydraulic solenoid valve SV3 coil&lt;br&gt;4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>C14A3</td>
<td>Optional Solenoid Control Valve (SCV) Output - Short to Battery</td>
<td>Low current detected on optional SCV output. Indicates a short to battery.</td>
<td>1. Check the optional SCV output circuit wiring and all of the output circuit connectors&lt;br&gt;2. Test the optional SCV output circuit wiring&lt;br&gt;3. Test the SCV relay&lt;br&gt;4. Test all 4 of the hydraulic solenoid valve SCV coils&lt;br&gt;5. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
<td>Lipo the 40-Point optional SCV output circuit wiring and all of the output circuit connectors &lt;br&gt;2. Test the optional SCV output circuit wiring&lt;br&gt;3. Test the SCV relay&lt;br&gt;4. Test all 4 of the hydraulic solenoid valve SCV coils&lt;br&gt;5. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
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</table>
| C14A4    | Optional Solenoid Control Valve (SCV) Output - Overcurrent | Overcurrent detected on optional SCV output. Indicates short to ground. | 1. Check the optional SCV output circuit wiring and all of the output circuit connectors  
2. Test the optional SCV output circuit wiring  
3. Test the SCV relay  
4. Test all 4 of the hydraulic solenoid valve SCV coils  
5. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance) |
| C14A5    | Optional Solenoid Control Valve (SCV) Output - Open Circuit | Open Circuit detected on optional SCV output. | 1. Check the optional SCV output circuit wiring and all of the output circuit connectors  
2. Test the optional SCV output circuit wiring  
3. Test the SCV relay  
4. Test all 4 of the hydraulic solenoid valve SCV coils  
5. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance) |
| C14B0    | Range Hi Output - Fault Undetermined | The fault type is undetermined due to hardware restrictions. Cycling the output will allow the software to determine whether the fault is because of a short to battery, short to ground, or an open circuit. | Cycle the mode selector to LOW and back to HIGH (key switch in RUN position) to allow the software to determine the fault type |
| C14B3    | Range Hi Output - Short to Battery | Low current detected on range Hi output. Indicates a short to battery | 1. Check the range Hi output circuit wiring and all of the output circuit connectors  
2. Test the range Hi output circuit wiring  
3. Test the hydraulic solenoid valve SV1 coil  
4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance) |
| C14B4    | Range Hi Output - Overcurrent | Overcurrent detected on range Hi output. Indicates short to ground. | 1. Check the range Hi output circuit wiring and all of the output circuit connectors  
2. Test the range Hi output circuit wiring  
3. Test the hydraulic solenoid valve SV1 coil  
4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance) |
| C14B5    | Range Hi Output - Open Circuit | Open circuit detected on range Hi output. | 1. Check the range Hi output circuit wiring and all of the output circuit connectors  
2. Test the range Hi output circuit wiring  
3. Test the hydraulic solenoid valve SV1 coil  
4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance) |
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<tr>
<td>C14C4</td>
<td>PTO Output - Overcurrent</td>
<td>Overcurrent detected on PTO output. Indicates short to ground.</td>
<td>1. Check the PTO output circuit wiring and all of the output circuit connectors &lt;br&gt;2. Test the PTO output circuit wiring &lt;br&gt;3. Test the hydraulic solenoid valve EH coil &lt;br&gt;4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
<td></td>
</tr>
<tr>
<td>C14C5</td>
<td>PTO Output - Open Circuit</td>
<td>Open Circuit detected on PTO output.</td>
<td>1. Check the PTO output circuit wiring and all of the output circuit connectors &lt;br&gt;2. Test the PTO output circuit wiring &lt;br&gt;3. Test the hydraulic solenoid valve EH coil &lt;br&gt;4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
<td></td>
</tr>
<tr>
<td>C1514</td>
<td>Front Hydraulic Pressure Sensor - Short to Ground</td>
<td>Front hydraulic pressure sensor is shorted to ground (out of range low)</td>
<td>1. Check front pressure sensor (left side of traction pump) wiring and connector &lt;br&gt;2. Test the pressure sensor wiring &lt;br&gt;3. Test the pressure sensor if possible and replace if necessary</td>
<td></td>
</tr>
<tr>
<td>C1515</td>
<td>Front Hydraulic Pressure Sensor - Open Circuit</td>
<td>Front hydraulic pressure sensor is open (out of range high)</td>
<td>1. Check front pressure sensor (left side of traction pump) wiring and connector &lt;br&gt;2. Test the pressure sensor wiring &lt;br&gt;3. Test the pressure sensor if possible and replace if necessary</td>
<td></td>
</tr>
<tr>
<td>C1524</td>
<td>Rear Hydraulic Pressure Sensor - Short to Ground</td>
<td>Rear hydraulic pressure sensor is shorted to ground (out of range low)</td>
<td>1. Check rear pressure sensor (right side of traction pump) wiring and connector &lt;br&gt;2. Test the pressure sensor wiring &lt;br&gt;3. Test the pressure sensor if possible and replace if necessary</td>
<td></td>
</tr>
<tr>
<td>C1525</td>
<td>Rear Hydraulic Pressure Sensor - Open Circuit</td>
<td>Rear hydraulic pressure sensor is open (out of range high)</td>
<td>1. Check rear pressure sensor (right side of traction pump) wiring and connector &lt;br&gt;2. Test the pressure sensor wiring &lt;br&gt;3. Test the pressure sensor if possible and replace if necessary</td>
<td></td>
</tr>
<tr>
<td>C153C</td>
<td>3-Point Hitch Raise Stall</td>
<td>3-point hitch raise output is enabled, but 3-point hitch position sensor does not report movement</td>
<td>1. If 3-point hitch is moving: &lt;br&gt;   A. Make sure 3-point hitch position sensor is properly installed (mounting bracket is stationary and sensor shaft moves with lift arm pivot shaft) &lt;br&gt;   B. Test the 3-point hitch position sensor &lt;br&gt;   2. If 3-point hitch is not moving: &lt;br&gt;   A. Make sure the hitch assembly is not obstructed or over loaded &lt;br&gt;   B. Service hydraulic cartridge valve SP1 and replace if necessary &lt;br&gt;   C. Test hydraulic relief valve RV2 and adjust, service, or replace if necessary</td>
<td></td>
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</table>
| B1027    | Cruise Control Speed Increase/Decrease Switch is Broken                      | Both CRUISE CONTROL INPUTS–SPEED INCREASE and CRUISE CONTROL INPUTS–SPEED DECREASE are active at the same time | Cruise speed increase/decrease is disabled | 1. Check the cruise control speed increase/decrease switch circuit wiring and all the circuit connectors  
2. Test the cruise control speed increase/decrease switch  
3. Test the cruise control speed increase/decrease switch circuit wiring |
| B1107    | Transmission Lever Switch Broken                                              | Both TRACTION INPUTS–TRANSMISSION FWD and TRACTION INPUTS–TRANSMISSION REV are active at the same time | Traction is disabled                   | 1. Use the transmission lever and the InfoCenter to determine which transmission lever switch does not match transmission lever movement (TRACTION INPUTS–TRANSMISSION FWD and TRACTION INPUTS–TRANSMISSION REV)  
2. Check the circuit wiring and all the circuit connectors for the unresponsive switch  
3. Test the unresponsive switch  
4. Test the unresponsive switch circuit wiring |
| B1117    | Optional InchMode Raise/Lower Switch Broken                                   | Both INCH MODE INPUTS–INCH MODE LOWER and INCH MODE INPUTS–INCH MODE RAISE are active at the same time | InchMode 3-point hitch control is disabled | 1. Check the optional InchMode raise/lower switch circuit wiring and all the circuit connectors  
2. Test the optional InchMode raise/lower switch  
3. Test the optional InchMode raise/lower switch circuit wiring |
| B1127    | Optional InchMode Forward/Reverse Switch Broken                               | Both INCH MODE INPUTS–INCH MODE FWD and INCH MODE INPUTS–INCH MODE REV are active at the same time | InchMode traction control is disabled   | 1. Check the optional InchMode forward/reverse switch circuit wiring and all the circuit connectors  
2. Test the optional InchMode forward/reverse switch  
3. Test the optional InchMode forward/reverse switch circuit wiring |
| B1137    | Paddle Switch Broken                                                          | Both 3-POINT INPUTS–3-POINT LOWER and 3-POINT RAISE are active at the same time   | 3-point hitch control is disabled      | 1. Use the paddle and the InfoCenter to determine which paddle switch does not match paddle movement (3-POINT INPUTS–3-POINT LOWER and 3-POINT RAISE)  
2. Check the circuit wiring and all the circuit connectors for the unresponsive switch  
3. Test the unresponsive switch  
4. Test the unresponsive switch circuit wiring |
| B1154    | Mode Selector - Short to Ground                                               | Short to ground detected on mode selector                                         | Default to low mode operation and disable PTO | 1. Check the mode selector circuit wiring and all circuit connectors  
2. Test the mode selector circuit wiring  
3. Test the mode selector if possible and replace if necessary |
| B1155    | Mode Selector - Open Circuit                                                  | Open circuit detected on mode selector                                           | Default to low mode operation and disable PTO | 1. Check the mode selector circuit wiring and all circuit connectors  
2. Test the mode selector circuit wiring  
3. Test the mode selector if possible and replace if necessary |
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| B1164   | 3-Point Hitch Position Sensor - Short to Ground                             | Short to ground detected on 3-point hitch position sensor | Disable autonomous 3-point hitch control                                          | 1. Check the 3-point hitch position sensor circuit wiring and all circuit connectors  
2. Test the 3-point hitch position sensor circuit wiring  
3. Test the 3-point hitch position sensor if possible and replace if necessary |
| B1165   | 3-Point Hitch Position Sensor - Open Circuit                                | Open circuit detected on 3-point hitch position sensor  | Disable autonomous 3-point hitch control                                          | 1. Check the 3-point hitch position sensor circuit wiring and all circuit connectors  
2. Test the 3-point hitch position sensor circuit wiring  
3. Test the 3-point hitch position sensor if possible and replace if necessary |
| U0100   | CAN Bus Communication Fault - Engine ECU                                   | All machine functions disabled                         |                                                                                  | 1. Check power supply to engine ECU  
A. Test fuse F-A2 10A  
B. Test engine ECU supply and ground circuit wiring  
2. Test CAN bus resistance |
| U012A   | CAN Bus Communication Fault - T2: TDM                                      | T2: TDM display blank but machine functions may continue |                                                                                  | 1. Check power supply to T2: TDM  
A. Test fuse F-A4 2A  
B. Test T2: TDM supply and ground circuit wiring  
2. Test external CAN bus termination resistor  
3. Test CAN bus resistance |
| U012B   | CAN Bus Communication Fault - Expansion Port (example: T3: InchMode option) | Optional InchMode feature shifts from an ACTIVE state to a PENDING state and InchMode control box switches are disabled |                                                                                  | 1. Check power supply to expansion port  
A. Test fuse F-C2 10A  
B. Test expansion port supply and ground circuit wiring  
2. Test external CAN bus termination resistor  
3. Test CAN bus resistance |
| U0156   | CAN Bus Communication Fault - InfoCenter                                   | InfoCenter display blank but machine functions may continue |                                                                                  | 1. Check power supply to InfoCenter  
A. Test fuse F-B3 2A  
B. Test InfoCenter supply and ground circuit wiring  
2. Test external CAN bus termination resistor  
3. Test CAN bus resistance |
| U1007   | Main Power Relay                                                           | The main power relay has failed                        |                                                                                  | 1. Test fuse F-B2 2A  
2. Test relay and replace if necessary  
3. Test main power relay circuit wiring and connector  
4. Test T1: TEC output fuses F-A1, F-B1, F-C1, and F-D1 7.5A |
| U1022   | T1: TEC Fuse Output PWR 2 Failure                                           | Power supply for outputs 1-4 of T1: TEC has failed.    |                                                                                  | Check power supply to T1: TEC outputs  
1. Test fuse F-A1 7.5A  
2. Test PWR 2 supply circuit wiring |
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<td>U1023</td>
<td>T1: TEC Fuse Output PWR 3 Failure</td>
<td>Power supply for outputs 9–12 of T1: TEC has failed.</td>
<td></td>
<td>Check power supply to T1: TEC outputs 1. Test fuse F-B1 7.5A 2. Test PWR 3 supply circuit wiring</td>
</tr>
<tr>
<td>U1024</td>
<td>T1: TEC Fuse Output PWR 4 Failure</td>
<td>Power supply for outputs 5–8 of T1: TEC has failed.</td>
<td></td>
<td>Check power supply to T1: TEC outputs 1. Test fuse F-C1 7.5A 2. Test PWR 4 supply circuit wiring</td>
</tr>
<tr>
<td>U1025</td>
<td>T1: TEC Fuse Output PWR 5 Failure</td>
<td>Power supply for outputs 13–16 of T1: TEC, has failed.</td>
<td></td>
<td>Check power supply to T1: TEC outputs 1. Test fuse F-D1 7.5A 2. Test PWR 5 supply circuit wiring</td>
</tr>
<tr>
<td>U1117</td>
<td>Source Address Contention Fault</td>
<td>T1: TEC received a message from another controller on the CAN bus using the same source address</td>
<td>Machine is disabled</td>
<td>Update machine software (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>U1308</td>
<td>Software Version Incompatibility - T2: TDM</td>
<td>T2: TDM software is incompatible</td>
<td>Machine is disabled</td>
<td>Update machine software (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>U1309</td>
<td>Software Version Incompatibility - Expansion Port (example: T3: InchMode option)</td>
<td>Expansion Port software is incompatible</td>
<td>Machine is disabled</td>
<td>Update machine software (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>U130A</td>
<td>Software Version Incompatibility - InfoCenter</td>
<td>InfoCenter software is incompatible</td>
<td>Machine is disabled</td>
<td>Update machine software (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>U130F</td>
<td>Software Version Incompatibility - Unknown</td>
<td>Unknown Software Version – Incompatible</td>
<td>Machine is disabled</td>
<td>Update machine software (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>U1701</td>
<td>Board Internal Error - IPE</td>
<td>Inputs or outputs on T1: TEC are not working correctly. Inputs can't be trusted</td>
<td>Machine is disabled</td>
<td>Replace the T1: TEC (contact your Authorized Toro Distributor for assistance)</td>
</tr>
</tbody>
</table>
Using the InfoCenter Display for Troubleshooting

The Service – Input/Output screens of the InfoCenter display can be very helpful when troubleshooting machine operation issues. Electrical components and their circuit wiring can be evaluated quickly using the Input/Output screens prior to testing the component individually. The Input/Output screens show the current state of the inputs and the outputs required to allow a machine operation to proceed.

**CAUTION**

It may be necessary to start and run the engine, raise and lower the attachments, or otherwise operate the machine during the troubleshooting process. Make sure the machine is in a well ventilated area and keep away from attachments and moving parts while troubleshooting to prevent personal injury.

If a machine operation is malfunctioning, the following procedure can help identify the component or circuit wiring causing the malfunction.

1. Park machine on a level surface, lower attachments if possible and stop engine.
2. Set the key switch to the RUN position and navigate to the InfoCenter Service – Input/Output Screen for the desired machine function. Traction has been selected for the following example.
3. Manually operate the input component. The component state on the InfoCenter display should alternate ON and OFF or the signal voltage from the component should change as the component is cycled. If ON and OFF do not alternate or signal voltage does not change during component operation, the component or its circuit wiring is faulty and should be tested; refer to Electrical Component Testing (page 6–14) and Appendix A (page A–1).

**Note:** --- means no signal from the input is available and the input or its circuit wiring should be tested.

When the correct inputs are received by the controllers, the outputs identified on the Output screen should show as ON (or a control amperage in the case of the traction pump control solenoids). If the inputs are properly positioned and the output remains OFF, a problem with controller power (circuit wiring or fuse) may exist, or the controller software may require reloading or replacement. Contact your Authorized Toro Distributor for assistance.

A faulty output component will not be identified by the Output screen. The Output screen reflects the actions of the controller, not the component(s) involved in the operation. If all inputs and outputs are correct for the machine operation selected, yet the operation does not function as it should, the output component may be faulty. Test the specific output component and the wiring from the controller to the component; refer to Electrical Component Testing (page 6–14) and Appendix A (page A–1).

**TRACTION (example):**

**Using the Inputs Screen**

- Move the transmission lever to the FORWARD, NEUTRAL and REVERSE positions. The TRANSMISSION FWD and REV inputs should alternate ON and OFF based on the lever position. If not, the transmission lever switches or their circuit wiring are faulty and should be tested.
• Depress the traction pedal slowly. The TR. PEDAL SIGNAL 1 and 2 voltages should increase as the pedal is depressed. Signal 1 should be approximately twice as high as signal 2. If not, the traction pedal or its circuit wiring is faulty and should be tested.

• Depress the decelerator pedal slowly. The BRAKE NEUTRAL input should be OFF when the pedal is depressed and ON when the pedal is fully at rest. If not, the decelerator pedal neutral switch or its circuit wiring is faulty and should be tested.

• Depress the decelerator pedal slowly. The BRAKE PEDAL SIGNAL voltage should increase as the pedal is depressed. If not, the decelerator pedal or its circuit wiring is faulty and should be tested.

• Toggle the parking brake switch ON and OFF. The PBRAKE OFF input should alternate ON and OFF. If not, the parking brake switch or its circuit wiring is faulty and should be tested.

• Press and release the differential lock button. The DIFF. LOCK input should alternate OFF and ON. If not, the differential lock button or its circuit wiring is faulty and should be tested.

• When the vehicle is stationary, both FRONT and REAR GROUND (speed sensors) should display 0.0MPH/KPH. When the vehicle is in motion, both speed sensors should display approximately the same speed. If not, one of the speed sensors or its circuit wiring is faulty and should be tested.

• When the engine is running and the vehicle is stationary, both FRONT and REAR TRACTION (pressure sensors) should display the system charge pressure of approximately 1860 kPa (270 psi). A charge pressure reading of less than 1103 kPa (160 psi) indicates a pressure sensor or a hydraulic charge circuit issue.

• When the engine is running and the vehicle is in motion, both FRONT and REAR TRACTION should display approximately the same pressure due to the traction pressure compensation feature. If not, one of the pressure sensors or its circuit wiring may be faulty and should be tested, or the traction pressure compensation software may require reloading or replacement. Contact your Authorized Toro Distributor for assistance in reloading the machine software.

**Using the Outputs Screen**

**Note:** An inappropriate output reading may indicate an issue with the controller. Contact your Authorized Toro Distributor for assistance with controller reprogramming or replacement.

• When the vehicle is stationary, FRONT/REAR FWD/REV HYDRO will display a minimum amount of amperage being sent to the various traction pump control valve solenoids. All four displays should be approximately the same. When the vehicle is in motion, the amount of amperage being sent to the various traction pump control valve solenoids should increase. If the output reading is appropriate and the vehicle does not perform correctly, the traction pump control valve solenoid or its circuit wiring may be faulty and should be tested.

• When the decelerator pedal is pressed, the BRAKE OUTPUT (optional electric trailer brake controller) toggles form OFF to ON. If the output reading is appropriate and the vehicle does not perform correctly, the optional electric trailer brake controller, the electric trailer brakes, or their circuit wiring may be faulty and should be tested.

• Once all the required conditions are satisfied (engine running, vehicle stationary, parking brake disengaged), pressing and releasing the differential lock button should toggle DIFF. LOCK OUTPUT ON and OFF. Also, the DIFF. LOCK OUTPUT is ON when the parking brake switch is ON and OFF when
the parking brake switch is OFF. If the output reading is appropriate and the vehicle does not perform correctly, the solenoid valve SV3 or its circuit wiring may be faulty and should be tested.

- Setting the mode selector to H then L or A should toggle RANGE HI ON and OFF. If the output reading is appropriate and the vehicle does not perform correctly, the solenoid valve SV1 or its circuit wiring may be faulty and should be tested.

- When the engine is running and the vehicle is stationary, switching the parking brake switch ON and OFF toggles the PBRAKE DISENGAGE ON and OFF. If the output reading is appropriate and the vehicle does not perform correctly, the solenoid valve SV2 or its circuit wiring may be faulty and should be tested.

- Switching the parking brake switch ON and OFF toggles the PBRAKE LIGHT ON and OFF. If the output reading is appropriate and the vehicle does not perform correctly, the parking brake switch light or its circuit wiring may be faulty and should be tested.
<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic fluid is leaking from the system.</td>
<td>The fitting(s), hose(s), or tube(s) are loose or damaged.</td>
<td>Secure or replace loose or damaged hydraulic connections.</td>
</tr>
<tr>
<td></td>
<td>The O-ring(s) or seal(s) are missing or damaged.</td>
<td>Install a new O-ring(s) or seal(s).</td>
</tr>
<tr>
<td>The hydraulic fluid foams excessively causing fluid leakage from the</td>
<td>The hydraulic fluid level in the hydraulic tank is low.</td>
<td>Adjust the hydraulic fluid level.</td>
</tr>
<tr>
<td>hydraulic tank breather.</td>
<td>The hydraulic system has a wrong type of fluid.</td>
<td>Replace the hydraulic fluid.</td>
</tr>
<tr>
<td>Note: Refer to the traction unit Operator’s Manual for hydraulic fluid specifications.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The incompatible hydraulic fluids are mixed in the system.</td>
<td>Replace the hydraulic fluid.</td>
</tr>
<tr>
<td></td>
<td>There is water in the hydraulic system.</td>
<td>Replace the hydraulic fluid.</td>
</tr>
<tr>
<td></td>
<td>The pump suction line has an air leak.</td>
<td>Replace the pump suction line.</td>
</tr>
<tr>
<td>The hydraulic system operates hot (exceeds 95° C (203° F)).</td>
<td>The hydraulic fluid level in the hydraulic tank is low.</td>
<td>Adjust the hydraulic fluid level.</td>
</tr>
<tr>
<td></td>
<td>The suction filter or suction line is damaged, loose, or clogged.</td>
<td>Secure, clean or replace the suction filter or suction line.</td>
</tr>
<tr>
<td></td>
<td>The hydraulic fluid is contaminated or the fluid viscosity is too light.</td>
<td>Replace the hydraulic fluid.</td>
</tr>
<tr>
<td>Note: Refer to the traction unit Operator’s Manual for hydraulic fluid specifications.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The hydraulic fluid cooler is damaged or plugged.</td>
<td>Repair or replace the hydraulic fluid cooler.</td>
</tr>
<tr>
<td></td>
<td>The fluid cooler air flow is obstructed.</td>
<td>Verify cooling fan operation and remove debris from in and around the fluid cooler.</td>
</tr>
<tr>
<td></td>
<td>The traction pump bypass valve(s) is open or damaged.</td>
<td>Close or replace the traction pump bypass valve(s).</td>
</tr>
<tr>
<td></td>
<td>The charge pressure is low (steering and lift circuit performance is also affected).</td>
<td>Verify charge pressure; refer to the InfoCenter SERVICE–INPUT/OUTPUT–TRACTION–TRACTION INPUTS FRONT TRACTION and REAR TRACTION readings while the machine is stationary.</td>
</tr>
<tr>
<td></td>
<td>The traction pump is worn or damaged.</td>
<td>Verify traction pump operation; refer to Traction Pump (P1 and P2) Tests in the Hydraulic System chapter of this manual.</td>
</tr>
<tr>
<td></td>
<td>The drive axle motor is worn or damaged.</td>
<td>Repair or replace the drive axle motor.</td>
</tr>
<tr>
<td>Note: If a traction circuit component has internal wear or damage, it is possible that the other traction components are also damaged.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Traction System Problems

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>The traction response is sluggish.</td>
<td>The hydraulic fluid is very cold.</td>
<td>Allow the hydraulic fluid to warm by safely operating the machine at rest.</td>
</tr>
<tr>
<td></td>
<td>The hydraulic fluid level in the hydraulic tank is low.</td>
<td>Adjust the hydraulic fluid level.</td>
</tr>
<tr>
<td></td>
<td>The traction pump bypass valve(s) is open or damaged.</td>
<td>Close or replace the traction pump bypass valve(s).</td>
</tr>
<tr>
<td>Engine speed is low.</td>
<td></td>
<td>Increase the engine speed.</td>
</tr>
<tr>
<td>A piston pump control solenoid is damaged.</td>
<td></td>
<td>Replace the appropriate piston pump control solenoid valve. 2 solenoid valves are used to control reverse operation (one for each pump/drive axle motor), and 2 solenoid valves are used to control forward operation (one for each pump/drive axle motor).</td>
</tr>
<tr>
<td>One or more orifice screen in the piston (traction) pump control assembly is partially obstructed or damaged.</td>
<td>Clean or repair piston (traction) pump passages.</td>
<td></td>
</tr>
<tr>
<td>The traction pump relief valves are leaking or damaged.</td>
<td>Clean or repair the piston (traction) pump relief valves.</td>
<td></td>
</tr>
<tr>
<td>The charge pressure is low (steering and lift circuit performance is also affected).</td>
<td>Verify charge pressure; refer to the InfoCenter SERVICE–INPUT/OUTPUT–TRACTION–TRACTION INPUTS FRONT TRACTION and REAR TRACTION readings while the machine is stationary.</td>
<td></td>
</tr>
<tr>
<td><strong>Note:</strong> If a traction circuit component has internal wear or damage, it is possible that the other traction components are also damaged.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The traction pump is worn or damaged.</td>
<td>Verify traction pump operation; refer to Traction Pump (P1 and P2) Tests in the Hydraulic System chapter of this manual.</td>
<td></td>
</tr>
<tr>
<td>The drive axle motor is worn or damaged.</td>
<td>Repair or replace the drive axle motor.</td>
<td></td>
</tr>
<tr>
<td>The machine travels too far before stopping when the traction pedal is released.</td>
<td>Traction pedal assembly movement is restricted or traction pedal assembly is damaged.</td>
<td>Test and replace traction pedal assembly if necessary.</td>
</tr>
<tr>
<td></td>
<td>A piston pump control solenoid is damaged.</td>
<td>Test and replace the control solenoid if necessary</td>
</tr>
<tr>
<td>The Front or rear axle operates in one direction only (forward or reverse).</td>
<td>The traction pump bypass valve(s) is open or damaged.</td>
<td>Close or replace the traction pump bypass valve(s).</td>
</tr>
<tr>
<td></td>
<td>An electrical problem exists with the control solenoid(s).</td>
<td>Test and replace the control solenoid if necessary.</td>
</tr>
<tr>
<td></td>
<td>Test the machine wire harness pump control solenoid circuit(s).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>One or more orifice screen in piston (traction) pump control assembly is partially obstructed or damaged.</td>
<td>Clean or repair piston (traction) pump passages.</td>
</tr>
<tr>
<td></td>
<td>The traction pump relief valves are leaking or damaged.</td>
<td>Clean or repair the piston (traction) pump relief valves.</td>
</tr>
<tr>
<td>Problem</td>
<td>Possible Cause</td>
<td>Corrective Action</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>No traction exists in either direction.</td>
<td>The hydraulic fluid level in the hydraulic tank is low (other hydraulic circuit performance is affected as well).</td>
<td>Adjust the hydraulic fluid level.</td>
</tr>
<tr>
<td></td>
<td>The traction pump bypass valve(s) is open or damaged.</td>
<td>Close or replace the traction pump bypass valve(s).</td>
</tr>
<tr>
<td></td>
<td>One or more orifice or screen in piston (traction) pump control assembly is partially obstructed or damaged.</td>
<td>Clean or repair piston (traction) pump passages.</td>
</tr>
<tr>
<td></td>
<td>The charge pressure is low (steering and lift circuit performance is also affected).</td>
<td>Verify charge pressure; refer to the InfoCenter SERVICE–INPUT/OUTPUT –TRACTION–TRACTION INPUTS FRONT TRACTION and REAR TRACTION readings while the machine is stationary.</td>
</tr>
<tr>
<td></td>
<td>The traction pump charge relief valve is leaking or damaged.</td>
<td>Clean or repair the charge relief valve.</td>
</tr>
<tr>
<td></td>
<td>Problem with the piston (traction) pump control solenoid circuit exists.</td>
<td>Verify traction pedal sensor operation and the machine wire harness traction pedal circuit.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Verify the TEC output to the pump control solenoids are occurring.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Test the machine wire harness pump control solenoid circuits.</td>
</tr>
<tr>
<td></td>
<td>The traction pump relief valves are leaking or damaged.</td>
<td>Clean or repair the piston (traction) pump relief valves.</td>
</tr>
<tr>
<td></td>
<td>The traction pump is worn or damaged.</td>
<td>Verify traction pump operation; refer to Traction Pump (P1 and P2) Tests in the Hydraulic System chapter of this manual.</td>
</tr>
<tr>
<td></td>
<td>The drive axle motor is worn or damaged.</td>
<td>Repair or replace the drive axle motor.</td>
</tr>
<tr>
<td><strong>Note:</strong> If a traction circuit component has internal wear or damage, it is possible that the other traction components are also damaged.</td>
<td>High range traction speed will not engage.</td>
<td>Replace solenoid valve if necessary.</td>
</tr>
<tr>
<td></td>
<td>An electrical problem exists in the solenoid valve (SV1) circuit.</td>
<td>Test and replace the valve solenoid if necessary.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Test the machine wire harness solenoid valve (SV1) circuit.</td>
</tr>
<tr>
<td></td>
<td>Solenoid valve (SV1) in the main manifold is leaking or faulty.</td>
<td>Clean the solenoid valve and replace the seals</td>
</tr>
</tbody>
</table>
## Traction System Problems (continued)

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>The parking brake cannot be disengaged with engine running.</td>
<td>An electrical problem exists in the solenoid valve (SV2) circuit.</td>
<td>Test and replace the valve solenoid if necessary.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Test the machine wire harness solenoid valve (SV2) circuit.</td>
</tr>
<tr>
<td></td>
<td>Solenoid valve (SV2) in the main manifold is leaking or faulty.</td>
<td>Clean the solenoid valve and replace the seals.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Replace solenoid valve if necessary.</td>
</tr>
<tr>
<td>The differential lock will not engage.</td>
<td>An electrical problem exists in the solenoid valve (SV3) circuit.</td>
<td>Test and replace the valve solenoid if necessary.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Test the machine wire harness solenoid valve (SV3) circuit.</td>
</tr>
<tr>
<td></td>
<td>Solenoid valve (SV3) in the main manifold is leaking or faulty.</td>
<td>Clean the solenoid valve and replace the seals.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Replace solenoid valve if necessary.</td>
</tr>
<tr>
<td>Problem</td>
<td>Possible Cause</td>
<td>Corrective Action</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Steering is sluggish, operates poorly or is inoperative.</td>
<td>Steering components (e.g. rod ends, steering cylinders, steering stops) are worn or binding.</td>
<td>Inspect steering components and repair or replace if necessary.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Verify and adjust rod end and steering stop lengths and adjust if necessary.</td>
</tr>
<tr>
<td>Oil supply to the steering control valve is insufficient (traction charge and lift circuits affected as well).</td>
<td>Verify gear pump (P4) performance; refer to the InfoCenter SERVICE–INPUT/OUTPUT –TRACTION–TRACTION INPUTS FRONT TRACTION and REAR TRACTION readings while the machine is stationary.</td>
<td></td>
</tr>
<tr>
<td>Relief valve (RV1) in the main manifold is stuck, leaking or damaged.</td>
<td>Clean the relief valve and replace the seals.</td>
<td>Replace relief valve if necessary.</td>
</tr>
<tr>
<td>Steering priority valve (EC1) in the main manifold is faulty.</td>
<td>Clean the relief valve and replace the seals.</td>
<td>Replace the priority valve if necessary.</td>
</tr>
<tr>
<td>Steering control valve is worn or damaged.</td>
<td>Rebuild or replace the steering control valve.</td>
<td></td>
</tr>
<tr>
<td>Turning steering wheel turns wheels in the wrong direction.</td>
<td>Hydraulic hoses to the steering cylinders are connected incorrectly.</td>
<td>Correct hydraulic hose connections.</td>
</tr>
<tr>
<td>Gear pumps (P3 and P4) are noisy from cavitation (steering, traction charge, lift circuit and attachment circuit performance is affected).</td>
<td>The hydraulic fluid level in the hydraulic tank is low (other hydraulic circuit performance is affected as well).</td>
<td>Adjust the hydraulic fluid level.</td>
</tr>
<tr>
<td></td>
<td>The suction filter or suction line is damaged, loose, or clogged.</td>
<td>Secure, clean or replace the suction filter or suction line.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# PTO System Problems

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>The PTO shaft will not engage.</td>
<td>An electrical problem exists in the proportional solenoid valve (EH) circuit.</td>
<td>Test and replace the valve solenoid if necessary.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Test the machine wire harness proportional solenoid valve (EH) circuit.</td>
</tr>
<tr>
<td></td>
<td>Proportional solenoid valve (EH) in the main manifold is stuck, leaking or faulty.</td>
<td>Clean the solenoid valve and replace the seals.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Replace the solenoid valve if necessary.</td>
</tr>
</tbody>
</table>
## 3-Point Hitch System Problems

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hitch cylinders will not raise or raise slowly.</td>
<td>Engine speed is too low.</td>
<td>Increase engine speed.</td>
</tr>
<tr>
<td></td>
<td>Hitch components are binding, worn or damaged.</td>
<td>Inspect hitch components and repair or replace if necessary.</td>
</tr>
<tr>
<td></td>
<td>The hydraulic fluid level in the hydraulic tank is low (other hydraulic circuit performance is affected as well).</td>
<td>Adjust the hydraulic fluid level.</td>
</tr>
<tr>
<td></td>
<td>Relief valve (RV2) in the main manifold is stuck, leaking or damaged.</td>
<td>Clean the relief valve and replace the seals.</td>
</tr>
<tr>
<td></td>
<td>An electrical problem exists in the proportional solenoid valve (SP1) circuit.</td>
<td>Test and replace the valve solenoid if necessary.</td>
</tr>
<tr>
<td></td>
<td>Proportional solenoid valve (SP1) in the main manifold is stuck, leaking or faulty.</td>
<td>Clean the solenoid valve and replace the seals.</td>
</tr>
<tr>
<td></td>
<td>Hitch cylinder circuit pressure is low (traction charge and steering circuits affected as well).</td>
<td>Verify charge pressure: refer to the InfoCenter SERVICE–INPUT/OUTPUT –TRACTION–TRACTION INPUTS FRONT TRACTION and REAR TRACTION readings while the machine is stationary. Verify gear pump (P4) performance; refer to Gear Pump (P4) Flow Text in the Hydraulic System chapter of this manual.</td>
</tr>
<tr>
<td>Hitch cylinders raise but will not stay up. <strong>NOTE:</strong> Hitch cylinders cannot provide an absolutely perfect seal. The lift arms will eventually lower if left supporting an attachment in the raised position during storage.</td>
<td>Proportional solenoid valve (SP1), (SP2), or check valve (CV2) in the main manifold is stuck, leaking or faulty.</td>
<td>Clean the valve(s) and replace the seals.</td>
</tr>
<tr>
<td></td>
<td>A hitch cylinder is leaking internally.</td>
<td>Test and repair or replace the hitch cylinder if necessary.</td>
</tr>
<tr>
<td>Hitch cylinders will not lower.</td>
<td>An electrical problem exists in the proportional solenoid valve (SP2) circuit.</td>
<td>Test and replace the valve solenoid if necessary.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Test the machine wire harness proportional solenoid valve (SP2) circuit.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Proportional solenoid valve (SP2) in the main manifold is stuck, leaking or faulty.</td>
</tr>
<tr>
<td></td>
<td>Gear pumps (P3 and P4) are noisy from cavitation (steering, traction charge, lift circuit and attachment circuit performance is affected).</td>
<td>The hydraulic fluid level in the hydraulic tank is low (other hydraulic circuit performance is affected as well).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The suction filter or suction line is damaged, loose, or clogged.</td>
</tr>
</tbody>
</table>
## Attachment/Loader Problems

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attachment cylinder or motor operates poorly or is inoperative.</td>
<td>A mechanical problem exists with the attachment cylinder or motor application that affects operation (example: binding or worn pivots, arms, linkage or couplings).</td>
<td>Inspect attachment components and repair or replace if necessary.</td>
</tr>
<tr>
<td>Relief valve in auxiliary load valve is stuck, leaking or damaged.</td>
<td></td>
<td>Clean the relief valve and replace the seals.</td>
</tr>
<tr>
<td>If a selector control valve kit (optional) is installed:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– An electrical problem exists in the selector control solenoid valve circuit.</td>
<td>Test and replace the valve solenoids if necessary.</td>
<td></td>
</tr>
<tr>
<td>– Selector control solenoid valve(s) are stuck, leaking or faulty.</td>
<td>Clean the solenoid valve(s) and replace the seals.</td>
<td>Replace the solenoid valve if necessary.</td>
</tr>
<tr>
<td>Attachment cylinder or motor is worn or damaged.</td>
<td>Test and repair or replace the attachment cylinder or motor if necessary.</td>
<td></td>
</tr>
<tr>
<td>Auxiliary load valve is worn or damaged.</td>
<td>Repair or replace the auxiliary load valve.</td>
<td></td>
</tr>
<tr>
<td>Gear pump (P3) is worn or damaged.</td>
<td>Verify gear pump (P3) performance; refer to Gear Pump (P3) Flow Test in the Hydraulic System chapter of this manual.</td>
<td></td>
</tr>
<tr>
<td>Attachment cylinder or motor operates in reverse.</td>
<td>Hydraulic hoses to the steering cylinders are connected incorrectly.</td>
<td>Correct hydraulic hose connections.</td>
</tr>
<tr>
<td>Problem</td>
<td>Possible Cause</td>
<td>Corrective Action</td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Loader cylinder operates poorly or is inoperative.</td>
<td>A mechanical problem exists with the loader cylinder that affects operation (example: binding or worn pivots, arms, linkage or couplings).</td>
<td>Inspect loader components and repair or replace if necessary.</td>
</tr>
<tr>
<td>Relief valve in auxiliary load valve is stuck, leaking or damaged.</td>
<td>Clean the relief valve and replace the seals.</td>
<td></td>
</tr>
<tr>
<td>If a selector control valve kit (optional) is installed:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– An electrical problem exists in the selector control solenoid valve circuit.</td>
<td>Test and replace the valve solenoids if necessary.</td>
<td>Test the machine wire harness selector control solenoid valve circuit.</td>
</tr>
<tr>
<td>– Selector control solenoid valve(s) are stuck, leaking or faulty.</td>
<td>Clean the solenoid valve(s) and replace the seals.</td>
<td>Replace the solenoid valve if necessary.</td>
</tr>
<tr>
<td>Loader cylinder is worn or damaged.</td>
<td>Repair or replace the auxiliary load valve.</td>
<td></td>
</tr>
<tr>
<td>Auxiliary load valve is worn or damaged.</td>
<td>Repair or replace the auxiliary load valve.</td>
<td></td>
</tr>
<tr>
<td>Loader valve is worn or damaged.</td>
<td>Repair or replace the loader valve.</td>
<td></td>
</tr>
<tr>
<td>Gear pump (P3) is worn or damaged.</td>
<td>Verify gear pump (P3) performance; refer to Gear Pump (P3) Flow Test in the Hydraulic System chapter of this manual.</td>
<td></td>
</tr>
<tr>
<td>Loader cylinder operates in reverse.</td>
<td>Hydraulic hoses to the steering cylinders are connected incorrectly.</td>
<td>Correct hydraulic hose connections.</td>
</tr>
<tr>
<td>Gear pumps (P3 and P4) are noisy from cavitation (steering, traction charge, lift circuit and attachment circuit performance is affected).</td>
<td>The hydraulic fluid level in the hydraulic tank is low (other hydraulic circuit performance is affected as well).</td>
<td>Adjust the hydraulic fluid level.</td>
</tr>
<tr>
<td>The suction filter or suction line is damaged, loose, or clogged.</td>
<td>Secure, clean or replace the suction filter or suction line.</td>
<td></td>
</tr>
</tbody>
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# Chapter 4

## Engine

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### Additional Reference Materials

- **Yanmar TNV (Tier 4) Series Service Manual**
- **Yanmar TNV (Tier 4) Series Troubleshooting Manual**
This chapter provides information for repairing the various systems that support the Yanmar diesel engine used in the Outcross 9060. The general maintenance procedures are described in the Operator’s Manual and the Yanmar TNV Series Operation Manual supplied with the machine. Detailed information on engine troubleshooting, testing, disassembly, and assembly is identified in the Yanmar TNV (Tier 4) Series Service Manual and the Yanmar TNV (Tier 4) Series Troubleshooting Manual.

The described adjustments and repairs require tools which are commonly available in many service shops. Special tools are described in the Yanmar Engine 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. Copies of the traction unit Parts Catalog for this machine are available at www.toro.com.

Traction Unit Operator’s Manual

The traction unit Operator’s Manual provides information regarding basic engine operation, general engine maintenance, and engine maintenance intervals for your machine. Refer to the traction unit Operator’s Manual for additional information.

Yanmar Service and Troubleshooting Manuals

The engine that powers your Outcross 9060 machine is a Yanmar Model 4TNV86CT, a Tier 4 compliant engine. The Yanmar TNV (Tier 4) Series Service Manual and the Yanmar TNV (Tier 4) Series Troubleshooting Manual are available for this engine. Ensure that the correct engine manuals are used when servicing the engine on your machine.

Shutting Off the Engine

IMPORTANT

The engine used on the Outcross 9060 machine is a turbo-charged diesel engine. Before shutting off the engine after full-load operation, allow the engine to run at low-idle speed for 2 minutes. This allows the turbocharger and internal engine components to adequately cool-down. Failure to allow this cool-down period may lead to premature turbocharger and engine failure.
Engine Electronic Control Unit (ECU)

The Yanmar engine that powers your Outcross 9060 machine uses an Electronic Control Unit (ECU) for engine management. The primary controller (T1: TEC), the status display controller (T2: TDM), the Yanmar Engine Control Unit (ECU), the InfoCenter Display, and the optional InchMode controller (T3: TEC) used on the Outcross 9060 machine communicate with each other on a Controller Area Network (CAN) bus system. All wire harness electrical connectors should be plugged into the ECU before the machine key switch is moved from the OFF position to either the ON or START position.

A variety of engine electrical components (e.g. ECU, fuel injectors, EGR sensor, exhaust DPF sensor, etc.) are identified and matched in the engine ECU program. If engine electrical components are replaced on the engine, the Yanmar SmartAssist–Direct tool (SA-D) must be used to update the ECU program to ensure correct engine operation. The Yanmar SA-D connector is located near the engine ECU, under the dash cover in the passenger foot well.

If the engine ECU identifies that an engine problem exists, an engine fault will be displayed on the T2: TDM screen and the engine speed may be reduced or the engine might stop. The Yanmar TNV (Tier 4) Series Troubleshooting Manual and the Yanmar SmartAssist–Direct tool (SA-D) should be used to provide assistance in identifying the cause of the problem and the repairs that may be necessary. Contact your Toro distributor for assistance in Yanmar engine troubleshooting.

**IMPORTANT**

Do not disconnect the engine ECU for 60 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.
The engine used on Outcross 9060 machine is a Yanmar TNV Series, turbocharged, 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, an exhaust gas recirculation (EGR) system, an electronic governor, a diesel exhaust particulate filter (DPF), and a turbocharger. Glow plugs are used to assist starting the engine. Numerous engine sensors are used to allow the ECU to monitor and control the engine operation for optimum engine performance.

During the operation of the engine, if conditions warrant, the ECU may generate an engine fault; refer to Machine and Engine Faults (page 3–6). Use the Yanmar TNV (Tier 4) Series Troubleshooting Manual and the Yanmar SmartAssist–Direct tool (SA-D) to provide assistance in identifying the cause of the problem and the repairs that may be necessary. Contact your authorized Toro Distributor for assistance.
Diesel Particulate Filter

1. Diesel Particulate Filter assembly (DPF)
2. Diesel Oxidation Catalyst (DOC)
3. Soot filter
4. Temperature sensor (2 each)
5. Pressure differential sensor

The diesel particulate filter (DPF) used on Yanmar Tier 4F compliant engines is designed to break down the hazardous elements in the exhaust and prevent the discharge of unburned 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). The length of time the engine will operate at a higher than normal exhaust temperature to burn out the soot is also related to the amount of particulate matter in the soot filter.
### Types of regeneration that are performed automatically (while the machine is operating)

<table>
<thead>
<tr>
<th>Type</th>
<th>Conditions</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive</td>
<td>Occurs during normal operation of the machine at high engine speed or high engine load</td>
<td>The DPF processes high heat exhaust gasses, oxidizing harmful emissions and incinerating soot to ash.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Passive regeneration occurs as part of normal engine operation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The InfoCenter does not display an icon during passive regeneration.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>While operating the machine, run the engine at full-engine speed and high load when possible to promote DPF regeneration.</td>
</tr>
<tr>
<td>Assist</td>
<td>Occurs because of prolonged operation at low engine speed, low engine load, or when the engine ECU detects the soot filter is becoming obstructed.</td>
<td>The engine ECU adjusts the exhaust intake throttle to raise the exhaust temperature.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The InfoCenter does not display an icon during assist regeneration.</td>
</tr>
<tr>
<td>Reset</td>
<td>Occurs every 100 hours of engine operation&lt;br&gt;Occurs after an assist regeneration if the engine ECU determines the assist regeneration did not sufficiently reduce the soot level</td>
<td>The InfoCenter displays the high exhaust temperature icon.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The engine ECU adjusts the exhaust intake throttle and the injector timing to raise the exhaust temperature.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Do not shut off the engine or reduce the engine speed while the reset regeneration is processing.</td>
</tr>
</tbody>
</table>
Regeneration (continued)

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

<table>
<thead>
<tr>
<th>Type</th>
<th>Conditions</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parked</td>
<td>Occurs when exhaust back pressure in the DPF increases due to continued soot buildup. May occur because the InfoCenter was set to inhibit reset regeneration and machine operation continued, adding more soot to the DPF after a reset regeneration was requested. May be caused by prolonged operation at low engine speed, low engine load, or the use of incorrect fuel or engine oil. Can be initiated when prompted by the engine ECU or manually after a minimum of 50 hours of engine operation.</td>
<td><img src="image" alt="InfoCenter displays the stationary regeneration icon." /> 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.</td>
</tr>
<tr>
<td>Recovery</td>
<td>Occurs when exhaust back pressure in the DPF increases due to soot buildup reaching a critical level. May occur because parked regeneration requests were ignored and machine operation continued, adding more soot to the DPF after a parked regeneration was requested. Can only be initiated when prompted by the engine ECU.</td>
<td><img src="image" alt="InfoCenter displays the stationary regeneration icon." /> 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.</td>
</tr>
</tbody>
</table>

Refer to the traction unit Operator’s Manual for additional DPF regeneration information, and instructions for using the InfoCenter DPF Regeneration Menus.

Soot Accumulation

If the types of regeneration that are performed automatically (while the machine is operating) are not allowed to complete, 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 T2: TDM display, the engine output power will be reduced.

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 T2: TDM display, the engine output power will be reduced.
Removing and Installing the Air Cleaner System

Note: Refer to the traction unit Operator's Manual for maintenance procedures and intervals of the air cleaner.

1. Remove the air cleaner components as necessary.
2. Examine the air cleaner assembly for wear or damage that could possibly cause air leaks.
Removing and Installing the Air Cleaner System (continued)

3. Examine the hoses for wear or damage and replace them if necessary.
4. Examine the hood and radiator/oil cooler seals for wear or damage and replace the seals if necessary.

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**IMPORTANT**

Leaks in the air filter system will allow dirt to enter 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.

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5. Assemble the air cleaner components as shown in Figure 10.
The engine that powers your Outcross 9060 machine is equipped with an exhaust system that includes a Diesel-Particulate Filter (DPF). The DPF includes a Diesel Oxidation Catalyst (DOC), a Soot Filter (SF), 2 temperature sensors, and a pressure differential sensor. The diesel-particulate filter (DPF) is kept clean through a series of regeneration processes that are controlled by the engine ECU; refer to Diesel Particulate Filter (page 4–5).

Reconditioning the soot filter (SF) may be necessary over the life of the machine which will require exhaust system disassembly. Soot filter reconditioning should be done by a company that has the necessary equipment. Contact your Toro Distributor for information on reconditioning the soot filter.

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.

Information about the diesel-particulate filter (DPF) operation and maintenance can be found in the Yanmar TNV (Tier 4) Series Service Manual and the Yanmar TNV (Tier 4) Series Troubleshooting Manual.
The radiator on your Outcross 9060 is combined with the hydraulic fluid cooler. The procedure for removing and installing the radiator and hydraulic fluid cooler as an assembly is provided.

**Note:** If desired, the radiator and hydraulic fluid cooler may be separated from each other in the machine and removed individually.

### Removing the Radiator and Hydraulic Fluid Cooler

1. Park the machine on a level surface, lower any attachments, shut off the engine, and remove the key from the key switch.

2. Raise and latch the hood, then remove the front screen; refer to Removing and Installing the Front Screen (page 8–3).
Removing the Radiator and Hydraulic Fluid Cooler (continued)

**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 the coolant away from children and pets.
Keep the coolant in a labelled container.
Discard the coolant in accordance with local hazardous waste ordinances.

3. Drain the coolant from the radiator.
4. Disconnect the upper and lower radiator hoses from the radiator. Disconnect the reservoir hose at the radiator. Cover or plug the disconnected coolant hoses to prevent contamination.
   
   **Note:** The lower hydraulic hose can be easily disconnected at the bulkhead below the vehicle frame.
5. Refer to General Precautions for Removing and Installing the Hydraulic System Components (page 5–49) and disconnect the hydraulic lines from the cooler.
6. Remove the fasteners securing the fuel cooler assembly to the hydraulic fluid cooler and move the fuel cooler out of the way.
7. Remove the top nut plate, top bracket, isolator mount and the fan shrouds.
8. Carefully remove the radiator and hydraulic fluid cooler assembly from the machine.
9. If necessary, remove the hydraulic fittings from the hydraulic fluid cooler and discard the O-rings.
10. Cover or plug the openings in the hydraulic fluid cooler and radiator to prevent contamination from entering the system.
11. Inspect the isolator mounts and all seals on the radiator frame and replace as necessary.

**Installing the Radiator and Hydraulic Fluid Cooler**

1. Lubricate new O-rings and place them onto the hydraulic fittings. If previously removed, install the fittings into the cooler ports using alignment marks made during removal; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–10).
2. Position the radiator and hydraulic fluid cooler assembly over the lower isolator mounts.
3. Install the isolator mount, top bracket and top nut plate.
4. Install the fan shrouds. Center the fan shroud around the fan blades before tightening the shroud fasteners.
Installing the Radiator and Hydraulic Fluid Cooler (continued)

5. Secure the fuel cooler assembly to the hydraulic fluid cooler.
6. Remove the covers and plugs from the openings in the radiator and the hydraulic fluid cooler and the disconnected coolant and hydraulic lines that were installed during removal.
7. Connect the hydraulic lines to the hydraulic fluid cooler.
8. Connect the upper and lower radiator hoses and the reservoir hose to the radiator and secure the hoses with the hose clamps.
9. Fill the reservoir with coolant; refer to the traction unit Operator’s Manual.
10. Add hydraulic fluid to the hydraulic reservoir as necessary; refer to the traction unit Operator’s Manual.
11. Start the engine and check for coolant and hydraulic fluid leaks. Repair any leaks as required.
12. Continue to run the engine to obtain the operating temperature. Check the coolant and hydraulic fluid levels and adjust as necessary before returning the machine to service.
13. Install the front screen.
The fuel system includes a fuel tank with an electric fuel level sender on the right side of the machine, a fuel/water separator and a low pressure electric fuel pump located behind the fuel tank, a fuel filter, a mechanical high pressure fuel pump at the front right side of the engine, and a fuel cooler located in front of the hydraulic fluid cooler assembly. For testing procedures for the low pressure electric fuel pump and the electric fuel level sender, refer to Electrical Component Testing (page 6–14).
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 handling diesel fuel.
- Do not handle diesel fuel while the engine is running, while the engine is hot, or when the machine is in an enclosed area.
- Handle diesel fuel outside whenever possible 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

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 the fuel filter or disconnecting a fuel hose).

IMPORTANT

Do not turn the key switch to the START position to prime the fuel system.

To prime the fuel system:
1. Ensure that the fuel tank has fuel in it.
2. Allow the electric fuel pump to prime the fuel system by turning the key switch to the Run position for 10 to 15 seconds.

Removing and Installing the Fuel Tank

1. Park the machine on a level surface, lower any attachments, shut off the engine, and remove the key from the key switch.
2. Unlatch and raise the hood.
3. Remove the front right fender.
4. Remove the right step.
5. Empty the fuel tank through the filler neck.
6. Support the fuel tank, then remove the 4 support bracket screws. Lower the fuel tank and bracket a few inches.
7. Disconnect the wire harness connection from the fuel sender.
**Removing and Installing the Fuel Tank (continued)**

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**IMPORTANT**

To prevent damage to the fuel hoses, numerous cable ties and clamps are used to secure the hoses to the machine components. Record the location of all cable ties and clamps that are removed from the machine so they can be properly replaced.

---

8. Label the fuel hoses for assembly purposes. Loosen the hose clamps and disconnect the hoses from the fuel tank.

9. Cover or plug the fuel hoses or fitting openings to prevent contamination from entering the fuel system.

10. Lower the tank and support bracket to the ground. Separate the tank and bracket by removing the 3 clamps if necessary.

11. If the fuel level sender is removed, use a new gasket when installing the fuel sender.

12. If the elbow fittings are removed from the fuel/water separator head, apply thread sealant to the fittings when installing.

13. To install the fuel tank, follow this procedure in reverse order.
Removing the Engine

1. Park the machine on a level surface, lower any attachments, shut off the engine and remove the key from the key switch.
2. Disconnect the battery; refer to Removing the Battery (page 6–81).
3. Remove the front screen; refer to Removing and Installing the Front Screen (page 8–3).
4. Remove the hood; refer to Removing and Installing the Hood (page 8–5).
5. Remove the air cleaner assembly; refer to Removing and Installing the Air Cleaner System (page 4–8).
6. Remove the left and right side shields.
Removing the Engine (continued)

**IMPORTANT**

To prevent damage to the fuel hoses, numerous cable ties and clamps are used to secure the hoses to the machine components. Record the location of all cable ties and clamps that are removed from the machine so they can be properly replaced.

7. Disconnect the fuel hoses; refer to Fuel System (page 4–14):
   A. Disconnect the hose between the engine fuel filter and the fuel cooler at the engine fuel filter.
   B. Disconnect the hose between the electric fuel pump and the engine fuel filter at the engine fuel filter.
   C. Disconnect the hose between the fuel cooler and the fuel tank at the fuel cooler.
   D. Cover or plug the fuel hoses or fitting openings to prevent contamination from entering the fuel system.

**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 coolant when the radiator or engine is hot.

**WARNING**

Ethylene-glycol antifreeze is poisonous.

Keep the coolant away from children and pets.

Keep the coolant in a labelled container.

Discard the coolant in accordance with local hazardous waste ordinances.

8. Disconnect the reservoir hose at the radiator and remove the coolant reservoir assembly.
9. Drain the coolant from the radiator.
10. Disconnect the upper and lower radiator hoses from the radiator. Cover or plug the disconnected coolant hoses to prevent contamination.
   **Note:** The lower hydraulic hose can be easily disconnected at the bulkhead below the vehicle frame.
11. Refer to General Precautions for Removing and Installing the Hydraulic System Components (page 5–49) and disconnect the hydraulic lines from the cooler.
12. Remove the top nut plate and the fan shroud. Reinstall the top nut plate.
13. Remove the 4 flange nuts and carriage screws securing the radiator mount assembly to the frame and remove the radiator assembly from the machine.
Removing the Engine (continued)

14. Remove the exhaust pipe from the engine; refer to Exhaust System (page 4–10).

15. Remove the Operator's platform; refer to Removing the Operator's Platform (page 8–6).

---

**CAUTION**

The hydraulic pump assembly weighs approximately 73 kg (160 lbs).

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16. Support the hydraulic pump assembly.

17. Disconnect the hydraulic pump assembly at the front PTO gearbox.

18. Refer to General Precautions for Removing and Installing the Hydraulic System Components (page 5–49) and disconnect the hydraulic lines from the front PTO gearbox. Plug the hydraulic lines and cap the fittings to prevent contamination from entering the hydraulic system.

19. Disconnect the PTO drive shaft at the front hub and slide the drive shaft rearward.

20. Disconnect the battery positive cable at starter solenoid and the engine ground cable near the left rear engine mount.

---

**CAUTION**

Make sure that the hoist or lift and load leveling bar used to remove the engine can properly support the engine. The engine and gearbox assembly weighs approximately 280 kg (617 lbs).

---

21. Connect a suitable hoist or lift and load leveling bar to the front and rear lift tabs on engine. Do not allow the lift chains or straps to contact the DPF.
Removing the Engine (continued)

1. Fusible link
2. Bracket – front left (for machines without air conditioning shown)
3. Flange nut (10 each)
4. Bracket – front right
5. Lock washer (8 each)
6. Cap screw (8 each)
7. Cap screw (8 each)
8. Engine mount – front (2 each)
9. Snubbing washer – front (2 each)
10. Bolt – front (2 each)
11. Flange-head screw
12. Wire harness bracket
13. Bolt – rear (2 each)
14. Snubbing washer – rear (2 each)
15. Engine mount – rear (2 each)
16. Flange nut (2 each)
17. Wire harness bracket
18. Cap screw

22. Remove lock nuts, snubbing washers and cap screws securing the engine mounts to the engine brackets.

**CAUTION**

Use 1 person to operate the lift or hoist while the other person guides the engine from the machine.
Removing the Engine (continued)

**IMPORTANT**

When removing the engine ensure that you do not damage the engine, fuel hoses, hydraulic lines, electrical harnesses or other parts.

23. Carefully raise the engine from the machine moving it toward the front of the machine.
24. Locate and retrieve the hydraulic pump drive coupler and O-ring. Discard the O-ring.
25. If necessary, remove the wire harness and engine mount brackets from the engine.
26. If necessary, remove the front PTO gear box from the engine; refer to Removing the Front PTO Gear Box (page 7–14).
27. If necessary, remove the flywheel housing and spring coupler; refer to Removing and Installing the Flywheel Housing and Drive Coupler (page 4–23).
28. Cover or plug all engine openings to prevent contaminants from entering the engine.

Installing the Engine

**IMPORTANT**

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

1. If front engine mount brackets were removed from the engine, tighten the bracket to engine fasteners from 46 to 57 N·m (34 to 42 ft-lb).
2. Apply anti-seize lubricant to the hydraulic pump drive coupler, the gearbox output shaft and the pump input shaft. Install the drive coupler in the gearbox and install a new O-ring on the hydraulic pump.

**CAUTION**

Make sure that the hoist or lift and load leveling bar used to remove the engine can properly support the engine. The engine and gearbox assembly weighs approximately 280 kg (617 lbs).

3. Connect a suitable hoist or lift and load leveling bar to the front and rear lift tabs on engine. Do not allow the lift chains or straps to contact the DPF.

**CAUTION**

Use 1 person to operate the lift or hoist while the other person guides the engine into the machine.
Installing the Engine (continued)

**IMPORTANT**

When installing the engine ensure that you do not damage the engine, fuel hoses, hydraulic lines, electrical harnesses or other parts.

4. Carefully lower the engine into the machine while aligning the hydraulic pump drive coupler.
5. Install the cap screws, snubbing washers and lock nuts securing the engine mounts to the engine brackets.
6. Remove the pump support and secure the hydraulic pump to the front PTO gearbox. Tighten the pump mounting screws from 153 to 188 N·m (113 to 139 ft-lb).
7. Secure the PTO drive shaft to the front hub.
8. Install the operator’s platform; refer to Installing the Operator’s Platform (page 8–13).
9. Connect the battery positive cable at the starter solenoid, and connect the engine ground cable near the left rear engine mount.
10. Install the exhaust pipe; refer to Exhaust System (page 4–10).
11. Install the radiator; refer to Installing the Radiator and Hydraulic Fluid Cooler (page 4–12).
12. Connect the fuel supply and return hoses to the engine and secure the fuel hoses with hose clamps; refer to Fuel System (page 4–14).
13. Install the air cleaner assembly; refer to Removing and Installing the Air Cleaner System (page 4–8).

**Note:** New radiator drain plugs are pre-coated with thread sealant. Clean the threads and apply thread sealant if installing a used drain plug.
14. Ensure the radiator drain plug is installed and fill the radiator and reservoir with coolant; refer to the traction unit Operator’s Manual.
15. Connect the battery cables; refer to Installing the Battery (page 6–81).
16. Ensure that all the wires, fuel lines, hydraulic hoses, and cables are clear of moving parts and secured to their original locations.
17. Check the engine-oil level and adjust as necessary.
18. Check the hydraulic-fluid level in the hydraulic reservoir and add correct if necessary; refer to the traction unit Operator’s Manual.
19. Prime the fuel system; refer to Priming the Fuel System (page 4–15).
20. Start the engine and operate the hydraulic controls to properly fill the hydraulic system; refer to Charging the Hydraulic System (page 5–59).
21. Check and adjust the engine coolant level; refer to the traction unit Operator’s Manual.
Removing and Installing the Flywheel Housing and Drive Coupler

**Note:** Removing the engine from the machine before removing the flywheel housing and drive coupler is required.

1. Remove the flywheel housing and drive coupler components as necessary.
2. Position the drive coupler to the engine flywheel and align mounting holes. Ensure that the coupler hub is away from the engine flywheel as shown.

3. Use medium strength thread locking compound and secure the coupler to the engine flywheel with eight 8 cap screws and hardened washers. Tighten cap screws in a crossing pattern from **23 to 28 N·m (17 to 21 ft·lb)**.

4. Position flywheel housing to engine and secure with 8 flange head screws. Tighten screws in a crossing pattern from **36 to 57 N·m (34 to 42 ft·lb)**.
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Additional Reference Materials

Danfoss H1 Closed Circuit Axial Piston Pumps Service Manual
Danfoss H1 Closed Circuit Axial Piston Pumps Repair Instructions
Danfoss K and L Frame Variable Motors Service Manual
Danfoss Steering Unit Type OSPB, OSPC and OSPF Service Manual
Gresen/Parker Hydraulics Model V10 Sectional Body Directional Control Valve Service Manual
General Information

Traction Unit Operator’s Manual and Accessory Installation Instructions

The traction unit Operator’s Manual and accessory Installation Instructions provide information regarding the operation, general maintenance and maintenance intervals for the machine and its accessories. Refer to the traction unit Operator’s Manual and accessory Installation Instructions for additional information.

Relieving Pressure from the Hydraulic System

Release all the pressure in the hydraulic system before performing any work on the hydraulic system.

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 any attachments fully.
3. Turn the key switch to the OFF position and allow the engine to stop.
4. Make sure all electrically operated control valves are actuated by setting the key switch to the RUN position but Do Not start the engine.
5. Slowly move the auxiliary load valve to the fully FORWARD and fully REARWARD positions.
6. If the machine is equipped with a front loader, move the loader control valve to the FORWARD, REARWARD, fully LEFT, and fully RIGHT positions.
7. Turn the steering wheel in both the LEFT and the RIGHT directions.
8. Turn the key switch to the OFF position.
Towing the Traction Unit

1. Access panel
2. 6 mm hex wrench
3. Bypass valves (4 each)
4. Manual valve
5. Hand pump

**IMPORTANT**

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

If it becomes necessary to tow or push the machine, the tandem piston (traction) pump must be set to bypass hydraulic fluid and the hydraulic brake circuit must be manually pressurized to release the brake. Move the machine at a speed **below 3.2 kph (2 mph)**, and for a very short distance. If the machine needs to be moved more than a short distance, the machine should be transported on a trailer.

**IMPORTANT**

Do not start or run the engine when the valves are set to the bypass position.

1. Remove the access panel from the right side of the control console and retrieve the 6 mm hex wrench provided.
Towing the Traction Unit (continued)

1. Bypass valve assembly
2. 6 mm hex wrench
3. Plug

4. Plunger (normal operating position)
5. Plunger (bypass position for towing)

Note: To prevent hydraulic fluid leakage, do not loosen the bypass valve assemblies.

2. Set the valves to the bypass position by inserting a 6 mm hex wrench through the valve plug and turning the plunger all the way in clockwise. Repeat this step for each bypass valve assembly (4 total).

3. To release the brake, lift and hold the manual valve while pumping the hand pump.

4. Pump the hand pump until resistance is felt. When enough pressure has been created, the manual valve will remain in the raised position and the brake will be released.

5. After towing and before starting the engine, insert a 6 mm hex wrench through the valve plug and turn the plunger all the way out counterclockwise. Repeat this step for each bypass valve assembly (4 total).

6. Push the manual valve down to engage the parking brake.

7. Secure the 6 mm hex wrench provided and install the access panel.
Traction Circuit (Closed-Loop) Component Failure

The traction system of the Outcross 9060 machine consists of two closed-loop circuits, each with its own piston (traction) pump, drive axle motor, and control valves. The two traction pumps (P1) and (P2) are part of the tandem piston (traction) pump. Pump (P1) supplies the front traction circuit, and pump (P2) supplies the rear traction circuit. If a component in one of the traction circuits should fail, unwanted material and contamination from the damaged component will circulate throughout that traction circuit. This contamination can damage other components in that circuit. The contamination must be removed as soon as possible to prevent additional component failure.

The recommended method of removing contamination from a traction circuit is to temporarily install a Toro high flow hydraulic filter into the traction circuit; refer to High Flow Hydraulic Filter Kit (page 2–17). If a traction circuit failure is suspect, the filter should be installed before connecting hydraulic test gauges to test traction circuit components or after replacing a failed traction circuit component. The filter will ensure that contaminates are removed from the closed-loop traction circuit and thus, prevent additional component damage. Refer to Filtering the Closed-Loop Traction Circuit (page 5–54) for additional information on using the Toro high flow hydraulic filter.

Note: If traction circuit contamination exists, the traction pump and drive axle motor drains could allow contaminates to enter the hydraulic tank.

The alternative to using the Toro high flow hydraulic filter kit after a traction circuit component failure would be to disassemble, drain and thoroughly clean all the components, the hydraulic tank, and the hydraulic tubes and hoses in the traction circuit. If any debris remains in the traction circuit and the machine is operated, the debris can cause additional circuit component failures.
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 and repair or replace them as necessary. Hoses that move during normal machine operation should be replaced every 2 years. Check hydraulic hoses for the following signs of deterioration or damage:

- Hydraulic hoses should not be hard, cracked, cut, abraded, charred, leaking, or otherwise damaged.
- Hydraulic hoses should not be kinked, crushed, flattened, or twisted.
- Hydraulic hose covers should not be blistered, soft, degraded, or loose.
- Hydraulic hose fittings should not be cracked, damaged, or badly corroded.

⚠️ WARNING ⚠️

Release all pressure in the hydraulic system before performing any work on the hydraulic system; refer to Relieving Pressure from the Hydraulic System (page 5–3).

- 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.

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 two wrenches, hold the hose straight with one wrench and tighten the hose swivel nut onto the fitting with the other wrench; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–8).

Note: If the hose has an elbow at one 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 the Toro Basics Series Training Book Hydraulic Hose Servicing (Part No. 94813SL).
Installing Hydraulic Hoses and Tubes (O-Ring Face Seal)

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 19).

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 5–9). 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 2–7).
**Installing Hydraulic Hoses and Tubes (O-Ring Face Seal)**  
(continued)

### Hose/Tube Installation Torque Table

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

### Flats From Wrench Resistance Table

<table>
<thead>
<tr>
<th>Size</th>
<th>FFWR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 (1/4 inch nominal hose or tubing)</td>
<td>1/2 to 3/4</td>
</tr>
<tr>
<td>6 (3/8 inch)</td>
<td>1/2 to 3/4</td>
</tr>
<tr>
<td>8 (1/2 inch)</td>
<td>1/2 to 3/4</td>
</tr>
<tr>
<td>10 (5/8 inch)</td>
<td>1/2 to 3/4</td>
</tr>
<tr>
<td>12 (3/4 inch)</td>
<td>1/3 to 1/2</td>
</tr>
<tr>
<td>16 (1 inch)</td>
<td>1/3 to 1/2</td>
</tr>
</tbody>
</table>

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.

   **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 (item 1 Figure 20). If connecting a hose, hold the hose in alignment with a wrench to prevent the hose from turning.

   **C.** Use a wrench to tighten the nut to the correct Flats From Wrench Resistance (compare items 2 and 3 in Figure 20).
Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings)

Installing a Non-Adjustable Fitting

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 tightening the fitting, determine the material used for the port the fitting is being installed in. Installing a fitting into an aluminum port requires reducing the 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 5–12).

   **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 2–7).

5. If a torque wrench is not available or if space at the port prevents the use of a torque wrench, use the Flats From Finger Tight (FFFT) procedure 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 value; refer to the Flats From Finger Tight (FFFT) Table (page 5–12).

   C. If the port material is aluminum, tighten the fitting to 60% of the listed value; refer to the Flats From Finger Tight (FFFT) Table (page 5–12).
Installing an Adjustable Fitting

1. Locknut
2. Back-up washer
3. O-ring

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.
4. Turn back the lock nut 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 23).
5. Install the adjustable fitting into the port by hand until the washer contacts the face of the port (Step 2 in Figure 23).
6. 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 23). Do not rotate the adjustable fitting more than 1 turn counterclockwise.

**IMPORTANT**

Before tightening the fitting, determine the material used for the port the fitting is being installed in. Installing a fitting into an aluminum port requires reducing the installation torque.

7. Tighten the fitting lock nut (Step 4 in Figure 23):
Installing an Adjustable Fitting (continued)

A. Hold the fitting in the correct alignment with a wrench and use a torque wrench and tighten the lock nut to the recommended torque value within the specified range of torque values; refer to the Fitting Installation Torque Table (page 5–12). This tightening procedure requires a drive-adapter wrench (e.g., crowfoot wrench); refer to Calculating the Torque Values When Using a Drive-Adapter Wrench (page 2–7).

B. If a torque wrench is not available or if space at the port prevents the use of a torque wrench, hold the fitting in the correct alignment with a wrench and tighten the lock nut with a second wrench.

C. If the port material is steel, tighten the fitting to the listed Flats From Finger Tight (FFFT) value; refer to the Flats From Finger Tight (FFFT) Table (page 5–12).

D. If the port material is aluminum, tighten the fitting to 60% of the listed FFFT value; refer to the Flats From Finger Tight (FFFT) Table (page 5–12).

Fitting Installation Torque Table

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

Flats From Finger Tight (FFFT) Table

<table>
<thead>
<tr>
<th>Size</th>
<th>FFFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 (1/4 inch nominal hose or tubing)</td>
<td>1.00 ± 0.25</td>
</tr>
<tr>
<td>6 (3/8 inch)</td>
<td>1.50 ± 0.25</td>
</tr>
<tr>
<td>8 (1/2 inch)</td>
<td>1.50 ± 0.25</td>
</tr>
<tr>
<td>10 (5/8 inch)</td>
<td>1.50 ± 0.25</td>
</tr>
<tr>
<td>12 (3/4 inch)</td>
<td>1.50 ± 0.25</td>
</tr>
<tr>
<td>16 (1 inch)</td>
<td>1.50 ± 0.25</td>
</tr>
</tbody>
</table>
The hydraulic schematic for the Outcross 9060 machine is located in Appendix A (page A–1).
The traction circuit of the Outcross 9060 machine consists of two closed-loop circuits, each with its own piston (traction) pump, axle motor, and control valves. The two traction pumps (P1) and (P2) are part of the tandem piston (traction) pump. Pump (P1) supplies the front traction circuit, and pump (P2) supplies the rear traction circuit. The tandem, variable displacement, bidirectional piston (traction) pump is directly coupled to the engine to provide hydraulic flow for the traction circuits. The swash plate movement for each pump is controlled separately by a pair of solenoid operated displacement control valves mounted to the pump (electro-hydraulic servo piston assembly). Pushing the traction pedal rotates a hall effect sensor that provides an input to the T1: TEC. The T1: TEC sends a corresponding PWM (Pulse Width Modulation) output signal to the displacement control valve solenoids to move the pump swash plate accordingly and control the pump’s output volume (vehicle speed and traction control).

Traction circuit pressure is constantly being monitored at both pumps when operating in the forward direction. A pair of pressure sensors provide information to the T1: TEC that is used for traction control.

The vehicle’s direction of travel is controlled by the T1: TEC based on input from the transmission lever located to the left of the steering wheel. When the direction lever is in the F (forward) position and the traction pedal is pushed, solenoid AB-C1 on the front pump and solenoid CD-C1 on the rear pump are energized. When the transmission lever is in the R (reverse) position and the
traction pedal is pushed, solenoid AB-C2 on the front pump and solenoid CD-C2 on the rear pump are energized.

Front and rear drive axle motors are positive displacement, 2 position axial piston motors. The 2 position drive motors can operate in either a low speed range or high speed range. The motors are spring biased to maximum displacement for low speed and are hydraulically shifted to minimum displacement for high speed. Solenoid valve (SV1) in the main manifold is energized by the TEC when the mode selector is set to the HIGH SPEED AUTO position. In high speed auto, hydraulic flow from solenoid valve (SV1) moves the swash plate in the drive motor to reduce the motor displacement and increase its potential rpm. The drive axle motors include a flushing valve that bleeds off a small amount of hydraulic fluid for cooling the closed-loop traction circuit. The charge circuit replenishes fluid that is bled from the traction circuit by the flushing valve, and the fluid that moves through the traction pump case to the tank during normal operation.

Operating pressure on the high pressure side of the closed-loop traction circuit is determined by the amount of load developed at the drive axle motors. As the load increases, circuit pressure can increase to the relief valve setting of 33,100 kPa (4800 psi) in either forward or reverse. Traction pressure to each axle can be viewed while the machine is moving in the forward direction by using the InfoCenter SERVICE–TRACTION–TRACTION INPUTS FRONT TRACTION and REAR TRACTION readings. If pressure exceeds the relief setting, fluid flows through the unseated relief valve to the low pressure side of the closed-loop traction circuit.

Note: The tandem piston (traction) pump includes a set of 4 bypass valves. The bypass valves are necessary to allow the machine to be towed a limited distance if necessary; Towing the Traction Unit (page 5–4).

Traction Charge Circuit

The traction pumps and drive axle motors use a small amount of hydraulic fluid for internal lubrication. Fluid is designed to leak across the pump and motor parts and into the component case drain. The tandem piston (traction) pump drains from its L3 port back to the hydraulic tank. The drive motors drain from their L1 ports back to the hydraulic tank. Each drive motor also includes a shuttle valve to increase the amount for fluid charge-out in the closed-loop traction circuit for cooling purposes. The traction charge circuit is designed to replace the hydraulic fluid that leaves the closed-loop traction circuit.

The gear pump section furthest from the piston pump, gear pump section (P4), supplies fluid to a variety of circuits including the traction charge circuit. Hydraulic fluid from gear pump (P4) enters the main manifold port P and flows through the steering priority valve (EC1); refer to Steering Circuit (page 5–18) for a full explanation of the steering priority valve (EC1) operation. Fluid flow continues through the flow regulator valve (EC2) until it reaches solenoid valve (SP1). Solenoid valve (SP1) is responsible for raising the 3-point hitch cylinders and is closed as long as the cylinders are not raising. Fluid is also sent to one end of the flow regulator valve (EC2) spool. As long as circuit flow is blocked at solenoid valve (SP1), the flow regulator valve (EC2) spool is shifted to direct flow to the traction charge, 2 speed drive motor control, brake release, differential lock and PTO clutch circuits.

Once the steering circuit needs have been satisfied, and since the 2 speed drive motor control, brake release, differential lock and PTO clutch circuits place very small demands on the fluid flow delivered by gear pump (P3), the remainder of the flow is directed to the traction charge circuit. Charge circuit flow passes through the charge filter before entering the tandem piston (traction) pump to prevent contaminants from entering the closed-loop traction circuit. The charge filter is located on the right side of the machine behind the front axle. Traction
charge pressure is limited to 2,000 kPa (290 psi) in the pump by a relief valve located in the tandem piston (traction) pump. Charge pressure at each traction (piston) pump can be viewed while the vehicle is stationary using the InfoCenter SERVICE–TRACTION–TRACTION INPUTS–FRONT TRACTION and REAR TRACTION readings. Charge pressure can also be measured at the charge pressure test port located near the charge filter assembly. Measured pressure should be approximately 2,068 kPa (300 psi).
Steering Circuit Diagram (neutral position)
Steering Circuit Diagram (turning to the right)
A two (2) section gear pump is coupled directly to the tandem piston (traction) pump. The gear pump section furthest from the piston pump, gear pump section (P4), supplies fluid to the steering, hitch lift and traction charge circuits. Gear pump section (P4) also supplies flow to the 2 speed drive motor control, brake release, differential lock and PTO clutch circuits.

Hydraulic flow from gear pump section (P4) is directed to the appropriate circuits by a steering priority valve (EC1) located in the main manifold. The steering priority valve ensures the steering circuit always has enough hydraulic flow to steer the machine, no matter what the hydraulic needs of the other circuits are at the time.

The steering wheel is directly attached to the steering valve. The steering valve is a closed center, load sensing rotary valve. The steering valve senses when fluid flow is needed for steering and the steering priority valve (EC1) shifts to supply hydraulic flow. Gear pump (P4) fluid flow that is not needed for the steering circuit is available for the remaining circuits.

Two (2) steering cylinders are used on the machine, one for steering the front wheels and one for steering the rear wheels. The cylinders are connected to the steering valve in series. To allow for synchronization of the front and rear steering cylinders, both the steering cylinders include an internal re-phasing check valve assembly in the cylinder piston. While rotating the steering wheel for a turn (either right or left), the cylinder check valve will open when the cylinder is fully extended or retracted. After both cylinders have moved fully, the 4 wheel steering system has been synchronized. If the steering wheel continues to be turned, the check valves will stay open and will allow flow through the circuit.

**Neutral Position**

When the steering wheel is in the neutral position (at rest) and the engine is running, hydraulic fluid from gear pump (P4) enters the main manifold port P, flows through the steering priority valve (EC1) and is routed to the steering valve where it dead heads at the control valve spool. Fluid is also sent to both ends of the steering priority valve (EC1) spool. On one end of the spool, fluid is directed to both the steering relief valve (RV1), and also to orifice OR1 then out the manifold LS/OR1 port to the steering valve. This flow provides steering load sensing that is directed through a small passage in the steering valve spool and sleeve before returning to the hydraulic tank. As long as this load sense flow is returning to the tank due to no steering input, the steering priority valve (EC1) spool is shifted to direct fluid to the flow regulator valve (EC2) for other uses.

**Left Turn**

When a left turn is made with the engine running, the turning of the steering wheel positions the steering valve spool so that the load sense flow is blocked. Without load sense flow, pressures on the ends of the steering priority valve (EC1) start to equalize causing (EC1) to move toward its un-shifted “neutral” position which directs the fluid needed to turn the machine to the steering valve. Fluid is routed out manifold port ST, into steering valve port P, through the steering valve spool, passes through the rotary meter and out the L port to the steering cylinders. The rotary meter ensures that the fluid flow to the cylinders is proportional to the amount that the steering wheel is turned. Fluid leaving the cylinders flows back through steering valve R port, the valve spool, out the T port and is then returned to the hydraulic reservoir. The steering valve returns to the neutral position when the steering wheel is released or turning is completed.

**Right Turn**

When a right turn is made with the engine running, the turning of the steering wheel positions the steering valve spool so that the load sense flow is blocked.
Right Turn (continued)

Without load sense flow, pressures on the ends of the steering priority valve (EC1) start to equalize causing (EC1) to move toward its un-shifted “neutral” position which directs the fluid needed to turn the machine to the steering valve. Fluid is routed out manifold port ST, into steering valve port P, through the steering valve spool, passes through the rotary meter and out the R port to the steering cylinders. The rotary meter ensures that the fluid flow to the cylinders is proportional to the amount that the steering wheel is turned. Fluid leaving the cylinders flows back through steering valve L port, the valve spool, out the T port and is then returned to the hydraulic reservoir. The steering valve returns to the neutral position when the steering wheel is released or turning is completed.

Steering Relief Operation

When the steering cylinders reach the end of their stroke or if a wheel should encounter an obstruction (e.g. a curb) while steering, the pressure in the steering circuit will rise. When steering circuit pressure rises to approximately 20,684 kPa (3000 psi), relief valve (RV1) in the main manifold opens and allows hydraulic flow to return to the hydraulic reservoir. This action causes the spool of the steering priority valve (EC1) to shift and send fluid away from the steering circuit and to the traction charge and hitch lift circuits. Relief valve (RV1) controls the action of the steering priority valve (EC1) and allows the valve to divert only enough fluid flow to the steering circuit to maintain relief pressure.
Hitch Cylinder Circuit Diagram (raising)
The 3-point hitch on the machine uses two (2) hydraulic cylinders to raise and lower the hitch arms. The cylinders are controlled by the paddle located below the left side of the steering wheel. A position sensor is connected to the hitch arm pivot shaft, allowing the T1: TEC to monitor the position of the 3-point hitch. Some attachments may be configured to control the 3-point hitch automatically.

The gear pump section furthest from the piston pump, gear pump section (P4), supplies fluid to a variety of circuits including the hitch lift circuit. Hydraulic fluid from gear pump (P4) enters the main manifold port P and flows through the steering priority valve (EC1); refer to Steering Circuit (page 5–18) for a full explanation of the steering priority valve (EC1) operation. Fluid flow continues through the flow regulator valve (EC2) where it dead heads at solenoid valve...
Fluid is also sent to one end of the flow regulator valve (EC2) spool. As long as circuit flow is blocked at solenoid valve (SP1), the flow regulator valve (EC2) spool is shifted to direct flow to the traction charge, 2 speed drive motor control, brake release, differential lock and PTO clutch circuits.

**Note:** Depending on the programmable attachment settings, raising and lowering the hitch may also disengage or engage the PTO.

### Raise

When the hitch paddle is pulled upward, solenoid valve (SP1) is energized and fluid flow is directed to the cap end of the hitch cylinders to raise the hitch arms. As the cylinders extend, fluid from the rod end of the cylinders is allowed to return to the hydraulic tank. If the hitch arms or the attachment being connected are restricted, or the attachment being connected is above the 3-point hitch capacity, relief valve (RV2) opens to prevent circuit pressure from exceeding 20,684 kPa (3000 psi).

**Note:** The maximum height the hitch arms can raise may be limited by the programmable attachment settings, or by the bed active switch when an optional cargo box is installed.

### Hold

When the hitch paddle is released, solenoid valve (SP1) is de-energized and the hydraulic fluid behind the cylinder piston is trapped to hold the cylinders in position. The fluid is trapped by a check valve inside solenoid valve (SP1), a check valve inside solenoid valve (SP2) and by check valve (CV2).

### Lower

When the hitch paddle is pushed downward, solenoid valve (SP2) is energized and the hydraulic fluid trapped behind the cylinder piston is allowed to return to the hydraulic tank. The weight of the hitch arms and/or the attachment lowers the hitch arms when the hydraulic fluid behind the cylinder piston is released.

**Note:** The minimum height the hitch arms can lower may be limited by the programmable attachment settings.
Brake Circuit

A hydraulically actuated wet multi-disc brake is installed between the rear axle motor and the rear axle assembly. When engaged, the brake prevents the rear axle input shaft from rotating.

The gear pump section furthest from the piston pump, gear pump section (P4), supplies fluid to a variety of circuits including the brake release. Hydraulic fluid from gear pump (P4) enters the main manifold port P and flows through the steering priority valve (EC1); refer to Steering Circuit (page 5–18) for a full explanation of the steering priority valve (EC1) operation. Fluid flow continues through the flow regulator valve (EC2) where it dead heads at solenoid valve (SP1). Fluid is also sent to one end of the flow regulator valve (EC2) spool. As long as circuit flow is blocked at solenoid valve (SP1), the flow regulator valve (EC2) spool is shifted to direct flow to the traction charge, 2 speed drive motor control, brake release, differential lock and PTO clutch circuits.

Parking Brake

The brake is automatically engaged by springs inside the brake assembly when the engine is not running (no hydraulic pressure available). When the engine is running and the parking brake switch is set to ENGAGE position, solenoid valve (SV2) in the main manifold is de-energized and hydraulic flow bypasses the brake circuit. The brake remains engaged by the springs inside the brake assembly. When the engine is running and the parking brake switch is set to the DISENGAGE position, solenoid valve (SV2) is energized and hydraulic flow passes through manual valve (MP) to push against the springs in the brake assembly and disengage the brake.

The parking brake may be disengaged when the engine is not running (no hydraulic pressure available) if necessary. Refer to Towing the Traction Unit (page 5–4) for additional information.

Service Brake

The brake will also engage when the decelerator pedal is fully depressed during vehicle operation. When the vehicle is in operation, the engine is running and the parking brake switch is in the DISENGAGE position. Solenoid valve (SV2) is energized and hydraulic flow keeps the brake disengaged. When the decelerator pedal is fully depressed, solenoid valve (SV2) de-energizes. The hydraulic pressure trapped in the circuit combined with the springs inside the brake assembly, shift manual valve (MP) and the allow the brake to engage.
Differential Lock Circuit

Hydraulic System: Hydraulic Flow Diagrams

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Outcross 9060
18234SL Rev C
Differential Lock Circuit (continued)

The drive axles include hydraulically actuated differential locks. The differential locks are engaged when the engine is running and the differential lock button is pressed, or while the engine is running and the parking brake is engaged.

The gear pump section furthest from the piston pump, gear pump section (P4), supplies fluid to a variety of circuits including the differential lock. Hydraulic fluid from gear pump (P4) enters the main manifold port P and flows through the steering priority valve (EC1); refer to Steering Circuit (page 5–18) for a full explanation of the steering priority valve (EC1) operation. Fluid flow continues through the flow regulator valve (EC2) where it dead heads at solenoid valve (SP1). Fluid is also sent to one end of the flow regulator valve (EC2) spool. As long as circuit flow is blocked at solenoid valve (SP1), the flow regulator valve (EC2) spool is shifted to direct flow to the traction charge, 2 speed drive motor control, brake release, differential lock and PTO clutch circuits.

When the differential lock switch is set to the DISENGAGE position, solenoid valve (SV3) in the main manifold is de-energized and hydraulic flow bypasses the differential lock circuit. Return springs in the differential lock assemblies keep the differential locks disengaged. When the differential lock switch is held in the ENGAGE position, solenoid valve (SV3) energizes and hydraulic flow is directed to the pistons of the differential lock assemblies. Each piston moves a fork and collar over a series of pins on the differential assembly to lock the axles together.
PTO Clutch Circuit

High Pressure
Low Pressure (Charge)
Return or Suction
Flow

Diagram (engaged)

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PTO Clutch Circuit (continued)

The PTO RPM is directly related to engine speed. A gear box located between the engine and the tandem piston (traction) pump (P1 and P2) includes a 1:0.42 gear reduction and a hydraulically actuated clutch for the PTO.

The gear pump section furthest from the piston pump, gear pump section (P4), supplies fluid to a variety of circuits including the PTO clutch. Hydraulic fluid from gear pump (P4) enters the main manifold port P and flows through the steering priority valve (EC1); refer to Steering Circuit (page 5–18) for a full explanation of the steering priority valve (EC1) operation. Fluid flow continues through the flow regulator valve (EC2) where it dead heads at solenoid valve (SP1). Fluid is also sent to one end of the flow regulator valve (EC2) spool. As long as circuit flow is blocked at solenoid valve (SP1), the flow regulator valve (EC2) spool is shifted to direct flow to the traction charge, 2 speed drive motor control, brake release, differential lock and PTO clutch circuits.

When the PTO switch is set to the DISENGAGE position, proportional solenoid valve (EH) in the main manifold is de-energized and hydraulic flow bypasses the PTO clutch circuit. Return springs on both sides of the PTO clutch assembly keep the clutch disengaged and the PTO brake engaged. When the machine is in Attachment Mode and the PTO switch is set to the ENGAGE position, proportional solenoid valve (EH) energizes and hydraulic flow is directed to a piston in the PTO clutch assembly. Hydraulic flow pushes the piston away from the PTO brake to release the brake and toward the PTO clutch to engage the clutch.

Note: Depending on the programmable attachment settings, raising and lowering the hitch may also disengage or engage the PTO.
The machine includes a single function hydraulic circuit to support the hydraulic demands of a rear mount attachment. Gear pump (P3), a 5-position auxiliary load valve located between the operator and passenger seats, and a pair of hydraulic lines with quick disconnect fittings are part of the standard attachment circuit. The attachment circuit can be expanded to include an additional hydraulic function by installing a selector control valve kit (optional); refer to Selector Control Valve (SCV) Circuit (optional) (page 5–33) for additional information.

The gear pump section closest to the piston pump, gear pump section (P3), supplies fluid to the attachment circuit. Hydraulic fluid from gear pump (P3) enters the auxiliary load valve and is directed as follows based on the auxiliary load valve position:

- When the auxiliary load valve is in the A (DETENT) or the A (MANUAL) positions, flow is directed to supply line A. Return flow from supply line B is allowed to return to the hydraulic tank.

- When the auxiliary load valve is in the NEUTRAL/HOLD position, flow bypasses the attachment supply lines A and B. The flow either returns to the hydraulic tank or is made available to supply the hydraulic demands of the optional loader. Return flow from both attachment supply lines A and B is blocked.

- When the auxiliary load valve is in the B position, flow is directed to attachment supply line B. Return flow from supply line A is allowed to return to the hydraulic tank.

- When the auxiliary load valve is in the FLOTAT position, flow bypasses the attachment supply lines A and B. The flow either returns to the hydraulic tank or is made available to supply the hydraulic demands of the optional loader. Attachment supply line flow is allowed to move in either direction with little to no pressure.

The hydraulic load for the attachment circuit is limited to 20,684 kPa (3000 psi) by a relief valve in the auxiliary load valve.
Front Loader Circuit (continued)

The machine includes a hydraulic circuit to support the hydraulic demands of an optional front mounted loader. Gear pump (P3), a 5-position auxiliary load valve located between the operator and passenger seats, a multi-position loader control valve located on the operator console, and a series of hydraulic supply lines with quick disconnect fittings are part of the loader circuit. The multi-position loader control valve can be moved to the left or right to operate the loader lift cylinders, and moved forward or rearward to operate the loader bucket curl cylinders.

**Note:** The front loader circuit can be expanded to include an additional hydraulic function by installing an optional selector control valve kit; refer to Selector Control Valve (SCV) Circuit (optional) (page 5–33) for additional information.

The gear pump section closest to the piston pump, gear pump section (P3), supplies fluid to the optional loader circuit. Hydraulic fluid from gear pump (P3) supplies the loader circuit when there is no hydraulic demand for a rear mount attachment (the auxiliary load valve is in the NEUTRAL/HOLD or FLOAT position). Flow passing through the auxiliary load valve enters the loader valve and is directed as follows based on the loader valve position:

• When the loader control valve is in the NEUTRAL/HOLD position, flow bypasses the 2 loader lift supply lines and the 2 loader bucket supply lines. In this position the hydraulic flow passes through the valve and returns to the hydraulic tank. Return flow from the loader lift and bucket supply lines is blocked.

• When the loader control valve is moved to the rear RAISE position, flow is directed to lift supply line A. Return flow from lift supply line B is allowed to return to the hydraulic tank.

• When the loader control valve is moved to the forward LOWER position, flow is directed to lift supply line B. Return flow from lift supply line A is allowed to return to the hydraulic tank.

• When the loader control valve is moved to the fully forward FLOAT position, flow bypasses the lift supply lines A and B. Lift supply line flow is allowed to move in either direction with little to no pressure.

• When the loader control valve is in the right CURL DOWN position, flow is directed to bucket supply line A.

• When the loader control valve is moved to the left CURL UP position, flow is directed to bucket supply line B.

The hydraulic load for the optional loader circuit is limited to 20,684 kPa (3000 psi) by a relief valve in the auxiliary load valve.
Selector Control Valve (SCV) Circuit (optional)

The hydraulic circuit for the attachment (rear) or loader (front) can be expanded to provide flow to an additional hydraulic load by installing a selector control valve kit. The kit is installed between the auxiliary load valve and the attachment, or between the loader valve and the loader. Once installed, the 4 solenoid valves included in the kit allow the operator to select between two different hydraulic operations via 2 sets of hydraulic supply lines.

The kit solenoid valves are controlled by a switch supplied with the kit.

- **Attachment (rear) SCV Kit** – A momentary button switch located on the operator control console near the PTO switch is an input to the T1: TEC. The T1: TEC uses signals from the switch to control the kit solenoid valves.

  1. When the SCV kit solenoid valves are de-energized, the right side set of hydraulic quick-disconnect couplers (standard) are active and the No. 1 Hydraulic Circuit icon appears on the InfoCenter display.

  2. When the SCV kit solenoid valves are energized, the left side set of hydraulic quick-disconnect couplers (supplied with kit) are active and the No. 2 Hydraulic Circuit icon appears on the InfoCenter display.

- **Loader (front) SCV Kit** – A 3 position rocker switch located on the loader control valve joystick is used to control the loader SCV valves. When the switch is in the OFF (center) position, all of the kit solenoid valves are de-energized and hydraulic flow is directed to the manifold ports marked 3. When the switch is in the ON (forward) position or MOMENTARY (rearward) position, all of the kit solenoid valves are energized and hydraulic flow is directed to the manifold ports marked 2.

Refer to the selector control valve kit *Installation Instructions* for additional information.
Testing the Hydraulic System

The most effective way to isolate hydraulic system problems is to use hydraulic test equipment, such as pressure gauges and flow meters, in the hydraulic circuit during circuit operation; refer to Special Tools (page 2–14).

**WARNING**

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 Relieving Pressure from the Hydraulic System in this chapter.

**WARNING**

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.

**CAUTION**

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 a hydraulic test, check the fluid supply, the filter condition, control linkage operation and adjustment, loose fasteners, or mechanical and electrical issues before you assume that a hydraulic component is the source of the problem.
IMPORTANT

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

1. Use the following resources to assist with hydraulic system troubleshooting.
   - The Hydraulic Schematic in Appendix A (page A–1)
   - Hydraulic Flow Diagrams (page 5–14)
   - General and system specific troubleshooting tables in Chapter 3 – Troubleshooting
2. Always wear the eye protection when you performing hydraulic system tests.
3. 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 wear on hydraulic components.
4. To prevent hydraulic system contamination, put metal caps or plugs on any hydraulic lines left open or exposed during testing or removal of components.
5. The engine must be in good operating condition. Use the tachometer on the T2: TDM display to verify and monitor engine RPM when performing a hydraulic test. Engine speed can affect the accuracy of the test readings. Use the information below when performing hydraulic system tests. If engine RPM is above or below the specified speed during a test, you will need to adjust the expected hydraulic performance parameters (aprox. 3% per 100 engine rpm at full throttle)

IMPORTANT

Hydraulic component output volume relates directly to engine RPM. For every 100 engine rpm the following component output volumes will change by the volume listed.

- Traction Pump: 100 engine RPM = 3.8 liters (1 gallon or 129 ounces) of hydraulic fluid displaced per minute
- Gear Pump (P3): 100 engine RPM = 1.7 liters (0.45 gallon or 57 ounces) of hydraulic fluid displaced per minute.
- Gear Pump (P4): 100 engine RPM = 1.1 liters (0.29 gallon or 37 ounces) of hydraulic fluid displaced per minute
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. 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.
8. Install the hydraulic fittings by hand and ensure that they are not cross-threaded before you tighten them with a wrench.
9. Position any test hoses away from parts that may move during the test procedure.
10. After you connect the test equipment, check the hydraulic-fluid level in the hydraulic tank and ensure that the fluid level is correct.
11. Perform all the hydraulic tests with the hydraulic fluid at normal operating temperature.
12. Record the results of all hydraulic tests performed.
Hydraulic Test Selection

Before beginning any hydraulic test, identify if the problem is related to the traction circuit, steering circuit, hitch cylinder circuit, or the attachment circuit. Once the faulty system has been identified, perform tests that relate to that circuit.

If a traction circuit problem exists, consider performing one or more of the following tests: Charge Pressure Test, and/or Traction Pump (P1) and (P2) Flow and Relief Valve Test.

If a steering or hitch cylinder circuit problem exists, consider performing one or more of the following tests: Steering Relief Valve (RV1) Pressure Test, Hitch Cylinder Test, Hitch Cylinder Relief Valve (RV2) Pressure Test, and/or Gear Pump (P4) Flow Test.

If an attachment/loader/dump circuit problem exists, consider performing one or more of the following tests: Circuit Relief Valve Pressure Test, and/or Gear Pump (P3) Flow Test.

Note: If an attachment motor performance is suspect, perform an Attachment Motor Efficiency Test; refer to the attachment Installation Instructions or Service Manual.

Traction Circuit Testing – Charge Pressure Test

Charge pressure testing involves recording the charge pressure with the traction pump under no load (swash plates closed) and comparing that reading to the charge pressure while the traction pump is under a moderate load (swash plates open). Charge pressure under no load at each traction (piston) pump can be viewed while the vehicle is stationary using the InfoCenter SERVICE–TRACTION–TRACTION INPUTS–FRONT TRACTION and REAR TRACTION readings. A procedure for checking the charge pressure while the traction pump is under load for this machine is being developed. Contact your local Toro Distributor for assistance.

Traction Circuit Testing – Traction Pump (P1) and (P2) Flow and Relief Valve Tests

The Outcross 9060 incorporates a tandem “dual” piston (traction) pump; one pump to drive the front axle and the other to drive the rear axle. Traction pump flow testing involves measuring the pump output flow in high range under load. A procedure for testing the traction pump(s) flow and the relief valves operation for this machine is being developed. Contact your local Toro Distributor for assistance.

Each pump includes two pressure relief valves (forward and reverse flow) set to open at 33,095 kPa (4800 psi). Relief valve testing involves increasing the traction circuit load, verifying the relief valve opens at or near the specified pressure. A procedure for testing the relief valve(s) operation for this machine is being developed. Contact your local Toro Distributor for assistance.
Figure 25
Steering Relief Valve (RV1) Pressure Test (turning to the right shown)

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately ten (10) minutes.
2. Park the machine on a level surface, lower the attachments and stop the engine. Remove the key from the key switch.
3. Make sure the hydraulic tank is full.
4. Open the main instrument panel.
Steering/Hitch Cylinder Circuit Testing – Steering Relief Valve (RV1) Pressure Test (continued)

5. Remove the relay mounting plate from the dash frame without disconnecting any of the relays from the wire harness. Move the relay assembly to one side.

6. Thoroughly clean the main hydraulic manifold and plug at the G3 port.

7. Remove the plug from the G3 port of the main manifold and install a size 6 SAE-ORB (9/16–18) diagnostic connector and cap (Toro part nos. 59–7410 and 354–79).

8. Connect a 34,475 kPa (5000 PSI) pressure gauge with hydraulic hose attached to test fitting in port G3 port of main manifold.

9. Start engine and idle at low speed. Check for hydraulic leakage at test connection and correct any issues before proceeding with test.

10. Increase engine speed to 2300 RPM.

**IMPORTANT**

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

11. Turn steering wheel all the way in one direction (turning to the right shown) and momentarily hold the steering wheel against resistance.

   **Gauge reading should be approximately:** 21,373 kPa (3100 PSI)

12. Release steering wheel, stop engine and record test results.

13. If steering relief pressure reading is incorrect:
Steering/Hitch Cylinder Circuit Testing – Steering Relief Valve (RV1) Pressure Test (continued)

A. If 3-point hitch raise/lower problems also exist, gear pump (P4) should be suspected of wear and inefficiency.

B. If steering wheel continues to turn at end of cylinder travel (with lower than normal effort), the steering cylinders or steering control valve should be suspected of wear or damage.

C. Adjust relief valve (RV1) to obtain correct relief pressure; refer to Adjusting the Manifold Relief Valves (page 5–48).

D. Clean, repair or replace relief valve (RV1); refer to Cartridge Valve Service (page 5–88).

14. When testing is complete, disconnect pressure gauge from manifold and install the test fitting cap.

Steering/Hitch Cylinder Circuit Testing – Hitch Cylinder Test

There are 2 cylinders involved with raising the hitch. The hitch is lowered by weight and is not “powered” downward. A procedure for checking the hitch cylinder condition (internal leakage) for this machine is being developed. Contact your local Toro Distributor for assistance.
For machines with an optional cargo bed installed, remove the cargo bed before testing the hitch cylinder relief valve. The hitch cylinder lift stroke is limited electrically on machines with an optional cargo bed installed.

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately ten (10) minutes.
2. Park the machine on a level surface, lower the attachments and stop the engine. Remove the key from the key switch.
3. Make sure the hydraulic tank is full.
4. Open the main instrument panel.
Steering/Hitch Cylinder Circuit Testing – Hitch Cylinder Relief Valve (RV2) Pressure Test (continued)

Figure 28

1. Relay assembly
2. Main hydraulic manifold
3. G3 port

5. Remove the relay mounting plate from the dash frame without disconnecting any of the relays from the wire harness. Move the relay assembly to one side.
6. Thoroughly clean the main hydraulic manifold and plug at the G3 port.
7. Remove the plug from the G3 port of the main manifold and install a size 6 SAE-ORB (9/16–18) diagnostic connector and cap (Toro part nos. 59–7410 and 354–79).
8. Connect a 34,475 kPa (5000 PSI) pressure gauge with hydraulic hose attached to test fitting in port G3 port of main manifold.
9. Start the engine and idle at low speed. Check for hydraulic leakage at test connection and correct any issues before proceeding with test.
10. Select AUTO LOW mode and increase engine speed to 2300 RPM.

**IMPORTANT**

Hold paddle switch at full raise position only long enough to get a system pressure reading. Holding the paddle switch at full raise position for an extended period may damage lift circuit components.

11. Raise the hitch cylinders all the way up and momentarily hold the paddle switch in the raise position.

Gauge reading should be approximately: 22,063 kPa (3200 PSI)

**Note:** Machine fault C153C may appear during testing as there will be no hitch movement while lift valve (SP1) is energized.
12. Release the paddle switch, stop the engine and record the test results.

13. If lift cylinder relief pressure reading is incorrect:
   A. If steering problems also exist, gear pump (P4) should be suspected of wear and inefficiency.
   B. Adjust relief valve (RV2) to obtain correct relief pressure; refer to Adjusting the Manifold Relief Valves (page 5–48).
   C. Clean, repair or replace relief valve (RV2); refer to Cartridge Valve Service (page 5–88).

14. When testing is complete, disconnect pressure gauge from manifold and install the test fitting cap.

**Steering/Hitch Cylinder Circuit Testing – Gear Pump (P4) Flow Test**

Gear pump flow testing compares the gear pump flow under no load with the gear pump flow under load. Previous gear pump flow tests involve installing a flow meter at or near the gear pump outlet. Access to the gear pump (P4) outlet of this machine is difficult, and a procedure for checking the gear pump (P4) flow is being developed for this machine. Contact your local Toro Distributor for assistance.

**Attachment/Loader Circuit Testing – Relief Valve Pressure Test**

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**Note:** The relief valve for the attachment and the loader hydraulic circuit is located in the auxiliary load valve.

1. Park the machine on a level surface, lower the attachments and stop the engine. Remove the key from the key switch.
2. Disconnect any attachment from the rear hydraulic supply lines.
1. Rear attachment upper quick-disconnect (A or retract port)

3. Remove the cap and connect a **34,500 kPa (5000 PSI)** pressure gauge to the rear attachment upper quick-disconnect (A or retract port) at the rear of the machine.

4. Start engine and increase engine speed to **(2300 RPM)**.

5. Shift the auxiliary load valve into the A position (rearward).

6. The pressure gauge reading should be **20,684 to 24,131 kPa (3000 to 3500 PSI)**.

7. Release the joystick, stop the engine and record the test results.

8. If circuit relief pressure reading is incorrect, clean, repair or replace the auxiliary load valve relief valve; refer to **Auxiliary Load Valve Service (page 5–105)**.

9. After testing, remove the pressure gauge and install the supply line cap.
A gear pump flow test should be performed to make sure that the circuits being supplied by the pump have adequate hydraulic flow. Over time, the gears and wear plates in a gear pump can wear. A worn pump will by-pass oil and make the pump less efficient. Eventually, enough oil loss will occur to cause circuit problems (e.g. attachment performance issues or the loader stalling when lifting heavy loads). Continued operation with a worn, inefficient gear pump can generate excessive heat and cause damage to seals and other components in the hydraulic system.

**IMPORTANT**

To prevent hydraulic tester damage, use a 57 LPM (15 GPM) Hydraulic Tester (pressure and flow) and additional hoses and fittings for this test; refer to Special Tools (page 2–14).

1. Park the machine on a level surface, lower the attachments and stop the engine. Remove the key from the key switch.
1. Auxiliary load valve  
2. P port fitting  
3. Hydraulic hose assembly

2. Remove the operator’s console; refer to Removing and Installing the Operator’s Console (page 8–17).

3. Connect the wire harness to the key switch if previously removed.

4. Thoroughly clean the junction of the hydraulic hose and the fitting at the auxiliary load valve P port and disconnect the hydraulic hose from the fitting.

**IMPORTANT**

To prevent hydraulic tester damage, make sure that the oil flow direction indicator on the tester is installed so the oil will flow from the disconnected hydraulic hose, through the tester and into the auxiliary load valve P fitting.

5. Install 15 GPM hydraulic tester (flow and pressure) in series with the disconnected hose and hydraulic fitting.

6. Make sure the flow control valve on the tester is fully open.

7. Start engine and increase engine speed to high idle speed (3000 RPM). Check for hydraulic leakage at test connection and correct before proceeding with test.

8. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately ten (10) minutes. Make sure the hydraulic reservoir is full.
IMPORTANT

Do not fully restrict oil flow through the hydraulic tester. In this test, the hydraulic tester is positioned before the circuit relief valve and pump damage can occur if the oil flow is fully restricted.

9. Watch pressure gauge carefully while slowly closing the flow control valve until 6895 kPa (1000 PSI) is obtained. Verify with the Status Display that the engine is still running at the correct high idle speed (3000 RPM).

10. Record the tester flow reading then open the tester flow control valve and stop the engine.

11. Gear pump (P3) flow should be between 44 LPM (12 GPM) and 41 LPM (10.5 GPM).

12. If a pressure of 6895 kPa (1000 PSI) cannot be obtained or flow was less than 41 LPM (10.5 GPM), check for a restriction in the pump inlet line. If inlet line is not restricted, the gear pump section is worn or damaged and should be service or replaced.

   Note: Gear pumps (P3) and (P4) must be serviced or replaced together.

13. The hydraulic tester can be used to test the circuit relief pressure:
   A. Disconnect any attachment from the rear hydraulic supply lines.
   B. Make sure the flow control valve on the tester is fully open.
   C. Start engine and increase engine speed to (2300 RPM).
   D. Shift the auxiliary load valve into the A or B position (forward or reverse).
   E. The hydraulic tester pressure reading should be 20,684 to 24,131 kPa (3000 to 3500 PSI).
   F. Release the joystick, stop the engine and record the test results.
   G. If circuit relief pressure reading is incorrect, clean, repair or replace the auxiliary load valve relief valve; refer to Auxiliary Load Valve Service (page 5–105).

14. After testing is complete, remove the hydraulic tester and any additional hoses or fittings installed for testing. Install the disconnected hydraulic hose; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–8).
Adjustments

Adjusting the Manifold Relief Valves

The main manifold includes 2 adjustable pressure relief valves; (RV1) relieves the steering circuit and (RV2) relieves the 3-point hitch lift circuit. An adjustment may be required to these valves if testing determines that the circuit pressure setting is incorrect; refer to Testing the Hydraulic System (page 5–34). Use the following process if a valve adjustment is required.

**Note:** Do not remove the valve from the hydraulic manifold for adjustment.

1. Park the machine on a level surface, lower the attachments, disengage the PTO and stop the engine. Remove the key from the key switch.
2. Locate the desired relief valve on the main manifold.
3. Remove the cap on the relief valve with a hex key “Allen” wrench.
4. To increase the pressure setting, turn the adjustment socket on the valve in a clockwise direction. A 1/8 turn on the socket will make a measurable change in pressure.
5. To decrease the pressure setting, turn the adjustment socket on the valve in a counterclockwise direction. A 1/8 turn on the socket will make a measurable change in pressure.
6. Install the cap on the valve.
7. Recheck the relief valve pressure using the correct test procedure and readjust if needed.
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 and attachments, turn the engine OFF, 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.

**WARNING**

Before disconnecting or doing any work on the hydraulic system, release all the pressure in the system; refer to Relieving Pressure from the Hydraulic System (page 5–3).

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

1. Check the hydraulic-fluid level in the hydraulic tank 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 tank and change the hydraulic fluid filters if the component failure is severe or the system is contaminated; refer to the traction unit Operator’s Manual.

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 Hydraulic Hoses and Tubes (O-Ring Face Seal)
After Repairing or Replacing the Components (continued)

(page 5–8) and Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–10).

5. After you complete the repairs, check the control linkages or cables for proper adjustment, binding, or broken parts.

6. Whenever hydraulic fluid has been drained from the pumps (system drain, flush, or pump removal/installation) it is important to properly prime the hydraulic pumps, refer to Priming the Hydraulic Pumps (page 5–58).

7. After you disconnect or replace any hydraulic component, operate the machine functions slowly until the air is out of the system; refer to Charging the Hydraulic System (page 5–59).

8. Check for hydraulic-fluid leaks. Shut off the engine and repair leaks if necessary.
Checking the Hydraulic Lines and Hoses

⚠️ 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.

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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.
Flushing the Hydraulic System

**IMPORTANT**

If a component failure occurs in the traction circuit; refer to Filtering the Closed-Loop Traction Circuit (page 5–54) for additional information.

**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).

1. Park the machine on a level surface, lower any attachments and stop the engine. Remove the key from the key switch.
2. Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–49).

**CAUTION**

Flush the hydraulic system with the hydraulic fluid as warm as possible, but to prevent additional system damage, Do Not operate a machine with contaminated hydraulic fluid to warm the fluid before draining.

**IMPORTANT**

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

3. Drain the hydraulic tank into a suitable container; refer to the traction unit Operator’s Manual.
4. Drain the hydraulic system hoses, tubes, lift cylinders and other components from low points in the system.
5. Remove and replace the hydraulic-fluid filters; refer to the traction unit Operator’s Manual.
6. Inspect and clean hydraulic tank. Remove the hydraulic tank if necessary; refer to Removing and Installing the Hydraulic Tank (page 5–62).
7. Connect all the hydraulic hoses, tubes, and components that were disconnected while draining the system; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–8).

**IMPORTANT**

Using other hydraulic fluids could damage the hydraulic system. Use the hydraulic fluids that are specified in the traction unit Operator’s Manual.
Flushing the Hydraulic System (continued)

8. Fill the hydraulic tank with the correct type and quantity of new hydraulic fluid; refer to the traction unit *Operator’s Manual*.

9. Prime the hydraulic pumps; refer to Priming the Hydraulic Pumps (page 5–58).

10. Charge the hydraulic system; refer to Charging the Hydraulic System (page 5–59).
Filtering the Closed-Loop Traction Circuit

The traction circuit of the Outcross 9060 machine consists of two closed-loop circuits, each with its own piston (traction) pump, drive axle motor, and control valves. The two traction pumps (P1) and (P2) are part of the tandem piston (traction) pump. Pump (P1) supplies the front traction circuit, and pump (P2) supplies the rear traction circuit. If a component in one of the traction circuits should fail, unwanted material and contamination from the damaged component will circulate throughout that traction circuit. This contamination can damage other components in that circuit. The contamination must be removed as soon as possible to prevent additional component failure.

Filtering of a closed-loop hydraulic system after a major component failure (e.g. traction (piston) pump or drive motor) is required to prevent debris from transmitting throughout the system. If a filtering tool is not used (to ensure system cleanliness), repeat failures and subsequent damage to other hydraulic components in the system will occur. To effectively remove contamination from the closed-loop traction circuit, use of a Toro bidirectional high flow hydraulic filter and hydraulic hose kit is recommended; refer to High Flow Hydraulic Filter Kit (page 2–17).

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

2. Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–49).

```
WARNING

Review and follow Jacking Instructions (page 1–8) before jacking up the machine.
```

3. Raise all four wheels off the floor and support with jack stands.

4. Install a temporary hydraulic filter directly upstream of the new component as follows:
Filtering the Closed-Loop Traction Circuit (continued)

**Figure 34**
Front Circuit Connection

1. Front drive motor
2. M1 port

A. If the front drive motor was serviced or replaced, disconnect the hydraulic hose at the M1 port (left) of the front drive motor.

**Figure 35**
Rear Circuit Connection

1. Rear drive motor
2. M1 port
Filtering the Closed-Loop Traction Circuit (continued)

B. If the rear drive motor was serviced or replaced, disconnect the hydraulic hose at the M1 port (right) of the rear drive motor.

C. If the tandem piston (traction) pump (P1) and (P2) was serviced or replaced, remove the front drive motor, drive coupler and motor mount to access the desired filter connection; refer to Axle Motors (page 5–76). Leave the hydraulic lines connected to the drive motor.

D. If the front drive circuit is contaminated because front traction pump (P1) failed, disconnect the hydraulic hose at the B port (middle right) of the tandem piston (traction) pump.

E. If the rear drive circuit is contaminated because rear traction pump (P2) failed, disconnect the hydraulic hose at the D port (middle left) of the tandem piston (traction) pump.

5. Connect the temporary hydraulic filter in series between the disconnected fitting and hose. Use a High Flow Hydraulic Filter Kit (page 2–17) and make sure that fittings and hose connections are properly tightened.

6. Fill the hydraulic tank with the correct type and quantity of new hydraulic fluid; refer to the traction unit Operator’s Manual.

7. Start engine and run at low idle speed. Check for and correct any hydraulic leaks before proceeding.
Filtering the Closed-Loop Traction Circuit (continued)

**CAUTION**

Use extreme caution when performing this test. The wheels will be rotating during the test.

**IMPORTANT**

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

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

**IMPORTANT**

If using a hydraulic filter that is not bidirectional, do not select reverse or operate the machine in the reverse direction. If flow is reversed when using a filter that is not bidirectional, debris from the filter will re-enter the traction circuit.

9. With a bidirectional hydraulic filter installed and the engine running at high idle speed, alternately select forward and reverse direction. Continue this process for an additional five (5) minutes while monitoring filter indicator.

10. Shut the engine OFF and remove the key from key switch.

11. Remove the temporary hydraulic filter from the machine and install any disconnected hydraulic hoses or tubes; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–8).

12. Lower machine to ground.

13. Check the hydraulic fluid level in the tank and adjust as necessary; refer to the traction unit Operator’s Manual.

14. Operate the machine and check for leaks before returning the machine to service.
Priming the Hydraulic Pumps

Whenever hydraulic fluid has been drained from the pumps (system drain, flush, or pump removal/installation) it is important to properly prime the hydraulic pumps. Priming the hydraulic pumps ensures that the tandem piston (traction) pump and gear pumps have sufficient fluid while charging the hydraulic system.

Use the following procedure to prime the hydraulic pumps:

**IMPORTANT**

If the tandem piston (traction) pump was rebuilt or replaced, make sure the traction pump housing is at least half full of clean hydraulic fluid after installation.

1. Make sure all hydraulic connections and lines are secured tightly.
2. Check the hydraulic-fluid level in the hydraulic tank and add correct type and quantity of fluid if necessary; refer to the traction unit Operator’s Manual.

![Figure 37](image)

1. Starter motor solenoid  
2. START terminal

**Note:** A blue wire connects to the starter motor solenoid START terminal. It is not necessary to remove this blue wire from the solenoid terminal for hydraulic pump priming.

3. Access the terminals on the back of the starter motor.
4. Connect remote starter switch electrical leads to the starter motor solenoid START terminal and the positive (+) terminal at the battery; refer to Special Tools (page 2–14).
5. Engage the remote starter switch and allow the starter to crank for 15 seconds to prime the hydraulic pumps. Wait 30 seconds to allow the starter motor and starter solenoid to cool. Repeat the cranking procedure a second time.
6. Disconnect the remote starter switch leads from the machine.
7. Charge the hydraulic system; refer to Charging the Hydraulic System (page 5–59).
Charging the Hydraulic System

**IMPORTANT**

Air must be purged from the system to reduce the chance of component damage.

When initially starting the hydraulic system with new or rebuilt components such as motors, pumps, or cylinders, it is important that the hydraulic system is charged properly to remove air from the system.

**IMPORTANT**

Flush the hydraulic system whenever there is a severe component failure or the system is contaminated; refer to Flushing the Hydraulic System (page 5–52).

1. Park the machine on a level surface and turn the engine OFF.
2. Ensure that all of the hydraulic connections, lines, and components are secured tightly.
3. Ensure that the hydraulic tank is full. Add the correct quantity and type 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 5–58).

**WARNING**

Review and follow Jacking Instructions (page 1–8) before jacking up the machine.

6. Raise the wheels off the floor and support the machine with jack stands.

**IMPORTANT**

Check hydraulic tank fluid level frequently while charging the system and add fluid as necessary.

7. Start the engine and let it idle at low speed.
   
   **Note:** The hydraulic pumps should pick up hydraulic fluid and fill the hydraulic system. If there is no indication of the system filling within 30 seconds, stop the engine and determine the cause.

8. After the hydraulic system starts to show signs of filling, operate the hitch lift cylinders up and down the full distance several times. If the cylinders do not move after 15 seconds or the pump emits abnormal sounds:
   
   A. Turn the engine OFF immediately
   
   B. Make sure one of the hydraulic fluid filters or the suction line is not loose
   
   C. Check for incorrect hose routing
   
   D. Ensure the suction line is not blocked
Charging the Hydraulic System (continued)

E. Make sure the charge relief valve (CV1) is not blocked or damaged (closed)

F. Test gear pump (P3) for damage

9. Operate the traction pedal in the forward and reverse directions. Make sure the wheels are turning in the proper direction and allow the wheels to turn slowly for ten (10) minutes.

10. Lower the machine to the ground.

11. For machines with an optional hydraulically operated equipment attached (rear attachments or a front loader) operate the attachment controls to fully cycle the attachment a few times.

12. Operate the traction unit by gradually increasing its work load to full over a ten (10) minute period.

13. Stop the machine, check the hydraulic components for leaks and tighten any loose connections.

14. Check the level and condition of the hydraulic fluid and adjust if necessary; refer to the traction unit Operator’s Manual.

Note: If new fluid shows any signs of contamination, flush hydraulic system again until the fluid is clean; refer to Flushing the Hydraulic System (page 5–52).
Hydraulic Tank

Figure 38

1. Hydraulic tank
2. Hydraulic hose assembly (breather from front PTO gear box)
3. Elbow fitting
4. Elbow barb fitting
5. Hose clamp
6. Hydraulic hose (breather from rear PTO gear box)
7. Straight barb fitting
8. Hose clamp (2 each)
9. Breather hose
10. Adapter fitting
11. Breather
12. Cap
13. Dipstick
14. Seal ring
15. Plug
16. Cap screw (2 each)
17. Plug
18. Temperature sender
19. Hydraulic hose (from main filter)
20. Hose clamp
21. Strainer assembly
22. Hose clamp
23. Suction hose (to pump assembly)
24. Flange nut (4 each)
25. Magnetic plug
26. Straight fitting (2 each)
27. Elbow fitting
28. Elbow fitting
29. Hydraulic hose (return from front PTO gear box)
30. Hose clamp
31. Straight barb fitting
32. Cap screw (2 each)
Removing and Installing the Hydraulic Tank

1. Remove the operator’s platform; refer to Removing the Operator’s Platform (page 8–6).

---

**IMPORTANT**

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

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2. Empty the hydraulic tank (approximate total volume 48 L (12.8 gal)).

3. Thoroughly clean the exterior of the reservoir, fittings and hoses to prevent contamination of the hydraulic system.

4. To ease assembly, label all the hydraulic hoses to identify their correct position on the tank.

5. Disconnect the hydraulic hoses. Install caps and plugs on the fittings and hoses to prevent contamination of the hydraulic system.

6. Remove the 4 cap screws and flange nuts and remove the hydraulic tank from the machine.

7. Remove the hydraulic fittings as necessary and discard O-rings.

8. To install the hydraulic tank, follow this procedure in reverse order.

9. Lubricate new O-rings and place them onto the fittings. If previously removed, install the fittings into the tank ports using alignment marks made during removal; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–10).

10. Connect all hydraulic hoses previously removed. Tighten the hydraulic hoses as specified in Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–8).

11. Fill the tank with new hydraulic fluid and check for leaks before returning the machine to service.
The hydraulic fluid cooler on your Outcross 9060 is combined with the radiator. The procedures for removing and installing the radiator and hydraulic fluid cooler as an assembly are provided; refer to **Radiator (page 4–11)**.

**Note:** If desired, the radiator and hydraulic fluid cooler may be separated in the machine and removed individually.
Removing the Tandem Piston (Traction) Pump (P1) and (P2)

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–49) prior to removing hydraulic system components.

1. Remove the operator platform; refer to Removing the Operator’s Platform (page 8–6).
2. Drain the hydraulic tank into a suitable container; refer to the traction unit Operator’s Manual.
3. Remove the auxiliary load valve; refer to Removing the Auxiliary Load Valve (page 5–103).
4. Remove the front loader control valve (if equipped); refer to Removing the Front Loader Control Valve (page 5–106).
5. Remove the main hydraulic manifold; Removing the Main Hydraulic Manifold (page 5–84).
Removing the Tandem Piston (Traction) Pump (P1) and (P2) (continued)

6. Remove the manifold support assembly.
7. Remove the air flap (item 2 in Figure 29).
8. Label and disconnect the wire harness at the 4 piston pump servo control solenoid coils.
9. Label and disconnect the wire harness at the 2 traction pressure sensors.
10. To prevent contamination of the hydraulic system during gear pump and piston (traction) pump removal, thoroughly clean the exterior of the gear pump, piston pump, and all fittings and hose/tube connections.
11. Disconnect the suction hose from the bottom of the gear pump and the pressure hoses from the top of the gear pump. Put plugs in the open hydraulic hoses. Label disconnected hydraulic hoses for proper reassembly.
12. Mark the fitting orientation to allow for correct assembly then remove the fittings from the gear pump and discard the O-rings.
13. Remove the 2 cap screws and plain washers that secure the gear pump to the piston pump and slide the gear pump rearward and out of the machine.
14. Plug the gear pump ports, then locate and discard the O-ring between the gear pump and the piston pump.
15. Label and remove all of the hydraulic lines that connect to the piston pump. Install plugs or caps on disconnected hydraulic hoses and fittings to prevent contamination of the hydraulic system.

Figure 41

1. Tandem piston (traction) pump
2. R-clamp
3. Hanger plate
4. Traction pressure sensor – front
5. Traction pressure sensor – rear

16. Remove the R-clamp (item 2 in Figure 30) from the hanger plate.
Removing the Tandem Piston (Traction) Pump (P1) and (P2) (continued)

⚠️ CAUTION ⚠️

Use an appropriate lift to remove the piston pump from the machine. The piston pump assembly weighs approximately 68 kg (150 lbs).

17. Remove the 2 cap screws and plain washers that secure the piston pump to the front PTO gear box and slide the piston pump rearward and out of the machine.
18. Locate and discard the O-ring between the piston pump and the front PTO gear box.
19. If fitting removal is necessary, mark the fitting orientation to allow for correct assembly then remove the fittings from the piston pump and discard the O-rings.

Installing the Tandem Piston (Traction) Pump (P1) and (P2)

1. Lubricate new O-rings and place them onto the fittings. If previously removed, install the fittings into the pump ports using alignment marks made during removal; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–10).
2. Apply clean petroleum jelly or light grease to a new O-ring (item 10 in Figure 29) and position the O-ring onto the piston pump flange.
3. Apply anti-seize lubricant to the splines of the piston pump shaft. Align the piston pump shaft and slide the piston pump into the front PTO gear box coupler.
4. Secure the piston pump to the front PTO gear box with 2 plain washers and cap screws. Tighten the cap screws from 153 to 188 N·m (113 to 139 ft-lbs).
5. Apply clean petroleum jelly or light grease to a new O-ring (item 7 in Figure 29) and position the O-ring onto the gear pump flange.
6. Apply anti-seize lubricant to the splines of the gear pump shaft. Align the gear pump shaft and slide the gear pump into the piston pump coupler.
7. Remove the plugs from the gear pump ports and secure the gear pump to the piston pump with 2 plain washers and socket head screws. Tighten the socket head screws from 46 to 57 N·m (34 to 42 ft-lbs).
8. Install and lubricate new gear pump fitting O-rings. Install the fittings into the gear pump ports using alignment marks made during removal and tighten the fittings; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–10).
9. Remove the caps and plugs from the hydraulic fittings and hydraulic lines then install the hydraulic lines to the piston pump and the gear pump; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–8). Tighten the gear pump suction hose clamp to 10 N·m (90 in-lb).
10. Connect the wire harness at the 2 traction pressure sensors.
11. Connect the wire harness at the 4 piston pump servo control solenoid coils.
12. Install the air flap (item 2 in Figure 29).
13. Install the manifold support assembly.
Installing the Tandem Piston (Traction) Pump (P1) and (P2) (continued)

14. Install the main hydraulic manifold; Installing the Main Hydraulic Manifold (page 5–85).

15. Install the front loader control valve (if equipped); refer to Installing the Front Loader Control Valve (page 5–107).

16. Install the auxiliary load valve; refer to Installing the Auxiliary Load Valve (page 5–103).

17. Install the operator platform; refer to Installing the Operator’s Platform (page 8–13).

18. Replace the hydraulic filters.

19. Fill the hydraulic reservoir with new hydraulic oil.

20. Prime the hydraulic pump; refer to Priming the Hydraulic Pumps (page 5–58).

21. Charge the hydraulic system; refer to Charging the Hydraulic System (page 5–59).

22. Stop engine then check for and correct any hydraulic oil leaks. Check hydraulic fluid level and adjust if necessary.
Figure 42

Tandem Piston (Traction) Pump (P1) and (P2) Service
**Tandem Piston (Traction) Pump (P1) and (P2) Service (continued)**

<table>
<thead>
<tr>
<th>Number</th>
<th>Component</th>
<th>Description</th>
<th>Number</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Housing (front)</td>
<td></td>
<td>22.</td>
<td>Cap screw (4 each)</td>
</tr>
<tr>
<td>2.</td>
<td>Center section assembly</td>
<td></td>
<td>23.</td>
<td>Orifice (4 each)</td>
</tr>
<tr>
<td>3.</td>
<td>Housing (rear)</td>
<td></td>
<td>24.</td>
<td>Dowel pin (4 each)</td>
</tr>
<tr>
<td>4.</td>
<td>Shaft (front)</td>
<td></td>
<td>25.</td>
<td>EDC feedback link (2 each)</td>
</tr>
<tr>
<td>5.</td>
<td>Swashplate bearing kit (2 each)</td>
<td></td>
<td>26.</td>
<td>Gasket (2 each)</td>
</tr>
<tr>
<td>6.</td>
<td>Swashplate (2 each)</td>
<td></td>
<td>27.</td>
<td>EDC housing (2 each)</td>
</tr>
<tr>
<td>7.</td>
<td>Piston assembly (2 each)</td>
<td></td>
<td>28.</td>
<td>Screw (12 each)</td>
</tr>
<tr>
<td>8.</td>
<td>Slipper retainer (2 each)</td>
<td></td>
<td>29.</td>
<td>Servo control solenoid coil (4 each)</td>
</tr>
<tr>
<td>9.</td>
<td>Slipper retainer guide (2 each)</td>
<td></td>
<td>30.</td>
<td>Coil nut (4 each)</td>
</tr>
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<td>10.</td>
<td>Slipper hold down pin (6 each)</td>
<td></td>
<td>31.</td>
<td>O-ring (8 each)</td>
</tr>
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<td>11.</td>
<td>Cylinder block assembly (2 each)</td>
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<td>32.</td>
<td>Servo control solenoid valve (4 each)</td>
</tr>
<tr>
<td>12.</td>
<td>Dowel pin (4 each)</td>
<td></td>
<td>33.</td>
<td>O-ring (4 each)</td>
</tr>
<tr>
<td>13.</td>
<td>Slider block (2 each)</td>
<td></td>
<td>34.</td>
<td>Nut (2 each)</td>
</tr>
<tr>
<td>14.</td>
<td>Servo piston assembly (2 each)</td>
<td></td>
<td>35.</td>
<td>Plug with O-ring (2 each)</td>
</tr>
<tr>
<td>15.</td>
<td>O-ring (4 each)</td>
<td></td>
<td>36.</td>
<td>Screw (12 each)</td>
</tr>
<tr>
<td>16.</td>
<td>Piston ring (4 each)</td>
<td></td>
<td>37.</td>
<td>Roller bearing assembly (2 each)</td>
</tr>
<tr>
<td>17.</td>
<td>Plug with O-ring (2 each)</td>
<td></td>
<td>38.</td>
<td>Retaining ring</td>
</tr>
<tr>
<td>18.</td>
<td>Plug with O-ring (4 each)</td>
<td></td>
<td>39.</td>
<td>Lip seal</td>
</tr>
<tr>
<td>19.</td>
<td>O-ring (4 each)</td>
<td></td>
<td>40.</td>
<td>O-ring</td>
</tr>
<tr>
<td>20.</td>
<td>Servo Cylinder (4 each)</td>
<td></td>
<td>41.</td>
<td>Shaft seal</td>
</tr>
<tr>
<td>21.</td>
<td>Locking plate (2 each)</td>
<td></td>
<td>42.</td>
<td>Retaining ring</td>
</tr>
<tr>
<td>22.</td>
<td>Cap screw (4 each)</td>
<td></td>
<td>43.</td>
<td>Bearing (2 each)</td>
</tr>
<tr>
<td>23.</td>
<td>Orifice (4 each)</td>
<td></td>
<td>44.</td>
<td>Coupling</td>
</tr>
<tr>
<td>24.</td>
<td>Dowel pin (4 each)</td>
<td></td>
<td>45.</td>
<td>Valve plate CW</td>
</tr>
<tr>
<td>25.</td>
<td>EDC feedback link (2 each)</td>
<td></td>
<td>46.</td>
<td>Plug with O-ring (6 each)</td>
</tr>
<tr>
<td>26.</td>
<td>Gasket (2 each)</td>
<td></td>
<td>47.</td>
<td>Lifting lug</td>
</tr>
<tr>
<td>27.</td>
<td>EDC housing (2 each)</td>
<td></td>
<td>48.</td>
<td>Screw</td>
</tr>
<tr>
<td>28.</td>
<td>Screw (12 each)</td>
<td></td>
<td>49.</td>
<td>O-ring</td>
</tr>
<tr>
<td>29.</td>
<td>Servo control solenoid coil (4 each)</td>
<td></td>
<td>50.</td>
<td>Charge pressure relief valve</td>
</tr>
<tr>
<td>30.</td>
<td>Coil nut (4 each)</td>
<td></td>
<td>51.</td>
<td>Nut</td>
</tr>
<tr>
<td>31.</td>
<td>O-ring (8 each)</td>
<td></td>
<td>52.</td>
<td>Spring (4 each)</td>
</tr>
<tr>
<td>32.</td>
<td>Servo control solenoid valve (4 each)</td>
<td></td>
<td>53.</td>
<td>SCR valve (4 each)</td>
</tr>
<tr>
<td>33.</td>
<td>O-ring (4 each)</td>
<td></td>
<td>54.</td>
<td>O-ring (4 each)</td>
</tr>
<tr>
<td>34.</td>
<td>Nut (2 each)</td>
<td></td>
<td>55.</td>
<td>Backup ring (4 each)</td>
</tr>
<tr>
<td>35.</td>
<td>Plug with O-ring (2 each)</td>
<td></td>
<td>56.</td>
<td>O-ring (4 each)</td>
</tr>
<tr>
<td>36.</td>
<td>Screw (12 each)</td>
<td></td>
<td>57.</td>
<td>O-ring (4 each)</td>
</tr>
<tr>
<td>37.</td>
<td>Roller bearing assembly (2 each)</td>
<td></td>
<td>58.</td>
<td>SCR valve plug (4 each)</td>
</tr>
<tr>
<td>38.</td>
<td>Retaining ring</td>
<td></td>
<td>59.</td>
<td>Gasket (2 each)</td>
</tr>
<tr>
<td>39.</td>
<td>Lip seal</td>
<td></td>
<td>60.</td>
<td>Valve plate CCW</td>
</tr>
<tr>
<td>40.</td>
<td>O-ring</td>
<td></td>
<td>61.</td>
<td>Pin (2 each)</td>
</tr>
<tr>
<td>41.</td>
<td>Shaft seal</td>
<td></td>
<td>62.</td>
<td>Shaft (rear)</td>
</tr>
<tr>
<td>42.</td>
<td>Retaining ring</td>
<td></td>
<td>63.</td>
<td>Screw (6 each)</td>
</tr>
</tbody>
</table>

---

**IMPORTANT**

If a tandem piston (traction) pump failure occurred, refer to Traction Circuit (Closed-Loop) Component Failure (page 5–6) for information regarding the importance of removing contamination from the traction circuit.

For tandem piston (traction) pump service information, see the Danfoss H1 Closed Circuit Axial Piston Pumps Service Manual and the Danfoss H1 Closed Circuit Axial Piston Pumps Repair Instructions.

For servo control solenoid coil service information, refer to Tandem Traction (Piston) Pump Control Solenoid Coils (page 6–75).

**Note:** The forward and reverse solenoid valves and coils for both the front and rear pump are identical.
Removing the Gear Pump (P3) and (P4)

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–49) prior to removing hydraulic system components.

1. Remove the operator’s platform; refer to Removing the Operator’s Platform (page 8–6)
2. Drain the hydraulic tank into a suitable container; refer to the traction unit Operator’s Manual.
3. To prevent contamination of the hydraulic system during pump removal, thoroughly clean the exterior of the pump and fittings.
4. Disconnect the suction hose from the bottom of the gear pump and the pressure hoses from the top of the gear pump. Put plugs in open hydraulic hoses. Label disconnected hydraulic hoses for proper reassembly.
5. Mark the fitting orientation to allow for correct assembly then remove the fittings from the pump and discard the O-rings.
6. Remove the 2 cap screws and plain washers that secure the gear pump to the piston pump.
Removing the Gear Pump (P3) and (P4) (continued)

7. Slide the gear pump rearward then upward and out of the machine to the left of the manifold support.
8. Plug the gear pump ports, then locate and discard the O-ring between the gear pump and the piston pump.

Installing the Gear Pump (P3) and (P4)

1. Apply clean petroleum jelly or light grease to a new O-ring (item 7 in Figure 32) and position the O-ring onto the gear pump flange.
2. Apply anti-seize lubricant to the splines of the gear pump shaft. Align the gear pump shaft and slide the gear pump into the piston pump coupler.
3. Remove the plugs from the gear pump ports and secure the gear pump to the piston pump with 2 plain washers and socket head screws. Tighten the socket head screws from 46 to 57 N·m (34 to 42 ft-lbs).
4. Install and lubricate new gear pump fitting O-rings. Install the fittings into pump ports using alignment marks made during removal and tighten the fittings; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–10).
5. Remove the plugs from the hydraulic hoses and install the hydraulic hoses to the gear pump; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–8). Tighten suction hose clamp to 10 N·m (90 in-lb).
6. Install the operator’s platform; refer to Installing the Operator’s Platform (page 8–13).
7. Replace the hydraulic filters.
8. Fill the hydraulic reservoir with new hydraulic oil.
9. Prime the hydraulic pump; refer to Priming the Hydraulic Pumps (page 5–58).
10. Charge the hydraulic system; refer to Charging the Hydraulic System (page 5–59).
11. Stop engine then check for and correct any hydraulic oil leaks. Check hydraulic fluid level and adjust if necessary.
If items other than pump seals are worn or damaged, the gear pump must be replaced as a complete assembly. Individual gears, housings and thrust plates are not available separately. Disassemble, inspect, and assemble gear pump for cleaning, inspection and seal replacement only.

**IMPORTANT**

Keep pump bodies, gears, flanges and thrust plates for each pump section together; do not mix parts between pump sections.
Disassembling the Gear Pump

1. Plug the pump ports and thoroughly clean the exterior of the pump with cleaning solvent. Make sure the work area is clean.

![Figure 45](image)

1. Marker line

2. Use a marker to make diagonal lines across the gear pump sections for assembly purposes; refer to Figure 45.

**IMPORTANT**

Use caution when clamping gear pump in a vise to avoid distorting any pump components.

3. Secure the front cover of the pump in a vise with the drive shaft pointing down.
4. Loosen the four (4) cap screws that secure the pump sections (P3) and (P4) to the front cover.
5. Remove the pump from the vise and remove the fasteners.

**Note:** Be careful to not drop parts or disengage gear mesh when separating pump sections.
6. Support the pump assembly and gently tap the pump bodies with a soft face hammer to loosen the pump sections.

**IMPORTANT**

Mark the relative positions of the gear teeth and the thrust plates so they can be reassembled in the same position. Do not touch the gear surfaces as residue on hands may be corrosive to gear finish.

7. Remove the thrust plates and the seals from each pump section. Before removing each gear set, apply marking dye to the mating teeth to retain the "timing". Pump efficiency may be affected if the teeth are not installed in the same position during assembly. Keep the parts for each pump section together; do not mix parts between sections.

Inspecting the Gear Pump

If internal parts are found to be worn or damaged, gear pump replacement is necessary.
1. Remove any nicks and burrs from all parts with emery cloth.
Inspecting the Gear Pump (continued)

CAUTION

Use eye protection such as goggles when using compressed air.

2. Clean all parts with solvent. Dry all parts with compressed air.

3. Inspect the drive gears and idler gears for the following:
   A. The gear shafts should be free of rough surfaces and excessive wear at
      the thrust plate points and sealing areas.
   B. The gear teeth should be free of excessive scoring and wear.
   C. Inspect each gear face edge for sharp edges or burrs. Remove sharp
      edges or burrs from the gear faces with emery cloth.

4. Inspect the thrust plates for the following:
   A. The bearing areas should not have excessive wear or scoring.
   B. The face of the thrust plates that are in contact with the gears should be
      free of wear, roughness or scoring.
   C. The thickness of the thrust plates should be equal.

5. Inspect the front flange and the rear cover for damage or wear.

Assembling the Gear Pump

When assembling the pump, check the marker line on each part to make sure
the parts are properly aligned during assembly.

1. Lubricate the body seals, pressure seals, uni-rings and the thrust plate
grooves with a thin coat of petroleum jelly. Lubricate all other internal parts
freely with clean hydraulic oil.

2. Install a new seal and retaining ring in the front cover; refer to Figure 44.

3. Place the front flange, seal side down, on a flat surface.

4. Assemble the front gear pump section (P3) as follows:
Assembling the Gear Pump (continued)

A. Install the pressure seals, flat side outward, into the grooves in the thrust plates. Follow by carefully placing the uni-rings, flat side outward, between the pressure seals and the grooves in the thrust plate.

B. Apply a light coating of petroleum jelly to the exposed side of the front flange.

C. Lubricate the drive shaft/gear with clean hydraulic oil. Insert the drive end of the drive shaft through the thrust plate with the pressure seal side down and the open side of the pressure seal pointing to the inlet side of the pump. Fit the drive shaft/gear into the front cover.

D. Lubricate the idler shaft/gear with clean hydraulic oil. Align the gear teeth position markings made during disassembly and install the idler gear shaft into the front thrust plate and front cover. Apply a light coating of clean hydraulic oil to the gear faces.

E. Install the rear thrust plate with the pressure seal side up and the open side of the pressure seal pointing to the inlet side of the pump.

F. Install the dowel pins in the body.

G. Apply a light coating of petroleum jelly to the new body seals and body seal grooves in the body. Install the new body seals into the body.

**IMPORTANT**

*Do not dislodge seals during installation.*

H. Align the marker lines and slide the body over the gear assembly.

5. Install the dowel pins in the flange.

6. Align the marker lines and install the flange over the shaft ends.

7. Install the drive hub and repeat step 4 for the rear gear pump section (P4).

8. Install dowel pins in rear cover.

9. Align the marker lines and slide the rear cover over the shaft ends.

10. Install the 4 cap screws with washers and hand tighten.

11. Place the front cover of the pump into a vise with soft jaws and alternately tighten the cap screws to 45 N·m (33 ft-lb).

12. Place a small amount of clean hydraulic oil in the pump inlet and rotate the drive shaft clockwise one revolution. If any binding is noted, disassemble the pump and check for assembly problems.
Removing the Axle Motors

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–49) prior to removing hydraulic system components.

1. To prevent contact between the face of the speed sensor and the drive coupling during axle motor removal, remove the speed sensor from the motor mount.

2. To prevent contamination of the hydraulic system during motor removal, thoroughly clean the exterior of the motor and fittings.

3. Label and disconnect the hydraulic hoses from the axle motor. To prevent contamination of hydraulic the system, plug the disconnected hoses and cap the fittings.

**Note:** The 2 cap screws that secure the rear axle motor to the motor mount also secure the hydraulic brake assembly.
Removing the Axle Motors (continued)

4. Remove the 2 cap screws that secure the axle motor to the motor mount. Separate the motor from the motor mount or hydraulic brake and remove the motor from the machine.

5. If removing the rear axle motor, retrieve and discard the gasket between the axle motor and the hydraulic brake assembly.

6. Remove and inspect the front drive coupler, or, remove and support the hydraulic brake assembly then remove and inspect the rear drive coupler.

7. If fitting removal is necessary, mark the fitting orientation to allow for correct assembly then remove the fittings from the pump and discard the O-rings.

Installing the Axle Motors

1. Lubricate new O-rings and place them onto the fittings. If previously removed, install the fittings into the motor ports using alignment marks made during removal; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–10).

2. Apply anti-seize lubricant to the splines of the drive coupler. Align the drive coupler splines and slide the drive coupler all the way onto the axle input shaft.

3. If installing the rear axle motor:
   A. Apply anti-seize lubricant to the splines of the hydraulic brake assembly.
   B. Align the hydraulic brake splines and slide the brake assembly shaft into the drive coupler.
   C. Install a new gasket between the hydraulic brake assembly and the rear axle motor.

4. Apply anti-seize lubricant to the splines of the axle motor shaft. Align the axle motor splines and slide the axle motor into the drive coupler (front motor) or hydraulic brake (rear motor).

5. Secure the axle motor using the 2 cap screws previously removed.

6. Remove caps and plugs from hydraulic fittings and hoses and install the hydraulic hoses to the axle motor; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–8).

7. Test axle motor operation before returning the machine to service:
   A. Check the hydraulic fluid level and adjust if necessary.
   B. Operate the machine slowly at first.
   C. Stop the engine then check for and correct any hydraulic leaks.
   D. Check the hydraulic fluid level and adjust if necessary.
The front and rear axle motors are identical. The motors include a flushing valve to help keep the hydraulic fluid in the closed-loop traction circuit cool. Refer to the detailed parts list and diagram for Assembly Notes 48:

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Plug with O-ring (2 each)</td>
</tr>
<tr>
<td>2</td>
<td>Minimum angle stop</td>
</tr>
<tr>
<td>3</td>
<td>Bias spring</td>
</tr>
<tr>
<td>4</td>
<td>Servo piston</td>
</tr>
<tr>
<td>5</td>
<td>O-ring</td>
</tr>
<tr>
<td>6</td>
<td>O-ring</td>
</tr>
<tr>
<td>7</td>
<td>Socket head screw (5 each)</td>
</tr>
<tr>
<td>8</td>
<td>End cap</td>
</tr>
<tr>
<td>9</td>
<td>Dowel</td>
</tr>
<tr>
<td>10</td>
<td>Dowel pin</td>
</tr>
<tr>
<td>11</td>
<td>Bearing</td>
</tr>
<tr>
<td>12</td>
<td>Gasket</td>
</tr>
<tr>
<td>13</td>
<td>Valve plate</td>
</tr>
<tr>
<td>14</td>
<td>Cylinder block kit</td>
</tr>
<tr>
<td>15</td>
<td>Swashplate</td>
</tr>
<tr>
<td>16</td>
<td>Swashplate bearing asm</td>
</tr>
<tr>
<td>17</td>
<td>Output shaft</td>
</tr>
<tr>
<td>18</td>
<td>Housing</td>
</tr>
<tr>
<td>19</td>
<td>Bearing</td>
</tr>
<tr>
<td>20</td>
<td>Retaining ring (2 each)</td>
</tr>
<tr>
<td>21</td>
<td>Retaining ring (2 each)</td>
</tr>
<tr>
<td>22</td>
<td>Seal</td>
</tr>
<tr>
<td>23</td>
<td>Support washer</td>
</tr>
<tr>
<td>24</td>
<td>Plug with O-ring (2 each)</td>
</tr>
<tr>
<td>25</td>
<td>Plug with O-ring (2 each)</td>
</tr>
<tr>
<td>26</td>
<td>Plug and spring asm (2 each)</td>
</tr>
<tr>
<td>27</td>
<td>Spool</td>
</tr>
<tr>
<td>28</td>
<td>Relief valve poppet</td>
</tr>
<tr>
<td>29</td>
<td>Spring</td>
</tr>
<tr>
<td>30</td>
<td>Plug</td>
</tr>
</tbody>
</table>

Figure 48
Axle Motor Service (continued)


Axle Differential Locks

The hydraulically actuated differential lock assemblies are incorporated into the axle assemblies; refer to the Carraro DriveTech Model 26.09M Axle Repair Manual for additional information.
Removing the Hydraulic Brake

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–49) prior to removing hydraulic system components.

1. Remove the rear axle motor; refer to Removing the Axle Motors (page 5–76).

2. To prevent contamination of the hydraulic system during brake removal, thoroughly clean the exterior of the brake assembly and fittings.

3. Disconnect the hydraulic hose from the brake assembly. To prevent contamination of hydraulic the system, plug the disconnected hose and cap the fitting.

4. Separate the hydraulic brake assembly from the motor mount and remove the brake from the machine.

5. Remove and inspect the rear drive coupler.

6. If fitting removal is necessary, mark the fitting orientation to allow for correct assembly then remove the fitting from the brake assembly and discard the O-rings.
Installing the Hydraulic Brake

1. Lubricate new O-rings and place them onto the fitting. If previously removed, install the fitting into the brake port using alignment mark made during removal; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–10).

2. Apply anti-seize lubricant to the splines of the drive coupler. Align the drive coupler splines and slide the drive coupler all the way onto the axle input shaft.

3. Apply anti-seize lubricant to the splines of the hydraulic brake assembly.

4. Align the hydraulic brake splines and slide the brake assembly shaft into the drive coupler.

5. Install a new gasket between the hydraulic brake assembly and the rear axle motor.

6. Install the rear axle motor; refer to Installing the Axle Motors (page 5–77).

7. Check the hydraulic brake oil level and adjust if necessary; refer to the traction unit Operator’s Manual.

8. Test the hydraulic brake operation before returning the machine to service.
Hydraulic Brake Service

1. Housing
2. Torque pin (2 each)
3. Compression spring (10 each)
4. Spring retainer
5. Compression spring (10 each)
6. Shaft
7. Bearing
8. Snap ring
9. Oil seal
10. Primary disc
11. Rotating disc (4 each)
12. Stationary disc (4 each)
13. Gasket
14. Backup ring
15. O-ring
16. O-ring
17. Backup ring
18. Power plate
19. Piston
20. Hex head screw (4 each)
21. Fill/drain plug (2 each)
22. Bleeder
23. Gasket (2 each)

Figure 50

Disassembling the Hydraulic Brake

1. Remove one of the fill/drain plugs and drain the oil from the brake housing.
2. Loosen the 4 hex head screws alternately and separate the power plate from the housing.
3. Remove the piston from the power plate with low pressure (103 kPa (15 psi)) compressed air through the hydraulic port.
Disassembling the Hydraulic Brake (continued)

4. Remove and discard the O-rings and backup washers.

**IMPORTANT**

If the shaft seal or bearing are removed for any reason, both must be replaced.

5. Press the shaft from the bearing and remove the shaft seal, retaining ring, and bearing.

Assembling the Hydraulic Brake

1. If previously removed, install a new bearing and retaining ring. Install a new shaft seal in the housing with the face of the seal toward the bearing. Press the shaft into the bearing while supporting the bearing inner race.

2. Install new piston O-rings and backup rings. The backup rings should be installed closest to the brake discs.

**CAUTION**

Piston installation depth is critical or the piston may cock, resulting in loss of braking. The surface of the piston at the base of the cutouts must be flush to 3.05 (0.12 inch) below the surface of the power plate.

3. Lubricate the piston and power plate bore with clean hydraulic oil and use a press to fit the piston into the power plate. Visually align the cutouts in the piston with the torque pin holes in the power plate.

4. Ensure the brake discs are clean and dry and install the discs as shown.

5. Use a new gasket and fit the power plate assembly over the housing. Install the 4 hex head screws and tighten them sequentially one turn at a time until the power plate assembly is properly seated. Tighten the screws from 108 to 122 N·m (80 to 90 ft-lb).
The ports on the main manifold are marked for easy identification of components and connections. Example: P is the pressure connection port from gear pump (P4) and SV1 is the location for the high/low speed solenoid valve; refer to the hydraulic schematic in Appendix A (page A–1) to identify the function of the hydraulic lines and cartridge valves at each port.

Although not recommended for most situations, relief valves (RV1) and (RV2) are adjustable; refer to Adjusting the Manifold Relief Valves (page 5–48).

Removing the Main Hydraulic Manifold

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–49) prior to removing hydraulic system components.
Removing the Main Hydraulic Manifold (continued)

1. Remove the operator’s platform; refer to Removing the Operator’s Platform (page 8–6).
2. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold and fittings.
3. Label and disconnect wire harness connectors from the solenoid valves.
4. Label and disconnect the hydraulic lines from the manifold and put caps or plugs on open hydraulic lines and fittings to prevent system contamination.
5. Remove the main manifold from the machine.
6. If hydraulic fittings are to be removed from the manifold, mark the fitting orientation to allow for correct assembly. Remove the fittings from the manifold and discard the O–rings.

Installing the Main Hydraulic Manifold

**Note:** The main hydraulic manifold is aluminum.

1. Lubricate new O-rings and place them onto the fittings. If previously removed, install the fittings into the manifold ports using alignment marks made during removal; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–10).
2. Position the manifold to the frame and secure with 4 cap screws.
3. Remove the caps and plugs from the fittings and hoses. Properly connect the hydraulic lines to the manifold; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–8).
4. Connect the wire harness connectors to the cartridge valve solenoids.
5. Install the operator’s platform; refer to Installing the Operator’s Platform (page 8–13).
Main Manifold Service

Figure 52

1. Solenoid coil (2 each)  
2. Coil nut (2 each)  
3. Manual valve – pull to open  
4. Hand pump  
5. Socket head screw (8 each)  
6. Mounting plate (4 each)  
7. Solenoid valve – SV1/SV2/SV3 (3 each)  
8. #4 zero-leak plug with O-ring (12 each)  
9. Relief valve – RV1/RV2 (2 each)  
10. Flow regulator – FR  
11. Pressure compensating valve – EC1  
12. #6 zero-leak plug with O-ring (3 each)  
13. Pressure compensating valve – EC2  
14. #6 zero-leak plug with O-ring (2 each)  
15. Orifice – 0.028 inch – OR1/OR2/OR3 (3 each)  
16. #2 zero-leak plug with O-ring (3 each)  
17. Solenoid valve – SP1  
18. Proportional valve – SP2  
19. Solenoid valve – EH  
20. Check valve – CV1/CV2 (2 each)  
21. #4 zero-leak plug with O-ring (2 each)  
22. Manifold block

The ports on the main manifold are marked for easy identification of components and connections. Example: P is the pressure connection port from gear pump (P4) and SV1 is the location for the high/low speed solenoid valve; refer to the hydraulic schematic in Appendix A (page A–1) to identify the function of the hydraulic lines and cartridge valves at each port.

The main hydraulic manifold include several zero-leak plugs. These plugs have a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero–leak plugs also have an O–ring as a secondary seal. If removing a zero–leak plug is necessary, lightly rap the plug head using a punch and hammer before using a hex wrench to remove the plug: the impact will allow plug removal with less chance of damage to the socket head of the plug. Tighten the plugs to the torque value provided.
A removable control orifice exists under the fitting in the LS/OR1 port, and under the plugs in the OR2 and OR3 ports of the main hydraulic manifold. If the fitting or plug is removed, remove the orifice for cleaning and label its position for assembly purposes.

Note: For cartridge valve service procedures, refer to Cartridge Valve Service (page 5–88).
Cartridge Valve Service

**Note:** For solenoid style cartridge valve coil testing information; refer to Hydraulic Solenoid Valve Coils (page 6–73).

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–49) prior to removing hydraulic system components.

1. Park the machine on a level surface. Lower any attachments, stop the engine, and remove the key from the key switch.

2. Ensure that the manifold is clean before you remove the cartridge valve from the manifold.

3. Remove the cartridge valve:
   A. For solenoid style valves, disconnect the wire harness connector and remove the nut that secures the solenoid coil to the cartridge valve. Carefully slide the coil off the valve.

   **IMPORTANT**

   **Handle the cartridge valve carefully.** 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.**

   B. Use a deep socket wrench to remove the cartridge valve from the manifold.

4. Record the correct location of the O-rings, the sealing rings, and the back-up rings. Remove and discard the seal kit from the cartridge valve.

5. Visually inspect the manifold port and the cartridge valve:
   A. Check for damaged threads on the cartridge valve and in the manifold block.
   B. If valve sealing surfaces appear pitted or damaged, the hydraulic system may be overheating or there may be water in the system.
   C. Contamination may cause valves to stick or hang up. Contamination can become lodged in small valve orifices or seal areas causing valve malfunction.

   **CAUTION**

   **Use eye protection such as goggles when using compressed air.**

   **Note:** Particles as fine as talcum powder can affect the operation of high pressure hydraulic valves.

6. Clean the cartridge valve.
   A. For non-solenoid operated valves: Submerge the valve in clean mineral spirits to flush out contamination. If the valve design allows, use a non–metallic probe to push the internal spool in and out 20 to 30 times to flush out contamination. Clean and dry the cartridge valve with compressed air.

   B. For solenoid operated valves: Temporarily install the solenoid on the cartridge valve and connect a 12 volt power source to the solenoid. While energized, flush out any contamination with a nonflammable aerosol brake cleaner. De-energize the solenoid. Repeat the flush
while energized procedure 5 or 6 times. Remove the solenoid from the cartridge.

7. Install the cartridge valve:
   A. Lubricate the new O-rings and the backup rings of the seal kit with clean hydraulic fluid and install them on the cartridge valve. The O-rings and the backup rings must be arranged correctly on the cartridge valve for proper operation and sealing; refer to notes taken during the seal removal.

---

**IMPORTANT**

*Use care when installing the cartridge valve. Slight bending or distortion of the stem tube can cause binding and malfunction. Make sure that deep well socket fully engages the valve base.*

---

B. Lubricate the threads on the cartridge valve with clean hydraulic fluid. Thread the cartridge valve carefully into the correct manifold port. The valve should thread in easily without binding.

C. Tighten the cartridge valve using a deep well socket to the torque specification shown.

D. For solenoid valves, slide the solenoid coil onto the cartridge valve. Tighten the coil nut to the torque specification shown.

8. If a problem still exists, remove the valve and clean it again or replace the valve.
Removing the Steering Control Valve

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–49) prior to removing hydraulic system components.

1. Remove the steering wheel and dash cover; refer to Removing the Steering Wheel, Instrument Panels and Dash Cover (page 8–16).

2. Clean the fittings and hydraulic line connections before disconnecting the hydraulic lines to prevent system contamination.

3. Disconnect the hydraulic hoses and tubes from the steering control valve. Cap the fittings and plug the lines to prevent contamination from entering the system.

4. Remove the four flange head screws securing the steering column and steering control valve to the plate.

5. Remove the steering column and steering control valve and retrieve the alignment bushing (item 7).

6. Inspect the four neoprene mounts between the plate and frame for damage and replace as necessary.

7. If fitting removal is necessary, mark the fitting orientation to allow for correct assembly then remove the fittings from the valve and discard the O-rings.
Installing the Steering Control Valve

1. Lubricate new O-rings and place them onto the fittings. If previously removed, install the fittings into the valve ports using alignment marks made during removal; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–10).

2. Apply anti-seize to the splines of the steering control valve and the bottom splines of the steering column. Install the alignment ring, then hold the steering control valve and steering column to the plate and install the four flange head screws. Tighten the screws from 46 to 57 N·m (34 to 42 ft-lb).

3. Connect the hydraulic hoses and lines to the steering control valve.

4. Install the dash cover and steering wheel; refer to Installing the Steering Wheel, Instrument Panels and Dash Cover (page 8–16).

Figure 54

1. Pressure (in) port – P
2. Tank (out) port – T
3. Left turn port – L
4. Right turn port – R
5. Load sensing port – LS
The Outcross 9060 uses a Danfoss type OSPC steering control valve. For steering control valve repair procedures, refer to the Danfoss Steering Unit Type OSPB, OSPC and OSPF Service Manual.
Steering Cylinders

Removing and Installing the Front Steering Cylinder

Removing and installing the front steering cylinder is accomplished by first removing the front axle assembly from the machine; refer to Front Axle (page 7–7).

Removing the Rear Steering Cylinder

![Figure 56]

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–49) prior to removing hydraulic system components.

1. Remove the bed; refer to Standard Bed (page 8–21).
2. Disconnect the rear speed sensor from the frame wire harness and remove the rear speed sensor. Cover the speed sensor face and plug or cover the sensor hole in the axle motor mount.
3. Remove the rear PTO gear box; refer to Removing the rear PTO Gear Box (page 7–21).
4. Raise the rear of the machine; refer to Jacking Instructions (page 1–8).
Removing the Rear Steering Cylinder (continued)

5. Disconnect the tie rods from the rear steering cylinder.
6. Clean the fitting and hydraulic line connections before disconnecting the hydraulic lines to prevent system contamination.
7. Disconnect the hydraulic hoses. Cap the fittings and plug the hoses to prevent system contamination.
8. Remove the fasteners securing the cylinder to the cylinder supports and remove the cylinder from the machine.
9. If hydraulic fittings will be removed, mark fitting orientation for proper assembly. Discard fitting O-rings.

Installing the Rear Steering Cylinder

1. Lubricate new O-rings and place them onto the fittings. If previously removed, install the fittings into the cylinder ports using alignment marks made during removal; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–10).
2. Install the steering cylinder to the machine and secure with 4 cap screws and flange nuts.
3. Remove the caps and plugs from the fittings and hoses and connect the hydraulic lines to the cylinder; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–8).
4. Install the tie rods to the rear steering cylinder; refer to Installing the Tie Rods (page 7–5).
5. Lower the machine to the ground.
6. Operate the steering cylinder. Check for hydraulic leaks and correct if necessary.
7. Install the rear PTO gear box; refer to Installing the Rear PTO Gear Box (page 7–22).
8. Install the rear speed sensor and connect the wire harness to the sensor.
9. Install the bed; refer to Standard Bed (page 8–21).
10. Check the hydraulic fluid level and adjust if necessary before returning the machine to service.
The front and rear cylinder bores, strokes and mounting brackets are different, but the cylinder design is the same. Use the same service procedure for either cylinder. The following service procedure assumes both tie rod assemblies have been previously removed from the cylinder assembly.

**Disassembling the Steering Cylinder**

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

---

**IMPORTANT**

When you clamp the steering cylinder in a vise, clamp against the mounting brackets only to prevent damage. Do not clamp the vise onto the barrel or rod.
Disassembling the Steering Cylinder (continued)

2. Mount the steering cylinder securely in a vise by clamping on the mounting brackets.

3. Remove the collar set screws and use a strap, chain, or spanner wrench to remove the collars from each end of the barrel.

4. Use a twisting motion to carefully pull the rod, piston, and head assemblies from the barrel.

5. Carefully push the remaining head assembly from the barrel.

6. Remove and discard the roll pin that secures the rods together. Separate (unscrew) the rods and remove the spacers and the piston assembly.

7. Remove and discard the seals, O-rings, and wear rings from the piston and heads.

Inspecting the Steering Cylinder

⚠️ CAUTION ⚠️

Use eye protection such as goggles when using compressed air.

1. Wash all the cylinder components in clean solvent and dry them with compressed air.

2. Inspect the internal surface of the barrel for deep scratches, out-of-roundness, and bending.

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

4. Check the re-phasing valve in the piston that exists to allow synchronization of the front and rear steering cylinders. The poppet valves should not be stuck in piston.

5. Replace the cylinder if the internal components are worn or damaged.

Assembling the Steering Cylinder

⚠️ IMPORTANT ⚠️

Avoid pinching, cutting, or otherwise damaging the O-rings, seals, and the wear ring during assembly. Lubricate the O-rings, seals, and the wear ring with clean hydraulic fluid prior to assembly.

1. Use a new seal kit and replace all the seals, O-rings, and the wear ring on the piston and heads.

2. Carefully fit the piston assembly over the male rod.

3. Thread the rods together until the roll pin holes in the rods align and install the roll pin.

⚠️ IMPORTANT ⚠️

When you clamp the steering cylinder in a vise, clamp against the mounting brackets only to prevent damage. Do not clamp the vise onto the barrel or rod.
Assembling the Steering Cylinder (continued)

4. Mount the steering cylinder barrel in a vise by clamping on the cylinder mounting brackets.

5. Coat the inner bore of the cylinder with clean hydraulic fluid and fit the piston and rod assembly into the cylinder barrel.

6. Install the 2 spacers and the 2 head assemblies.

7. Secure the heads in the barrel with the external collars. Tighten the external collars with a strap, chain, or spanner wrench.

8. Install and tighten the set screws in the external collars.
Removing the 3-Point Hitch Cylinder

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–49) prior to removing hydraulic system components.

1. Remove any attachments from the 3-point hitch.
2. Remove the stabilizer assembly, lift link assembly, and standard arm assembly.
3. Clean the fitting and hydraulic line connections before disconnecting the hydraulic lines to prevent system contamination.
4. Remove the upper pin securing the hitch cylinder to the lift arm.
5. Tilt the hitch cylinder rearward and disconnect the hydraulic hoses. Cap the fittings and plug the hoses to prevent contamination from entering the system.
6. Remove the lower pin securing the hitch cylinder to the frame and remove the cylinder from the machine.
Installing the 3-Point Hitch Cylinder

1. Lubricate new O-rings and place them onto the fittings. If previously removed, install the fittings into the cylinder ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–10).

2. Apply general purpose grease to the lower cylinder clevis. Position the hitch cylinder to the machine frame and install the lower pin.

3. Remove the caps and plugs from the fittings and hoses and connect the hydraulic lines to the cylinder; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–8).

4. Install the upper pin securing the cylinder to the lift arm.

5. Install the standard arm assembly, lift link assembly, and stabilizer assembly.

6. Grease the lower cylinder pin fitting with Mobil high-temp XHP-222 or equivalent.

7. Operate the 3-point hitch. Check for hydraulic leaks and correct if necessary.

8. Check the hydraulic fluid level and adjust if necessary before returning the machine to service.
Disassembling the Hitch Cylinder

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

**IMPORTANT**

When you clamp the cylinder in a vise, clamp against the cylinder clevis only to prevent damage. Do not clamp the vise onto the barrel.

2. Mount the cylinder in a vise by clamping on the cylinder clevis.
Disassembling the Hitch Cylinder (continued)

3. Remove the set screw then use a strap, chain, or spanner wrench to loosen and remove the external collar.
4. Extract the shaft with head and piston by carefully twisting and pulling on the shaft.

**IMPORTANT**

When you clamp the shaft in a vise, clamp against the shaft clevis only to prevent damage. Do not clamp the vise onto the shaft.

5. Mount shaft securely in a vise and remove lock nut from the shaft. Slide the piston, head, and external collar off the shaft.
6. Remove piston seal, wear ring and O-ring from the piston. Remove O-ring, back-up ring, dust seal, wear ring and shaft seal from the head.

Inspecting the Hitch Cylinder

**CAUTION**

Use eye protection such as goggles when using compressed air.

1. Wash all the cylinder components in clean solvent and dry them with compressed air.
2. Inspect the internal surface of the barrel for deep scratches, out-of-roundness, and bending.
3. Inspect the head, shaft, and piston for excessive pitting, scoring, and wear.
4. Replace the cylinder if the internal components are worn or damaged.

Assembling the Hitch Cylinder

**IMPORTANT**

Avoid pinching, cutting, or otherwise damaging the O-rings, seals, and the wear ring during assembly. Lubricate the O-rings, seals, and the wear ring with clean hydraulic fluid prior to assembly.

1. Use a new seal kit and replace all the seals, O-rings, and the wear ring on the piston and head.

**IMPORTANT**

When you clamp the shaft in a vise, clamp against the shaft clevis only to prevent damage. Do not clamp the vise onto the shaft.

2. Mount shaft securely in a vise and slide the external collar, head, and piston onto the shaft.
3. Install the locknut and tighten to 312 N·m (230 ft-lb).
4. Slide cylinder barrel carefully over shaft assembly and install the external collar.
Assembling the Hitch Cylinder (continued)

**IMPORTANT**

When you clamp the cylinder in a vise, clamp against the cylinder clevis only to prevent damage. Do not clamp the vise onto the barrel.

5. Mount the cylinder in a vise by clamping on the cylinder clevis.
6. Use a strap, chain, or spanner wrench to tighten the external collar. Install and tighten the set screw.

**PTO Clutch**

The hydraulically actuated PTO clutch assembly is incorporated into the front gear box assembly; refer to Front PTO Gear Box (page 7–14) and PTO Clutch (page 7–19) for additional information.
Auxiliary Load Valve

Removing the Auxiliary Load Valve

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–49) prior to removing hydraulic system components.

1. Remove the operator’s console: refer to Removing and Installing the Operator’s Console (page 8–17).
2. Disconnect the frame wire harness from the hydraulic (AUX) switch.
3. Clean the fitting and hydraulic line connections before disconnecting the hydraulic lines to prevent system contamination.
4. Disconnect the hydraulic lines at the valve assembly. Cap the fittings and plug the lines to prevent contamination from entering the system.
5. Remove the 4 cap screws securing the valve assembly to the machine and remove the valve assembly.
6. Remove and discard fitting O-rings.

Installing the Auxiliary Load Valve

1. Lubricate new O-rings and place them onto the fittings. If previously removed, install the fittings into the valve ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–10).
2. Secure the valve assembly to the machine with 4 cap screws.
3. Remove the caps and plugs from the fittings and hydraulic lines and connect the hydraulic lines to the valve; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–8).
4. Connect the frame wire harness to the hydraulic (AUX) switch.
5. Operate the auxiliary load valve. Check for hydraulic leaks and correct if necessary.

6. Install the operator’s console; refer to Removing and Installing the Operator’s Console (page 8–17).

7. Test the attachment/loader circuit relief valve pressure before returning the machine to service; refer to Attachment/Loader Circuit Testing – Relief Valve Pressure Test (page 5–43).

8. Check the hydraulic fluid level and adjust if necessary before returning the machine to service.
Auxiliary Load Valve Service

Servicing the Auxiliary Load Valve

For complete service information; refer to the Gresen/Parker Hydraulics Model V10 Sectional Body Directional Control Valve Service Manual.

1. Disassemble the auxiliary load valve as necessary.
2. Clean and inspect the section housings.
3. Install new seals where available.
Removing the Front Loader Control Valve

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–49) prior to removing hydraulic system components.

1. Remove the operator’s console: refer to Removing and Installing the Operator’s Console (page 8–17).

2. Clean the fitting and hydraulic line connections before disconnecting the hydraulic lines to prevent system contamination.

3. Disconnect the hydraulic lines at the valve assembly. Cap the fittings and plug the lines to prevent contamination from entering the system.

4. Remove the 4 cap screws securing the valve assembly to the machine and remove the valve assembly.

5. If hydraulic fittings will be removed, mark fitting orientation for proper assembly. Discard fitting O-rings.
Installing the Front Loader Control Valve

1. Lubricate new O-rings and place them onto the fittings. If previously removed, install the fittings into the valve ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–10).

2. Secure the valve assembly to the machine with 4 cap screws.

3. Remove the caps and plugs from the fittings and hydraulic lines and connect the hydraulic lines to the valve; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–8).

4. Operate the front loader control valve. Check for hydraulic leaks and correct if necessary.

5. Install the operator’s console; refer to Removing and Installing the Operator’s Console (page 8–17).

6. Check the hydraulic fluid level and adjust if necessary before returning the machine to service.
Front Loader Control Valve Service

Figure 63

1. Relief plug seal kit
2. Section seal kit (3 each)
3. Work port cavity plug seal kit (2 each)
4. Spring return spool positioner
5. 4-position float spool positioner
6. Spool seal (3 each)
7. Dust boot
8. Joystick assembly

Servicing the Loader Control Valve

For complete service information; refer to the Gresen/Parker Hydraulics Model V10 Sectional Body Directional Control Valve Service Manual.

1. Disassemble the auxiliary load valve as necessary.
2. Clean and inspect the section housings.
3. Install new seals where available.
Two different optional selector control valve kits are available. The loader selector control valve kit expands the loader or front hydraulic capability, and the rear selector control valve kit expands the rear or auxiliary hydraulic capability.

The ports on the manifolds are marked for easy identification of components and connections; refer to the hydraulic schematic in Appendix A (page A–1) to identify the function of the hydraulic lines and cartridge valves at each port.

**Removing the Selector Control Valve Manifolds**

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–49) prior to removing hydraulic system components.

1. The loader selector control valve manifolds are located on the right side loader arm. The rear selector control valve manifolds are located on the right side frame rail behind the operator’s platform. Remove the bed to access the rear selector control valve manifolds; refer to Standard Bed (page 8–21).

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

3. Label and disconnect wire harness connectors from the solenoid valves.

4. Label and disconnect the hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings to prevent system contamination.

5. Remove the manifold from the machine.

6. If hydraulic fittings are to be removed from the manifold, mark the fitting orientation to allow for correct assembly. Remove the fittings from the manifold and discard the O-rings.
Installing the Selector Control Valve Manifolds

1. Lubricate new O-rings and place them onto the fittings. If previously removed, install the fittings into the valve ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–10).

2. Position the manifolds to the bracket and secure with 2 cap screws.

3. Remove the caps and plugs from the fittings and hoses. Properly connect the hydraulic lines to the manifold; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–8).

4. Connect the wire harness connectors to the cartridge valve solenoids.
Selector Control Valve Manifold (optional) Service

Figure 65

1. Manifold block
2. Coil nut
3. Coil nut
4. Solenoid coil (2 each)
5. Solenoid valve – normally closed
6. Solenoid valve – normally open
7. #8 zero-leak plug with O-ring

The ports on the selector control valve manifolds are marked for easy identification of components and connections; refer to the hydraulic schematic in Appendix A (page A–1) to identify the function of the hydraulic lines and cartridge valves at each port.

The selector control valve manifolds include a zero–leak plug. This plug has a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero–leak plug also has an O–ring as a secondary seal. If removing a zero–leak plug is necessary, lightly rap the plug head using a punch and hammer before using a hex wrench to remove the plug: the impact will allow plug removal with less chance of damage to the socket head of the plug. Tighten the plug to the torque value provided.

Note: For cartridge valve service procedures, refer to Cartridge Valve Service (page 5–88).
# Chapter 6

## Electrical System

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General Information

**IMPORTANT**

Before performing any welding on the machine, turn the key switch to the OFF position. To prevent damage to the machine electrical system, disconnect the ground (-) cable to the frame when welding on the frame, or disconnect the ground (-) cable to the operator platform when welding on the operator platform.

Traction Unit Operator’s Manual and Accessory Installation Instructions

The traction unit Operator’s Manual and accessory Installation Instructions provide information regarding the operation, general maintenance and maintenance intervals for the machine and its accessories. Refer to the traction unit Operator’s Manual and accessory Installation Instructions for additional information.

Yanmar Engine Electrical Components

When servicing or troubleshooting the engine electrical components, use the correct engine service manual and troubleshooting manual. Yanmar engine service and troubleshooting manuals are available online, on the Toro Service Reference flash drive, and in print from your authorized Toro Distributor.
The InfoCenter Display is a five button LCD device located on the main instrument panel. The InfoCenter provides information to the machine operator during machine operation, provides electrical system diagnostic assistance for technicians and allows access to adjustable machine and attachment settings. Power for the InfoCenter is available when the main power relay is energized (key switch is in the ON or START position). A 2 Amp fuse (F–B3) protects the InfoCenter power circuit.

The primary controller (T1: TEC), the status display controller (T2: TDM), the Yanmar Engine Control Unit (ECU), the InfoCenter Display, and the optional InchMode controller (T3: TEC) used on the Outcross 9060 machine communicate with each other on a Controller Area Network (CAN) bus system.

**Note:** The InfoCenter Display, TECs, TDM and the engine ECU used on the Outcross 9060 machine are matched for correct machine operation. If any of these components are replaced for any reason, system software needs to be reloaded (contact an Authorized Toro Distributor for assistance).
InfoCenter Display (continued)

Figure 67
InfoCenter Screens

Software Version 122-0656 A shown
Primary Controller (T1: TEC)

Outcross 9060 machines use a primary controller (T1: TEC) to manage machine electrical functions. The T1: TEC is a 5004 series microcontroller that monitors the condition of various machine switches and sensors (inputs) and directs electrical power to control appropriate machine functions (outputs) based on the state of the inputs. The T1: TEC works in conjunction with the T2: TDM to manage the engine start and run signals, the electric fuel pump, and the various hydraulic solenoid valves. The status of inputs to the controller as well as outputs from the controllers can be monitored with the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23).

The T1: TEC is attached to the machine under the main instrument panel. Power for the T1: TEC logic and memory is available at all times (unswitched). The logic and memory circuit is protected by a 2 Amp fuse (F–B2). Power for the T1: TEC outputs is available when the main power relay is energized (key switch is in the ON or START position). A series of four 7.5 Amp fuses (F–A1, B1, C1, and D1) protect the T1: TEC output circuits.

The primary controller (T1: TEC), the status display controller (T2: TDM), the Yanmar Engine Control Unit (ECU), the InfoCenter Display, and the optional InchMode controller (T3: TEC) used on the Outcross 9060 machine communicate with each other on a Controller Area Network (CAN) bus system.

**Note:** The InfoCenter Display, TECs, and the TDM used on the Outcross 9060 machine are matched for correct machine operation. If any of these components are replaced for any reason, system software needs to be reloaded (contact an Authorized Toro Distributor for assistance).
The status display module (T2: TDM) is an LCD device located on the main instrument panel that presents operating hours, fuel level, engine coolant temperature, hydraulic oil temperature, electrical system voltage, engine RPM, 3-point hitch position, and active faults. A single button located near the T2: TDM is used to select the various display screens. A red LED active fault indicator is also part of the T2: TDM. The fault indicator flashes when one or more active machine or engine faults exist. Power for the TDM is available when the main power relay is energized (key switch is in the ON or START position). A 2 Amp fuse (F–A4) protects the TDM power circuit.
The T2: TDM is also a 2002 series microcontroller that monitors the condition of various machine switches and sensors (inputs) and communicates the status of these inputs to the T1: TEC via the CAN. The status of inputs to the controller can be monitored with the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23).

The primary controller (T1: TEC), the status display controller (T2: TDM), the Yanmar Engine Control Unit (ECU), the InfoCenter Display, and the optional InchMode controller (T3: TEC) used on the Outcross 9060 machine communicate with each other on a Controller Area Network (CAN) bus system.

**Note:** The InfoCenter Display, TECs, and the TDM used on the Outcross 9060 machine are matched for correct machine operation. If any of these components are replaced for any reason, system software needs to be reloaded (contact an Authorized Toro Distributor for assistance).
The Yanmar engine that powers your Outcross 9060 machine uses an Electronic Control Unit (ECU) for engine management. The engine ECU is located under the right side of the dash cover. All wire harness electrical connectors should be plugged into the ECU before the machine key switch is moved from the OFF position to either the ON or START position. The primary controller (T1: TEC), the status display controller (T2: TDM), the Yanmar Engine Control Unit (ECU), the InfoCenter Display, and the optional InchMode controller (T3: TEC) used on the Outcross 9060 machine communicate with each other on a Controller Area Network (CAN) bus system.

The engine electrical components (e.g. ECU, fuel injectors, EGR, exhaust DPF) are identified and matched in the engine ECU program. If engine electrical components are replaced on the engine, the Yanmar SmartAssist–Direct tool (SA-D) must be used to update the ECU program which will ensure correct engine operation. The Yanmar SA-D connector is located near the engine ECU, just under the dash cover. Contact your Toro distributor for assistance.

If the engine ECU identifies that an engine problem exists, the engine speed may be reduced or the engine might stop. The *Yanmar TNV (Tier 4) Series Troubleshooting Manual* and the Yanmar SmartAssist–Direct tool (SA-D) should be used to provide assistance in identifying the cause of the problem and the repairs that may be necessary.

**IMPORTANT**

Do not disconnect the engine ECU for 60 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.
InchMode Controller (T3: TEC) (optional)

The optional InchMode feature includes the InchMode controller (T3: TEC) to manage traction, hitch lift, and PTO functions while standing next to the machine. The T3: TEC is a 2002 series microcontroller that monitors the condition of various machine switches and sensors (inputs) and communicates the status of these inputs to the T1: TEC via the CAN. The status of inputs to the controller can be monitored with the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23).

The T3: TEC is attached to the operator seat base. Power for the T3: TEC is available when the main power relay is energized (key switch is in the ON or START position). A 10 Amp fuse (F–C5) protects the T3: TEC power circuit.

The primary controller (T1: TEC), the status display controller (T2: TDM), the Yanmar Engine Control Unit (ECU), the InfoCenter Display, and the optional InchMode controller (T3: TEC) used on the Outcross 9060 machine communicate with each other on a Controller Area Network (CAN) bus system.

Note: The InfoCenter Display, TECs, and the TDM used on the Outcross 9060 machine are matched for correct machine operation. If any of these components are replaced for any reason, system software needs to be reloaded (contact an Authorized Toro Distributor for assistance).
CAN bus Communications

The primary controller (T1: TEC), the status display controller (T2: TDM), the Yanmar Engine Control Unit (ECU), the InfoCenter Display, and the optional InchMode controller (T3: TEC) used on the Outcross 9060 machine communicate with each other on a Controller Area Network (CAN) bus system. Using this network allows the traction unit to fully integrate all the different electrical components of the machine and bring them together as one. The CAN bus system reduces the number of electrical components and connections used on the machine and allows the number of wires in the wire harness to be significantly reduced. The integration of electrical functions also allows the InfoCenter Display to assist with electrical system diagnostics.

Each of the components that is controlled by the CAN bus link only needs four (4) wires to operate and communicate to the system: CAN High, CAN Low, power and ground. The key switch needs to be in the RUN or START position for the components on the network to be activated.

Two specially designed, twisted wires form the CAN bus. These wires provide the data pathways between the components on the network. The engineering term for these cables are CAN High and CAN Low. The CAN bus wires are yellow (CAN-High) and green (CAN Low). At each end of the twisted pair of bus cables is a 120 ohm termination resistor; refer to CAN bus Terminator Resistors (page 6–71).

![Diagram](image_url)

**Figure 73**

1. Main fuse block
2. Toro DIAG connector
3. Connector cover

The Toro DIAG electronic control diagnostics service system is available to Authorized Toro Distributors to support machine fault diagnosis and maintenance services of the machine electrical control devices. The Toro DIAG connector is located below the dash next to the main fuse block.
Electrical Drawings

The electrical schematic and wire harness drawings for the Outcross 9060 machine are located in Appendix A (page A–1).
The Outcross 9060 uses a single 12 Volt maintenance free battery mounted below the left side of the operator’s platform. The battery is charged by an 80 Amp 12 volt alternator mounted to the engine, which is driven by a single row V-belt.

Use the T2: TDM display to monitor the 12 Volt electrical system. It will tell you if the charging system has an output, but not its capacity.
1. Check to make sure each alternator drive belt is not loose, worn or damaged.
2. Turn the key switch to the ON position and set the T2: TDM display to view the voltmeter.
3. Record the initial system voltage.
4. Start the engine and warm the engine to normal operating temperature.
5. Set the engine RPM to 2300 RPM.
6. Turn on all additional system loads (e.g. lights, blower).
7. The system voltage should be at least 0.5 volt higher then the initial voltage recorded in step 3.
8. If the charging system performance is less than desired, refer to the Yanmar Service Manual or Troubleshooting Manual for additional information.

Checking the Operation of the Interlock Switches

**CAUTION**

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

Your Outcross 9060 is equipped with a primary (T1: TEC) and a (T2: TDM) which monitor interlock switch operation. If all of the interlock switches necessary to allow a specific machine operation are not in their desired position, the machine alarm will sound and an Operator’s Advisory may appear on the InfoCenter Display; refer to Operator Advisories (page 3–3).

The machine interlocks include:
- Operator seat switch
- Parking brake switch
- Traction pedal
- Transmission lever switches
- Paddle (3-point hitch) switches
- Auxiliary hydraulic lever
- PTO switch
- InchMode switches (optional)

Use the InfoCenter Display to test the various interlock switches (inputs) before physically testing the switch and its circuitry; refer to Using the InfoCenter Display for Troubleshooting (page 3–23). Procedures for physically testing individual interlock switches is included in Electrical Component Testing (page 6–14).
Electrical Component Testing

Fuses

The main power supply, cab power supply, and rear attachment power supply are protected by three separate 60 Amp maxi fuses. The maxi fuse holders are part of the operator platform wire harness and are located under the main instrument panel. The individual control circuits are protected by a variety of smaller amperage fuses found in the main fuse block located in the driver foot well above the traction and decelerator pedals. An accessory fuse block may be mounted below the main fuse block. Machines with a cab include additional control circuits protected by fuses found in the cab fuse block located in the cab control panel above the passenger seat. Machines with an optional Road Light kit include lighting circuits protected by fuses found in the kit wire harness under the roof. Refer to the Electrical Schematic and Wire Harness Drawings/Diagrams in Appendix A (page A–1) for specific circuit information.

Fuse Identification, Location and Function

Main Fuse Block
- Fuse F−A1 (7.5 Amp) supplies power to the T1: TEC outputs 1 thru 4.
- Fuse F−B1 (7.5 Amp) supplies power to the T1: TEC outputs 9 thru 12.
- Fuse F−C1 (7.5 Amp) supplies power to the T1: TEC outputs 5 thru 8.
- Fuse F−D1 (7.5 Amp) supplies power to the T1: TEC outputs 13 thru 16.
- Fuse F−A2 (10 Amp) supplies unswitched power to the engine ECU.
- Fuse F−B2 (2 Amp) supplies unswitched power to the key switch and logic power to the T1: TEC
- Fuse F−C2 (10 Amp) supplies unswitched power to expansion ports #1 and #2.
Fuse Identification, Location and Function (continued)

- Fuse F–D2 (15 Amp) supplies unswitched power to the cab control panel for an optional radio, and to the International (EC) road light kit.
- Fuse F–A3 (10 Amp) supplies power to the optional hour meter, optional bed active switch, backup alarm, traction speed sensors, cruise control auto off switch, and ECO mode switch bulb.
- Fuse F–B3 (2 Amp) supplies power to the InfoCenter display.
- Fuse F–C3 (10 Amp) supplies power to the headlights/worklights.
- Fuse F–D3 (10 Amp) supplies power to the power point, USB charge port, and optional selector control valve (SCV) kit.
- Fuse F–A4 (2 Amp) supplies power to the T2: TDM outputs 1 thru 3.
- Fuse F–B4 (10 Amp) supplies power to the North American (NA) road light kit.
- Fuse F–C4 (10 Amp) supplies power to the horn.
- Fuse F–D4 (10 Amp) supplies power to the optional beacon.
- Fuse F–A5 (10 Amp) supplies power to the air-ride seat compressor.
- Fuse F–B5 (20 Amp) supplies power to the optional trailer brake controller.
- Fuse F–C5 (10 Amp) supplies switched power to expansion ports #1 and #2.
- Fuse F–D5 (15 Amp) supplies switched power to the rear attachment connector.

Accessory Fuse Block

- Fuse (10 Amp) supplies power to the loader selector control valve (SCV) kit.

![Figure 75](image-url)

1. Cab fuse block
2. Knob (2 each)
3. Access panel

**Cab Fuse Block**

- Fuse IF–1 is unused and available for optional equipment
- Fuse IF–2 (40 Amp) supplies power to the mixing box blower and the defroster blower.
- Fuse IF–3 (20 Amp) supplies power to the windshield wipers.
- Fuse IF–4 (25 Amp) supplies power to the condenser fans.
Fuse Identification, Location and Function (continued)

1. Fuse – RH tail light
2. Fuse – RH brake/turn
3. Fuse – LH brake/turn
4. Fuse – LH tail light

Optional Road Light Kit Wire Harness

• Four (5 Amp) fuses are integrated into the optional turn signal/hazard wire harness. Each fuse is in a separate covered fuse holder. The harness is located under the roof.

Testing Fuses

1. Make sure that key switch is OFF and key is removed from switch.
2. Remove fuse from fuse block for testing. Fuse should have continuity across the terminals.
Fusible Link Harness

Figure 77

1. Starter motor
2. Fusible link harness
3. To starter B+ terminal
4. To engine wire harness P22 connector
5. Fusible link for glow plug circuit
6. Fusible link for starter circuit

The Outcross 9060 uses two (2) fusible links for circuit protection. These fusible links are located in a harness that connects the starter B+ terminal to the engine wire harness. If either of these links should fail, current to the protected circuits will be interrupted.

Testing the Fusible Link Harness

1. Locate and unplug the fusible link harness connector from the engine wire harness.
2. Use a multimeter to make sure that continuity exists between the fusible link terminals.

Note: It is not recommended to replace individual fusible link conductors of the fusible link harness. If any of the harness links are open (failed), replace the entire fusible link harness.
3. If either fusible link is open, replace the fusible link harness.
4. After fusible link testing is complete, make sure that the fusible link harness is securely attached to starter B+ terminal and the engine wire harness.
The machine controllers communicate with each other on a Controller Area Network (CAN) bus system. Using this network allows full integration of all the different electrical components of the machine, allowing them to operate together as one. The integration of the controllers allows the InfoCenter Display to assist with electrical system diagnostics.

Two specially designed, twisted wires form the CAN bus. These wires provide the data pathways between the components on the network. The engineering term for these cables are CAN High and CAN Low. The CAN bus wires are yellow (CAN-High) and green (CAN Low). At each end of the CAN bus is a 120 ohm termination resistor; refer to CAN bus Terminator Resistors (page 6–71).

Testing the CAN bus

1. Main fuse block
2. Toro DIAG connector
3. Connector cover

1. Make sure that key switch is OFF and key is removed from switch.
2. The Toro DIAG connector is part of the CAN bus and is located below the dash next to the main fuse block. Locate the Toro DIAG connector and remove the connector cover.
3. Use a multimeter (ohms setting) to measure the resistance across terminals A and B.
   • A reading of 54 to 66 ohms indicates the CAN bus is intact.
   • A reading of 120 ohms indicates one of the CAN bus terminator resistors is not connected, damaged, or the CAN bus wiring is damaged; refer to CAN bus Terminator Resistors (page 6–71) and/or Appendix A (page A–1).
4. Install the Toro DIAG connector cover after testing.
Outcross 9060 machines use a primary controller (T1: TEC) to manage machine electrical functions. The T1: TEC is a 5004 series microcontroller that monitors the condition of various machine switches and sensors (inputs) and directs electrical power to control appropriate machine functions (outputs) based on the state of the inputs. The T1: TEC works in conjunction with the T2: TDM to manage the engine start and run signals, the electric fuel pump, and the various hydraulic solenoid valves. The status of inputs to the controller as well as outputs from the controllers can be monitored with the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23).

The T1: TEC is attached to the machine under the main instrument panel. Power for the T1: TEC logic and memory is available at all times (unswitched). The logic and memory circuit is protected by a 2 Amp fuse (F−B2). Power for the T1: TEC outputs is available when the main power relay is energized (key switch is in the ON or START position). A series of four 7.5 Amp fuses (F−A1, B1, C1, and D1) protect the T1: TEC output circuits.
### T1: TEC Inputs

<table>
<thead>
<tr>
<th>INPUT NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN 1</td>
<td>Bed Active Switch</td>
</tr>
<tr>
<td>IN 2</td>
<td>AC (air conditioning) Active Switch</td>
</tr>
<tr>
<td>IN 3</td>
<td>Parking Brake Switch</td>
</tr>
<tr>
<td>IN 4</td>
<td>Seat Switch</td>
</tr>
<tr>
<td>IN 5</td>
<td>Transmission Forward Switch</td>
</tr>
<tr>
<td>IN 6</td>
<td>Transmission Reverse Switch</td>
</tr>
<tr>
<td>IN 7</td>
<td>Decelerator Neutral Switch</td>
</tr>
<tr>
<td>IN 8</td>
<td>3-Point Hitch Lower Switch</td>
</tr>
<tr>
<td>IN 9</td>
<td>3-Point Hitch Raise Switch</td>
</tr>
<tr>
<td>IN 10</td>
<td>PTO Enable Switch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INPUT NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN 11</td>
<td>Hydraulic AUX Switch</td>
</tr>
<tr>
<td>IN 12</td>
<td>SCV (Selector Control Valve) Switch</td>
</tr>
<tr>
<td>IN 13</td>
<td>Front Speed Sensor</td>
</tr>
<tr>
<td>IN 14</td>
<td>Rear Speed Sensor</td>
</tr>
<tr>
<td>AIN1</td>
<td>Traction Pedal – APS1</td>
</tr>
<tr>
<td>AIN2</td>
<td>Traction Pedal – APS2</td>
</tr>
<tr>
<td>AIN3</td>
<td>Decelerator Pedal</td>
</tr>
<tr>
<td>AIN4</td>
<td>3-Point Hitch Position Sensor</td>
</tr>
<tr>
<td>AIN5</td>
<td>Front Pressure Sensor</td>
</tr>
<tr>
<td>AIN6</td>
<td>Rear Pressure Sensor</td>
</tr>
</tbody>
</table>

### T1: TEC Outputs

<table>
<thead>
<tr>
<th>OUTPUT NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUT LS</td>
<td>Cab Power Relay</td>
</tr>
<tr>
<td>OUT 1</td>
<td>Engine ECU – START</td>
</tr>
<tr>
<td>OUT 2</td>
<td>Engine ECU – RUN</td>
</tr>
<tr>
<td>OUT 3</td>
<td>Parking Brake Solenoid (SV2)</td>
</tr>
<tr>
<td>OUT 4</td>
<td>High Range Traction Speed Solenoid (SV1)</td>
</tr>
<tr>
<td>OUT 5</td>
<td>Differential Lock Solenoid (SV3)</td>
</tr>
<tr>
<td>OUT 6</td>
<td>Electric Brake Controller (optional)</td>
</tr>
<tr>
<td>OUT 7</td>
<td>Not Used</td>
</tr>
<tr>
<td>OUT 8</td>
<td>SCV Enable Solenoid Valves (optional)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OUTPUT NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUT 9</td>
<td>Front Traction Pump – Forward Solenoid (AB-C1)</td>
</tr>
<tr>
<td>OUT 10</td>
<td>Front Traction Pump – Reverse Solenoid (AB-C2)</td>
</tr>
<tr>
<td>OUT 11</td>
<td>Rear Traction Pump – Forward Solenoid (CD-C1)</td>
</tr>
<tr>
<td>OUT 12</td>
<td>Rear Traction Pump – Reverse Solenoid (CD-C2)</td>
</tr>
<tr>
<td>OUT 13</td>
<td>PTO Enable Solenoid (EH)</td>
</tr>
<tr>
<td>OUT 14</td>
<td>3-Point Hitch Lower Solenoid (SP2)</td>
</tr>
<tr>
<td>OUT 15</td>
<td>3-Point Hitch Raise Solenoid (SP1)</td>
</tr>
<tr>
<td>OUT 16</td>
<td>Not Used</td>
</tr>
</tbody>
</table>

The machine electrical schematic and wire harness drawings in Appendix A (page A–1) can be used to identify possible circuit problems between the controller and the input or output devices (e.g. switches and solenoid valve coils).
When testing for wire harness continuity at the connector for the controller, take care to not damage the connector pins with multimeter test leads. If connector pins are enlarged or damaged during testing, connector repair may be necessary for proper machine operation.

A 50 pin platform wire harness connector is attached to the controller. The connection terminal function for the controller and the wire harness connector pins are shown above. If the wire harness connector is removed from the T1: TEC for any reason, tighten the harness connector screw from 2.8 to 3.2 N·m (25 to 28 in-lb).

Because of the solid state circuitry built into the controller, there is no method to test the controller directly. A controller may be damaged if an attempt is made to test it with an electrical test device (e.g. digital multimeter or test light).

Note: The InfoCenter Display, TECs, and the TDM used on the Outcross 9060 machine are matched for correct machine operation. If any of these components are replaced for any reason, system software needs to be reloaded (contact an Authorized Toro Distributor for assistance).
The status display module (T2: TDM) is an LCD device located on the main instrument panel that presents operating hours, fuel level, engine coolant temperature, hydraulic oil temperature, electrical system voltage, engine RPM, 3-point hitch position, and active faults. The status display button located below the T2: TDM is used to select the various display screens. Refer to Status Display Controller (T2: TDM) (page 6–7) for a complete explanation of the TDM features. Power for the TDM is available when the main power relay is energized (key switch is in the ON or START position). A 2 Amp fuse (F–A4) protects the TDM power circuit.

The T2: TDM is also a 2002 series microcontroller that monitors the condition of various machine switches and sensors (inputs) and communicates the status of these inputs to the T1: TEC via the CAN. The status of inputs to the controller can be monitored with the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23).

The primary controller (T1: TEC), the status display controller (T2: TDM), the Yanmar Engine Control Unit (ECU), the InfoCenter Display, and the optional InchMode controller (T3: TEC) used on the Outcross 9060 machine communicate with each other on a Controller Area Network (CAN) bus system.
Status Display Controller (T2: TDM) (continued)

T2: TDM Inputs

<table>
<thead>
<tr>
<th>INPUT NUMBER</th>
<th>DESCRIPTION</th>
<th>INPUT NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN 2</td>
<td>Cruise Speed Increase/Decrease Switch – Decrease</td>
<td>IN 7</td>
<td>Cruise Speed Increase/Decrease Switch – Increase</td>
</tr>
<tr>
<td>IN 3</td>
<td>Differential lock switch</td>
<td>AIN1</td>
<td>Mode Selector Switch</td>
</tr>
<tr>
<td>IN 4</td>
<td>Economy (ECO) Mode Switch</td>
<td>AIN2</td>
<td>Status Display Button</td>
</tr>
<tr>
<td>IN 5</td>
<td>Cruise Control Off/On/Set Switch – ON (enable)</td>
<td>AIN3</td>
<td>Hydraulic Fluid Temperature Sender</td>
</tr>
<tr>
<td>IN 6</td>
<td>Cruise Control Off/On/Set Switch – SET (engage)</td>
<td>AIN4</td>
<td>Fuel Level Sender</td>
</tr>
</tbody>
</table>

T2: TDM Outputs

<table>
<thead>
<tr>
<th>OUTPUT NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUT 1</td>
<td>Parking Brake Light</td>
</tr>
<tr>
<td>OUT 2</td>
<td>Not Used</td>
</tr>
<tr>
<td>OUT 3</td>
<td>Warning Buzzer</td>
</tr>
</tbody>
</table>

The machine electrical schematic and wire harness drawings in Appendix A (page A–1) can be used to identify possible circuit problems between the controller and the input or output devices.

**IMPORTANT**

When testing for wire harness continuity at the connector for the controller, take care to not damage the connector pins with multimeter test leads. If connector pins are enlarged or damaged during testing, connector repair may be necessary for proper machine operation.

Figure 82

1. Platform wire harness connector P15
2. Status display controller (T2: TDM)
Status Display Controller (T2: TDM) (continued)

A 20 pin platform wire harness connector is attached to the controller. The connection terminal function for the controller and the wire harness connector pins are shown above.

Because of the solid state circuitry built into the controller, there is no method to test the controller directly. A controller may be damaged if an attempt is made to test it with an electrical test device (e.g. digital multimeter or test light).

**Note:** The InfoCenter Display, TECs, and the TDM used on the Outcross 9060 machine are matched for correct machine operation. If any of these components are replaced for any reason, system software needs to be reloaded (contact an Authorized Toro Distributor for assistance).
The optional InchMode feature includes the InchMode controller (T3: TEC) to manage traction, hitch lift, and PTO functions while standing next to the machine. The T3: TEC is a 2002 series microcontroller that monitors the condition of various machine switches and sensors (inputs) and communicates the status of these inputs to the T1: TEC via the CAN. The status of inputs to the controller can be monitored with the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23).

The T3: TEC is attached to the operator seat base. Power for the T3: TEC is available when the main power relay is energized (key switch is in the ON or START position). A 10 Amp fuse (F–C5) protects the T3: TEC power circuit.

The primary controller (T1: TEC), the status display controller (T2: TDM), the Yanmar Engine Control Unit (ECU), the InfoCenter Display, and the optional InchMode controller (T3: TEC) used on the Outcross 9060 machine communicate with each other on a Controller Area Network (CAN) bus system.

### T3: TEC Inputs

<table>
<thead>
<tr>
<th>INPUT NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN 2</td>
<td>InchMode Enable Switch</td>
</tr>
<tr>
<td>IN 3</td>
<td>InchMode Raise/Lower Switch</td>
</tr>
<tr>
<td></td>
<td>– Lower</td>
</tr>
<tr>
<td>IN 4</td>
<td>InchMode Raise/Lower Switch</td>
</tr>
<tr>
<td></td>
<td>– Raise</td>
</tr>
<tr>
<td>IN 5</td>
<td>InchMode Forward/Reverse Switch</td>
</tr>
<tr>
<td></td>
<td>– Forward</td>
</tr>
<tr>
<td>IN 6</td>
<td>InchMode Forward/Reverse Switch</td>
</tr>
<tr>
<td></td>
<td>– Reverse</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INPUT NUMBER</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>IN 7</td>
<td>InchMode PTO Switch</td>
</tr>
<tr>
<td>AIN1</td>
<td>Not Used</td>
</tr>
<tr>
<td>AIN2</td>
<td>Not Used</td>
</tr>
<tr>
<td>AIN3</td>
<td>Not Used</td>
</tr>
<tr>
<td>AIN4</td>
<td>Not Used</td>
</tr>
</tbody>
</table>
**T3: TEC Outputs**

<table>
<thead>
<tr>
<th>OUTPUT NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUT 1</td>
<td>Not Used</td>
</tr>
<tr>
<td>OUT 2</td>
<td>Not Used</td>
</tr>
<tr>
<td>OUT 3</td>
<td>Not Used</td>
</tr>
</tbody>
</table>

The machine electrical schematic and wire harness drawings in Appendix A (page A–1) can be used to identify possible circuit problems between the controller and the input or output devices.

**IMPORTANT**

When testing for wire harness continuity at the connector for the controller, take care to not damage the connector pins with multimeter test leads. If connector pins are enlarged or damaged during testing, connector repair may be necessary for proper machine operation.

![Figure 84](image)

1. InchMode wire harness connector P01  
2. InchMode controller (T3: TEC)

A 20 pin InchMode wire harness connector is attached to the controller. The connection terminal function for the controller and the wire harness connector pins are shown above.

Because of the solid state circuitry built into the controller, there is no method to test the controller directly. A controller may be damaged if an attempt is made to test it with an electrical test device (e.g. digital multimeter or test light).

**Note:** The InfoCenter Display, TECs, and the TDM used on the Outcross 9060 machine are matched for correct machine operation. If any of these components are replaced for any reason, system software needs to be reloaded (contact an Authorized Toro Distributor for assistance).
### Key Switch

<table>
<thead>
<tr>
<th>POSITION</th>
<th>CLOSED CIRCUITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>1 + 6, 4 + 5</td>
</tr>
<tr>
<td>RUN</td>
<td>1 + 3 + 4 + 5 + 6</td>
</tr>
<tr>
<td>START</td>
<td>1 + 2 + 4 + 5 + 6</td>
</tr>
</tbody>
</table>

The key switch on the console has three (3) positions – OFF, RUN and START. The key switch is an input used by the T1: TEC to manage various machine functions.

### Testing the Key Switch

The key switch and its circuit wiring can be tested as a T1: TEC input using the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the instrument panel from the console.
4. Disconnect the wire harness connector from the switch and remove the switch from the instrument panel if necessary.

**Note:** Key switch terminals 1 and 6 are connected internally. Terminals 4 and 5 are also connected internally. These terminals should have continuity regardless of the switch position.

5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. Replace the switch if necessary.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Install the switch, connect the wire harness and install the instrument panel after testing.
9. Connect the battery negative (-) cable at the battery.
### Mode Selector

<table>
<thead>
<tr>
<th>POSITION</th>
<th>SIGNAL VOLTAGE (E) ±0.2 VDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0° – A (attachment mode)</td>
<td>0.5 VDC</td>
</tr>
<tr>
<td>40° – H (auto high mode)</td>
<td>1.5 VDC</td>
</tr>
<tr>
<td>80° – L (auto low mode)</td>
<td>2.5 VDC</td>
</tr>
<tr>
<td>120° – I (InchMode)</td>
<td>3.5 VDC</td>
</tr>
<tr>
<td>160° – S (setup mode)</td>
<td>4.5 VDC</td>
</tr>
</tbody>
</table>

The mode selector is an analog hall effect sensor that communicates the desired mode of operation to the T2: TDM. The selector is located on the main instrument panel. The T2: TDM communicates the mode signals to the T1: TEC via the CAN network. The T1: TEC uses information from the mode selector to control numerous aspects of machine operation. The selector signals are also constantly monitored for fault detection. Refer to the machine [Outcross Traction Unit Software Guide](#) for additional operating mode information.

If a mode selector fault occurs, the machine will operate in Auto Low mode.

**Note:** The traction pedal must be at rest, the machine must be stationary, and the PTO and hydraulic AUX must be disabled before changing operating modes.

### Testing the Mode Selector

The mode selector and its circuit wiring can be tested as a T2: TDM input using the InfoCenter Display. The current operating mode should be displayed on the main screen, and the display should change with switch position changes. If testing determines that a sensor and its circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the instrument panel from the dash.
4. Disconnect the wire harness connector from the mode selector. Remove the knob and remove the selector from the instrument panel if necessary.
   **Note:** Pins A, B and C are not used in this application.
5. Connect pin F to a 5 VDC power supply, and connect pin D to ground.
6. Using a multimeter (DC voltage setting) check the signal voltage present at pin E as follows:
7. Replace the position sensor if necessary.
8. If the position sensor tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
9. Install the mode selector and connect the wire harness after testing.
Parking Brake Switch

<table>
<thead>
<tr>
<th>POSITION</th>
<th>CLOSED CIRCUITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>2 + 3, 5 + 6</td>
</tr>
<tr>
<td>OFF</td>
<td>1 + 2, 4 + 5</td>
</tr>
</tbody>
</table>

The parking brake switch is located on the main instrument panel. Push down on the top of the switch to engage the parking brake (switch light illuminated) and push down on the bottom of the switch to disengage the parking brake.

The T1: TEC monitors the position of the parking brake switch. The parking brake is spring loaded and engages automatically when hydraulic pressure is not present. When the engine is running and the parking brake switch is set to the OFF position, the T1: TEC energizes the hydraulic solenoid valve (SV2) to pressurize the brake circuit and disengage the brake.

Testing the Parking Brake Switch

The parking brake switch and its circuit wiring can be tested as a T1: TEC input using the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the instrument panel from the dash.
4. Disconnect the wire harness connector from the switch and remove the switch from the instrument panel if necessary.
5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. The switch indicator light can be tested by applying (+) 12 VDC to terminal 8 and a (-) ground to terminal 7.
7. Replace the switch if necessary.
8. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
9. Install the switch, connect the wire harness and install the instrument panel after testing.
10. Connect the battery negative (-) cable at the battery.
Power Take Off (PTO) Enable Switch

<table>
<thead>
<tr>
<th>POSITION</th>
<th>CLOSED CIRCUITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF (DOWN)</td>
<td>COM B + NC B</td>
</tr>
<tr>
<td></td>
<td>COM C+ NC C</td>
</tr>
<tr>
<td>ON (UP)</td>
<td>COM B + NO B</td>
</tr>
<tr>
<td></td>
<td>COM C+ NO C</td>
</tr>
</tbody>
</table>

The power take off (PTO) enable switch is located on the console. This switch is pulled up to engage the PTO shaft and pushed down to disengage the PTO shaft.

The T1: TEC monitors the position of the PTO switch. Using information from the PTO switch and other inputs, the T1: TEC energizes the hydraulic solenoid valve (EH) to engage the PTO clutch.

Testing the Power Take Off (PTO) Switch

The PTO enable switch and its circuit wiring can be tested as a T1: TEC input using the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the instrument panel from the console.
4. Disconnect the wire harness connector from the switch and remove the switch from the instrument panel if necessary.
5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. Replace the switch if necessary.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Install the switch, connect the wire harness and install the instrument panel after testing.
9. Connect the battery negative (-) cable at the battery.
The ECO mode switch is located on the main instrument panel. Push down on the top of the switch to enable ECO mode (switch light illuminated) and push down on the bottom of the switch to disable ECO mode.

The T2: TDM monitors signals from the ECO mode switch. The T2: TDM communicates the switch position to the T1: TEC via the CAN network. When ECO mode is enabled, the maximum engine speed is reduced to 2300 RPM as long as the PTO or Hydraulic AUX function is not active.

Testing the Economy (ECO) Mode Switch

The ECO mode switch and its circuit wiring can be tested as a T2: TDM input using the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the instrument panel from the dash.
4. Disconnect the wire harness connector from the switch and remove the switch from the instrument panel if necessary.
5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. The switch indicator light can be tested by applying (+) 12 VDC to terminal 8 and a (-) ground to terminal 7.
7. Replace the switch if necessary.
8. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
9. Install the switch, connect the wire harness and install the instrument panel after testing.
10. Connect the battery negative (-) cable at the battery.
Hydraulic Auxiliary (AUX) Switch

Figure 85
(shown with operator’s console removed)

1. Auxiliary load valve assembly      2. Hydraulic Auxiliary (AUX) switch

**Note:** Hydraulic AUX switch functionality is dependant on attachment configuration.

The hydraulic AUX switch is a normally open ball switch that is held closed while the joystick is in the neutral position (N.O.H.C.). The switch is located in the joystick assembly of the auxiliary load valve. While hydraulic flow to attachments is controlled mechanically by moving the joystick, the machine can be configured through the InfoCenter to use joystick movement (via the hydraulic AUX switch) to control the electrical demands of an attachment.

The T1: TEC monitors the position of the hydraulic AUX switch. Signals from the hydraulic AUX switch can be used by the T1: TEC to control ground speed and engine speed.

**Testing the Hydraulic AUX Switch**

The hydraulic AUX switch and its circuit wiring can be tested as a T1: TEC input using the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Remove the operator’s console; refer to Removing and Installing the Operator’s Console (page 8–17).
2. Disconnect the wire harness connector from the switch.
3. Check the continuity of the switch by connecting a multimeter (ohms setting) across the switch terminals.
4. When the joystick is in the neutral position there should be continuity (zero ohms resistance) between the switch terminals.
5. When the joystick is any of the forward or rearward positions there should be no continuity (infinite ohms resistance) between the switch terminals.
Testing the Hydraulic AUX Switch (continued)

6. Replace the switch if necessary.

7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).

8. Connect the wire harness and install the operator’s console after testing.
Seat Switch

1. Seat switch harness connector

The seat switch and its electrical connector are located in the operator seat assembly. The seat switch is a normally open proximity switch that closes when the operator is on the seat. Testing of the switch can be done without seat removal by disconnecting the switch wire from the platform wire harness.

The T1: TEC monitors the position of the seat switch. Using seat switch position (open or closed) and a variety of other inputs, the T1: TEC manages a variety of machine functions.

Testing the Seat Switch

The seat switch and its circuit wiring can be tested as a T1: TEC input using the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23). If testing determines that the switches and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the wire harness connector from the switch.
3. Check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.
4. With no pressure on the seat, there should be no continuity between the seat switch terminals.
5. Press directly onto the seat switch through the seat cushion. There should be continuity as the seat cushion approaches the bottom of its travel.
6. Replace the switch if necessary; refer to Servicing the Operator Seat (page 8–19).
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Connect the wire harness after testing.
The paddle and transmission lever switches are attached to the paddle and transmission lever assembly located under the steering wheel to the left of the steering column. The 2 paddle switches are used to control the 3-point hitch (raise and lower). The 2 paddle switches may also be used to control additional machine functions when certain attachments are connected. The 2 transmission lever switches are used to control the tandem piston pump (forward and reverse). The switches are normally open TEC inputs. All 4 switches are identical.

**Testing the Paddle and Transmission Lever Switches**

The paddle and transmission lever switches and their circuit wiring can be tested as a T1: TEC input using the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23). If testing determines that any of the switches and their circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Remove the dash cover; refer to Removing the Steering Wheel, Instrument Panels and Dash Cover (page 8–16).
2. Disconnect machine wire harness connector from the switch being tested.
3. Use a multimeter (ohms setting) to test the switch function. Continuity (zero ohms resistance) should exist across the switch terminals when the switch is depressed. There should be no continuity (infinite ohms resistance) across the switch terminals when the switch is released.
Testing the Paddle and Transmission Lever Switches (continued)

4. Replace the switch if testing determines that it is faulty.

5. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).

6. After testing is complete, connect machine wire harness connector to the switch.

7. Install the dash cover; refer to Installing the Steering Wheel, Instrument Panels and Dash Cover (page 8–16).
Headlight/Worklight Switch

<table>
<thead>
<tr>
<th>POSITION</th>
<th>CLOSED CIRCUITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEADLIGHTS ON</td>
<td>2 + 3, 5 + 6</td>
</tr>
<tr>
<td>OFF</td>
<td>NONE</td>
</tr>
<tr>
<td>WORKLIGHTS ON</td>
<td>1 + 2, 4 + 5</td>
</tr>
</tbody>
</table>

The headlight/worklight switch is located on the steering instrument panel. Pushing down on the top of the switch energizes the headlights, and on machines with an optional North American Light Kit, energizes the hazard lights. Pushing down on the bottom of the switch energizes the headlights and the optional Worklights.

Testing the Headlight/Worklight Switch

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the instrument panel from the steering column cover.
4. Disconnect the wire harness connector from the switch and remove the switch from the instrument panel if necessary.
5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. Replace the switch if necessary.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Install the switch, connect the wire harness and install the instrument panel after testing.
9. Connect the battery negative (-) cable at the battery.
Cruise Control Off/On/Set Switch

<table>
<thead>
<tr>
<th>POSITION</th>
<th>CLOSED CIRCUITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>NONE</td>
</tr>
<tr>
<td>CRUISE ON</td>
<td>2 + 3</td>
</tr>
<tr>
<td>(enable)</td>
<td></td>
</tr>
<tr>
<td>CRUISE SET</td>
<td>2 + 3</td>
</tr>
<tr>
<td>(engage)</td>
<td>5 + 6</td>
</tr>
</tbody>
</table>

The cruise control switch is located on the console. When the bottom of the switch is depressed, the cruise control feature is off. When the switch is moved to the center position, the cruise control feature is enabled but no speed is set. When the machine is moving in the forward direction above the minimum speed and the top of the switch is momentarily depressed, the cruise control feature is engaged and the current traction speed will be maintained.

The T2: TDM monitors the position of the cruise control off/on/set switch. The T2: TDM communicates the switch position to the T1: TEC via the CAN network. Using inputs from the cruise control off/on/set switch and the traction pedal position sensors, the T1: TEC holds the tandem piston (traction) pump forward control solenoids in their current position. Once engaged, the cruising speed can be increased (+) or decreased (−) incrementally through the Cruise Control Speed Increase/Decrease Switch.

The cruise control function is disabled when the switch is set to OFF, the decelerator pedal is depressed, the shift lever is moved from the FORWARD position, the parking brake switch is engaged, a speed sensor or hydraulic pressure sensor fault is active, or when CAN communication between the T1: TEC and the T2: TDM is lost.

Testing the Cruise Control Off/On/Set Switch

The cruise control off/on/set switch and its circuit wiring can be tested as a T2: TDM input using the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (−) cable at the battery.
3. Remove the instrument panel from the console.
4. Disconnect the wire harness connector from the switch and remove the switch from the instrument panel if necessary.
5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. Replace the switch if necessary.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Install the switch, connect the wire harness and install the instrument panel after testing.
9. Connect the battery negative (−) cable at the battery.
Cruise Control Speed Increase/Decrease Switch

<table>
<thead>
<tr>
<th>POSITION</th>
<th>CLOSED CIRCUITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>INCREASE SPEED</td>
<td>2 + 3, 5 + 6</td>
</tr>
<tr>
<td>NEUTRAL</td>
<td>NONE</td>
</tr>
<tr>
<td>DECREASE SPEED</td>
<td>2 + 1, 5 + 4</td>
</tr>
</tbody>
</table>

The cruise control speed increase/decrease switch is located on the console. When the cruise control feature is engaged and top of the switch is depressed, the cruise control speed will increase. When the cruise control feature is engaged and bottom of the switch is depressed, the cruise control speed will decrease. The amount of change can be as low as 0.1 mph when in attachment-rate control mode, or as high as 1.0 mph in auto low or high mode.

The T2: TDM monitors signals from the cruise control increase/decrease switch. The T2: TDM communicates the increase/decrease requests to the T1: TEC via the CAN network. Using inputs from the cruise control off/on/set switch and the traction pedal position sensors, the T1: TEC adjusts the tandem piston (traction) pump forward control solenoids accordingly.

Testing the Cruise Control Speed Increase/Decrease Switch

The cruise control speed increase/decrease switch and its circuit wiring can be tested as a T2: TDM input using the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the instrument panel from the console.
4. Disconnect the wire harness connector from the switch and remove the switch from the instrument panel if necessary.
5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. Replace the switch if necessary.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Install the switch, connect the wire harness and install the instrument panel after testing.
9. Connect the battery negative (-) cable at the battery.
Air Conditioning On/Off Switch

<table>
<thead>
<tr>
<th>POSITION</th>
<th>CLOSED CIRCUITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>NONE</td>
</tr>
<tr>
<td>ON</td>
<td>1+ 2 + 3</td>
</tr>
</tbody>
</table>

Testing the Air Conditioning On/Off Switch

The air conditioning on/off switch, working with the AC switch signal relay, and its circuit wiring can be tested as a T1: TEC input using the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23). If testing determines that the switch and its circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the roof from the cab.
4. Disconnect the wire harness connectors from the switch and remove the switch from the AC control panel if necessary.
5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. Replace the switch if necessary.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Install the switch, connect the wire harness, inspect and repair the roof seals as necessary, and install the roof after testing.
9. Connect the battery negative (-) cable at the battery.
Heater/Air Conditioning Blower Speed Switch

<table>
<thead>
<tr>
<th>POSITION</th>
<th>CLOSED CIRCUITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>NONE</td>
</tr>
<tr>
<td>LOW</td>
<td>B + C + L</td>
</tr>
<tr>
<td>MED</td>
<td>B + C + M</td>
</tr>
<tr>
<td>HIGH</td>
<td>B + C + H</td>
</tr>
</tbody>
</table>

Testing the Heater/Air Conditioning Blower Speed Switch

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the roof from the cab.
4. Disconnect the wire harness connector from the switch and remove the switch from the AC control panel if necessary.
5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. Replace the switch if necessary.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Install the switch, connect the wire harness, inspect and repair the roof seals as necessary, and install the roof after testing.
9. Connect the battery negative (-) cable at the battery.
InchMode Enable Switch (optional)

<table>
<thead>
<tr>
<th>POSITION</th>
<th>CLOSED CIRCUITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>2 + 3, 5 + 6</td>
</tr>
<tr>
<td>ON</td>
<td>2 + 1, 5 + 4</td>
</tr>
</tbody>
</table>

Note: Once the InchMode feature is enabled through the InfoCenter, the InchMode enable switch must be depressed before any of the InchMode operations will function.

The InchMode enable switch is located on the InchMode control box. Pushing down on the top of the switch supplies power to the InchMode raise/lower, forward/reverse, and PTO switches. The switch returns to the OFF position when released.

The T3: TEC monitors signals from the InchMode enable switch. The T3: TEC communicates the switch position to the T1: TEC via the CAN network. Using inputs from the InchMode enable switch, the mode selector, and the traction control lever and pedals, the system enables InchMode operation and waits for signals from the other InchMode switches.

Testing the InchMode Enable Switch

The InchMode enable switch and its circuit wiring can be tested as a T3: TEC input using the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23). If testing determines that the switch and its circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the instrument panel from the InchMode control box.
4. Disconnect the wire harness connector from the switch and remove the switch from the instrument panel if necessary.
5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. Replace the switch if necessary.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Install the switch, connect the wire harness and install the instrument panel after testing.
9. Connect the battery negative (-) cable at the battery.
## InchMode Raise/Lower and Forward/Reverse Switches (optional)

<table>
<thead>
<tr>
<th>POSITION</th>
<th>CLOSED CIRCUITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAISE or FORWARD</td>
<td>2 + 3, 5 + 6</td>
</tr>
<tr>
<td>OFF</td>
<td>NONE</td>
</tr>
<tr>
<td>LOWER or REVERSE</td>
<td>2 + 1, 5 + 4</td>
</tr>
</tbody>
</table>

**Note:** Once the InchMode feature is enabled through the InfoCenter, the InchMode enable switch must be depressed before any of the InchMode operations will function.

The InchMode raise/lower and forward/reverse switches are located on the InchMode control box. The T3: TEC monitors signals from the InchMode raise/lower and forward/reverse switches. The T3: TEC communicates the switch positions to the T1: TEC via the CAN network. With the traction control lever and pedals in the neutral position, the T1: TEC uses inputs from the InchMode switches to energize the tandem piston (traction) pump control solenoids or the hitch lift circuit hydraulic valves accordingly to move the machine.

### Testing the Raise/Lower and Forward/Reverse Switches

The InchMode raise/lower and forward/reverse switches and their circuit wiring can be tested as a T3: TEC input using the InfoCenter Display; refer to *Using the InfoCenter Display for Troubleshooting* (page 3–23). If testing determines that a switch and its circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (−) cable at the battery.
3. Remove the instrument panel from the InchMode control box.
4. Disconnect the wire harness connector from the switch and remove the switch from the instrument panel if necessary.
5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. Replace the switch if necessary.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Install the switch, connect the wire harness and install the instrument panel after testing.
9. Connect the battery negative (−) cable at the battery.
Loader Selector Control Valve (SCV) Switch (optional)

<table>
<thead>
<tr>
<th>POSITION</th>
<th>CLOSED CIRCUITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON (forward)</td>
<td>2 + C</td>
</tr>
<tr>
<td>OFF</td>
<td>NONE</td>
</tr>
<tr>
<td>MOMENTARY (rearward)</td>
<td>1 + C</td>
</tr>
</tbody>
</table>

A 3 position rocker switch located on the loader control valve joystick is used to control the loader SCV valves. When the switch is in the OFF (center) position, all of the kit solenoid valves are de-energized and hydraulic flow is directed to the manifold ports marked 3. When the switch is in the ON (forward) position or MOMENTARY (rearward) position, all of the kit solenoid valves are energized and hydraulic flow is directed to the manifold ports marked 2.

Testing the Loader Selector Control Valve (SCV) Switch

The loader selector control valve (SCV) switch and its circuit wiring can be tested as a T1: TEC input using the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23). If testing determines that a switch and its circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the switch cap and switch from the joystick.
4. Disconnect the wire harness connectors from the switch.
5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. Replace the switch if necessary.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Connect the wire harness and install the switch and switch cap after testing.
9. Connect the battery negative (-) cable at the battery.
The traction pedal assembly includes 2 analog hall effect sensors that do not require calibration. The sensors operate on 5 VDC supplied by the T1: TEC. Signal voltage from the pedal sensors are used by the T1: TEC (along with information from additional inputs) to determine appropriate current flow to the tandem piston (traction) pump control valves. The sensor signals are also constantly monitored for traction fault detection.

If a traction pedal fault occurs while the machine is moving, the machine will slowly come to a stop. The decelerator pedal can be used to stop the machine sooner if necessary. A traction pedal fault will disable traction control until the ignition key is cycled OFF and ON.

### Testing the Traction Pedal Assembly

The traction pedal assembly and its circuit wiring can be tested as a T1: TEC input using the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23). If testing determines that the assembly and its circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the platform wire harness from the traction pedal. Check the pedal and the harness connector for damage or corrosion.
3. Connect pins C and D to a 5 VDC power supply, and connect pins B and E to ground.
4. Using a multimeter (DC voltage setting) with the traction pedal at rest, less than 0.62 VDC should be present at pin A and less than 0.75 VDC should be present at pin F.
5. Using a multimeter (DC voltage setting) with the traction pedal fully depressed, 2.5 VDC should be present at pin A and 4.5 VDC should be present at pin F.
6. Replace the traction pedal assembly if necessary.
7. If the traction pedal tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
Testing the Traction Pedal Assembly (continued)

8. Connect the pedal assembly to the platform wire harness.
The decelerator pedal position sensor is a potentiometer (variable resistor). Signal voltage from the pedal sensor is used by the T1: TEC (along with information from additional inputs) to determine appropriate current flow to the tandem piston (traction) pump control valves. The decelerator pedal sensor works with the decelerator pedal neutral switch for decelerator fault detection.

If a decelerator pedal fault occurs while the machine is moving, the machine will quickly come to a stop. A decelerator pedal fault will disable traction control until the ignition key is cycled OFF and ON.

**Testing the Decelerator Pedal Position Sensor**

The decelerator pedal sensor and its circuit wiring can be tested as a T1: TEC input using the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23). If testing determines that the sensor and its circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Remove the decelerator pedal assembly.
3. Disconnect the machine wire harness connector from the decelerator pedal sensor, and remove the sensor from the machine.
Testing the Decelerator Pedal Position Sensor (continued)

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.

4. Use a multimeter (ohms setting) and measure the resistances between the sensor terminals as follows:
   A. Check that the resistance between the terminals B and C is approximately 5,000 ohms.
   B. Measure the resistance between the terminals A and C and then measure the resistance between the terminals A and B. The total of the 2 measured resistances should be approximately 5,000 ohms.
   C. Rotate the decelerator pedal position sensor to other positions and repeat step B. The total of the 2 measured resistances should always be approximately 5,000 ohms.

5. Replace the decelerator pedal sensor if necessary.

6. If the decelerator pedal sensor tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).

7. Install the decelerator pedal sensor and connect the wire harness after testing.

8. Install the decelerator pedal assembly.
Decelerator Pedal Neutral Switch

The decelerator pedal neutral switch is a normally open switch held closed when the decelerator pedal is at rest (N.O.H.C.). The switch is located directly above the decelerator pedal assembly. When the decelerator pedal is depressed, the switch plunger is extended, opening the switch contacts. The decelerator pedal neutral switch works in conjunction with the decelerator pedal position sensor for decelerator fault detection. The decelerator pedal neutral switch is monitored by the T1: TEC.

If a decelerator pedal fault occurs while the machine is moving, the machine will quickly come to a stop. A decelerator pedal fault will disable traction control until the ignition key is cycled OFF and ON.

Testing the Decelerator Pedal Neutral Switch

The decelerator pedal neutral switch and its circuit wiring can be tested as a T1: TEC input using the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the wire harness connector from the switch.
Testing the Decelerator Pedal Neutral Switch (continued)

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

4. When the switch plunger is depressed (decelerator pedal at rest) there should be continuity (zero ohms resistance) between the switch terminals.

5. When the switch plunger is extended (decelerator pedal depressed) there should be no continuity (infinite ohms resistance) between the switch terminals.

6. Replace the switch if necessary.

7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).

8. Connect the wire harness after testing.
3-Point Hitch Position Sensor

The 3-point hitch position sensor is an analog hall effect sensor that communicates the height of the 3-point hitch to the T1: TEC. The sensor is located on the left end of the lift arm pivot shaft. The T1: TEC uses information from the sensor to control the attachment height while operating in attachment mode. The sensor signals are also constantly monitored for 3-point hitch fault detection.

If a 3-point hitch fault occurs, all automatic 3-point control is disabled and only momentary raise and lower is allowed via the paddle switches.

**Note:** When the optional cargo bed is installed, the 3-point hitch position sensor works in conjunction with the bed active switch to limit the maximum lift arm height.

### Testing the 3-Point Hitch Position Sensor

The 3-point position sensor and its circuit wiring can be tested as a T1: TEC input using the InfoCenter Display; refer to **Using the InfoCenter Display for Troubleshooting (page 3–23)**. If testing determines that the sensor and its circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface and lower any attachments. Use the status display and record the hitch position number if possible before stopping the engine.

2. Disconnect the frame wire harness and remove the position sensor. Check the sensor and the harness connector for damage or corrosion.

3. Connect pin 1 to a 5 VDC power supply, and connect pin 2 to ground.

4. Using a multimeter (DC voltage setting) with the sensor rotated fully counterclockwise, approximately 0.5 VDC should be present at pin 3.

5. Using a multimeter (DC voltage setting) with the sensor rotated fully clockwise, approximately 4.5 VDC should be present at pin 3.

6. Replace the position sensor if necessary:
Testing the 3-Point Hitch Position Sensor (continued)

A. Ensure that the sensor shaft orientation is correct.

B. Loosen the jam nut

C. Thread the sensor shaft into the lift arm pivot shaft until it bottoms out.

D. Turn the sensor shaft out until the scallops in the shaft align with the dimples in the lift arm.

E. Tighten the jam nut to lock the sensor shaft in position.

F. Check the V-ring and replace it if it is worn or damaged. Install the V-ring in the correct orientation; refer to Figure 80.

G. Install the position sensor.

7. Connect the wire harness to the sensor.

8. If the position sensor tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
Hydraulic Fluid Temperature Sender

The hydraulic fluid temperature sender is attached to the left side of the hydraulic tank. The resistance of the temperature sender decreases as the fluid temperature in the tank increases. The hydraulic fluid temperature sender is an input to the T2: TDM and provides information for the TDM hydraulic temperature gauge.

Testing the Hydraulic Fluid Temperature Sender

1. Drain or pump approximately 30 liters (8 gallons) of hydraulic tank fluid from the tank so the level is below the sender port.
2. Locate hydraulic oil temperature sender and disconnect wire harness connector.
3. Thoroughly clean the hydraulic tank around the temperature sender. Remove the sender from the tank and discard the O-ring.

⚠️ CAUTION ⚠️

Handle the hot oil with extreme care to prevent personal injury or fire.
4. Put the sensing end of the sender in a container of oil with a thermometer and slowly heat the oil.

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

5. Check resistance of the sender with a multimeter (ohms setting) as the oil temperature increases.
   A. The meter should indicate from 11.6 to 13.5 kilohms at 20°C (68°F).
   B. The meter should indicate 2.3 to 2.5 kilohms at 60°C (140°F).
   C. The meter should indicate 605 to 669 ohms at 100°C (212°F).

6. If the sender tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).

7. Use a new O-ring and install the sender in the hydraulic tank. Tighten the sender to **16 N·m (12 ft-lb)**.

8. Connect the sender to the frame wire harness.

9. Fill hydraulic system to the proper level.
Speed Sensors

The traction system uses two speed sensors to monitor the ground speed of the machine. One speed sensor is located in the front axle hydraulic motor mount and the second speed sensor is located in the rear axle hydraulic motor mount. The T1: TEC compares information from the speed sensors and the tandem piston (traction) pump control solenoid valves to regulate traction speed. The sensor signals are constantly monitored for fault detection.

A speed sensor fault will disable the cruise control and PTO, and the machine will be forced to stop. Once the traction pedal is returned to the rest position, the machine will operate in limp home mode (reduced ground speed and PTO disabled) until the ignition key is cycled OFF and ON.

Testing the Speed Sensors

The speed sensors and their circuit wiring can be tested as a T1: TEC input using the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23). If testing determines that a sensor and its circuit wiring are not functioning correctly, proceed with the following test procedure:

**Note:** Testing the speed sensor requires the use of specialized equipment. In this procedure, visually inspect and clean the sensor then test the wire harnesses.

1. Park the machine on a level surface, lower any attachments and stop the engine.
   
   **Note:** It may be necessary to remove the bed to gain access the rear speed sensor.

2. Disconnect the wire harness connector from the sensor and remove the sensor from the hydraulic motor mount.

3. Clean any corrosion from the sensor and wire harness connector contacts.

4. Check the face of the sensor for damage. Replace the sensor if the face is chipped or scratched.

5. Test the machine wire harness to the speed sensor:
Testing the Speed Sensors (continued)

A. Set the key switch to the RUN position.

B. Use a multimeter set to DC voltage and check for approximately 12 VDC across the supply (+) pin A and ground (−) pin B of the frame wire harness connector. This confirms the integrity of the circuit supply and ground wires.

C. Navigate to the InfoCenter Traction Inputs screen and scroll down to display the Front Ground or Rear Ground readings.

D. Connect a 12 VDC power supply across the signal (+) pin C and ground (−) pin B of the frame wire harness connector. Rapidly open and close the test circuit repeatedly. The InfoCenter speed reading should increase slightly. This confirms the integrity of the circuit ground and signal wires.

E. Turn the key switch to OFF.

6. If the wire harness tests correctly and a circuit problem still exists, replace the speed sensor.
Two pressure sensors are used to monitor the traction circuit hydraulic pressure when the machine is moving in the forward direction. The pressure sensor for the front axle motor circuit is located on the left side of the tandem piston pump, and the pressure sensor for the rear axle motor circuit is located on the right side of the tandem piston pump. The T1: TEC uses information from the sensors to assure each traction pump (front and rear) is doing the same amount of work based on system pressure. The sensor signals are constantly monitored for fault detection.

A pressure sensor fault will disable the cruise control and PTO, and the machine will be forced to stop. Once the traction pedal is returned to the rest position, the machine will operate in limp home mode (reduced ground speed and PTO disabled) until the ignition key is cycled OFF and ON.

**Testing the Pressure Sensors**

The pressure sensors and their circuit wiring can be tested as a T1: TEC input using the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23). If testing determines that a sensor and its circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.

   **Note:** Remove the right fender to gain access the rear axle pressure sensor.

2. Disconnect the wire harness connector from the sensor and clean any corrosion from the sensor and wire harness connector contacts.

3. Test the machine wire harness to the pressure sensor:
   A. Set the key switch to the RUN position.
   B. Navigate to the InfoCenter Traction Inputs screen and scroll down to display the Front Traction and Rear Traction readings.
Testing the Pressure Sensors (continued)

C. Connect a 1.5 VDC dry cell battery across the signal (+) pin C and ground (−) pin B of the frame wire harness connector. A fully charged battery should produce a pressure reading of approximately 8960 kPa (1300 psi) on the InfoCenter Display. This confirms the integrity of the circuit ground and signal wires.

D. Use a multimeter set to DC voltage and check for approximately 5 VDC across the supply (+) pin A and ground (−) pin B of the frame wire harness connector. This confirms the integrity of the circuit supply and signal wires.

E. Turn the key switch to OFF.

4. Test the pressure sensor:
   A. Remove the pressure sensor.

B. Connect a 4.5 to 5.5 VDC power supply to the supply (+) pin A and ground (−) pin B of the sensor.

C. Connect a multimeter set to DC voltage to the signal (+) pin C and ground (−) pin B of the sensor. A small amount of voltage (0.5 VDC) should be present on the multimeter display.

5. Replace pressure sensor if necessary. Apply thread sealant to the sensor threads prior to installation and tighten to 20 N·m (15 ft-lb).

6. Connect the frame wire harness to the pressure sensor after testing.
Fuel Pump

Figure 100

1. Fuel pump 4. Fuel/Water separator
2. Fuel hose (from tank) 5. Fuel hose (to engine)
3. Fuel hose (separator to pump)

<table>
<thead>
<tr>
<th>Fuel Pump Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump Capacity</td>
</tr>
<tr>
<td>Pressure</td>
</tr>
<tr>
<td>Current Draw</td>
</tr>
</tbody>
</table>

Testing the Fuel Pump

The electric fuel pump is located inside the right side frame rail behind the hydraulic reservoir. Testing the fuel pump involves measuring the amount of fuel an unrestricted pump can deliver over a set period of time.

1. Park the machine on a level surface, lower any attachments and set the key switch to OFF.
2. Make sure fuel hoses are in good condition and free of obstructions.
   
   **Note:** Since the fuel/water separator is upstream of the fuel pump, the condition of the fuel/water separator will influence fuel pump performance.
3. Drain the fuel/water separator; refer to the traction unit *Operator's Manual*. Verify filter element age and condition and replace if necessary.
4. Disconnect the fuel hose coming from the fuel pump at the engine fuel filter.
Testing the Fuel Pump (continued)

1. Engine fuel filter
2. Fuel hose (from pump)

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**IMPORTANT**

When testing the fuel pump output, do not turn the key switch to the START position

5. Place the disconnected hose end into a 0.95 liter (1 quart) graduated cylinder and set the key switch to the ON/RUN position for 30 seconds. The pump should deliver approximately 350 ml (11.8 ounces) in 30 seconds. Replace the fuel pump if necessary.

6. Connect fuel hoses and secure with hose clamps.

7. Prime the fuel system; refer to Priming the Fuel System (page 4–15).
**Fuel Level Sender**

The fuel level sender is attached to the top of the fuel tank. The resistance of the fuel sender increases as the fuel level in the fuel tank decreases. The fuel sender is an input to the T2: TDM and provides information for the TDM fuel gauge. The fuel sender is a sliding float design with a single wire harness connector.

**Testing the Fuel Level Sender**

1. Remove the fuel tank assembly; refer to Removing and Installing the Fuel Tank (page 4–15).
2. Remove screws and lock washers that secure the fuel sender to the fuel tank.
3. Carefully remove fuel sender and gasket from the fuel tank. Clean all fuel from the sender.
4. Inspect sender gasket for damage and replace if necessary.
5. Verify fuel sender float is able to move freely through its entire range of operation.

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

6. Using a multimeter (ohms setting), check the resistance of the sender at the harness connector with the float in the full (up) position, and in with the float in the empty (down) position.
7. Replace sender if testing determines that it is faulty.
8. If the sender tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
9. Carefully install sender into fuel tank and install fuel tank assembly.
Warning Buzzer

The warning buzzer sounds to notify the operator when a machine problem exists. Electrical current for the buzzer is provided as an output from the T2: TDM. The warning buzzer is attached to the machine under the main instrument panel.

Testing the Warning Buzzer

1. Remove the dash cover; refer to Removing the Steering Wheel, Instrument Panels and Dash Cover (page 8–16)

2. Disconnect the platform wire harness connector from the buzzer.

**IMPORTANT**

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

3. Connect a 12 VDC power supply to the buzzer (+) terminal and a ground to the (-) terminal. The buzzer should sound.

4. Replace the buzzer if necessary.

5. Connect the platform wire harness to the buzzer and install the dash cover.
Relays with 4 Terminals

Outcross 9060 machines use a number of electrical relays that have four (4) terminals. A tag near the wire harness relay connector can be used to identify each relay.

The following relays are located under the main instrument panel:

- The main power relay supplies power to the fuses (and all of the circuits protected by the fuses) in the main fuse block rows 1, 3, 4 and 5; refer to Fuse Identification, Location and Function (page 6–14). The main power relay is energized when the key switch is in the START or RUN position.
- The cab power relay supplies power to the fuses (and all of the circuits protected by the fuses) in the cab fuse block; refer to Fuse Identification, Location and Function (page 6–14). The cab power relay is energized when the key switch is in the START or RUN position.
- The rear attachment power relay supplies power to rear attachments via the 7 pin rear attachment harness connector. The rear attachment power relay is energized when the key switch is in the START or RUN position.
- The start relay supplies power to the engine starter. The start relay is energized by the Yanmar engine ECU.
- The glow plug relay supplies power to the engine glow plugs. The glow plug relay is energized by the Yanmar engine ECU.

Testing Relays with 4 Terminals

1. Make sure key switch is OFF. Remove key from key switch.
Testing Relays with 4 Terminals (continued)

2. Disconnect the ground cable at the battery; refer to Removing the Battery (page 6–81).

3. Access the relay to be tested and disconnect the wire harness connector from the relay. Remove the relay from the mounting bracket for testing.

![Relay Diagram](image)

**Figure 105**
Relay with 4 Terminals

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

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

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

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

7. Replace the relay as necessary.

8. If the relay tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).

9. Connect the wire harness, install any items removed to access the relay, and connect the battery ground cable.
Relays with 5 Terminals

Outcross 9060 machines use a number of electrical relays that have five (5) terminals. A tag near the wire harness relay connector can be used to identify each relay.

![Diagram of relays](image)

**Figure 106**

1. EGR relay  
2. Brake light relay (optional)

The Exhaust Gas Recirculation (EGR) relay is located under the main instrument panel. The EGR relay is used to provide current to the engine EGR valve. The EGR relay is energized by the Yanmar engine ECU.

The brake light relay for the optional International Road Light kit is located under the main instrument panel. The brake light relay is used to provide power to the brake lights on international machines only. The brake light relay is energized by the T1: TEC.
The optional rear Selector Control Valve (SCV) relay is located below the rear SCV hydraulic manifolds. The rear SCV relay is used to provide current to the 4 rear SCV hydraulic solenoid valves. The rear SCV relay is energized by the T1: TEC.
The three relays used to control the air conditioning (AC) system are located under the cab cover.

- The AC condenser fans relay provides current to both of the condenser fans and the AC clutch relay. The AC condenser fans relay is energized by the air conditioning system thermostat.
- The AC switch signal relay is an input to the T1: TEC. The relay is energized by the AC On/Off switch. The T1: TEC monitors the condition of the signal relay and increases the engine low idle RPM when the AC system is On.
- The AC clutch relay and the AC condenser fans relay must be energized to engage the compressor clutch. The AC clutch relay is energized by the thermostat as long as the minimum AC system pressure exists (AC pressure switch closed).

Testing Relays with 5 Terminals

The AC switch signal relay, working with the air conditioning on/off switch, and its circuit wiring can be tested as a T1: TEC input using the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–23). If testing determines that the relay and its circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Make sure key switch is OFF. Remove key from key switch.
2. Disconnect the ground cable at the battery; refer to Removing the Battery (page 6–81).
3. Access the relay to be tested and disconnect the wire harness connector from the relay. Remove the relay from the mounting bracket for testing.

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Figure 109
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**Note:** Prior to taking small resistance readings with a digital multimeter, short the meter test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from the measured value of the component you are testing.

4. Using a multimeter, verify that coil resistance between terminals 85 and 86 is from 71 to 88 ohms.
5. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should
Testing Relays with 5 Terminals (continued)

make and break continuity between terminals 30 and 87 as +12 VDC is applied and removed from terminal 85.

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

7. Replace the relay as necessary.

8. If the relay tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).

9. Connect the wire harness, install any items removed to access the relay, and connect the battery ground cable.
Diode Assemblies

<table>
<thead>
<tr>
<th>Multimeter Red (+) Lead</th>
<th>Multimeter Black (-) Lead</th>
<th>Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIODE TERMINAL A</td>
<td>DIODE TERMINAL B</td>
<td>VERY LOW</td>
</tr>
<tr>
<td>DIODE TERMINAL B</td>
<td>DIODE TERMINAL A</td>
<td>VERY HIGH</td>
</tr>
</tbody>
</table>

Five (5) different diodes are used on the Outcross 9060 machines. The maximum current allowed through any of the diodes is 6 amps. The diodes can be identified by their black color and diode symbol on the end of the diode body.

- A diode assembly (D1) is used for circuit protection from voltage spikes that occur when the starter solenoid is de-energized. The diode plugs into the engine wire harness near the starter motor.
- A diode assembly (D2) is used to protect the engine ECU from reverse polarity in the EGR relay circuit. The diode plugs into the engine wire harness near the Yanmar ECU.
- A diode assembly (D3) is used for circuit protection from voltage spikes that occur when the optional horn is energized. The diode plugs into the engine wire harness near the Yanmar ECU.
- A diode assembly (D4) is used to control current flow between the hazard switch and the turn signal switch of the optional International Road Light Kit – right side lights. The diode plugs into the international road light wire harness behind the main instrument panel.
- A diode assembly (D5) is used to control current flow between the hazard switch and the turn signal switch of the optional International Road Light Kit – left side lights. The diode plugs into the international road light wire harness behind the main instrument panel.

Testing the Diode Assemblies

1. Locate and remove the diode from the wire harness.
2. Use a multimeter to check for voltage drop across the diode terminals (diode test setting). Contact the multimeter red (+) lead to diode terminal A and the black (−) lead to diode terminal B. A reading of less than 0.7 volts should be displayed on the multimeter.
   OR
   Use the table provided and a multimeter (ohms setting) to measure the resistance across the diode terminals.
3. Replace the diode if necessary.
4. If the diode tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
Resistor Assembly

A 1.6K ohm (1600 ohm) resistor assembly is used for proper 12 Volt alternator operation. The resistor plugs into the engine wire harness near the starter. The resistor can be identified by its gray color and resistor symbol on the end of the resistor body.

Testing the Resistor Assembly

1. Disconnect the resistor from the wire harness.

2. Measure the resistance across the resistor terminals using a digital multimeter (ohms setting). The resistance across the terminals should be at or near the resistors rated resistance. Replace the resistor if a reading other than the rated resistance is obtained.

3. If the resistor tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
CAN bus Terminator Resistors

System communication between various electrical components on Outcross 9060 machines is accomplished on a CAN bus communications network. Two specially designed, twisted wires form the CAN–bus. These wires provide the data pathways between the components on the network. The engineering term for these cables are CAN High and CAN Low. The CAN bus wires are yellow (CAN High) and green (CAN Low). A 120 ohm termination resistor is located at each end of the CAN bus.

One resistor is part of a short harness plugged into the platform wire harness #2 expansion port (external) and is replaceable separately. The expansion port is located near the rear attachment electrical connector below the right rear corner of the operator platform.

The second CAN bus termination resistor is part of the Yanmar engine ECU (integrated) and can be tested as part of the CAN bus wiring. The integrated termination resistor is not replaceable separately.

Note: Refer to Appendix A (page A–1) for additional information on the CAN bus wiring.

IMPORTANT

Both terminator resistors are required for proper electrical system operation.

Testing the CAN bus Terminator Resistors

1. CAN bus terminator resistor (external) 2. Keyway

Figure 111

1. One terminator resistor is external (plugged into the platform wire harness #2 expansion port located near the rear attachment electrical connector below the right rear corner of the operator platform). Locate the external termination resistor and unplug it from the wire harness for testing.

   The insulator wedge in the external termination resistor is blue for identification purposes. There also is a center keyway to prevent the termination resistor from plugging into the wrong wire harness connector.

   A. Make sure that key switch is OFF and key is removed from switch.

   B. Use a digital multimeter (ohms setting) to measure the resistance value for the external termination resistor. There should be 120 ohms resistance between terminals A and B.

   C. If testing determines the external termination resistor is faulty, replace the resistor.

   D. After testing is complete, make sure the external termination resistor is fully installed into the connector and secured to the wire harness.
2. One CAN bus termination resistor is integrated into the Yanmar engine ECU.
   A. Make sure that key switch is OFF and key is removed from switch.
   B. Unplug the external terminator resistor from the platform wire harness (located near the rear attachment electrical connector below the right rear corner of the operator platform).
   C. Locate and remove the cap from the Yanmar SA-D connector.
   D. Use a digital multimeter (ohms setting) to measure the resistance value for the integrated termination resistor. There should be 120 ohms resistance between terminals 2 and 3 of the Yanmar SA-D connector.
   E. If testing determines the integrated termination resistor is faulty, replace the engine ECU; contact an Authorized Toro Distributor for assistance.
   F. After testing is complete, install the SA-D connector cap, and make sure the external termination resistor is fully installed into the connector and secured to the wire harness.

3. If the resistors test correctly and a circuit problem still exists, check the remainder of the CAN–bus; refer to Appendix A (page A–1) or contact an Authorized Toro Distributor for assistance.
Electric coil actuated hydraulic valves are used on the main manifold and the optional Selector Control Valve (SCV) manifolds. When the coil or the coil relay is energized by the T1: TEC, the hydraulic valve shifts to control hydraulic flow.

A faulty solenoid coil or solenoid circuit wiring problem will not be identified by the Info Center Display. The Info Center Display can be used to verify that output current from the appropriate controller is available for the solenoid coil, but the display will not verify that the solenoid coil and circuit wiring is functioning correctly; refer to Using the InfoCenter Display for Troubleshooting (page 3–23). To assist in troubleshooting, identical replaceable solenoid coils can be exchanged. If the problem follows the coil, the coil is likely at fault. If the problem remains unchanged, something other than the coil is the likely problem source (e.g. switch, circuit wiring, hydraulic problem).

Testing the Hydraulic Solenoid Valve Coils

Typically, a failed solenoid coil will either be shorted (very low or no resistance) or open (infinite resistance).

1. Locate the hydraulic solenoid valve coil to be tested and disconnect the wire harness connector from the coil.
Testing the Hydraulic Solenoid Valve Coils (continued)

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

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

A. The coils of solenoid valves SP1 and SP2 on the main manifold, and the optional SCV solenoid valve coils are the same. Resistance of these coils should be approximately 7.1 ohms when tested at 20 C (68 F). These are replaceable coils.

B. The coils of solenoid valves SV1, SV2, SV3 and EH on the main manifold are the same. Resistance of these coils should be approximately 7.3 ohms when tested at 20 C (68 F). These are not replaceable coils. If one of these coils fail a resistance test, replace the entire valve assembly; refer to Cartridge Valve Service (page 5–88).

3. Replace serviceable coils as necessary:

A. Remove the nut from the hydraulic valve.

B. Slide the solenoid coil from the valve.

C. Clean any corrosion or dirt from the valve stem.

D. Install the coil and the nut onto the valve and tighten nut to 7 N-m (60 in-lb).

4. If the solenoid coil resistance is correct and a circuit problem still exists, check the wire harness; refer to Appendix A (page A–1).

5. After testing is completed, connect the wire harness connector to the solenoid coil.
Tandem Traction (Piston) Pump Control Solenoid Coils

Figure 114

1. Tandem piston (traction) pump (P1 and P2) 4. Solenoid AB-C2 (front pump valve C2 – reverse)
2. Solenoid AB-C1 (front pump valve C1 – forward) 5. Solenoid CD-C2 (rear pump valve C2 – reverse)
3. Solenoid CD-C1 (rear pump valve C1 – forward)

The tandem traction (piston) pump uses two separate electronic control assemblies. One assembly controls the output for the front pump and one for the rear pump. Each control assembly includes two (2) electrically controlled solenoid valves. One solenoid valve controls the pump displacement in the forward direction, and the other controls the pump displacement in the reverse direction. The control assemblies are attached to the right side of the piston pump. Electrical outputs from the T1: TEC supplies power to the solenoid coils. The coils are named for the pump they control (AB = front pump and CD = rear pump) and their control function (C1 = forward direction and C2 = reverse direction).

Note: A faulty solenoid coil or solenoid circuit wiring problem will not be identified by the Info Center Display. The Info Center Display can be used to verify that output current from the appropriate controller is available for the solenoid coil, but the display will not verify that the solenoid coil and circuit wiring is functioning correctly; refer to Using the InfoCenter Display for Troubleshooting (page 3–23). To assist in troubleshooting, the piston pump solenoid coils can be exchanged because they are identical. If the problem follows the exchanged coil, a problem with the coil is likely. If the problem remains unchanged, something other than the solenoid coil is at fault (e.g. traction pedal, circuit wiring, hydraulic problem).
Testing the Pump Control Solenoid Coil

Typically, a failed solenoid coil will either be shorted (very low or no resistance) or open (infinite resistance).

1. Locate the pump control solenoid coil to be tested and disconnect the wire harness connector from the coil.

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

2. Using a multimeter (ohms setting), measure the resistance between the two (2) connector terminals on the solenoid coil. Coil resistance should be **3.66 ohms when tested at 20 C (68 F)**.

   ![Diagram of solenoid coil with labels]

   **Figure 115**

   1. Solenoid coil
   2. O-ring (2 each)
   3. Coil nut

3. Replace the coil as necessary:
   
   A. Use a 12 point, 26 mm socket to remove the coil nut.
   
   B. Slide the coil and O-rings from the valve stem. Discard the O-rings and clean all corrosion or dirt from the valve.
   
   C. Lubricate new O-rings with petroleum jelly and slide the new coil with O-rings onto the valve stem.
   
   D. Use a 12 point, 26 mm socket to install and tighten the coil nut from **5 N·m (44 in-lb)**. Do not over-tighten coil nut.

4. If the solenoid coil resistance is correct and a circuit problem still exists, check the wire harness; refer to Appendix A (page A–1).

5. After testing is completed, connect the wire harness connector to the solenoid coil.
Service and Repairs

Note: For engine component repair information, see the Yanmar Model 4TNV86CT–DTR Service Manual or Troubleshooting Manual.

Caring for the Battery

⚠️ WARNING ⚠️

- Wear safety goggles and rubber gloves when working with electrolyte.
- Charge battery in a well ventilated place so gasses produced while charging can dissipate.
- Since the gases are explosive, keep open flames and electrical sparks away from the battery; do not smoke.
- Nausea may result if the gases are inhaled.
- Unplug charger from electrical outlet before connecting or disconnecting charger leads to or from battery posts.

1. When using a maintainable battery, the battery-electrolyte must be kept at the proper level.
2. The top of the battery must be kept clean.
3. 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.
4. Check battery condition weekly or after every 50 hours of operation. Keep terminals and entire battery case clean because a dirty battery will discharge slowly.

⚠️ IMPORTANT ⚠️

Do not remove fill caps while cleaning.

A. Clean battery by washing entire case with a solution of baking soda and water. Rinse with clear water.
B. Coat battery posts and cable connectors with Toro Part No. 107-0392 battery terminal protector or petroleum jelly to prevent corrosion.

⚠️ 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.

5. Tighten the battery cables on the battery terminals to provide a good electrical contact.
6. If corrosion occurs at the battery terminals, disconnect the battery cables. Always disconnect the negative (-) cable first. Clean the cable clamps and terminals separately. Connect the battery cables. Always connect the positive (+) cable first. Apply a coating of Toro Part No. 107-0392 battery...
Caring for the Battery (continued)

- Add a terminal protector or a light coat of petroleum jelly to the terminals to reduce corrosion after you make the connections.

7. Check the battery-electrolyte level every 25 operating hours and every 30 days if machine is in storage.

   **Note:** Do not fill the cells above the fill line.

8. Maintain the cell level with the distilled or demineralized water.
Storing the Battery

If you store the machine for more than 30 days:

1. Remove the battery and charge it fully; refer to Charging the Battery (page 6–84).

2. Store the battery:
   • on a shelf or on the machine
   • with cables disconnected if stored on the machine
   • in a cool atmosphere to avoid quick deterioration of the battery charge
   • in an environment that will not be below freezing for an extended period
Servicing the Battery

Figure 116

1. Battery
2. Operator platform terminal block
3. Starter motor
4. Engine ground connection
5. Chassis ground connection

Battery Specifications

<table>
<thead>
<tr>
<th>Battery-electrolyte specific gravity</th>
<th>Fully Charged: 1.25 to 1.28 at 27°C (80°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Discharged: less than 1.24</td>
</tr>
<tr>
<td>Battery specifications</td>
<td>BCI Group 34</td>
</tr>
<tr>
<td></td>
<td>690 CCA at -18°C (0°F)</td>
</tr>
<tr>
<td></td>
<td>Reserve Capacity of 110 minutes at 27°C (80°F)</td>
</tr>
<tr>
<td>Battery dimensions (including terminal posts and caps)</td>
<td>Length 19.6 cm (10.9 inches)</td>
</tr>
<tr>
<td></td>
<td>Width 13.2 cm (6.6 inches)</td>
</tr>
<tr>
<td></td>
<td>Height 18.3 cm (8.0 inches)</td>
</tr>
</tbody>
</table>

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.

**CAUTION**

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.
Removing the Battery

1. Negative (-) battery cable
2. Positive (+) battery cable
3. Battery
4. Battery retainer
5. Side cover
6. Washer (2 each)
7. Knob (2 each)

**IMPORTANT**

Be careful when removing the battery cables and ensure that you do not damage the terminal posts or cable connectors.

1. Ensure that the key switch and all accessories are in the OFF position.
2. Remove the knobs, washers and side cover from the left side of the machine.
3. Disconnect the negative (-) cable from the battery terminal, then disconnect the positive (+) cable from the battery terminal.
4. Remove the two (2) wing nuts and the battery hold down rod.
5. Make sure that the battery filler caps are secure and remove the battery from the battery compartment.

Installing the Battery

**IMPORTANT**

To prevent possible electrical problems, install only a fully charged battery.
Installing the Battery (continued)

1. Ensure that the key switch and all accessories are in the OFF position.
2. Ensure that the battery tray is clean and install the battery and retainer.
3. Ensure that all the battery terminals, battery cables and battery hold down components are in good condition.
4. Connect the positive (+) cable connector onto the positive (+) battery terminal.
5. 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.
6. Connect the negative (-) cable connector to the negative (-) battery terminal.
7. After you make the connections, apply battery terminal protector Toro Part No. 107-0392 or a light layer of petroleum jelly to the battery terminals and cable connectors to reduce corrosion.
8. Make sure that rubber boot is properly placed over positive cable end and positive battery post.
9. Install the side cover.

Inspecting, Maintaining, and Testing the Battery

Temperature Correcting Specific Gravity

<table>
<thead>
<tr>
<th>Cell Temperature</th>
<th>100°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell Specific Gravity</td>
<td>1.245</td>
</tr>
</tbody>
</table>

38°C minus 27°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 27°C (80°F) 1.253

Minimum Voltage

<table>
<thead>
<tr>
<th>Minimum Voltage</th>
<th>Battery-Electrolyte Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>70°F (and up)</td>
</tr>
<tr>
<td>9.6</td>
<td>60°F</td>
</tr>
<tr>
<td>9.5</td>
<td>50°F</td>
</tr>
<tr>
<td>9.4</td>
<td>40°F</td>
</tr>
<tr>
<td>9.3</td>
<td>30°F</td>
</tr>
<tr>
<td>9.1</td>
<td>20°F</td>
</tr>
<tr>
<td>8.9</td>
<td>10°F</td>
</tr>
<tr>
<td>8.7</td>
<td>0°F</td>
</tr>
</tbody>
</table>

1. Inspect the battery as follows:
   A. Check for cracks. Replace the battery if cracked or leaking.
   B. Check the battery terminals for corrosion. Use the wire brush to clean corrosion from the posts.
Inspecting, Maintaining, and Testing the Battery (continued)

**IMPORTANT**

Before cleaning the battery, tape or block the vent holes of the filler caps and ensure that the caps are secure.

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 (sodium bicarbonate) 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.

**IMPORTANT**

Make sure the area around the battery caps is clean before opening the caps.

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**

Make sure the area around the battery caps is clean before opening the 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.

B. Temperature correct each cell reading. For each 6°C (10°F) above 27°C (80°F) add 0.004 to the specific gravity reading. For each 6°C (10°F) below 27°C (80°F) subtract 0.004 from the specific gravity reading; refer to Temperature Correcting Specific Gravity (page 6–82).

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 Battery Charge Rate (page 6–84) or until all cells specific gravity is 1.225 or greater with the difference in specific gravity between the highest and lowest cell being 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 a very reliable means of testing a battery as it simulates the battery cold-cranking capacity. A commercial battery load tester is required to do this test.
Inspecting, Maintaining, and Testing the Battery (continued)

**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 12.0 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.

F. Apply a test load of 1/2 the cold cranking amperage rating of the battery; refer to Battery Specifications (page 6–80).

G. Take a test voltage reading while still under load after 15 seconds, then immediately remove the load.

H. Use Minimum Voltage (page 6–82) to determine the minimum voltage for the center cell electrolyte temperature reading.

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.

### Charging the Battery

#### Battery Charge Level

<table>
<thead>
<tr>
<th>Battery Charge Level</th>
<th>Specific Gravity</th>
<th>Open Circuit Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>1.265</td>
<td>12.68</td>
</tr>
<tr>
<td>75%</td>
<td>1.225</td>
<td>12.45</td>
</tr>
<tr>
<td>50%</td>
<td>1.190</td>
<td>12.24</td>
</tr>
<tr>
<td>25%</td>
<td>1.155</td>
<td>12.06</td>
</tr>
<tr>
<td>0%</td>
<td>1.120</td>
<td>11.89</td>
</tr>
</tbody>
</table>

#### Battery Charge Rate

<table>
<thead>
<tr>
<th>Battery Reserve Capacity (Minutes)</th>
<th>Battery Charge Level (Percent of Fully Charged)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>75%</td>
</tr>
<tr>
<td>80 or less</td>
<td>3.8 hrs @ 3 A</td>
</tr>
<tr>
<td>81 to 125</td>
<td>5.3 hrs @ 4 A</td>
</tr>
<tr>
<td>126 to 170</td>
<td>5.5 hrs @ 5 A</td>
</tr>
<tr>
<td>171 to 250</td>
<td>5.8 hrs @ 6 A</td>
</tr>
<tr>
<td>above 250</td>
<td>6 hrs @ 10 A</td>
</tr>
</tbody>
</table>
Charging the Battery (continued)

To minimize damage to the battery and allow the battery to charge fully, use the following slow charging procedure. You can accomplish this charging procedure with a constant current battery charger that is available locally.

**IMPORTANT**

**Follow the manufacturer's instructions when using a battery charger.**

**Note:** Using the specific gravity of the battery cells is the most accurate procedure of determining the battery condition.

1. Use Battery Charge Level (page 6–84) to determine the battery charge level from the specific gravity of the battery cells or open circuit voltage.

2. Use the manufacturer's battery charger instructions or Battery Charge Rate (page 6–84) to determine the charging time and rate.

**CAUTION**

Charging a frozen battery can cause explosion and can cause personal injury. Let the battery warm to 15°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 terminals.

3. Follow the battery charger manufacturer's instructions, connect the charger cables to the battery terminals. 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 52°C (125°F) or the electrolyte is violently gassing or spewing, lower the charge rate or temporarily stop charging the battery.

6. Beginning three hours before the end of the scheduled charge, 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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# Additional Reference Materials

*Carraro DriveTech Model 26.09M Axle Repair Manual*
General Information

Traction Unit Operator’s Manual and Accessory Installation Instructions

The traction unit *Operator’s Manual* and accessory *Installation Instructions* provide information regarding the operation, general maintenance and maintenance intervals for the machine and its accessories. Refer to the traction unit *Operator’s Manual* and accessory *Installation Instructions* for additional information.
## Adjustments

### Adjusting the Tie Rod Length

![Figure 118](g254281)

1. Jam nut
2. Tie rod length

1. Loosen the jam nut and turn the inner tie rod shaft to adjust the tie rod length:
   - Front Tie Rod Length = (10.22 ± 0.03 inch).
   - Rear Tie Rod Length = (10.45 ± 0.03 inch).
2. Tighten the jam nut.

### Adjusting Axle Stop Bolts

![Figure 119](g254460)

1. Front axle
2. Rear axle

1. Front axle stop bolt
2. Rear axle stop bolt
Adjusting Axle Stop Bolts (continued)

Adjust the axle stop bolts after the axle has been installed on the machine and the tie rods have been installed.
Service and Repairs

Tie Rods

Removing the Tie Rods

![Diagram of tie rods and related components]

**Figure 120**

1. Cotter pin
2. Slotted nut
3. Outer tie rod
4. Jam nut
5. Inner tie rod

1. Remove and discard the cotter pin.

**Note:** Move or remove the axle stop bolts to access the slotted nuts.

2. Remove the slotted nut.

3. Use a suitable tool (pickle fork) to separate the outer tie rod from the axle assembly.

4. Use the flats on the steering cylinder rod nearest the tie rod being removed to hold the cylinder rod and remove the inner tie rod.

Installing the Tie Rods

1. Check and adjust the tie rod length if necessary; refer to Adjusting the Tie Rod Length (page 7–3).

   **Note:** New inner tie rods have a thread locking compound pre-applied on the steering cylinder end. Clean the threads and apply a high strength thread locking compound if installing a used inner tie rod.

2. Use the flats on the steering cylinder rod nearest the tie rod being installed to hold the cylinder rod and install the inner tie rod.
Installing the Tie Rods (continued)

3. Secure the outer tie rod to the axle with the slotted nut. Tighten the nut from 129 to 149 N·m (95 to 110 ft-lb).

4. Check and adjust the axle stop bolts; refer to Adjusting Axle Stop Bolts (page 7–3).

5. Continue to tighten the slotted nut to align if necessary and install a new cotter pin.

6. Grease the outer tie rod with Mobil high-temp XHP-222 grease or equivalent until the boot swells. Do not allow the grease to purge from boot.
Figure 121

1. Front axle  9. Socket head screw (4 each)  17. Cap screw (4 each)
2. Flange nut (4 each)  10. Steering cylinder  18. Plain washer (4 each)
3. Speed sensor  11. Cap screw (2 each)  19. Spacer (4 each)
4. Axle drive motor  12. Flange nut (2 each)  20. Lug nut (12 each)
5. Flange head screw (2 each)  13. Retainer (2 each)  21. Wheel assembly (2 each)
6. Flange head screw (2 each)  14. Flange head screw (4 each)  22. Slotted nut
7. Cover (2 each)  15. Flat washer (4 each)  23. Cotter pin
8. Coupler assembly  16. Tie rod assembly (2 each)
Removing the Front Axle

1. Raise and support the front of the machine; refer to Jacking Instructions (page 1–8).
2. Remove the front wheels.
3. Remove the front axle drive motor from the motor mount. Retrieve the coupler assembly (item 8) and support the motor.
4. Disconnect the front axle speed sensor (item 3) from the machine wire harness.
5. Disconnect and plug the hydraulic hoses at the steering cylinder and the differential lock. Cap the hydraulic fittings.

⚠️ **WARNING**

The front axle assembly weighs approximately 231 kg (510 lbs).

6. Use a trolley jack to support the center of the front axle.
   
   **Note:** The front axle mounting bolts are held in position (captured) to the machine frame.

7. Remove the 4 flange nuts securing the front axle to the frame.
8. Lower and remove the front axle from the machine.
9. If necessary, remove the motor mount with covers and the steering cylinder assembly.

Installing the Front Axle

1. If previously removed, install the steering cylinder assembly.
   
   🔄 A. Fit the steering cylinder to the axle with 4 spacers, plain washers and cap screws. Tighten the screws from 359 to 386 N·m (265 to 285 ft-lb).
   
   🔄 B. Install the tie rod assemblies; refer to Installing the Tie Rods (page 7–5).

2. If previously removed, install the motor mount.
   
   🔄 A. Fit the motor mount to the axle with 4 cap screws. Tighten the screws from 111 to 138 N·m (82 to 102 ft-lb).
   
   🔄 B. Install the covers.
3. Raise and secure the axle to the machine with 4 flange nuts.
4. Install the hydraulic lines to the steering cylinder and the differential lock.
5. Connect the front axle speed sensor to the machine wire harness.
6. Apply anti-seize lubricant to the splines of the front axle and the coupler assembly and install the coupler.
7. Apply anti-seize lubricant to the splines of the front axle drive motor and install the motor.
8. Check and adjust all 4 axle stop bolts as necessary; refer to Adjusting Axle Stop Bolts (page 7–3).
9. Check the oil level in each wheel hub and the front axle and adjust as necessary; refer to the traction unit Operator’s Manual.
10. Grease the front axle with Mobil high-temp XHP-222 grease or equivalent; refer to the traction unit Operator’s Manual.
Installing the Front Axle (continued)

11. Apply anti-seize lubricant to the inner edge of the wheel and install the wheel. Tighten the lug nuts in a crossing pattern from 380 to 434 N·m (280 to 320 ft-lb).

12. Check and adjust front tire air pressure as necessary.
Removing the Rear Axle

1. Raise and support the rear of the machine; refer to Jacking Instructions (page 1–8).

2. Remove the rear wheels.
Removing the Rear Axle (continued)

3. Remove the rear tie rods; refer to Removing the Tie Rods (page 7–5).
4. Remove the rear axle drive motor and brake assembly from the motor mount. Locate and retrieve the dowel pin (item 7). Retrieve the coupler assembly (item 14) and support the motor and brake.
5. Disconnect the rear axle speed sensor (item 8) from the machine wire harness.
6. Disconnect and plug the hydraulic hoses at the steering cylinder and the differential lock. Cap the hydraulic fittings.
7. Fully extend the drawbar.

⚠️ WARNING ⚠️

The rear axle assembly weighs approximately 208 kg (460 lbs).

8. Use a trolley jack to support the center of the rear axle.
9. Remove the 4 U-bolts securing the rear axle to the frame.
10. Lower and remove the rear axle from the machine.
11. If necessary, remove the motor mount and the steering cylinder assembly.

Installing the Rear Axle

1. If previously removed, install the steering cylinder assembly. Tighten the screws that secure the cylinder brackets to the rear axle from 359 to 386 N·m (265 to 285 ft-lb).
2. If previously removed, install the motor mount. Install the dowel pin and fit the motor mount to the axle with 4 cap screws. Tighten the screws from 111 to 138 N·m (82 to 102 ft-lb).
3. Raise and secure the axle to the machine with 4 U-bolts and flange nuts. Ensure the axle is against the frame and each U-bolt is flush against the bottom of the axle before tightening. Tighten the U-bolts as follows:
   A. Tighten each pair of U-bolts in a crossing pattern to 81 N·m (60 ft-lb).
   B. Tighten each pair of U-bolts in a crossing pattern to 169 N·m (125 ft-lb).
   C. Tighten each pair of U-bolts in a crossing pattern to 257 N·m (190 ft-lb).
4. Install the hydraulic lines to the steering cylinder and the differential lock.
5. Connect the rear axle speed sensor to the machine wire harness.
6. Apply anti-seize lubricant to the splines of the rear axle and the coupler assembly and install the coupler.
7. Apply anti-seize lubricant to the splines of the brake assembly and the rear axle drive motor. Install the brake assembly, a new gasket and the drive motor.
8. Install the rear tie rods; refer to Installing the Tie Rods (page 7–5).
9. Check and adjust all 4 axle stop bolts as necessary; refer to Adjusting Axle Stop Bolts (page 7–3).
10. Check the oil level in the brake assembly and adjust as necessary; refer to traction unit Operator’s Manual.
11. Check the oil level in each wheel hub and the rear axle and adjust as necessary; refer to traction unit Operator’s Manual.
Installing the Rear Axle (continued)

12. Grease the rear axle with Mobil high-temp XHP-222 grease or equivalent; refer to the traction unit Operator’s Manual.

13. Apply anti-seize lubricant to the inner edge of the wheel and install the wheel. Tighten the lug nuts in a crossing pattern from 380 to 434 N·m (280 to 320 ft-lb).

14. Check and adjust front tire air pressure as necessary.
Refer to the traction unit Operator’s Manual for axle fluid change procedures. Additional axle service information can be found in the Carraro Drivetech Repair Manual for Model 26.09M.
Front PTO Gear Box

![Diagram of Front PTO Gear Box]

**Figure 124**

1. Front PTO gear box  
2. Flange head screw (7 each)  
3. Coupler  
4. Dowel pin (2 each)

---

**CAUTION**

The front PTO gear box weighs approximately 42 kg (93 lbs). Use an appropriate lift to remove and install the gear box.

**Note:** The front PTO gear box output shaft seal can be replaced in the machine. The PTO drive shaft must be disconnected but the gear box does not have to be removed.

**Removing the Front PTO Gear Box**

1. Remove the engine assembly; refer to Removing the Engine (page 4–17).
2. Remove the front PTO gearbox from the flywheel housing and retrieve the coupler and dowel pins.
Replacing Front Gear Box Seals

Figure 125

1. Retaining ring
2. Hub
3. Flange head screw (4 each)
4. Plate (2 each)
5. Shaft seal (2 each)

1. Remove the retaining ring and the hub from the gear box output shaft.
2. Remove the flange head screws and plate to access either shaft seal.
3. Carefully remove and discard the shaft seal.
4. Clean the gear box housing bore and cover the shaft splines with tape to protect the shaft seal during installation.
5. Install the shaft seal and remove the tape from the shaft splines.
6. Install the plate and tighten the flange head screws from 24.5 to 32.5 N·m (18 to 24 ft-lb).
7. Apply anti-seize lubricant to the splines of the output shaft and hub, then install the hub and retaining ring.
Disassembling the Front PTO Gear Box

1. Cover
2. Shaft seal
3. Plate
4. Flange head screw (4 each)
5. Retaining ring
6. Bearing
7. Retaining ring (2 each)
8. Gear – 64T
9. Key (2 each)
10. Input shaft
11. Bearing
12. Wave washer
13. Wave washer
14. Bearing
15. Retaining ring
16. Thrust washer (2 each)
17. Gear – 77T
18. Needle bearing
19. Clutch assembly
20. O-ring
21. Dowel pin (2 each)
22. Plug
23. Case
24. Eyebolt
25. Coupler
26. Retaining ring
27. Hub
28. Plate
29. Shaft seal
30. Plug
31. Plug (4 used)
32. Bearing (2 each)
33. Retaining ring (2 each)
34. Output shaft
35. Gear – 84T
36. Wave washer
37. Cap screw (11 each)

1. Remove the retaining ring and hub from the output shaft.
2. Remove the socket head cap screws and use the tabs provided to pry the cover from the gear box.
3. Retrieve the dowel pins from the cover or case, and retrieve the wave washers from the clutch shaft and the output shaft assemblies.
4. Remove the input shaft assembly from the gear box case.
Disassembling the Front PTO Gear Box (continued)

5. Remove the clutch shaft and the output shaft assemblies from the gear box case together.
6. Remove the plates and shaft seals.
7. Clean the gear box cover and case, removing any old sealant.

Assembling the Front PTO Gear Box

1. If previously removed, fit the dowel pins into the gear box case or cover.
2. Engage the clutch shaft and the output shaft assemblies together. Position the tabs on the brake disc pack outside of the stops in the gear box case and install the shafts into the gearbox case together.
3. Install the output shaft assembly into the gear box case.
4. Clean any residue from the gear box and cover mating surfaces with solvent and apply silicone sealant to only the mating surfaces.
5. Place the wave washers over the clutch shaft and output shaft bearings.
6. Fit the cover over the shaft bearings, wave washers and dowel pins.
7. Apply medium strength thread locking compound and install the socket head cap screws. Tighten the cap screws in a crossing pattern from 31 to 36 N·m (23 to 26 ft-lb).
8. Rotate the input shaft by hand to confirm proper gear box assembly.
9. Replace the gear box seals; refer to Replacing Front Gear Box Seals (page 7–15).

Installing the Front PTO Gear Box

1. Apply a thin layer of anti-seize lubricant to the splines of the input shaft and the flywheel adapter.
   
   **Note:** Long dowel pins are provided to enable shaft spline alignment during gearbox installation.

2. Fit the gear box to the housing and install the 7 flange head screws. Tighten screws in an alternating pattern from 46 to 57 N·m (34 to 42 ft-lb).
Installing the Front PTO Gear Box (continued)

3. Apply a thin layer of anti-seize lubricant to the splines of the output shaft and the coupler, then install the coupler.
The PTO clutch is a hydraulically actuated mechanism located in the front PTO gear box. The front PTO gear box must be removed from the machine and disassembled to access the PTO clutch; refer to Removing the Front PTO Gear Box (page 7–14) and Disassembling the Front PTO Gear Box (page 7–16).

PTO Clutch Service

**Note:** The disc packs are available in pre-measured sets. Do not mix old and new discs or replace discs individually.

1. Pull and discard the bearing from the front of the clutch shaft.
2. Remove the retaining ring, thrust washers, 77T gear and needle bearing from the clutch shaft.
3. Remove the internal retaining ring then remove and discard the entire clutch disc pack.
4. Use a press and spring compression tool part number 138–3968 to compress the clutch spring and remove the retaining ring, thrust washer and spring from the clutch shaft; refer to Spring Compression Tool (page 2–18).
PTO Clutch Service (continued)

5. Remove the clutch piston then remove and discard the piston O-ring.

6. Remove the external retaining ring then remove and discard the entire brake disc pack.

7. Install the new brake disc pack. Install the retaining ring and align the steel tabs.
   
   **Note:** Do not twist, nick, cut or otherwise damage the piston O-ring during installation or assembly.

8. Lubricate the new O-ring with petroleum grease and install onto the piston, then carefully fit the piston into the basket.
   
   **Note:** Be careful not to scratch or otherwise damage the surface of the clutch shaft when installing the retaining ring.

9. Install the spring and thrust washer on the clutch shaft. Compress the spring and install the retaining ring.

10. Install the clutch disc pack in the basket and install the retaining ring.

11. Coat the needle bearing with oil and install one of the thrust washers, needle bearing, 77T gear, remaining thrust washer and the retaining ring onto the clutch shaft.

12. Press a new bearing onto the clutch shaft.

13. Remove and discard the clutch shaft O-ring in the rear gear box housing.

14. Lubricate the new clutch shaft O-ring with petroleum grease and install onto the rear housing.
Rear PTO Gear Box

Figure 129

1. Rear PTO gear box
2. Flange head screw (6 each)
3. Breather hose
4. Hose clamp

**CAUTION**

The rear PTO gear box weighs approximately 38 kg (84 lbs). Use an appropriate lift to remove and install the gear box.

**Note:** The rear PTO gear box shaft seals can be replaced in the machine.
The PTO drive shaft must be disconnected but the gear box does not have to be removed.

Removing the rear PTO Gear Box

1. Disconnect the breather hose from the top of the gear box.
2. Remove the PTO drive shaft; refer to Removing the PTO Drive Shaft (page 7–24).
3. Support the rear PTO gear box from overhead.
4. Remove the 6 cap screws securing the rear of the gear box housing to the frame and lift the gearbox from the machine.
Replacing Rear Gear Box Seals

1. Remove the retaining ring and the hub from the gear box input shaft.
2. Remove the flange head screws, plate and retaining ring to access either shaft seal.
3. Carefully remove and discard the shaft seal.
4. Clean the gear box housing bore and cover the shaft splines with tape to protect the shaft seal during installation.
5. Install the shaft seal and remove the tape from the shaft splines.
6. Install the retaining ring and the plate. Tighten the flange head screws from 24.5 to 32.5 N·m (18 to 24 ft-lb).
7. Apply a thin layer of anti-seize lubricant to the splines of the input shaft and hub, then install the hub and retaining ring.

Installing the Rear PTO Gear Box
1. Support the rear PTO gear box from overhead.
2. Lift the gearbox into the machine and install the 6 cap screws securing the rear of the gear box housing to the frame.
Installing the Rear PTO Gear Box (continued)

3. Connect the breather hose to the top of the gear box.
4. Check and adjust the rear PTO gear box fluid level; refer to the traction unit Operator’s Manual.
5. Install the PTO drive shaft; refer to Installing the PTO Drive Shaft (page 7–26).
Removing the PTO Drive Shaft

**CAUTION**

It may be necessary to raise the operator platform to remove the PTO drive shaft. If so, block the operator platform to prevent it from lowering accidently.

1. Remove the bed.
2. Remove the PTO shaft cover.
3. Remove the 2 shaft guards.
4. Remove the screws securing the flange yokes to the gear box hubs and remove the PTO shaft.
5. Slide the slip yoke off of the tube yoke.
Servicing the PTO Drive Shaft Cross Bearings

Figure 132
1. Tube yoke
2. Boot
3. Slip yoke
4. Grease fitting
5. Retaining ring (8 each)
6. Cross bearing
7. Flange yoke

IMPORTANT

When placing yoke in vise, clamp lightly on the solid part of the yoke to prevent damage. The use of a vise with soft jaws is recommended.

1. Lightly clamp each yoke in a vise and remove the snap rings that secure the bearings to the yoke.
2. Support the yoke and use a press to remove the cross and bearings from the yokes:
   A. Place a small socket against one bearing and a large socket against the yoke on the opposite side.
   B. While supporting the large socket, apply pressure on small socket to partially push the opposite bearing into the large socket.
   C. Remove the yoke from the press, grasp the partially removed bearing and tap on the yoke to completely remove the bearing.
   D. Repeat the process for the remaining bearings.
3. Thoroughly clean and inspect all components.
4. Support the yoke and use a press to install a new cross and bearings into the yokes:
   A. Apply a coating of grease to the bearing bores of the end yoke and the shaft yoke. Also, apply grease to the bearings and seal of the bearing.
Servicing the PTO Drive Shaft Cross Bearings (continued)

assembly. Make sure that all the bearing rollers are properly seated in the bearing cage.

B. Press one bearing partially into the yoke.

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Take care when installing the cross into the bearing to avoid damaging the bearing seal.

C. Carefully insert the cross into the bearing and yoke.
D. Hold the cross in alignment and press the bearing in until it hits the yoke.
E. Carefully place the second bearing into the yoke bore and onto the cross shaft. Press the bearing into the yoke.
F. Install the snap rings to secure the bearings in place.
G. Repeat procedure for the remaining bearings.

5. Make sure that assembled joint moves without binding. Slight binding can usually be eliminated by lightly rapping the yoke lugs with a soft faced hammer. If binding continues, disassemble the joint to identify the source of the binding.

Installing the PTO Drive Shaft

1. Apply a coating of grease to the slip yoke and tube yoke splines and fit the slip onto the tube yoke.
2. Position the PTO shaft in the machine and secure the flange yokes to the gear box hubs.
3. Apply Mobil high-temp XHP–222 grease or equivalent to the grease fitting on the slip yoke.

4. Install the 2 shaft guards.
5. Grease the slip yoke grease fitting.

6. Install the PTO shaft cover.
7. Install the bed.
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General Information

Traction Unit Operator’s Manual and Accessory Installation Instructions

The traction unit Operator’s Manual and accessory Installation Instructions provide information regarding the operation, general maintenance and maintenance intervals for the machine and its accessories. Refer to the traction unit Operator’s Manual and accessory Installation Instructions for additional information.
Front Screen

Removing and Installing the Front Screen

1. Park the machine on a level surface, lower any attachments, shut off the engine and remove the key from the key switch.
2. Release the hood latches and raise the hood.
3. Release the front screen latch and tilt the screen forward.
4. Remove the fasteners at either end of the screen tether.
5. Remove the bolt and nut from the screen hinge and remove the screen.
6. Inspect the screen for worn or damaged bumpers or seals and replace them as necessary.
7. To install the screen, follow this procedure in reverse order.
Figure 134

1. Lynch pin (2 each)  
2. Hood skin  
3. Hood prop  
4. Shoulder screw  
5. lock nut  
6. Lock nut  
7. Washer  
8. Shoulder screw  
9. Foam block (2 each)  
10. Hood frame  
11. Bulb seal
Removing and Installing the Hood

1. Park the machine on a level surface, lower any attachments, shut off the engine and remove the key from the key switch.
2. Release the hood latches and raise the hood.
3. Disconnect the hood from the platform wire harness.
4. Support the hood and remove the fasteners at either end of the hood prop.

⚠️ CAUTION ⚠️

The hood assembly is bulky. The hood assembly can safely be removed by two technicians, one on each side of the machine.

5. Remove the lynch pins from the hood hinge and remove the hood.
6. Inspect the hood for worn or damaged seals (radiator area) and replace them as necessary.
7. To install the hood, follow this procedure in reverse order.
Figure 135

1. Operator platform
2. Front lift point (2 each)
3. Rear lift point (2 each)
4. Front cowl
5. Plug (2 each)
6. Flange nut (4 each)
7. Snubbing washer (4 each)
8. Front fender (2 each)
9. Cap screw (4 each)

Removing the Operator’s Platform

1. Remove the front loader if equipped.
2. Remove the bed; refer to Standard Bed (page 8–21), or the optional cargo bed Installation Instructions.
3. Remove the front cowl.
4. Disconnect the battery; refer to Removing the Battery (page 6–81).
5. Remove the front fenders.
Removing the Operator’s Platform (continued)

**IMPORTANT**

To prevent damage to the electrical wire harnesses, coolant hoses, and refrigerant hoses, numerous cable ties and clamps are used to secure these items to the machine. Record the location of all cable ties and clamps that are removed from the machine during operator platform removal so that they can be properly replaced during installation.

---

**Figure 136**

1. Access panel  
2. Battery negative (-) cable  
3. Battery negative (+) cable  
4. Hydraulic manifold ST port  
5. Hydraulic manifold LS/OR1 port  

6. Remove the access panel from the right side of the control console.  
7. Disconnect the battery positive (+) and negative (-) cables from the terminal bracket posts.  
8. Disconnect the hoses at the hydraulic manifold ST and LS/OR1 ports. Cap the fittings and plug the hoses to prevent contamination from entering the hydraulic system.
Figure 137

1. Engine ECU
2. Engine wire harness connector
3. Frame wire harness connector (blue ring)
4. Frame wire harness connector (green ring)
5. 3-pin engine harness connector P63
6. 7-pin engine harness connector P18

9. Disconnect the engine wire harness from the engine ECU.
10. Separate the operator platform wire harness from the frame wire harness at the 2 connectors (under the right side of the dash cover).
11. Disconnect the 3-pin engine wire harness connector P63 from the main harness.
12. Disconnect the 7-pin engine wire harness connector P18 from the main harness.
13. Remove the main instrument panel mounting screws and lift the panel to access the glow, start and EGR relays. Remove the cap screw securing the relay bracket to the frame and pass the assembly out of the operator platform.
Removing the Operator's Platform (continued)

1. Hydraulic hose (rear steering cylinder, right fitting)
2. Hydraulic hose (front steering cylinder, left fitting)
3. Hydraulic hose (hydraulic tube fitting)

14. Label and disconnect the 3 hoses at the rear bulkhead. Cap the fittings and plug the hoses to prevent contamination from entering the hydraulic system.
15. For machines equipped with a cab heater, label and disconnect the coolant hoses at the front of the engine. Cap the fittings and plug the hoses to prevent contamination from entering the engine or coolant lines.

**IMPORTANT**

Important: Do not allow refrigerant to discharge into the atmosphere. Before opening or disconnecting parts from the refrigerant circuit, empty the refrigerant into a specified recycling bottle, and dispose of it correctly.
Removing the Operator's Platform (continued)

16. For machines equipped with air conditioning, discharge the refrigerant hoses in accordance with local regulations and disconnect the hoses at the compressor. Cap the fittings and plug the hoses to prevent contamination from entering the air conditioning system.

17. Remove the rubber boot from the auxiliary load valve.

18. For machines equipped with a front loader, remove the knob, jam nut and rubber boot from the loader valve.

19. Remove the 4 flange nuts, snubbing washers and cap screws securing the operator platform to the frame.

---

**CAUTION**

The standard operator platform assembly weighs approximately 748 kg (1,650 lb). The operator platform and cab assembly weighs approximately 952 kg (2,100 lb). Use an appropriate hoist to raise and lower the operator platform assembly.

---

20. Using the 4 lift points provided, raise the operator platform a few inches. Place blocks between the operator platform mounts and the chassis, then ensure all the required hoses and wire harnesses are disconnected and free to separate from the chassis.
Removing the Operator’s Platform (continued)

IMPORTANT

The operator’s platform assembly can rest on the right and left steps. Support the front and rear of the platform assembly with blocks or jack stands to prevent it from tipping.

21. Raise the operator platform clear of the machine, then lower the platform assembly to the floor.

Installing the Operator’s Platform

1. Using the 4 lift points provided, lower the operator platform over the machine chassis. Place blocks between the operator platform mounts and the chassis, then ensure all the required hoses and wire harnesses are safely routed to the chassis.

2. Align the cab to the chassis and install the 4 cap screws, snubbing washers and flange nuts. Install the plugs over the 2 front mounts.

3. For machines equipped with a front loader, fit the rubber boot over the loader valve and install the jam nut and knob.

4. Install the rubber boot over the auxiliary load valve.

IMPORTANT

To prevent damage to the electrical wire harnesses, coolant hoses, and refrigerant hoses, numerous cable ties and clamps are used to secure these items to the machine. Replace all cable ties and clamps that were removed from the machine during operator platform removal.

5. Connect the refrigerant lines at the compressor if equipped.

6. Connect the heater hoses at the engine if equipped.

7. Connect the 3 hydraulic hoses to the bulkhead at the rear of the operator platform.

8. Install the relay assembly and the main instrument panel.

9. Connect the 7-pin engine wire harness connector P18 to the main harness.

10. Connect the 3-pin engine wire harness connector P63 to the main harness.

11. Connect the operator platform wire harness to the frame wire harness at the 2 connectors (under the right side of the dash cover).

12. Connect the engine wire harness to the engine ECU.

13. Connect the hoses at the hydraulic manifold ST and LS/OR1 ports.

14. Connect the battery positive (+) and negative (-) cables to the terminal bracket posts.

15. Install the access panel to the right side of the control console.

16. Install the front fenders.

17. Connect the battery; refer to Installing the Battery (page 6–81).

18. Install the front cowl.

19. Install the bed; refer to Standard Bed (page 8–21), or the optional cargo bed Installation Instructions.
Installing the Operator’s Platform (continued)

20. For machines equipped with a cab heater, operate the heater and adjust the coolant level as required; refer to the traction unit Operator’s Manual.

21. For machines equipped with air conditioning, have a certified refrigeration technician fill/recharge and test the air conditioning system.

22. Operate the machine carefully at first to allow the hydraulic system to refill with fluid. Check for and correct any hydraulic leaks. Check and adjust the hydraulic fluid level as required; refer to the traction unit Operator’s Manual.
Steering Wheel, Instrument Panels and Dash Cover

2. Button head screw (5 each) 8. Button head screw (3 each) 14. Steering wheel cover
3. Washer (2 each) 9. Flange head screw (2 each) 15. Button head screw (4 each)
5. Button head screw (4 each) 11. Steering wheel

Figure 142
Removing the Steering Wheel, Instrument Panels and Dash Cover

1. Park the machine on a level surface, lower any attachments, shut off the engine and remove the key from the key switch.

2. Disconnect the battery; refer to Removing the Battery (page 6–81).

3. Remove the steering wheel. If necessary, use a suitable puller to remove the steering wheel from the steering column.

   Note: The main instrument panel can be passed through the dash cover opening without disconnecting all the controls from the wire harness.

4. Remove the main instrument panel. If necessary, label all the wire harness connections for assembly purposes and disconnect the wire harness from the panel controls.

5. Remove the windshield from machines with a cab.

6. Remove the steering instrument panel. Label all the wire harness connections for assembly purposes and disconnect the wire harness from the panel controls.

7. Remove the steering column cover.

8. Remove the console instrument panel fasteners and move the panel to allow access to the 2 dash cover to console fasteners.

9. Remove the dash cover.

Installing the Steering Wheel, Instrument Panels and Dash Cover

1. Install the dash cover.

2. Install the 2 dash cover to console fasteners, then install the console instrument panel.

3. Install the steering column cover.

4. Install the steering instrument panel.

5. Install the windshield from machines with a cab.

6. Install the main instrument panel.

7. Apply a thin coating of anti-seize lubricant to the steering column splines and install the steering wheel, washer and lock nut. Tighten the lock nut from 28 to 35 N·m (20 to 26 ft-lb).

8. Connect the battery; refer to Installing the Battery (page 6–81).

9. Verify instrument panel controls function before returning the machine to service.
Removing and Installing the Operator's Console

1. Park the machine on a level surface, lower any attachments, shut off the engine and remove the key from the key switch.

2. Disconnect the battery; refer to Removing the Battery (page 6–81).

3. Remove the access panel from the left side of the console.

4. Remove the console instrument panel. Label all the wire harness connections for assembly purposes and disconnect the wire harness from the panel controls.

5. Remove the main instrument panel fasteners and move the panel to allow access to the 2 fasteners securing the dash cover to the console.

6. Remove the console.

7. To install the console, follow this procedure in reverse order.
Apply medium strength thread locking compound and tighten the seat belt mounting screws from \textbf{68 to 81 N-m (50 to 60 ft-lb)}. 
Servicing the Operator Seat

Figure 145

1. Backrest cushion
2. Seat cushion
3. RH support cover
4. LH armrest
5. RH support cover
6. Bushing (2 each)
7. Backrest
8. Plug (2 each)
9. Cable tie (3 each)
10. LH adjustment rail
11. Bumper (2 each)
12. Washer
13. Cap screw (2 each)
14. Seat frame
15. Nut
16. Spring (2 each)
17. Magnet
18. Seat switch
19. Rivet (4 each)
20. Mounting plate
21. Return spring
22. Torx screw (5 each)
23. RH adjustment rail
24. Rail stop
25. Torx screw
26. Torx screw (3 each)
27. Washer (3 each)
28. Handle
29. Flat head screw (3 each)
30. Adaptor plate
31. Screw
32. Lever
33. Handle
34. Nut
35. Support bracket
36. Cap screw
Remove the operator seat to gain access to the seat suspension assembly. Most of the operator seat suspension components can be serviced with the lower seat suspension mounted to the frame platform. If the air spring assembly requires removal, the lower seat suspension must be removed from the seat platform.
Standard Bed

1. Standard bed
2. Flange head screw (4 each)
3. Flange nut (4 each)

---

**CAUTION**

The standard bed weighs approximately 107 kg (235 lbs). Make sure the hoist, lift or stands used to remove the bed can properly support the weight.
Front Loader Attachment

Figure 148

1. Front loader arm assembly  
2. Support assembly  
3. Shim  
4. Female coupler assembly  
5. Front loader control valve

Refer to General Precautions for Removing and Installing the Hydraulic System Components (page 5–49) prior to removing hydraulic system components.

⚠ CAUTION ⚠

The front loader arm assembly weighs approximately 218 kg (480 lbs).
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_Sanden SD Compressor Service Guide_
General Information

Traction Unit Operator’s Manual and Accessory Installation Instructions

The traction unit Operator’s Manual and accessory Installation Instructions provide information regarding the operation, general maintenance and maintenance intervals for the machine and its accessories. Refer to the traction unit Operator’s Manual and accessory Installation Instructions for additional information.

Electrical Components, Schematics and Wire Harness Drawings

For information regarding machine electrical cab components (switches and relays); refer to Chapter 6: Electrical System (page 6–1). The electrical schematic and wire harness drawings for the operator cab are included in Appendix A (page A–1).
The air conditioning system used in the machine operator cab consists of the following components:

- A compressor mounted on the left side of the engine driven by 2 poly V-belts.
- A condenser assembly with two (2) condenser fans located outside the rear of the cab roof assembly.
- An evaporator, a drier-receiver and an expansion valve mounted in the headliner of the cab.
- A refrigerant pressure switch
- A thermostat
- An evaporator freeze switch
- 3 relays (condenser fans, air conditioning switch signal, compressor clutch)
- The necessary hoses and tubes that connect the air conditioning system components.
- A blower fan motor that provides air movement through the evaporator and into the cab. The fan motor is a component of the mixing box located in the cab headliner. The fan motor is also used for the cab heating system.
- Operator controls to turn the air conditioning on, to adjust the fan speed and to control the cab air temperature.

There are a number of factors that can affect the performance of the machine air conditioning system. To ensure the best system operation, inspect the following components.

- Make sure that the heater control fully closes the heater valve in the cab headliner.
- Make sure that the condenser and evaporator fins are not obstructed and clean.
- Verify that refrigerant charge quantity and system operating pressures are correct.
- Make sure that exposed metal surfaces inside cab are insulated.
- If the ambient temperatures exceeds 43C (110F) apply additional window tinting to lower the solar heat load to the cab.
Cab Heater System

The cab heater system used in the machine operator cab consists of the following components:

• A heater core in the mixing box mounted in the headliner of the cab.
• Hoses to allow a circuit for engine coolant to circulate through the heater core.
• A blower fan motor that provides air movement through the heater core and into the cab. The fan motor is a component of the mixing box located in the cab headliner. The fan motor is also used for the air conditioning system.
• Operator controls to adjust the fan speed and to control the amount of coolant passing through the heater core (air temperature).
Adjustments

Adjusting the Compressor Belt Tension

Compressor belt(s) tension = 19 mm (0.75 inch) deflection when 6.8 kg (15 lb) is applied half way between the engine and compressor pulleys.

1. Loosen nut at bottom of tensioner plate and lift or gently pry compressor upward to decrease belt(s) deflection.
2. Tighten nut and recheck belt tension.
Adjusting the Doors

1. Use shims under the striker stud if necessary for proper door latch engagement.

2. Check the door adjustment to ensure proper sealing at the 3 points indicated. The distance between the sealing surface of the frame and the outer edge of the door trim when the door is fully latched should be from **19 to 25 mm (0.8 to 1.0 inch)**.

3. Loosen the striker stud lock nut to move the striker stud and adjust the door fit. Disassemble the striker stud and rotate the adjuster to increase stud movement if necessary.

---

**Figure 150**

1. Striker stud
2. Shim (as required)
3. Adjuster
4. Lock nut
5. Striker guard
6. Frame
7. Door seal
8. Door panel
Service and Repairs

General Precautions for Removing and Installing Air Conditioning System Components

⚠️ WARNING ⚠️

The air conditioning system is under high pressure. Do not loosen any system fitting or component until after the system has been completely discharged by a certified air conditioning service technician.

⚠️ CAUTION ⚠️

Always wear safety goggles or a face shield when working with air conditioning system components. Also, do not allow refrigerant contact with your skin or eyes as there would be the possibility of serious injury.

⚠️ CAUTION ⚠️

Never use compressed air to leak test or pressure test the air conditioning system. Under certain conditions, pressurized mixtures of refrigerant and air can be combustible.

1. Before servicing any air conditioning system components, park machine on a level surface, lower cutting decks or attachments and stop engine. Remove key from the key switch.
2. Clean machine before disconnecting, removing or disassembling any air conditioning system components. Thorough cleaning will prevent system contamination while performing service procedures.
3. Before loosening or removing any air conditioning system hose or other component, have a certified air conditioning service technician recover the system refrigerant and then evacuate the air conditioning system completely. It is illegal to vent refrigerant to the atmosphere.
4. Put caps or plugs on any air conditioning system lines, fittings or components left open or exposed to prevent moisture and contaminants from entering the system.
5. Put labels on disconnected lines and hoses for proper installation after repairs are completed.
6. If compressor is removed from machine, keep compressor in the same orientation as the installed position. This will prevent compressor oil from filling the compressor cylinders.
7. Note the position of fittings (especially elbow fittings) before removal. Mark parts if necessary to make sure they will be aligned properly when reinstalling hoses and tubes.
8. Always use a DOT approved tank for storing used and recycled refrigerants.
9. The air conditioning system uses R134a refrigerant. DO NOT use other refrigerants in the system. Air conditioning system capacity is approximately 1.4 kg (40 oz or 2.53 lbs) of R134a refrigerant.

10. Refrigerant containers (either full or empty) are under pressure that will increase if the containers are heated. DO NOT expose refrigerant containers to high heat sources or flame.

11. Be sure the work area is properly ventilated to prevent any accumulation of refrigerant or other fumes.

12. Make sure that caps are always placed on the pressure hose ports. These caps prevent refrigerant leakage from the system.

13. The drier−receiver component is used to collect moisture that will reduce air conditioning performance. If the air conditioning system is opened for component repair or replacement, make sure that the drier−receiver ports are plugged to prevent damage to the drier−receiver. If either the compressor or expansion valve is replaced, replacement of the drier−receiver is also recommended.

14. After installing air conditioning components, have a certified air conditioning service technician evacuate the air conditioning system completely, properly recharge the system with R134a refrigerant and then leak test the system.
The air conditioning compressor used on the Outcross 9060 is a Sanden model SD7H15. For air conditioning compressor repair procedures; refer to the Sanden SD Compressor Service Guide.

**Note:** Replacement of the drier–receiver is recommended whenever the compressor is serviced or replaced.

### Removing and Installing the Compressor

1. Disconnect the compressor electrical connector from machine wire harness.

#### WARNING

The air conditioning system is under high pressure. Do not loosen any system fitting or component until after the system has been completely discharged by a certified air conditioning service technician.

2. Have refrigerant evacuated from air conditioning system by a certified air conditioning service technician. Disconnect the hoses at the compressor, then cap the fittings and plug the hoses to prevent contamination from entering the air conditioning system.

3. Loosen the bottom tensioner plate lock nut and relieve the belt tension. Remove and inspect the V-belts for wear or damage. Replace the V-belts in pairs as necessary.
Removing and Installing the Compressor (continued)

**IMPORTANT**

To prevent compressor oil from filling the compressor cylinders, keep compressor in the same orientation as the installed position.

4. Remove the compressor from the bracket. Locate and retrieve any shims (item 2).

5. Remove the tensioner plate from the compressor if necessary.

   **Note:** Use shims as needed to minimize the gap between the compressor and the bracket before tightening fasteners.

6. To install the compressor, follow this procedure in reverse order.

7. Adjust the compressor belt tension; refer to Adjusting the Compressor Belt Tension (page 9–5).

8. Have a certified air conditioning service technician evacuate the air conditioning system completely, properly recharge the system with R134a refrigerant and then leak test the system. Air conditioning system capacity is 2.5 pounds of R134a refrigerant.
Remove the roof to access the heating and air conditioning components. Inspect and repair damaged roof seals as necessary before installing the roof.
Control Panel and Windshield Wiper Assembly

Removing the Control Panel and Windshield Wiper Assembly

**Note:** If possible, operate the windshield wipers to ensure the wiper motor shaft is in its home position prior to disassembly.

1. Mark the wipers left and right. Disconnect the washer supply hoses at the bulkhead fittings and remove windshield wipers.
2. Remove the windshield wiper boots, lock nuts, cups, and rubber washers from the roof panel.
3. Remove the 4 cap screws securing the control panel cover. Disconnect the windshield wiper/washer switch from the wire harness and remove the cover assembly.
4. Remove the 8 cap screw securing the control panel assembly to the left and right brackets, then lower the control panel enough to disconnect the

---

**Figure 153**

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Flange nut (2 each)</td>
</tr>
<tr>
<td>2</td>
<td>Wiper arm – LH</td>
</tr>
<tr>
<td>3</td>
<td>Wiper arm – RH</td>
</tr>
<tr>
<td>4</td>
<td>Boot (2 each)</td>
</tr>
<tr>
<td>5</td>
<td>Lock nut (4 each)</td>
</tr>
<tr>
<td>6</td>
<td>Cap screw (3 each)</td>
</tr>
<tr>
<td>7</td>
<td>Cap screw</td>
</tr>
<tr>
<td>8</td>
<td>Wiper linkage assembly</td>
</tr>
<tr>
<td>9</td>
<td>Lock nut (4 each)</td>
</tr>
<tr>
<td>10</td>
<td>Control panel wire harness</td>
</tr>
<tr>
<td>11</td>
<td>Bracket – RH</td>
</tr>
<tr>
<td>12</td>
<td>Cap screw (12 each)</td>
</tr>
<tr>
<td>13</td>
<td>Control panel assembly</td>
</tr>
<tr>
<td>14</td>
<td>Control panel cover assembly</td>
</tr>
<tr>
<td>15</td>
<td>Cap screw (4 each)</td>
</tr>
<tr>
<td>16</td>
<td>Defroster fan</td>
</tr>
<tr>
<td>17</td>
<td>Wiper motor</td>
</tr>
<tr>
<td>18</td>
<td>Bracket – LH</td>
</tr>
<tr>
<td>19</td>
<td>Roof wire harness</td>
</tr>
<tr>
<td>20</td>
<td>Cup (2 each)</td>
</tr>
<tr>
<td>21</td>
<td>Rubber washer (2 each)</td>
</tr>
<tr>
<td>22</td>
<td>Roof panel</td>
</tr>
</tbody>
</table>
Removing the Control Panel and Windshield Wiper Assembly (continued)

control panel wire harness from the roof harness. Remove the control panel assembly.

5. Continue to disassemble the control panel as necessary.

Installing the Control Panel and Windshield Wiper Assembly

1. Install all components previously removed from the control panel.
2. If the wiper motor or wiper linkage assembly was removed:

   A. Verify linkage arm lengths and adjust as necessary.
   
   B. Fit the wiper linkage shafts to the control panel, install the lock nuts and tighten the nuts to 35 to 40 N·m (26 to 30 ft-lb).

   Note: The wiper motor shaft must be in its home position prior to installing the linkage. Replacement wiper motors are shipped with the shaft in the home position. You may also energize and operate the wiper motor for at least one cycle to set the motor to its home position.
   
   C. Align the linkage drive arms as shown (center arm cap screw head upward) and fit the center arm over the wiper motor shaft. Tighten the center arm cap screw from 11 to 12 N·m (95 to 105 ft-lb).

3. Connect the control panel wire harness to the roof harness and install the control panel assembly.

4. Install the windshield wiper rubber washers, cups, and lock nuts against the roof panel. Tighten the lock nuts so the rubber washers deform enough to assure tightness, approximately 14 N·m (10 ft-lb) or less.

5. With the wiper motor in its home position, install the wiper arms as shown (RH driver side wiper parallel to roof and LH passenger side wiper parallel to cab post). Install the flange nuts and tighten from 23 to 25 N·m (17 to 18 ft-lb).

6. Connect the washer hoses at the bulkhead fittings.
Installing the Control Panel and Windshield Wiper Assembly (continued)

7. Test wiper and washer operation before returning the machine to service.
Doors

Figure 155

1. Door assembly (LH shown)  
2. Washer (6 each)  
3. Flange nut (14 each)  
4. Acorn nut (8 each)  
5. Door mount (LH shown)  
6. Door spring (2 each)  
7. Lanyard (2 each)  
8. Ball stud (4 each)  
9. Retainer (8 each)  
10. Flange head screw (8 each)  
11. Washer (4 each)  
12. Striker stud (2 each)  
13. Shim (as required)  
14. Adjuster (2 each)  
15. Hex nut (2 each)  
16. Striker guard (2 each)  
17. Shoulder bolt (2 each)

CAUTION

Each door assembly weighs approximately 41 kg (90 lbs).
Doors (continued)

Install the gas spring (item 6) as shown, with the barrel end at the door and the rod end at the frame.

Adjust the door fit against the frame as necessary; refer to Adjusting the Doors (page 9–6).
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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.

<table>
<thead>
<tr>
<th>ABBREVIATION</th>
<th>COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>BK</td>
<td>BLACK</td>
</tr>
<tr>
<td>BR or BN</td>
<td>BROWN</td>
</tr>
<tr>
<td>BU</td>
<td>BLUE</td>
</tr>
<tr>
<td>GN</td>
<td>GREEN</td>
</tr>
<tr>
<td>GY</td>
<td>GRAY</td>
</tr>
<tr>
<td>OR</td>
<td>ORANGE</td>
</tr>
<tr>
<td>PK</td>
<td>PINK</td>
</tr>
<tr>
<td>R or RD</td>
<td>RED</td>
</tr>
<tr>
<td>T</td>
<td>TAN</td>
</tr>
<tr>
<td>VIO</td>
<td>VIOLET</td>
</tr>
<tr>
<td>W or WH</td>
<td>WHITE</td>
</tr>
<tr>
<td>Y or YE</td>
<td>YELLOW</td>
</tr>
</tbody>
</table>

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)

<table>
<thead>
<tr>
<th>Diagram Label</th>
<th>Metric Size</th>
<th>AWG Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>050</td>
<td>0.5 mm</td>
<td>20 GA</td>
</tr>
<tr>
<td>175</td>
<td>0.75 mm</td>
<td>18 GA</td>
</tr>
<tr>
<td>100</td>
<td>1.0 mm</td>
<td>16 GA</td>
</tr>
<tr>
<td>150</td>
<td>1.5 mm</td>
<td>14 GA</td>
</tr>
</tbody>
</table>
Wire Harness Diagram – Engine
Wire Harness – Cab Heat/Air Conditioning
Wire Harness – Loader Selector Control Valve (SCV) Switch (optional)
Wire Harness – Rear Selector Control Valve (SCV) Kit (optional)
Wire Harness – Domestic Road Light Kit (optional)
Wire Harness – International Road Light Kit (optional)