Greensmaster® eTriFlex 3360 and 3370
(Model 04580 and 04590)
## Revision History

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>06/2019</td>
<td>Initial Issue</td>
</tr>
<tr>
<td>B</td>
<td>12/2019</td>
<td>Model 04590 information added</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

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Preface

This service manual was written expressly for service technicians. Basic shop safety knowledge and mechanical/electrical skills are assumed. The Toro Company has made every effort to make the information in this manual complete and correct.

The purpose of this publication is to provide the service technician with information about troubleshooting, testing, and repairing major systems and components. This manual may also be specified for use on numerous products. Refer to the Table of Contents for a list of the systems and the related topics covered in this manual.


The Toro Company reserves the right to change the product specifications or this publication without notice.
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 2–8) or Standard Torque for Dry, Zinc Plated, and Steel Fasteners (Metric Fasteners) (page 2–9).

**Fluid Specifications**

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

**Note:** Refer to the service decal on the machine and the machine Operator’s Manual for commonly used fluid specifications and capacities.
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_Kawasaki FS481V Service Manual_
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Safety Instructions

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 give the general information about the correct operation, maintenance, service, testing, or repair of the machine.
Think Safety First

Toro Products are tested and certified 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.

⚠️ WARNING ⚠️

To reduce the potential of injury or death, comply with the safety instructions in this manual, as well as information found in the Operator’s Manuals and the Operator and Safety Training Videos found on www.toro.com.

• Avoid unexpected starting of the engine…
  Always turn off the engine, remove the key and unplug the 48V battery disconnect before cleaning, adjusting, or repair.

• Avoid lacerations and amputations…
  Stay clear of all moving parts whenever the engine is running. Treat all normally moving parts as if they were moving whenever the engine is running or has the potential to start.

• Avoid burns…
  Do not touch the engine, muffler, or other components, which may be hot during operation, while the unit is running or shortly after it has been running.

• Avoid fires and explosions…
  Use extreme care in handling fuel. Fuel is flammable and its vapors are explosive.
  – Extinguish all cigarettes, cigars, pipes, and other sources of ignition.
  – Avoid spilling fuel and never smoke while working with any type of fuel or lubricant.
  – Wipe up any spilled fuel or oil immediately.
  – Never remove the fuel cap or add fuel when the engine is running.
  – Always use approved, labeled containers for storing or transporting fuel and lubricants.
  – Do not add or drain fuel in an enclosed space.
  – Do not store the machine or fuel container where there is an open flame, spark, or pilot light, such as on a water heater or other appliance.

• Avoid asphyxiation…
  Do not operate an engine in a confined area without proper ventilation.

• Avoid injury from batteries…
  – Battery acid is poisonous and can cause burns. Avoid contact with skin, eyes and clothing.
  – Battery gases can explode. Keep cigarettes, sparks and flames away from the battery.

• Avoid injury due to inferior parts…
  Use only original equipment parts to ensure that important safety criteria are met.
Think Safety First (continued)

- **Avoid injury to bystanders…**
  
  Always clear the area of bystanders before starting or testing powered equipment.

- **Avoid injury due to projectiles…**
  
  Always clear the area of sticks, rocks or any other debris that could be picked up and thrown by the powered equipment.

- **Avoid modifications…**
  
  Never alter or modify any part unless it is a factory approved procedure.

- **Avoid unsafe operation…**
  
  Always test the safety interlock system after making adjustments or repairs on the machine. Refer to the Electrical section in this manual for more information.

- **Avoid electrical shock…**
  
  - Never touch electrical wires or components while the engine is running. They can be sources of shock.
  
  - De-energize the system if you are having to do repairs.
  
  - If testing electrical components ensure you are working in a dry environment.

- **Use personal protective equipment…**
  
  - Use appropriate personal protective equipment (PPE) for protecting yourself from potential hazards in the environment in which you will work.
  
  - Each process outlined in this manual may need different PPE to protect the service person. Use the proper PPE for the task at hand.

- **Using tools…**
  
  - All tools should be in proper working order. Do not use tools that are broken or in disrepair.
  
  - Use the proper tool for the proper application.

- **Using lifts, hoists, and jacks…**
  
  - All lifts, hoists, and jacks should be used in accordance with the manufacturer information.
  
  - Inspect lifts, hoists, and jacks prior to use.
  
  - Do not over load lifts, hoists, and jacks.
  
  - Do not work under a suspended load.
  
  - Ensure chock blocks are used on equipment that can move.
  
  - Use lifts or jacks and jack stands that are rated to support the total weight of the machine and any attachments.
  
  - Do not rely on jacks to support the machine.
  
  - If you are unfamiliar with any lifts, hoists or jacks, do not use them until you know how to operate them correctly.

- **Using fire extinguishers…**
  
  Use the proper class of fire extinguisher in case of fire.

  Ensure fire extinguishers are serviced regularly, and replace any fire extinguishers that are discharged or in use beyond their expiration dates.

  - **Class A** fire extinguishers are for ordinary combustible materials such as paper, wood, cardboard, and most plastics. The numerical rating on these types of extinguishers indicates the amount of water it holds and the amount of fire it can extinguish. Geometric symbol (green triangle).
Think Safety First (continued)

- **Class B** fire extinguishers are for fires that involve flammable or combustible liquids such as gasoline, kerosene, grease and oil. The numerical rating for class B extinguishers indicates the approximate number of square feet of fire it can extinguish. Geometric symbol (red square).

- **Class C** fire extinguishers are for fires that involve electrical equipment such as appliances, wiring, circuit breakers and outlets. Never use water to extinguish class C fires - the risk of electrical shock is far too great! Class C extinguishers do not have a numerical rating. The C classification means the extinguishing agent is non-conductive. Geometric symbol (blue circle).

- **Class ABC** fire extinguishers are a dry chemical type used for multiple purposes. See above descriptions for additional information.
**DANGER**

Mechanical or hydraulic jacks may fail to support the machine and cause a serious injury.

- Use jack stands to support the raised machine.
- Use only mechanical or hydraulic jacks to lift the machine.

1. Park the machine on a level surface, lower the cutting units, shut off the engine, remove the key from the key switch and unplug the 48V battery disconnect.

2. Position the jack securely under the desired jacking point:
   - Foot step on the left side of the machine
   - Jack bracket on the right side of the machine
   - Caster fork at the rear of the machine

3. After raising the machine, use an appropriate jack stand at the following locations to support the machine.

**IMPORTANT**

Use two jack stands (one under each battery tray) when supporting the rear of the machine.
Safety and Instructional Decals

Numerous safety and instructional decals are affixed to the traction unit and the cutting units of the Greensmaster 3360/3370. If any decal becomes illegible or damaged, replace it with a new decal. Part numbers are listed in your Parts Catalog and Operator’s Manual. Order replacement decals from your Authorized Toro Distributor.
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Specifications

Overall Dimensions

Figure 3

Engine (Model 04580 only)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make/Designation</td>
<td>Kawasaki, 4-cycle, V-Twin Cylinder, OHV, Air Cooled, Gasoline Engine - Model FS481V.</td>
</tr>
<tr>
<td>Bore x Stroke</td>
<td>73 x 72 mm (2.87 x 2.83 inches)</td>
</tr>
<tr>
<td>Total displacement</td>
<td>603 cc³ (36.8 in³)</td>
</tr>
<tr>
<td>Governor</td>
<td>Mechanical</td>
</tr>
<tr>
<td>Carburetor</td>
<td>Single-barrel, float controlled with fixed main jets</td>
</tr>
<tr>
<td>Choke</td>
<td>Manual</td>
</tr>
<tr>
<td>Fuel Pump</td>
<td>Pulse Type</td>
</tr>
<tr>
<td>Fuel</td>
<td>Refer to the Traction Unit Operator’s Manual</td>
</tr>
<tr>
<td>Fuel tank capacity</td>
<td>18.5 L (4.9 US gallons)</td>
</tr>
<tr>
<td>Operating RPM (fixed)</td>
<td>2,400 rpm ± 100</td>
</tr>
<tr>
<td>Engine oil</td>
<td>Refer to the Traction Unit Operator’s Manual</td>
</tr>
<tr>
<td>Crankcase-oil capacity</td>
<td>1.7 L (1.8 qt) with new filter</td>
</tr>
<tr>
<td>Ignition System</td>
<td>Flywheel magneto, transistor type</td>
</tr>
<tr>
<td>Spark Plugs</td>
<td>NGK BPR4ES</td>
</tr>
<tr>
<td>Spark Plug Gap</td>
<td>0.75 mm (0.030 inches)</td>
</tr>
<tr>
<td>Alternator/Regulator</td>
<td>12 VDC, 15 amp</td>
</tr>
<tr>
<td>Engine Weight (dry)</td>
<td>37 kg (82 lb)</td>
</tr>
</tbody>
</table>
### Chassis

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front and Rear tire</td>
<td>Standard = 19 x 10.50 x 8, 4 ply Smooth</td>
</tr>
<tr>
<td></td>
<td>Optional = 20 x 10 x 8, 4 ply Turf Tread</td>
</tr>
<tr>
<td></td>
<td>83 to 110 kPa (12 to 16 psi)</td>
</tr>
<tr>
<td>Wheel lug nut torque</td>
<td>95 to 122 N·m (70 to 90 ft-lb)</td>
</tr>
</tbody>
</table>

### DPA Cutting Units

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame construction</td>
<td>Precision machined die cast aluminum crossmember with two bolt-on die-cast aluminum side plates.</td>
</tr>
<tr>
<td>Reel construction</td>
<td>Reels are 53.3 cm (21 inches) in length and 12.7 cm (5 inch) in diameter. High strength, low alloy steel blades are thru hardened and impact resistant. Reels are available in 8, 11 and 14 blade configurations.</td>
</tr>
<tr>
<td>Reel bearings</td>
<td>Two stainless steel ball bearings are press fit onto the reel shaft and retained by a threaded insert. Low drag seals/slingers for added protection with an O-ring sealed counterweight mounting surface. Reel position is maintained by a wave washer with no end play adjustment required.</td>
</tr>
<tr>
<td>Reel drive</td>
<td>The reel shaft is 35 mm (1.375 inch) diameter tube with an internally splined threaded nut on each end.</td>
</tr>
<tr>
<td>Height-of-cut</td>
<td>Cutting height is adjusted on the front roller by two vertical screws. Standard bench height of cut range is 1.6 to 1.1 mm (0.062 to 0.438 inch) depending on type of bedknife installed. An optional high height-of-cut kit is available to obtain a cut range of 11.1 to 25.4 mm (0.438 to 1.0 inch). Effective HOC may vary depending on turf conditions, type of bedknife, rollers, and attachments installed.</td>
</tr>
<tr>
<td>Bedknife and bedbar</td>
<td>Replaceable single edged Edgemax™ bedknife (solid tool steel construction) is standard. Bedknife is fastened to the bedbar with thirteen bedknife screws. A variety of optional bedknives and a more aggressive bedbar are available.</td>
</tr>
<tr>
<td>Bedknife adjustment</td>
<td>Dual adjustment (one on each side of the bedbar) with 0.018 mm (0.0007 inch) bedknife movement for each detent.</td>
</tr>
<tr>
<td>Rollers</td>
<td>The front roller is a 6.3 cm (2.5 inches) diameter roller that is available in full, wide spaced Wiehle and narrow spaced Wiehle configurations. The rear roller is a 5.1 cm (2 inches) diameter full roller.</td>
</tr>
<tr>
<td>Grass shield</td>
<td>Non-adjustable shield with adjustable cut-off bar to improve grass discharge from reel in varying moisture conditions.</td>
</tr>
<tr>
<td>Counterbalance weight</td>
<td>A pair of cast iron weights mounted on right side of the cutting unit compensate for the electric reel motor mounted on the left side of the cutting unit.</td>
</tr>
</tbody>
</table>
DPA Cutting Units (continued)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutting unit weight (approximate)</td>
<td>8 blade* = 32.7 kg (72 lb)</td>
</tr>
<tr>
<td></td>
<td>11 blade* = 34 kg (75 lb)</td>
</tr>
<tr>
<td></td>
<td>14 blade* = 35 kg (78 lb)</td>
</tr>
</tbody>
</table>
| Options                                        | Refer to the Cutting Unit Parts Catalog or contact your local Authorized Toro Distributor for available cutting unit options.

*Cutting unit weights do not include a front roller.

Universal Groomer (Optional)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grooming reel diameter</td>
<td>6 cm (2.375 inches)</td>
</tr>
<tr>
<td>Groomer blade type</td>
<td>51 twin tip steel blades with 3/8 inch blade spacing. A groomer brush can be installed in place of a grooming reel.</td>
</tr>
<tr>
<td>Groomer mounting</td>
<td>The groomer is mounted to the cutting unit side plates. The drive assembly for the grooming reel is located on the opposite side of the cutting unit from the cutting unit motor.</td>
</tr>
</tbody>
</table>
| Groomer height setting                         | Mowing: 0.8 to 15.7 mm (0.030 to 0.620 inch).  
HOC range: 1.5 to 19.1 mm (0.060 to 0.750 inch). |
| Width-of-groomer                               | 54.6 cm (21.5 inches).          |
| Height adjustment knob                         | Allows a 0.003 inch (0.08 mm) increment of height adjustment for each click of the adjuster. |
| Quick-up feature                               | Allows grooming reel to be raised above the height/depth adjustment for no grooming reel action while mowing. |
| Groomer drive                                  | The groomer drive assembly is attached to the right side of the cutting unit. |
| Groomer rotation                               | Forward: the groomer rotates in the same direction as the reel  
Reverse: the groomer rotates in the opposite direction as the reel  
Neutral: the groomer does not rotate |
Torque Specifications

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

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

As noted in the following tables, the torque values should be reduced by 25% for 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)**.

---

**Figure 4**
Torque Conversion Factor = $A / B$

1. Torque wrench
2. Drive-adapter wrench (crowfoot)
3. A (effective length of torque wrench)
4. B (effective length of torque wrench and drive-adapter wrench)
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.
### 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>N-cm</td>
<td>in-lb</td>
<td>N-cm</td>
</tr>
<tr>
<td># 6 - 32 UNC</td>
<td>10 ± 2</td>
<td>147 ± 23</td>
<td>15 ± 2</td>
<td>169 ± 23</td>
</tr>
<tr>
<td># 6 - 40 UNF</td>
<td>13 ± 2</td>
<td>282 ± 56</td>
<td>29 ± 3</td>
<td>328 ± 34</td>
</tr>
<tr>
<td># 8 - 32 UNC</td>
<td>13 ± 2</td>
<td>282 ± 56</td>
<td>31 ± 4</td>
<td>350 ± 45</td>
</tr>
<tr>
<td># 8 - 36 UNF</td>
<td>18 ± 2</td>
<td>339 ± 56</td>
<td>42 ± 5</td>
<td>475 ± 56</td>
</tr>
<tr>
<td># 10 - 24 UNC</td>
<td>18 ± 2</td>
<td>339 ± 56</td>
<td>48 ± 5</td>
<td>542 ± 56</td>
</tr>
<tr>
<td># 10 - 32 UNF</td>
<td>18 ± 2</td>
<td>339 ± 56</td>
<td>48 ± 5</td>
<td>542 ± 56</td>
</tr>
<tr>
<td>1/4 - 20 UNC</td>
<td>48 ± 7</td>
<td>599 ± 79</td>
<td>100 ± 10</td>
<td>1130 ± 113</td>
</tr>
<tr>
<td>1/4 - 28 UNF</td>
<td>53 ± 7</td>
<td>734 ± 113</td>
<td>115 ± 12</td>
<td>1299 ± 136</td>
</tr>
<tr>
<td>5/16 - 18 UNC</td>
<td>115 ± 15</td>
<td>1186 ± 169</td>
<td>200 ± 25</td>
<td>2260 ± 282</td>
</tr>
<tr>
<td>5/16 - 24 UNC</td>
<td>138 ± 17</td>
<td>1146 ± 192</td>
<td>225 ± 25</td>
<td>2542 ± 282</td>
</tr>
<tr>
<td></td>
<td>ft-lb</td>
<td>N-m</td>
<td>ft-lb</td>
<td>N-m</td>
</tr>
<tr>
<td>3/8 - 16 UNC</td>
<td>16 ± 2</td>
<td>22 ± 3</td>
<td>30 ± 3</td>
<td>41 ± 4</td>
</tr>
<tr>
<td>3/8 - 24 UNF</td>
<td>17 ± 2</td>
<td>24 ± 3</td>
<td>35 ± 4</td>
<td>47 ± 5</td>
</tr>
<tr>
<td>7/16 - 14 UNC</td>
<td>27 ± 3</td>
<td>37 ± 4</td>
<td>50 ± 5</td>
<td>68 ± 7</td>
</tr>
<tr>
<td>7/16 - 20 UNC</td>
<td>29 ± 3</td>
<td>39 ± 4</td>
<td>55 ± 6</td>
<td>75 ± 8</td>
</tr>
<tr>
<td>1/2 - 13 UNC</td>
<td>30 ± 3</td>
<td>65 ± 9</td>
<td>75 ± 8</td>
<td>102 ± 11</td>
</tr>
<tr>
<td>1/2 - 20 UNF</td>
<td>32 ± 4</td>
<td>72 ± 9</td>
<td>85 ± 9</td>
<td>115 ± 12</td>
</tr>
<tr>
<td>5/8 - 11 UNC</td>
<td>65 ± 10</td>
<td>119 ± 16</td>
<td>150 ± 15</td>
<td>203 ± 20</td>
</tr>
<tr>
<td>5/8 - 18 UNF</td>
<td>75 ± 10</td>
<td>129 ± 20</td>
<td>170 ± 18</td>
<td>230 ± 24</td>
</tr>
<tr>
<td>3/4 - 10 UNC</td>
<td>93 ± 12</td>
<td>190 ± 27</td>
<td>265 ± 27</td>
<td>359 ± 37</td>
</tr>
<tr>
<td>3/4 - 16 UNF</td>
<td>115 ± 15</td>
<td>224 ± 34</td>
<td>300 ± 30</td>
<td>407 ± 41</td>
</tr>
<tr>
<td>7/8 - 9 UNC</td>
<td>140 ± 20</td>
<td>305 ± 34</td>
<td>430 ± 45</td>
<td>583 ± 61</td>
</tr>
<tr>
<td>7/8 - 14 UNF</td>
<td>155 ± 25</td>
<td>353 ± 41</td>
<td>475 ± 48</td>
<td>644 ± 65</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 locking compound 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 ± 6 in-lb, 644 ± 68 N·cm</td>
<td>78 ± 8 in-lb, 881 ± 90 N·cm</td>
</tr>
<tr>
<td>M6 X 1.0</td>
<td>96 ± 10 in-lb, 1085 ± 113 N·cm</td>
<td>133 ± 14 in-lb, 1503 ± 158 N·cm</td>
</tr>
<tr>
<td>M8 X 1.25</td>
<td>19 ± 2 ft-lb, 26 ± 3 N·m</td>
<td>28 ± 3 ft-lb, 38 ± 4 N·m</td>
</tr>
<tr>
<td>M10 X 1.5</td>
<td>38 ± 4 ft-lb, 52 ± 5 N·m</td>
<td>54 ± 6 ft-lb, 73 ± 8 N·m</td>
</tr>
<tr>
<td>M12 X 1.75</td>
<td>66 ± 7 ft-lb, 90 ± 10 N·m</td>
<td>93 ± 10 ft-lb, 126 ± 14 N·m</td>
</tr>
<tr>
<td>M16 X 2.0</td>
<td>166 ± 17 ft-lb, 225 ± 23 N·m</td>
<td>229 ± 23 ft-lb, 310 ± 31 N·m</td>
</tr>
<tr>
<td>M20 X 2.5</td>
<td>325 ± 33 ft-lb, 440 ± 45 N·m</td>
<td>450 ± 46 ft-lb, 610 ± 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</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Square Head</td>
</tr>
<tr>
<td>1/4 - 20 UNC</td>
<td>140 ± 20 in-lb</td>
</tr>
<tr>
<td>5/16 - 18 UNC</td>
<td>215 ± 35 in-lb</td>
</tr>
<tr>
<td>3/8 - 16 UNC</td>
<td>35 ± 10 ft-lb</td>
</tr>
<tr>
<td>1/2 - 13 UNC</td>
<td>75 ± 15 ft-lb</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Thread Size</th>
<th>Baseline Torque**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1, Type 23 or Type F</td>
<td></td>
</tr>
<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>
</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>Type A</td>
<td>Type B</td>
<td></td>
</tr>
<tr>
<td>No. 6</td>
<td>18</td>
<td>20 ± 5 in-lb</td>
</tr>
<tr>
<td>No. 8</td>
<td>15</td>
<td>30 ± 5 in-lb</td>
</tr>
<tr>
<td>No. 10</td>
<td>12</td>
<td>38 ± 7 in-lb</td>
</tr>
<tr>
<td>No. 12</td>
<td>11</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]</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]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can be used to pre-fill (pack) bearings, boots, and seals before assembly, ease installation of components during assembly, or fill cavities between moving parts through grease fittings after assembly. Unless otherwise noted, refer to the machine Operator’s Manual or Installation Instructions for grease specifications.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>THREAD LOCKING COMPOUND (thread locker)</strong></th>
<th>![Image]</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]</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]</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]</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>
<tr>
<td><strong>GASKET COMPOUND</strong></td>
<td>![Gasket Compound Image]</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>SILICONE SEALANT</strong></th>
<th>![Silicone Sealant Image]</th>
</tr>
</thead>
<tbody>
<tr>
<td>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).</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>AEROSOL PROTECTANT/LUBRICANT</strong></th>
<th>![Aerosol Protectant Image]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most commonly used to coat battery terminals, ring terminals, and fork terminals to reduce corrosion problems. Apply an aerosol protectant to the connection after you secure the terminal connection. Do Not use an aerosol protectant on small multi-pin electrical connectors. An aerosol lubricant may also be specified. Refer to the specific service procedure for details.</td>
<td></td>
</tr>
</tbody>
</table>

---
Special Tools

Special tools for servicing Toro Commercial Products are available from your Toro Distributor. Some of these tools may have been supplied with your machine, are available as Toro parts, or may also be available from a local tool supplier.

Multimeter

**Obtain this tool locally**

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

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

---

Battery Terminal Protector

**Toro Part No. 107-0392**

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

---

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, disconnect 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.
Generator Rotor Tool

K-Line Part No. TOR6029

The starter/generator rotor tool is recommended to safely remove and install the starter/generator rotor from the housing/stator assembly. The tool includes the base plate, threaded shaft and handle.

3WD Motor Rotor Tool

Toro Part No. 139–8420

The 3WD motor rotor tool is recommended to remove and install the rotor from the optional 3WD motor housing. The tool includes the puller hub, threaded shaft, handle and four screws.

Lithium-Ion Battery Shipping Kit

Toro Part No. 137–9650

Use the original packaging or the battery shipping kit and a certified carrier to ship one of the lithium-ion batteries. The kit includes the appropriate carton, packing, labels, and instructions necessary to confirm to current lithium-ion battery shipping regulations in the USA.

Note: Outside of the USA, contact the appropriate government agency in your country for detailed regulations on shipping the lithium-ion batteries.

Gauge Bar Assembly
Gauge Bar Assembly (continued)

**Toro Part No. 94–9010**

Use the gauge bar to verify height-of-cut adjustment.

---

**Cutting Reel Shim**

**Toro Part No. 125–5611**

Use the 0.05 mm (0.002 in) shim like a feeler gauge to measure the gap between the reel and the bedknife during reel adjustment.

---

**Cutting Performance Paper**

**Toro Part No. 125–5610** (300 strips)

Cutting performance paper is used to test the cutting reel performance after adjusting the reel to bedknife clearance.

---

**Reel Drive Shaft**

**K-Line Part No. TOR4112**

Use the drive shaft for rotating the reel during cutting unit adjustment or any time the cutting unit motor is removed.

---

**Reel Thread Repair Taps**

15/16–16 Right-Hand Thread – Toro Part No. 137–0926

15/16–16 Left-Hand Thread – Toro Part No. 137–0927

Use to clean or repair the internal threads of cutting unit reels.
Backlapping Brush Assembly

**Toro Part No. 29–9100**

For applying lapping compound to cutting units while keeping hands a safe distance from the rotating reel.

Components for the brush assembly are also available individually.

Brush 36-4310  
Handle 29-9080  
Handle cap 2410-18

---

**Angle Indicator and Magnetic Mount**

**Angle Indicator: Toro Part No. 131–6828**

**Magnetic Mount: Toro Part No. 131–6829**

Because the top grind angle on bedknives is critical for edge retention, and therefore after-cut appearance, Toro has developed these service tools for accurately measuring the top grind angle on all bedknives.

Since there can be variations in the mounting surface of the bedbar, it is necessary to grind the bedknife after installing it to the bedbar.

1. Place the angle indicator on the bottom side of the bedknife with the digital display facing you as shown.
2. Press the Alt Zero button on the angle indicator.
3. Remove the angle indicator and place the magnetic mount on the edge of the bedknife so the face of the magnet is flat against the top angle of the bedknife.
4. Place the angle indicator on the mount with the digital display facing you as shown. The angle displayed on the indicator is the current bedknife top angle.

---

**Figure 7**

1. Bedknife  
2. Angle Indicator  
3. Bedbar

**Figure 8**

1. Angle indicator surface  
2. Magnetic mount  
3. Bedknife  
4. Bedbar  
5. Angle indicator
Bedknife Screw Tool

K-Line Part No. TOR510880A

This screwdriver-type bit is made to fit Toro bedknife attaching screws. Use this bit with a torque wrench to secure the bedknife to the bedbar.

IMPORTANT

Important: To prevent damage to the bedbar, DO NOT use an air or manual impact wrench with this tool.

Diameter/Circumference Measuring Tape

K-Line Part No. TOR6023

Spring steel measuring tape for accurately measuring the circumference and outside diameter of cutting reel and other spherical components. Tape calibration is in fixed inch readings (no adjustments).

Roller Rebuilding Tools

The following combination of washers and spacers can be used to install bearings and seals into the front and rear rollers (2 each required).

Bearing installation washer: 107-8133 (black)
Seal installation spacer: 107-3505
Seal installation washer: 104-6126 (yellow)

K-Line Part No. TOR4105

As an alternative to using the washers and spacer listed above, this special tool set can be used to install bearings and seals into the front and rear rollers.
Turf Evaluator Tool

Toro Part No. 04399

Many turf discrepancies are subtle and require closer examination. In these instances, the Turf Evaluator grass viewing tool is helpful. It can assist turf managers and service technicians in determining causes for poor reel mower performance and in comparing the effective height-of-cut of one mowed surface to another. This tool should be used with the Toro Guide to Evaluation Reel Mower Performance and Using the Turf Evaluator (Toro part no. 97931SL) available from an local authorized Toro Distributor.

Cutting Unit Motor Rotor Tool

K-Line Part No. TOR6028

The cutting unit motor rotor tool is recommended to remove and install the rotor from the cutting unit motor housing. The tool includes the puller hub, threaded shaft, handle and four screws.

Drive Shaft Removal Tool

Toro Part No. 137–0920

Use to remove the optional Universal Groomer drive shaft from the reel if the drive shaft hex is damaged.

Adapter Wrench

Toro Part No. 137-0921

Use to hold the optional Universal Groomer drive shaft securely when removing or installing the drive adapter.
Syringe – 50cc (2 ounce)

Toro Part No. 137-0872

Aids in accurately filling the optional Universal Groomer gear box with oil.
# Chapter 3
## Troubleshooting

## Table of Contents

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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

1. Gather Information
   • Information reported by the customer
   • Information observed by you
   • Establish the what, where and when of the issue

2. Evaluate Potential Causes
   • Consider possible causes of the problem to develop a hypothesis
   • Narrow down the focus of the problem

3. 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

4. Repair
   • Return the unit to service by repairing, rebuilding or replacing

5. 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 drive the machine when the manual parking brake is engaged, an advisory is identified on the InfoCenter Display that the manual parking brake needs to be in disengaged. 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>Cause</th>
<th>InfoCenter Message/Corrective Action Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>B200A (Model 04580 Only)</td>
<td>START DENIED</td>
<td>Starter has been active for 30 seconds</td>
<td>Start Denied</td>
</tr>
<tr>
<td>B2013 (Model 04580 Only)</td>
<td>START DENIED</td>
<td>Fault(s) Active</td>
<td>Start Denied</td>
</tr>
<tr>
<td>B201B (Model 04580 Only)</td>
<td>START DENIED</td>
<td>Starter/Generator not ready</td>
<td>Start Denied</td>
</tr>
<tr>
<td>B2024 (Model 04580 Only)</td>
<td>ENGINE RPM RESTRICTED</td>
<td>Engine Oil Pressure Low</td>
<td>Engine RPM Restricted</td>
</tr>
<tr>
<td>B2152</td>
<td>TRACTION DISABLED</td>
<td>Traction not ready</td>
<td>Traction Denied</td>
</tr>
<tr>
<td>B2155</td>
<td>TRACTION DISABLED</td>
<td>Parking brake engaged</td>
<td>Traction Denied</td>
</tr>
<tr>
<td>B2159</td>
<td>TRACTION DISABLED</td>
<td>Out of seat</td>
<td>Traction Denied</td>
</tr>
<tr>
<td>B215A</td>
<td>TRACTION DISABLED</td>
<td>Traction illegally engaged</td>
<td>Traction Denied</td>
</tr>
<tr>
<td>B215B (Model 04580 Only)</td>
<td>TRACTION DISABLED</td>
<td>Engine not running</td>
<td>Traction Denied</td>
</tr>
<tr>
<td>B2162</td>
<td>LIFT/LOWER CALIBRATION</td>
<td>Lift/Lower actuator 1 (center/rear) not calibrated</td>
<td>Calibrate Lift/Lower 1</td>
</tr>
<tr>
<td>B2163</td>
<td>LIFT/LOWER CALIBRATION</td>
<td>Lift/Lower actuator 2 (left) not calibrated</td>
<td>Calibrate Lift/Lower 2</td>
</tr>
<tr>
<td>B2164</td>
<td>LIFT/LOWER CALIBRATION</td>
<td>Lift/Lower actuator 3 (right) not calibrated</td>
<td>Calibrate Lift/Lower 3</td>
</tr>
<tr>
<td>B2116A</td>
<td>TRACTION ADVISORY</td>
<td>Traction pedal position sensor needs calibration</td>
<td>Calibrate traction pedal</td>
</tr>
<tr>
<td>B2116B</td>
<td>TRACTION MOTOR CALIBRATION</td>
<td>Traction motor not calibrated</td>
<td>Calibrate traction motor</td>
</tr>
<tr>
<td>B2116C</td>
<td>STEERING CENTER CALIBRATION</td>
<td>Steering System – Center not calibrated</td>
<td>Calibrate steering center</td>
</tr>
<tr>
<td>B2116D</td>
<td>STEERING RANGE CALIBRATION</td>
<td>Steering System – Range not calibrated</td>
<td>Calibrate steering range</td>
</tr>
<tr>
<td>B2300 (Model 04590 Only)</td>
<td>SYSTEM SHUTDOWN</td>
<td>Battery Fault(s) Active</td>
<td>System Shutdown</td>
</tr>
<tr>
<td>B2301 (Model 04590 Only)</td>
<td>MACHINE DISABLED</td>
<td>Battery charger connected</td>
<td>Machine Disabled</td>
</tr>
<tr>
<td>B2302 (Model 04590 Only)</td>
<td>LOW BATTERY</td>
<td>Battery Low</td>
<td>Charge battery</td>
</tr>
<tr>
<td>B2303 (Model 04590 Only)</td>
<td>BATTERY OVERLOAD</td>
<td>Battery Overload</td>
<td>Reduce power draw</td>
</tr>
</tbody>
</table>
### Operator Advisories (continued)

<table>
<thead>
<tr>
<th>Advisory Number</th>
<th>Advisory Name</th>
<th>Cause</th>
<th>InfoCenter Message/Corrective Action Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>B2304 (Model 04590 Only)</td>
<td>BATTERY TEMPERATURE LOW</td>
<td>Battery Temp Low</td>
<td>Warm machine</td>
</tr>
<tr>
<td>B2305 (Model 04590 Only)</td>
<td>BATTERY TEMPERATURE HIGH</td>
<td>Battery Temp High</td>
<td>Cool machine</td>
</tr>
<tr>
<td>B2408</td>
<td>CUTTING UNIT LOWER DENIED</td>
<td>Function switch in HIGH</td>
<td>Lower Denied</td>
</tr>
<tr>
<td>B2503</td>
<td>PTO DENIED</td>
<td>Fault(s) Active</td>
<td>PTO Denied</td>
</tr>
<tr>
<td>B2509</td>
<td>PTO DENIED</td>
<td>Out of seat</td>
<td>PTO Denied</td>
</tr>
<tr>
<td>B250B (Model 04580 Only)</td>
<td>PTO DENIED</td>
<td>Engine not running</td>
<td>PTO Denied</td>
</tr>
<tr>
<td>B2513 (Model 04590 Only)</td>
<td>PTO DENIED</td>
<td>Low Battery</td>
<td>PTO Denied</td>
</tr>
<tr>
<td>B2550</td>
<td>BACKLAP DENIED</td>
<td>Function switch not in NEUTRAL</td>
<td>Backlap Denied</td>
</tr>
<tr>
<td>B2551</td>
<td>BACKLAP DENIED</td>
<td>Parking brake not engaged</td>
<td>Backlap Denied</td>
</tr>
<tr>
<td>B2553</td>
<td>BACKLAP DENIED</td>
<td>Fault(s) Active</td>
<td>Backlap Denied</td>
</tr>
<tr>
<td>B255C (Model 04580 Only)</td>
<td>BACKLAP DENIED</td>
<td>Engine not running</td>
<td>Backlap Denied</td>
</tr>
<tr>
<td>B2560</td>
<td>CLIP SETTINGS OUT OF RANGE</td>
<td>Settings are outside the recommended range</td>
<td>Clip Settings Out of Range</td>
</tr>
<tr>
<td>B2704</td>
<td>CONTROLLER CHANGED</td>
<td>New controller detected</td>
<td>New Controller Detected</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 an Authorized Toro Distributor.
When the machine is being calibrated, dialog messages appear in the InfoCenter. These messages are intended to instruct you through the calibration process. Refer to the following table for a list of each dialog message:

<table>
<thead>
<tr>
<th>Message Number</th>
<th>InfoCenter Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Return pedal to neutral</td>
</tr>
<tr>
<td>4</td>
<td>Move pedal to max forward and hold</td>
</tr>
<tr>
<td>5</td>
<td>Max forward calibration passed</td>
</tr>
<tr>
<td>9</td>
<td>Max forward calibration failed. Voltage out of spec</td>
</tr>
<tr>
<td>13</td>
<td>Move pedal to max reverse and hold</td>
</tr>
<tr>
<td>14</td>
<td>Max reverse calibration passed</td>
</tr>
<tr>
<td>16</td>
<td>Max reverse calibration failed. Voltage out of spec</td>
</tr>
<tr>
<td>17</td>
<td>Calibration failed. Pedal position unknown</td>
</tr>
<tr>
<td>18</td>
<td>Return pedal to neutral. Continue?</td>
</tr>
<tr>
<td>100</td>
<td>Calibration engaged</td>
</tr>
<tr>
<td>101</td>
<td>Calibration complete</td>
</tr>
<tr>
<td>102</td>
<td>Cycle keyswitch</td>
</tr>
<tr>
<td>110</td>
<td>Inhibit calibration. Component not responding</td>
</tr>
<tr>
<td>111</td>
<td>Inhibit calibration. Component not ready</td>
</tr>
<tr>
<td>112</td>
<td>Inhibit calibration. Fault active</td>
</tr>
<tr>
<td>113</td>
<td>Inhibit calibration. Not in seat</td>
</tr>
<tr>
<td>114</td>
<td>Inhibit calibration. Not in neutral</td>
</tr>
<tr>
<td>115</td>
<td>Inhibit calibration. In neutral</td>
</tr>
<tr>
<td>116</td>
<td>Inhibit calibration. Pbrake engaged</td>
</tr>
<tr>
<td>300</td>
<td>Return pedal to neutral</td>
</tr>
<tr>
<td>301</td>
<td>Center steering wheel. Continue?</td>
</tr>
<tr>
<td>302</td>
<td>Manually center rear wheel. Continue?</td>
</tr>
<tr>
<td>303</td>
<td>Steer rear wheel max left. Continue?</td>
</tr>
<tr>
<td>304</td>
<td>Steer rear wheel max right. Continue?</td>
</tr>
<tr>
<td>305</td>
<td>Rear wheel center out of range</td>
</tr>
<tr>
<td>306</td>
<td>Rear wheel angle out of range</td>
</tr>
<tr>
<td>400</td>
<td>Caution: Machine must be on jack stands. Continue?</td>
</tr>
<tr>
<td>401</td>
<td>Inhibit calibration. Contactor open</td>
</tr>
<tr>
<td>402</td>
<td>Inhibit calibration. Pedal in Neutral</td>
</tr>
<tr>
<td>403</td>
<td>Return pedal to neutral</td>
</tr>
<tr>
<td>404</td>
<td>Wait for wheels to stop</td>
</tr>
<tr>
<td>405</td>
<td>Move pedal to max forward and hold</td>
</tr>
<tr>
<td>406</td>
<td>Calibration active. Hold pedal</td>
</tr>
<tr>
<td>500</td>
<td>Lift/Lower extend active</td>
</tr>
<tr>
<td>501</td>
<td>Lift/Lower retract active</td>
</tr>
<tr>
<td>502</td>
<td>Move joystick to lower position</td>
</tr>
<tr>
<td>503</td>
<td>Move joystick to raise position</td>
</tr>
<tr>
<td>Message Number</td>
<td>InfoCenter Message</td>
</tr>
<tr>
<td>----------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>504</td>
<td>Is the Cutting Unit installed? Continue?</td>
</tr>
<tr>
<td>1100</td>
<td>Traction diagnostic messages enabled</td>
</tr>
<tr>
<td>1101</td>
<td>Steering diagnostic messages enabled</td>
</tr>
</tbody>
</table>
**Machine Faults**

Machine faults are generated by the machine controllers to identify an electrical system malfunction (fault) that occurs during machine operation. The fault IDs conform to SAE J2012 standards. When a fault occurs, a red warning light will illuminate and a code for the active fault will appear on the InfoCenter display.

Faults can be viewed via the InfoCenter Faults screen. The fault code includes the number of the controller that generated the fault. For example: C1A32:SC7 is a steering motor voltage fault generated by the SC7 (steering motor). “Active” or the time the fault last occurred expressed in machine Key On hours will appear next to the fault. Selecting an individual fault displays the current machine Key On hours for reference, the last time (expressed in Key On hours) the specific fault occurred, the first time (expressed in Key On hours) the specific fault occurred, and the number of times the specific fault has occurred.

Recent non-active faults can be cleared from the Faults screen only after the correct PIN has been entered at the **Settings > Protected Menus** screen.

### Machine Faults

<table>
<thead>
<tr>
<th>Fault ID</th>
<th>Fault Title</th>
<th>Controller(s) Affected</th>
<th>Fault Condition/Circuit Description</th>
<th>Additional Notes</th>
<th>Service Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1007</td>
<td>Joystick Raise/Lower Broken</td>
<td>T1</td>
<td>The joystick lower and joystick raise inputs are active at the same time.</td>
<td>The machine will not be capable of raising or lowering the cutting units, depending on which switch failed.</td>
<td>1. Use the InfoCenter <strong>Diagnostics &gt; Lift/Lower &gt; Inputs</strong> screen to observe joystick switch operation.</td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> The Mode Switch may also be referred to as the Function Control Switch</td>
<td></td>
<td></td>
<td></td>
<td>2. Test the joystick switches.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3. Check the circuit wiring and all the circuit connectors for the unresponsive switch.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4. Inspect and test the joystick wiring and connectors (P01, P04, P05).</td>
</tr>
<tr>
<td>B1197</td>
<td>Mode Switch Broken</td>
<td>T1</td>
<td>Two or more signals from the mode switch are active at the same time.</td>
<td>Traction is disabled.</td>
<td>1. Use the icons on the InfoCenter main information screen to observe the switch operation.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>2. Test the mode switch.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3. Test the switch circuit wiring. The signals begin at connector P43, pins 1, 3, and 6.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4. Swap the T1: Primary controller with a known-good unit (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>C0051</td>
<td>Steering Input Device - Out of Range</td>
<td>SC7</td>
<td>The steering input device signals are outside the expected range.</td>
<td>Traction is disabled.</td>
<td>1. Use the InfoCenter <strong>Diagnostics &gt; Steering &gt; Inputs</strong> screen to observe the input device operation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Test the steering input device.</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>3. Test the input device circuit wiring and connector P72.</td>
</tr>
<tr>
<td>C0526</td>
<td>Steering Position Sensor - Out of Range</td>
<td>SC7</td>
<td>The steering position sensor signals are outside the expected range.</td>
<td>Traction is disabled.</td>
<td>1. Use the InfoCenter <strong>Diagnostics &gt; Steering &gt; Inputs</strong> screen to observe the steering position sensor operation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Test the steering position sensor.</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>3. Test the steering position sensor circuit wiring and connector P69.</td>
</tr>
</tbody>
</table>
### Machine Faults (continued)

<table>
<thead>
<tr>
<th>Fault ID</th>
<th>Fault Title</th>
<th>Controller(s) Affected</th>
<th>Fault Condition/Circuit Description</th>
<th>Additional Notes</th>
<th>Service Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>C0528</td>
<td>Steering Position Sensor - Not Responding</td>
<td>SC7</td>
<td>The controller does not see a change in the steering position sensor when comparing steering motor commands and steering sensor movement.</td>
<td>Traction is disabled.</td>
<td>1. Use the InfoCenter Diagnostics &gt; Steering &gt; Inputs screen to observe the steering position sensor operation.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>2. Test the steering position sensor.</td>
</tr>
<tr>
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<td></td>
<td>3. Test the steering position sensor circuit wiring and connector P69.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4. Verify rear caster fork movement is not restricted.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5. Verify steering gear box movement operation.</td>
</tr>
<tr>
<td>C0529</td>
<td>Steering Position Sensor Signal Correlation Fault</td>
<td>SC7</td>
<td>The sum of the 2 signals from the steering position sensor are not correlating correctly.</td>
<td>Traction is disabled.</td>
<td>1. Use the InfoCenter Diagnostics &gt; Steering &gt; Inputs screen to observe the steering position sensor operation.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>2. Test the steering position sensor.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3. Test the steering position sensor circuit wiring and connector P69.</td>
</tr>
<tr>
<td>C1013</td>
<td>Engine Run Output - Short to Battery</td>
<td>T1</td>
<td>Low current detected on the engine run output. Indicates a short to a high (+) source.</td>
<td></td>
<td>1. Check the engine run output circuit wiring and connectors (P01, P45, P70).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Test the engine run output circuit wiring.</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>3. Test the engine relay and fuel solenoid.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>4. Swap the T1: Primary controller with a known-good unit (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>C1014</td>
<td>Engine Run Output – Overcurrent</td>
<td>T1</td>
<td>Overcurrent detected in engine run output, indicating a short to ground.</td>
<td></td>
<td>1. Check the engine run output circuit wiring and connectors (P01, P45, P70).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Test the engine run output circuit wiring to ground.</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>3. Test the engine relay and fuel solenoid.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>4. Swap the T1: Primary controller with a known-good unit (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>C1015</td>
<td>Engine Run Output - Open Circuit</td>
<td>T1</td>
<td>Open circuit detected on engine run output.</td>
<td></td>
<td>1. Check the engine run output circuit wiring and connectors (P01, P45, P70).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Test the engine run output circuit wiring.</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>3. Test the engine relay and fuel solenoid.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>4. Swap the T1: Primary controller with a known-good unit (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>Fault ID</td>
<td>Fault Title</td>
<td>Controller(s) Affected</td>
<td>Fault Condition/Circuit Description</td>
<td>Additional Notes</td>
<td>Service Actions</td>
</tr>
<tr>
<td>---------</td>
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<td>-----------------------------------------------------------------------------------------------------</td>
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<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>C1023</td>
<td>Parking Brake Disengage Output - Short to Battery</td>
<td>T1</td>
<td>Low current detected on parking brake disengage output. Indicates a short to a high (+) source.</td>
<td>The short could be to battery voltage or to another signal that is in a high (+) state.</td>
<td>1. Check the parking brake disengage output circuit wiring and connectors (P01, P74, P75).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Test the parking brake disengage output circuit wiring.</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>3. Test the brake actuator relay and the brake actuator.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4. Swap the T1: Primary controller with a known-good unit (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>C1024</td>
<td>Parking Brake Disengage Output - Overcurrent</td>
<td>T1</td>
<td>Overcurrent detected on parking brake disengage output. Indicates short to ground.</td>
<td></td>
<td>1. Check the parking brake disengage output circuit wiring and connectors (P01, P74, P75).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Test the parking brake disengage output circuit wiring to ground.</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>3. Test the brake actuator relay and the brake actuator.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4. Swap the T1: Primary controller with a known-good unit (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>C1025</td>
<td>Parking Brake Disengage Output - Open Circuit</td>
<td>T1</td>
<td>Open circuit detected on parking brake disengage output.</td>
<td></td>
<td>1. Check the parking brake disengage output circuit wiring and connectors (P01, P74, P75).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Test the parking brake disengage output circuit wiring.</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>3. Test the brake actuator relay and the brake actuator.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4. Swap the T1: Primary controller with a known-good unit (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>C10C4</td>
<td>Steering Feedback Output - Overcurrent</td>
<td>T1</td>
<td>Overcurrent detected on steering feedback output. Indicates short to ground.</td>
<td></td>
<td>1. Check the steering feedback output circuit wiring and connectors (P01, P72).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Test the steering feedback output circuit wiring to ground.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3. Test the steering input device brake coil.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4. Swap the T1: Primary controller with a known-good unit (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>Fault ID</td>
<td>Fault Title</td>
<td>Controller(s) Affected</td>
<td>Fault Condition/Circuit Description</td>
<td>Additional Notes</td>
<td>Service Actions</td>
</tr>
<tr>
<td>----------</td>
<td>-------------------------------------------------</td>
<td>------------------------</td>
<td>-------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>C10C5</td>
<td>Steering Feedback Output - Open Circuit</td>
<td>T1</td>
<td>Open circuit detected on steering feedback output.</td>
<td></td>
<td>1. Check the steering feedback output circuit wiring and connectors (P01, P72).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Test the steering feedback output circuit wiring.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3. Test the steering input device brake coil.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4. Swap the T1: Primary controller with a known-good unit (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>C10E3</td>
<td>48V Logic Enable Relay Output - Short to Battery</td>
<td>T1</td>
<td>Low current detected on logic relay output. Indicates a short to a high (+) source.</td>
<td>The short could be to battery voltage or to another signal that is in a high (+) state.</td>
<td>1. Check the logic relay output circuit wiring and connectors (P01, P47)</td>
</tr>
<tr>
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<td>2. Test the logic relay output circuit wiring.</td>
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<td>3. Test the logic relay.</td>
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<td>4. Swap the T1: Primary controller with a known-good unit (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>C10E4</td>
<td>48V Logic Enable Relay Output - Overcurrent</td>
<td>T1</td>
<td>Overcurrent detected on logic relay output. Indicates short to ground.</td>
<td></td>
<td>1. Check the logic relay output circuit wiring and connectors (P01, P47)</td>
</tr>
<tr>
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<td>2. Test the logic relay output circuit wiring to ground.</td>
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<td>3. Test the logic relay.</td>
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<td>4. Swap the T1: Primary controller with a known-good unit (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>C10E5</td>
<td>48V Logic Enable Relay Output - Open Circuit</td>
<td>T1</td>
<td>Open circuit detected on logic relay output.</td>
<td></td>
<td>1. Check the logic relay output circuit wiring and connectors (P01, P47)</td>
</tr>
<tr>
<td></td>
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<td>2. Test the logic relay output circuit wiring.</td>
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<td>3. Test the logic relay.</td>
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<td>4. Swap the T1: Primary controller with a known-good unit (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>C1801</td>
<td>Cutting Unit Motor - High Temp Shutdown</td>
<td>T2, T3, T4</td>
<td>The motor temperature is greater than 130° C (266° F) in the indicated cutting unit.</td>
<td>PTO is disabled.</td>
<td>1. Let the machine cool off.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>2. Check the reel to bedknife contact and the condition of the cutting unit.</td>
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<td>3. Reduce the reel speed.</td>
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<td></td>
<td>4. Reduce the mow speed.</td>
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<td>5. Test the 48V ground to the motor.</td>
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<td></td>
<td>6. Swap cutting reel motors between cutting units. Replace and reprogram the motor if the fault moves to the new position (contact an Authorized Toro Distributor for assistance).</td>
</tr>
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</table>
| C180C    | Cutting Unit Motor - High Temp Warning | T2, T3, T4             | The motor temperature is greater than 120° C (248° F) in the indicated cutting unit. | Motor current is limited on a linear basis until the motor temperature drops below 120° C (248° F) or exceeds 130 °C (266 °F). | 1. Let the machine cool off.  
2. Check the reel to bedknife contact and the condition of the cutting unit.  
3. Reduce the reel speed.  
4. Reduce the mow speed.  
5. Test the 48V ground to the motor.  
6. Swap cutting reel motors between cutting units. Replace and reprogram the motor if the fault moves to the new position (contact an Authorized Toro Distributor for assistance). |
| C1811    | Cutting Unit Motor Controller - High Temp Shutdown | T2, T3, T4             | The motor controller temperature is greater than 100° C (212° F) in the indicated cutting unit. | PTO is disabled. | 1. Let the machine cool off.  
2. Check the reel to bedknife contact and the condition of the cutting unit.  
3. Reduce the reel speed.  
4. Reduce the mow speed.  
5. Test the 48V ground to the motor.  
6. Swap cutting reel motors between cutting units. Replace and reprogram the motor if the fault moves to the new position (contact an Authorized Toro Distributor for assistance). |
| C181C    | Cutting Unit Motor Controller - High Temp Warning | T2, T3, T4             | The motor controller temperature is greater than 90° C (194° F) in the indicated cutting unit. | Motor current is limited on a linear basis until the motor controller temperature drops below 90° C (194° F) or exceeds 100° C (210° F). | 1. Let the machine cool off.  
2. Check the reel to bedknife contact and the condition of the cutting unit.  
3. Reduce the reel speed.  
4. Reduce the mow speed.  
5. Test the 48V ground to the motor.  
6. Swap cutting reel motors between cutting units. Replace and reprogram the motor if the fault moves to the new position (contact an Authorized Toro Distributor for assistance). |
| C1820    | Cutting Unit Motor Speed Sensor - Out of Range | T2, T3, T4             | One of the three hall effect sensors fails in the indicated cutting unit. | Hall effect sensors are used to detect the motor speed. If a sensor fails, the motor will have trouble maintaining speed and may become unstable. | 1. Cycle the key switch.  
2. Replace and program the motor (contact an Authorized Toro Distributor for assistance). |
| C1821    | Cutting Unit Motor Speed - High | T2, T3, T4             | The speed of the motor is greater than 2,500 RPM in the indicated cutting unit. |  | 1. Cycle the key switch.  
2. Replace and program the motor (contact an Authorized Toro Distributor for assistance). |
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<tr>
<td>C1822</td>
<td>Cutting Unit Motor - Stall</td>
<td>T2, T3, T4</td>
<td>The speed of the motor is 0 RPM for more than 3 seconds in the indicated cutting unit.</td>
<td>PTO is disabled. 1. Check the cutting unit and the motor for mechanical resistance. 2. Check the bedknife adjustment and the condition of the reel. 3. Try spinning the motor without a load. If it doesn't spin, replace and program the motor (contact an Authorized Toro Distributor for assistance).</td>
<td></td>
</tr>
<tr>
<td>C1831</td>
<td>Cutting Unit Motor Internal Regulator Voltage - High</td>
<td>T2, T3, T4</td>
<td>The internal regulator voltage is greater than 15V in the indicated cutting unit.</td>
<td>PTO is disabled. 1. Cycle the key switch. 2. Replace and program the motor (contact an Authorized Toro Distributor for assistance).</td>
<td></td>
</tr>
<tr>
<td>C1832</td>
<td>Cutting Unit Motor Internal Regulator Voltage - Low</td>
<td>T2, T3, T4</td>
<td>The internal regulator voltage is less than 10V in the indicated cutting unit.</td>
<td>PTO is disabled. <strong>Note:</strong> If this fault is present on multiple cutting unit motors, check the 48V logic relay and connector (P47). 1. Inspect all cutting unit wiring and connectors. 2. Inspect the battery terminals. 3. Swap cutting reel motors between cutting units. Replace and program the motor if the fault moves to the new position (contact an Authorized Toro Distributor for assistance).</td>
<td></td>
</tr>
<tr>
<td>C1841</td>
<td>Cutting Unit Motor Logic Voltage - High</td>
<td>T2, T3, T4</td>
<td>The 48V logic voltage measures greater than 67.5V in the indicated cutting unit.</td>
<td>PTO is disabled. <strong>Note:</strong> If more than one Logic Voltage - High fault is reported, go to fault U1501 and follow the listed service actions. 1. Swap cutting reel motors between cutting units. Replace and program the motor if the fault moves to the new position (contact an Authorized Toro Distributor for assistance). 2. Inspect the harness connectors at the cutting unit motor for damage, corrosion, debris, and proper alignment of the pins inside the connectors. 3. Test the connectors for 48V with the engine shut off and the key in the On position. 4. Test the power and ground wiring resistance in the harness connectors.</td>
<td></td>
</tr>
<tr>
<td>C1842</td>
<td>Cutting Unit Motor Logic Voltage - Low</td>
<td>T2, T3, T4</td>
<td>The 48V logic voltage measures less than 32V in the indicated cutting unit.</td>
<td>PTO is disabled. <strong>Note:</strong> If more than one Logic Voltage - Low fault is reported, go to fault U1502 and follow the listed service actions. 1. Check the 48V logic power connection to the motor. 2. If the battery voltage is good with engine shut off but not good with the engine on, test the starter/generator.</td>
<td></td>
</tr>
<tr>
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<tr>
<td>C1851</td>
<td>Cutting Unit Motor Bus Voltage - High</td>
<td>T2, T3, T4</td>
<td>The 48V logic voltage measures greater than 67.5V in the indicated cutting unit.</td>
<td>PTO is disabled. <strong>Note:</strong> If more than one Bus Voltage - High fault is reported, go to fault U1511 and follow the listed service actions.</td>
<td>1. Swap cutting reel motors between cutting units. Replace and program the motor if the fault moves to the new position (contact an Authorized Toro Distributor for assistance). 2. Inspect the harness connectors at the cutting unit motor for damage, corrosion, debris, and proper alignment of the pins inside the connectors. 3. Test the connectors for 48V with the engine shut off and the key in the On position. 4. Test the power and ground wiring resistance in the harness connectors.</td>
</tr>
<tr>
<td>C1852</td>
<td>Cutting Unit Motor Bus Voltage - Low</td>
<td>T2, T3, T4</td>
<td>The 48V bus voltage measures less than 32V in the indicated cutting unit.</td>
<td>PTO is disabled. <strong>Note:</strong> If more than one Bus Voltage - Low fault is reported, go to fault U1512 and follow the listed service actions.</td>
<td>1. Test the 48V bus Maxi blade fuse under the left side cover. 2. Check the 2 pin, 48V bus connector of the cutting unit motor.</td>
</tr>
<tr>
<td>C1861</td>
<td>Cutting Unit Motor - Over Current</td>
<td>T2, T3, T4</td>
<td>An internal over current condition is detected in the indicated cutting unit.</td>
<td>PTO is disabled.</td>
<td>1. Cycle the key switch. 2. Replace and program the motor (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>C1901</td>
<td>Lift/Lower Motor Controller - High Temp Shutdown</td>
<td>SC2, SC3, SC4</td>
<td>The temperature is greater than 75°C (167°F) in the indicated actuator.</td>
<td>Lift/Lower is disabled.</td>
<td>1. Check for mechanical resistance in the cutting unit suspension making the actuator work extra hard. 2. Replace and program the actuator (contact an Authorized Toro Distributor for assistance). 3. Cycle the key switch. 4. Use the InfoCenter to calibrate the actuator.</td>
</tr>
<tr>
<td>C190C</td>
<td>Lift/Lower Motor Controller - High Temp Warning</td>
<td>SC2, SC3, SC4</td>
<td>The temperature is greater than 65°C (149°F) in the indicated actuator.</td>
<td>Lift/Lower speed reduced until the actuator temperature drops below 65°C (149°F) or exceeds 75°C (167°F).</td>
<td>1. Check for mechanical resistance in the cutting unit suspension making the actuator work extra hard. 2. Replace and program the actuator (contact an Authorized Toro Distributor for assistance). 3. Cycle the key switch. 4. Use the InfoCenter to calibrate the actuator.</td>
</tr>
<tr>
<td>C1910</td>
<td>Lift/Lower Motor Speed Sensor - Out of Range</td>
<td>SC2, SC3, SC4</td>
<td>An internal sensor has failed in the indicated actuator.</td>
<td>Lift/Lower is disabled.</td>
<td>1. Replace and program the actuator (contact an Authorized Toro Distributor for assistance). 2. Cycle the key switch. 3. Use the InfoCenter to calibrate the actuator.</td>
</tr>
<tr>
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| C1912   | Lift/Lower Motor - Stall          | SC2, SC3, SC4          | The maximum allowed current is being drawn by the indicated actuator. | Lift/Lower is disabled for 5 seconds. | 1. Check for mechanical resistance in the cutting unit suspension making the actuator work extra hard.  
2. Use the InfoCenter to calibrate the actuator.  
3. Replace and program the actuator (contact an Authorized Toro Distributor for assistance).  
4. Cycle the key switch.  
5. Use the InfoCenter to calibrate the actuator. |
| C1919   | Lift/Lower Motor - Position Error | SC2, SC3, SC4          | An internal sensor fails in the indicated actuator. | Lift/Lower is disabled. | 1. Verify proper power and ground to the actuator.  
2. Replace and program the actuator (contact an Authorized Toro Distributor for assistance).  
3. Cycle the key switch.  
4. Use the InfoCenter to calibrate the actuator. |
| C1921   | Lift/Lower Motor Logic Voltage - High | SC2, SC3, SC4    | The 48V logic voltage measures greater than 67.5V in the indicated actuator. | Lift/Lower is disabled. | 1. Check the logic power connection to the actuator.  
2. Replace and program the actuator (contact an Authorized Toro Distributor for assistance).  
3. Cycle the key switch.  
4. Use the InfoCenter to calibrate the actuator. |
| C1922   | Lift/Lower Motor Logic Voltage - Low | SC2, SC3, SC4    | The 48V logic voltage measures less than 32V in the indicated actuator. | Lift/Lower is disabled. | 1. Check the logic power connection to the actuator.  
2. Replace and program the actuator (contact an Authorized Toro Distributor for assistance).  
3. Cycle the key switch.  
4. Use the InfoCenter to calibrate the actuator. |
| C1931   | Lift/Lower Motor Bus Voltage - High | SC2, SC3, SC4    | The 48V bus voltage measures greater than 67.5V in the indicated actuator. | Lift/Lower is disabled. | 1. Check the bus power connection to the actuator.  
2. Replace and program the actuator (contact an Authorized Toro Distributor for assistance).  
3. Cycle the key switch.  
4. Use the InfoCenter to calibrate the actuator. |
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<tr>
<td>C1932</td>
<td>Lift/Lower Motor Bus Voltage - Low</td>
<td>SC2, SC3, SC4</td>
<td>The 48V bus voltage measures less than 32V in the indicated actuator.</td>
<td>Lift/Lower is disabled. Note: If more than one Bus Voltage - Low faults are reported, go to fault U1512 and follow the listed service actions.</td>
<td>1. Test the actuator 48V bus standard blade fuse (under seat). 2. Verify proper power and ground to the actuator. 3. Replace and program the actuator (contact an Authorized Toro Distributor for assistance). 4. Cycle the key switch. 5. Use the InfoCenter to calibrate the actuator.</td>
</tr>
<tr>
<td>C1941</td>
<td>Lift/Lower Controller - Internal Software Failure</td>
<td>SC2, SC3, SC4</td>
<td>An internal software failure is detected in the indicated actuator.</td>
<td>Lift/Lower is disabled.</td>
<td>1. Update machine software (contact an Authorized Toro Distributor for assistance). 2. Replace and program the actuator (contact an Authorized Toro Distributor for assistance). 3. Cycle the key switch. 4. Use the InfoCenter to calibrate the actuator.</td>
</tr>
<tr>
<td>C1942</td>
<td>Lift/Lower Motor Overload</td>
<td>SC2, SC3, SC4</td>
<td>3 or more amps are drawn for more than 10 seconds reaching an overload condition in the indicated actuator.</td>
<td>Lift/Lower is disabled for 30 seconds.</td>
<td>1. Let the actuator rest for 30 seconds. 2. Use the InfoCenter to re-calibrate the actuator. 3. Replace and program the actuator (contact an Authorized Toro Distributor for assistance). 4. Cycle the key switch. 5. Use the InfoCenter to calibrate the actuator.</td>
</tr>
<tr>
<td>C1A01</td>
<td>Steering Motor - High Temp Shutdown</td>
<td>SC7</td>
<td>The temperature of the motor of the steering motor is greater than 120° C (248° F).</td>
<td>Traction and steering is disabled.</td>
<td>1. Check for binding or restriction of the rear caster wheel assembly. 2. Allow the steering motor to cool down. 3. If the fault repeats, replace and program the steering motor (contact an Authorized Toro Distributor for assistance). 4. Cycle the key switch. 5. Use the InfoCenter to calibrate the steering system – center first, then the steering system – range.</td>
</tr>
<tr>
<td>C1A11</td>
<td>Steering Motor Controller - High Temp Shutdown</td>
<td>SC7</td>
<td>The temperature of the controller in the steering motor is greater than 80° C (176° F).</td>
<td>Traction and steering is disabled.</td>
<td>1. Check for binding or restriction of the rear caster wheel assembly. 2. Allow the steering motor to cool down. 3. If the fault repeats, replace and program the steering motor (contact an Authorized Toro Distributor for assistance). 4. Cycle the key switch. 5. Use the InfoCenter to calibrate the steering system – center first, then the steering system – range.</td>
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</table>
| C1A20    | Steering Motor Speed Sensor - Out of Range       | SC7                    | A sensor inside the motor fails.                    | Traction and     | 1. Replace and program the steering motor (contact an Authorized Toro Distributor for assistance).  
|          |                                                  |                        | steering is disabled.                               | steering is       | 2. Cycle the key switch.                                                           |
|          |                                                  |                        |                                                     | disabled.         | 3. Use the InfoCenter to calibrate the steering system – center first, then the steering system – range. |
| C1A22    | Steering Motor - Stall                           | SC7                    | The steering motor draws too much current for too long (longer than 1 second when the traction speed is higher than 15%, or longer than 5 seconds when the traction speed is lower than 5%). | Traction and     | 1. Check for binding or restriction of the rear caster wheel assembly.            |
|          |                                                  |                        |                                                     | steering is      | 2. Replace and program the steering motor (contact an Authorized Toro Distributor for assistance). |
|          |                                                  |                        |                                                     | disabled.         | 3. Cycle the key switch.                                                           |
|          |                                                  |                        |                                                     |                   | 4. Use the InfoCenter to calibrate the steering system – center first, then the steering system – range.   |
| C1A27    | Steering Motor Position Error                    | SC7                    | There is a disagreement between the encoder in the steering motor and the steering position sensor.  | Traction is      | 1. Verify steering position sensor adjustment.                                   |
|          |                                                  |                        |                                                     | disabled.         | 2. Check for binding or restriction of the rear caster wheel assembly.            |
|          |                                                  |                        |                                                     |                   | 3. Verify proper wiring of the steering position sensor connector (P69).          |
|          |                                                  |                        |                                                     |                   | 4. Test the steering position sensor.                                              |
|          |                                                  |                        |                                                     |                   | 5. Replace and program the steering motor (contact an Authorized Toro Distributor for assistance). |
|          |                                                  |                        |                                                     |                   | 6. Cycle the key switch.                                                           |
|          |                                                  |                        |                                                     |                   | 7. Use the InfoCenter to calibrate the steering system – center first, then the steering system – range.   |
| C1A32    | Steering Motor Bus Voltage - Low                 | SC7                    | The steering motor detects that the 48V bus voltage did not reach at least 14V within 3.2 seconds of Key On. | Traction and     | 1. Test the steering motor 48V bus standard blade fuse (under seat).             |
|          |                                                  |                        |                                                     | steering is      | 2. Verify proper power and ground to the steering motor connector (P46).          |
|          |                                                  |                        |                                                     | disabled.         | 3. Replace and program the steering motor (contact an Authorized Toro Distributor for assistance). |
|          |                                                  |                        |                                                     |                   | 4. Cycle the key switch.                                                           |
|          |                                                  |                        |                                                     |                   | 5. Use the InfoCenter to calibrate the steering system – center first, then the steering system – range. |
| C1A41    | Steering Controller - Over Current               | SC7                    | A current sensor fails in the steering motor controller. | Traction and     | 1. Replace and program the steering motor (contact an Authorized Toro Distributor for assistance). |
|          |                                                  |                        |                                                     | steering is      | 2. Cycle the key switch.                                                           |
|          |                                                  |                        |                                                     | disabled.         | 3. Use the InfoCenter to calibrate the steering system – center first, then the steering system – range. |
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<tr>
<td>C1A55</td>
<td>Steering Motor Phase U - Open Circuit</td>
<td>SC7</td>
<td>The steering motor controller detects an open circuit on motor phase U.</td>
<td>Traction and steering is disabled.</td>
<td>1. Test the steering motor 48V bus standard blade fuse (under seat) and the power connection to the 48V battery. 2. Replace and program the steering motor (contact an Authorized Toro Distributor for assistance). 3. Cycle the key switch. 4. Use the InfoCenter to calibrate the steering system – center first, then the steering system – range.</td>
</tr>
<tr>
<td>C1A5C</td>
<td>Steering Motor Phase V - Open Circuit</td>
<td>SC7</td>
<td>The steering motor controller detects an open circuit on motor phase V.</td>
<td>Traction and steering is disabled.</td>
<td>1. Test the steering motor 48V bus standard blade fuse (under seat) and the power connection to the 48V battery. 2. Replace and program the steering motor (contact an Authorized Toro Distributor for assistance). 3. Cycle the key switch. 4. Use the InfoCenter to calibrate the steering system – center first, then the steering system – range.</td>
</tr>
<tr>
<td>C1A5D</td>
<td>Steering Motor Phase W - Open Circuit</td>
<td>SC7</td>
<td>The steering motor controller detects an open circuit on motor phase W.</td>
<td>Traction and steering is disabled.</td>
<td>1. Test the steering motor 48V bus standard blade fuse (under seat) and the power connection to the 48V battery. 2. Replace and program the steering motor (contact an Authorized Toro Distributor for assistance). 3. Cycle the key switch. 4. Use the InfoCenter to calibrate the steering system – center first, then the steering system – range.</td>
</tr>
<tr>
<td>C1A69</td>
<td>Steering Wheel Sensor - Feedback Noisy</td>
<td>SC7</td>
<td>The steering motor controller detects noise on the output of the steering input device.</td>
<td>Traction and steering is disabled.</td>
<td>1. Test the steering input device wiring and connector (P72). 2. Replace and program the steering motor (contact an Authorized Toro Distributor for assistance). 3. Cycle the key switch. 4. Use the InfoCenter to calibrate the steering system – center first, then the steering system – range.</td>
</tr>
<tr>
<td>C1A6C</td>
<td>Steering Controller - Internal Hardware Failure</td>
<td>SC7</td>
<td>An internal hardware component of the steering motor controller fails.</td>
<td>Traction and steering is disabled.</td>
<td>1. Replace and program the steering motor (contact an Authorized Toro Distributor for assistance). 2. Cycle the key switch. 3. Use the InfoCenter to calibrate the steering system – center first, then the steering system – range.</td>
</tr>
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</table>
| C1A7D    | Steering Controller - Internal Software Failure  | SC7                    | An unexpected steering motor controller software error occurs. | Traction and steering is disabled.                                                | 1. Replace and program the steering motor (contact an Authorized Toro Distributor for assistance).  
                                |                                                  |                        |                                                                                      | 2. Cycle the key switch.  
                                |                                                  |                        |                                                                                      | 3. Use the InfoCenter to calibrate the steering system — center first, then the steering system — range. |
| C1A7E    | Steering Motor Software - Hardware Incompatibility | SC7                    | The steering motor controller software is not compatible with the hardware. | Traction and steering is disabled.                                                | 1. Replace and program the steering motor (contact an Authorized Toro Distributor for assistance).  
                                |                                                  |                        |                                                                                      | 2. Cycle the key switch.  
                                |                                                  |                        |                                                                                      | 3. Use the InfoCenter to calibrate the steering system — center first, then the steering system — range. |
| P0524    | Oil Pressure Low - Kill Engine                   | T1                     | The engine oil pressure is low for more than 10 seconds while the engine is running. | Engine ETR output shuts off.                                                      | 1. Check and adjust the engine oil level.  
                                |                                                  |                        |                                                                                      | 2. Inspect and test the wiring and connectors (P70, pin F to P01, pin 24).  
                                |                                                  |                        |                                                                                      | 3. Test the engine oil pressure switch.  
                                |                                                  |                        |                                                                                      | 4. Test the engine lubrication system; refer to the Kawasaki FS481V Service Manual. |
| P058E    | Battery - High Temp Shutdown                     | SC8                    | A Li-ion battery cell temperature was measured to be 70° C (158° F) or higher. | Battery contactor in Li-ion battery controller is opened.                        | Allow the machine to cool before operating.                                                                                    |
| P058F    | Battery - Low Temp Shutdown                      | SC8                    | A Li-ion battery cell temperature was measured to be -20° C (-4° F) or lower. | Battery contactor in Li-ion battery controller is opened.                        | Allow the machine to warm before operating.                                                                                                                                 |
| P063C    | Starter/Generator Logic Voltage - Low            | T6                     | The starter/generator measures the 48V logic voltage at less than 36V. | PTO and starter/generator is disabled.                                             | 1. Check the logic power to the starter/generator connector (P21).  
                                |                                                  |                        |                                                                                      | 2. Test the starter/generator (test procedure pending).  
                                |                                                  |                        |                                                                                      | 3. Replace and program the starter/generator (contact an Authorized Toro Distributor for assistance). |
| P063D    | Starter/Generator Logic Voltage - High           | T6                     | The starter/generator measures the 48V logic voltage at greater than 65V. | PTO and starter/generator is disabled.                                             | 1. Test the 48V batteries.  
                                |                                                  |                        |                                                                                      | 2. Verify that all starter/generator motor-to-controller connections are good.  
                                |                                                  |                        |                                                                                      | 3. Test the starter/generator (test procedure pending).  
<pre><code>                            |                                                  |                        |                                                                                      | 4. Replace and program the starter/generator (contact an Authorized Toro Distributor for assistance). |
</code></pre>
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<tr>
<td>P06E9</td>
<td>Starter/Generator Timeout</td>
<td>T1</td>
<td>The starter function of the starter/generator was engaged for more than the maximum time permitted.</td>
<td>Starter/Generator is disabled.</td>
<td>1. Cycle the key switch.</td>
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<td>2. Test the key switch.</td>
</tr>
<tr>
<td>P0A1B</td>
<td>Traction Controller - Short</td>
<td>SC5, SC6</td>
<td>Either the traction controller FET has shorted, the motor phases have shorted, or the phase wires from the motor to controller are shorted in the indicated controller.</td>
<td>Traction is disabled.</td>
<td>1. Verify that U, V, and W motor phases are correctly connected.</td>
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<td>2. Test each motor phase to ground.</td>
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<td>3. Check the phase resistance to 48V bus and 48V ground after the controller capacitor bank has been de-energized.</td>
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<td>4. Replace and program the traction motor controller (contact an Authorized Toro Distributor for assistance).</td>
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<td>5. Cycle the key switch.</td>
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<td>6. Use the InfoCenter to calibrate the traction motors.</td>
</tr>
<tr>
<td>P0A2A</td>
<td>Traction Motor - Temperature Sensor Failure</td>
<td>SC5, SC6</td>
<td>The temperature sensor is out of the normal operating range in the indicated motor.</td>
<td>Traction performance is limited.</td>
<td>1. Test the wiring to the motor.</td>
</tr>
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<td>2. Replace the motor.</td>
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<td></td>
<td>For SC5, use the InfoCenter to calibrate the traction pedal first, then the traction motors. For SC6, use the InfoCenter to calibrate the traction motors.</td>
</tr>
<tr>
<td>P0A2F</td>
<td>Traction Motor - High Temp Warning</td>
<td>SC5, SC6, T5</td>
<td>The traction motor temperature is greater than: 150° C (302° F) for (SC5, SC6) or 120° C (248° F) for T5.</td>
<td>Traction performance is limited.</td>
<td>1. Reduce the ground speed.</td>
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<td>2. Check for mechanical resistance in the wheels that would make the motors work extra hard.</td>
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<td>3. Replace the traction motor.</td>
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<td>For SC5 and SC6, use the InfoCenter to calibrate the traction motors. For T5, program the traction motor (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>P0A36</td>
<td>Starter/Generator Temperature Sensor Failure</td>
<td>T6</td>
<td>The starter/generator FET and the motor sensor fail.</td>
<td>PTO and starter/generator is disabled.</td>
<td>Replace and program the starter/generator (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>P0A3B</td>
<td>Starter/Generator Motor - High Temp Warning</td>
<td>T6</td>
<td>The starter/generator temperature is greater than 120° C (248° F).</td>
<td>Starter/Generator current is limited on a linear basis until the temperature drops below 120° C (248° F) or exceeds 130° C (266° F). Note: This fault is not produced by a bad sensor.</td>
<td>1. Clean the air intake screen on the back of the starter/generator. Be sure the starter/generator is pulling air through the air intake by feeling with your hand or by testing with a piece of paper.</td>
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<td>2. Let the machine cool.</td>
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<td>3. Reduce the cutting loads by reducing the reel speed or reducing mow speed.</td>
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<td>4. Replace the starter/generator motor.</td>
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| P0A3C    | Traction Motor Controller - High Temp Warning | SC5, SC6, T5          | The temperature is greater than 90°C (194° F) in the indicated traction motor controller.          | Traction motor current is limited on a linear basis until the temperature drops below 90°C (194° F) or exceeds 100° C (212° F). | 1. Reduce the ground speed.  
2. Check for mechanical resistance in the wheels that would make the motors work extra hard.  
3. Replace and program the traction motor controller (contact an Authorized Toro Distributor for assistance). The T5 controller is part of the motor assembly and is not replaceable separately.  
4. Cycle the key switch.  
5. Use the InfoCenter to calibrate the traction motor controller.  
For SC5, calibrate the traction pedal first, then the traction motors.  
For SC6, calibrate the traction motors. |
| P0A3E    | Starter/Generator Controller - High Temp Warning | T6                     | The starter/generator controller temperature is greater than 90° C (194° F).                     | Starter/Generator current is limited on a linear basis until the temperature drops below 90°C (194° F) or exceeds 100° C (212° F). | 1. Clean the air intake screen on the back of the starter/generator. Be sure the starter/generator is pulling air through the air intake by feeling with your hand or by testing with a piece of paper.  
2. Let the machine cool.  
3. Reduce the cutting loads by reducing the reel speed or reducing mow speed.  
4. Replace and program the starter/generator controller (contact an Authorized Toro Distributor for assistance). |
| P0A44    | Traction Motor Speed - High        | SC5, SC6, T5           | The ground speed is more than the allowed maximum speed of the machine as measured by the indicated traction motor. | Traction is disabled.                                                                                   | 1. Inspect the wiring of the speed sensors.  
2. Check supply voltage to the speed sensor.  
3. Replace the traction motor.  
For SC5 and SC6, use the InfoCenter to calibrate the traction motors.  
For T5, program the traction motor (contact an Authorized Toro Distributor for assistance). |
| P0A54    | Traction Motor Controller - Over Current | SC5, SC6, T5           | The current draw exceeds the hardware and software limits of the indicated traction motor.         | Traction is disabled.                                                                                   | 1. Cycle the key switch to clear the fault.  
2. Contact an Authorized Toro Distributor or the Toro Technical Assistance Center and report that this fault occurred. |
| P0A5A    | Starter/Generator Current Sensor Out of Range | T6                     | One of the sensors inside the starter/generator controller fails.                                 | PTO and starter/generator is disabled.                                                                   | 1. Cycle the key switch.  
2. If the fault repeats, replace and program the starter/generator controller (contact an Authorized Toro Distributor for assistance). |
## Machine Faults (continued)

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<tr>
<td>P0A5C</td>
<td>Starter/Generator Hardware - DC Over Current</td>
<td>T6</td>
<td>The starter/generator controller detects an internal overcurrent condition.</td>
<td>PTO and starter/generator is disabled.</td>
<td>Replace and program the starter/generator controller (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>P0A80</td>
<td>Battery - Internal Hardware Failure</td>
<td>SC8</td>
<td>A Li-ion battery internal hardware component has failed.</td>
<td>Battery contactor in Li-ion battery controller is opened.</td>
<td>The Li-ion battery is likely damaged. Forward a copy of the battery output file (.BDS) to Toro Service (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>P0A1A</td>
<td>Battery Contactor - Stuck Closed</td>
<td>SC8</td>
<td>The battery contactor in the Li-ion battery controller is measured to be closed when it should be open.</td>
<td>Battery contactor in Li-ion battery controller is opened. Note: If the contacts are &quot;welded&quot; together, the contactor will not open.</td>
<td>The Li-ion battery controller (SC8) is likely damaged. Forward a copy of the battery output file (.BDS) to Toro Service (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>P0A2A</td>
<td>Battery Contactor - Stuck Open</td>
<td>SC8</td>
<td>The battery contactor in the Li-ion battery controller is measured to be open when it should be closed.</td>
<td>Battery contactor in Li-ion battery controller is opened.</td>
<td>The Li-ion battery controller (SC8) is likely damaged. Forward a copy of the battery output file (.BDS) to Toro Service (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>P0AC2</td>
<td>Battery - Over Current</td>
<td>SC8</td>
<td>A battery cell is pulling too much current for too long. Note: This fault can either be caused by too much power draw or a Li-ion battery cell imbalance.</td>
<td>Battery contactor in Li-ion battery controller is opened.</td>
<td>Cycle the key switch. 1. Operate the machine in a reduced power condition (example: disengage the cutting units). 2. Check the Li-ion battery and machine wire harnesses for corrosion or damage. 3. A Li-ion battery may be damaged, forward a copy of the battery output file (.BDS) to Toro Service (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>P0AE4</td>
<td>Hybrid/EV - Contactor Stuck Open</td>
<td>T6</td>
<td>There is a problem with control of the 48V main contactor – the contactor is open when it should be closed.</td>
<td>PTO, starter/generator, and lift/lower is disabled. Note: If this fault occurs with a starter/generator undervoltage fault or system undervoltage related fault, test the key switch.</td>
<td>1. Check the voltage across the coil of the main contactor with the key On. It should be approximately 48V when the contactor is closed. 2. Check the voltage across the contactor with the key On. It should be 0V when the contactor is closed. 3. Test the main contactor.</td>
</tr>
<tr>
<td>Fault ID</td>
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| P0AE5   | Hybrid/EV - Contactor Stuck Closed | T6                     | There is a problem with control of the 48V main contactor – the contactor is closed when it should be open. | PTO, starter/generator, and lift/lower is disabled. | 1. Check the voltage across the coil of the main contactor with the key Off. It should be 0V when the contactor is open.  
2. Check the voltage across the contactor with the key Off. It should be 48V when the contactor is open.  
3. Test the main contactor. |
| P0AE6   | Precharge Failure                 | T6                     | The minimum precharge voltage (38V) was not achieved in the appropriate time. | PTO, starter/generator, and lift/lower is disabled. | Start with a component that may have just blown a fuse and disconnect one cutting unit motor or lift/lower actuator at a time until the fault stops repeating.  
• The starter/generator must remain connected because it reports this fault.  
• If one of the cutting unit motors or lift/lower actuators is reporting a COMM fault, that is likely the shorted component. |
| P0AFA   | Battery - Low Voltage             | SC8                    | A Li-ion battery cell voltage was measured to be low, but is still recoverable. | Battery contactor in Li-ion battery controller is opened. | 1. Charge the batteries. The contactor in Li-ion battery controller should be allowed to close once the battery voltage reaches 42V.  
2. Test the battery pack voltage at the Li-ion battery controller B+ and B- terminals.  
• If the battery pack voltage is above 21V, reprogram the Li-ion battery controller or replace the controller if necessary (contact an Authorized Toro Distributor for assistance).  
• If the battery pack voltage is below 21V, replace the batteries. |
| P0AFB   | Battery - High Voltage            | SC8                    | A Li-ion battery cell voltage was measured to be high. | Battery contactor in Li-ion battery controller is opened. | • If the fault occurred with a full Li-ion battery during a regenerative charge (coasting – traction motors charging battery), everything is likely fine. Cycle the key switch and continue operation.  
• If the fault occurred when the Li-ion battery state of charge is less than 90%, forward a copy of the battery output file (.BDS) to Toro Service (contact an Authorized Toro Distributor for assistance). |
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</table>
| P0C06    | Traction Motor Phase Short   | SC5, SC6               | Two traction motor phases are shorted together but not shorted to ground in the indicated traction motor controller or motor. | Traction is disabled.                                                            | 1. Verify that the U, V, and W motor phase cables are in the correct order.  
2. Check the motor power cables.  
3. Replace and program the traction motor controller (contact an Authorized Toro Distributor for assistance).  
4. Cycle the key switch.  
5. Use the InfoCenter to calibrate the traction motor controller.  
For SC5, calibrate the traction pedal first, then the traction motors.  
For SC6, calibrate the traction motors.  
6. Replace the traction motor. Use the InfoCenter to calibrate the traction motors. |
| P0C19    | Traction Motor Power Mismatch| SC5, SC6               | The motor is not responding to the power setpoint in the indicated traction motor.                    | Traction is disabled.                                                            | 1. Verify that the U, V, and W motor phase cables are in the correct order.  
2. Verify the speed feedback sensor (sin-cos) is wired correctly.  
3. Use the InfoCenter to calibrate the traction motors.  
4. Contact an Authorized Toro Distributor or the Toro Technical Assistance Center and report that this fault occurred. |
| P0D2F    | Traction Motor Logic Voltage - Low | SC5, SC6, T5          | The traction motor measures the 48V logic voltage at less than: 38V (SC5, SC6) or 32V for T5         | Traction is disabled.                                                            | 1. Measure the voltage at the motor connector to determine whether the voltage is low, or the controller is measuring low.  
2. Check the 48V battery voltage.  
3. Inspect the wiring to the motor.  
4. Replace the traction motor.  
For SC5 and SC6, use the InfoCenter to calibrate the traction motors.  
For T5, program the traction motor (contact an Authorized Toro Distributor for assistance). |
| P0D30    | Traction Motor Logic Voltage - High | SC5, SC6, T5          | The traction motor measures the 48V logic voltage at greater than: 65V (SC5, SC6) or 67.5V for T5   | Traction is disabled.                                                            | 1. Measure the voltage at the motor connector to determine whether the voltage is high, or the controller is measuring high.  
2. Check the 48V battery voltage.  
3. Inspect the wiring to the motor.  
4. Replace the traction motor.  
For SC5 and SC6, use the InfoCenter to calibrate the traction motors.  
For T5, program the traction motor (contact an Authorized Toro Distributor for assistance). |
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<tr>
<td>P0E8E</td>
<td>Traction Motor Bus Voltage - Low</td>
<td>SC5, SC6, T5</td>
<td>The traction motor measures the 48V bus voltage at less than: 38V (SC5, SC6) or 32V for T5</td>
<td>Traction is disabled. <strong>Note:</strong> If more than one Bus Voltage - Low fault is reported, go to fault U1512 and follow the listed service actions.</td>
<td>1. Test the MIDI fuse for the 48V bus voltage to the controller (SC5 fuse under seat, SC6 fuse under left side cover). &lt;br&gt;2. Measure the voltage at the motor connector to determine whether the voltage is low, or the controller is measuring low. &lt;br&gt;3. Check the battery voltage. &lt;br&gt;4. Inspect the wiring to the motor. &lt;br&gt;5. Replace the traction motor. For SC5 and SC6, use the InfoCenter to calibrate the traction motors. For T5, program the traction motor (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>P0E8F</td>
<td>Traction Motor Bus Voltage - High</td>
<td>SC5, SC6, T5</td>
<td>The traction motor measures the 48V bus voltage at greater than: 65V (SC5, SC6) or 67.5V for T5</td>
<td>Traction is disabled. <strong>Note:</strong> If more than one Bus Voltage - High fault is reported, go to fault U1511 and follow the listed service actions.</td>
<td>1. Measure the voltage at the motor connector to determine whether the voltage is high, or the controller is measuring high. &lt;br&gt;2. Check the battery voltage. &lt;br&gt;3. Inspect the wiring to the motor. &lt;br&gt;4. Replace the traction motor. For SC5 and SC6, use the InfoCenter to calibrate the traction motors. For T5, program the traction motor (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>P1501</td>
<td>Traction Motor - High Temp Shutdown</td>
<td>SC5, SC6, T5</td>
<td>The traction motor temperature is greater than: 170° C (338° F) (SC5, SC6) or 130° C (266 °F) for T5.</td>
<td>Traction is disabled.</td>
<td>1. Reduce ground speed. &lt;br&gt;2. Check for mechanical resistance in the wheels that would make the motors work extra hard. &lt;br&gt;3. Replace the traction motor. For SC5 and SC6, use the InfoCenter to calibrate the traction motors. For T5, program the traction motor (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>P1511</td>
<td>Traction Motor Controller - High Temp Shutdown</td>
<td>T5</td>
<td>The optional 3WD traction motor controller temperature is greater than 100° C (212° F).</td>
<td>Traction is disabled.</td>
<td>1. Reduce ground speed. &lt;br&gt;2. Check for mechanical resistance in the wheels that would make the motors work extra hard. &lt;br&gt;3. The T5 controller is part of the motor assembly and is not replaceable separately. Replace and program the traction motor (contact an Authorized Toro Distributor for assistance).</td>
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</table>
| P1520    | Traction Motor Speed Sensor - Out of Range | SC5, SC6, T5          | The speed sensor reading is outside the normal operating range in the indicated traction motor.       | Traction is disabled.                                                              | 1. Inspect the wiring and connectors.  
2. Test the supply voltage to the speed sensor.  
3. Test the ground to the speed sensor.  
4. Replace the traction motor.  
   For SC5 and SC6, use the InfoCenter to calibrate the traction motors.  
   For T5, program the traction motor (contact an Authorized Toro Distributor for assistance). |
| P1522    | Traction Motor Speed Sensor - Stall      | SC5, SC6, T5          | The speed sensor reading indicates no movement (stall) in the indicated traction motor.             | Traction is disabled.                                                              | 1. Inspect the wiring and connectors.  
2. Test the supply voltage to the speed sensor.  
3. Test the ground to the speed sensor.  
4. Replace the traction motor.  
   For SC5 and SC6, use the InfoCenter to calibrate the traction motors.  
   For T5, program the traction motor (contact an Authorized Toro Distributor for assistance). |
| P1527    | Traction Motor Speed Sensor - Data Invalid | SC5, SC6              | The speed sensor reading is invalid in the indicated traction motor.                                | Traction is disabled.                                                              | 1. Inspect the wiring and connectors.  
2. Test the supply voltage to the speed sensor.  
3. Test the ground to the speed sensor.  
4. Replace the traction motor.  Use the InfoCenter to calibrate the traction motors. |
| P1529    | Traction Motor Speed Sensor - Wrong Direction | SC5, SC6              | The speed sensor shows the motor moving in the wrong direction in the indicated traction motor.      | Traction is disabled.                                                              | 1. Inspect the wiring and connectors.  
2. Verify the sin/cos wires are correct from the traction controller to the traction motor.  
3. Test the supply voltage to the speed sensor.  
4. Test the ground to the speed sensor.  
5. Test the cables on the U, V, and W phases.  
6. Replace the traction motor.  Use the InfoCenter to calibrate the traction motors. |
| P152C    | Traction Motor Speed Sensor - Feedback Noisy | SC5, SC6              | The speed sensor feedback is noisy in the indicated traction motor.                                | Traction is disabled.                                                              | 1. Inspect the wiring and connectors.  
2. Test the supply voltage to the speed sensor.  
3. Test the ground to the speed sensor.  
4. Test the cables on the U, V, and W phases.  
5. Replace the traction motor.  Use the InfoCenter to calibrate the traction motors. |
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| P1531   | Traction Motor Internal Regulator - Voltage High | T5                     | The internal regulator voltage is greater than 15V. | 3WD Traction is disabled.                                  | 1. Inspect the wiring and connectors (P19, P20).  
2. Check the 48V logic relay and connections.  
3. Inspect the battery terminals.  
4. Replace and program the traction motor (contact an Authorized Toro Distributor for assistance). |
| P1532   | Traction Motor Internal Regulator - Voltage Low  | T5                     | The internal regulator voltage is less than 10V. | 3WD Traction is disabled.                                  | 1. Inspect the wiring and connectors (P19, P20).  
2. Inspect the battery terminals.  
3. Replace and program the traction motor (contact an Authorized Toro Distributor for assistance). |
| P1541   | Traction Motor Phase - Voltage High              | SC5, SC6               | The motor phase voltage is out-of-range high in the indicated traction motor. | Traction is disabled. If the fault occurs at start up (contactor does not close):  
1. Test the cables on the U, V, and W phases.  
2. Inspect the motor power cables connections.  
3. Replace and program the traction motor controller (contact an Authorized Toro Distributor for assistance).  
4. Cycle the key switch.  
5. Use the InfoCenter to calibrate the traction motor controller.  
   For SC5, calibrate the traction pedal first, then the traction motors.  
   For SC6, calibrate the traction motors.  
If the fault occurs while the motor is running:  
1. Inspect the motor power cables connections.  
2. Test the traction motor contactor.  
3. Replace and program the traction motor controller (contact an Authorized Toro Distributor for assistance).  
4. Cycle the key switch.  
5. Use the InfoCenter to calibrate the traction motor controller.  
   For SC5, calibrate the traction pedal first, then the traction motors.  
   For SC6, calibrate the traction motors. |
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</table>
| P1542   | Traction Motor Phase - Voltage Low | SC5, SC6 | The motor phase voltage is out-of-range low in the indicated traction motor. | Traction is disabled. | 1. Test the cables on the U, V, and W phases.  
2. Inspect the motor power cables connections.  
3. Replace and program the traction motor controller (contact an Authorized Toro Distributor for assistance).  
4. Cycle the key switch.  
5. Use the InfoCenter to calibrate the traction motor controller.  
   For SC5, calibrate the traction pedal first, then the traction motors.  
   For SC6, calibrate the traction motors.  
If the fault occurs while the motor is running:  
1. Inspect the motor power cables connections.  
2. Test the traction motor contactor.  
3. Replace and program the traction motor controller (contact an Authorized Toro Distributor for assistance).  
4. Cycle the key switch.  
5. Use the InfoCenter to calibrate the traction motor controller.  
   For SC5, calibrate the traction pedal first, then the traction motors.  
   For SC6, calibrate the traction motors. |
| P1554   | Traction Motor Contactor Coil - Short Circuit | SC5 | The coil engage output of the controller is shorted. | Traction is disabled. | 1. Check the connection between the controller output and the motor.  
2. Test the traction motor contactor.  
3. Replace and program the traction motor controller (contact an Authorized Toro Distributor for assistance).  
4. Cycle the key switch.  
5. Use the InfoCenter to calibrate traction pedal first, then the traction motors. |
| P1555   | Traction Motor Contactor Coil - Open Circuit | SC5 | An open circuit is detected on the NMC signal from the controller. | Traction is disabled. | 1. Check the connections between the controller outputs and the motor (P35, P10).  
2. Test the traction motor contactor.  
3. Replace and program the traction motor controller (contact an Authorized Toro Distributor for assistance).  
4. Cycle the key switch.  
5. Use the InfoCenter to calibrate traction pedal first, then the traction motors. |
## Machine Faults (continued)

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</thead>
</table>
| P156C    | Traction Controller - Internal Hardware Failure  | SC5, SC6               | An internal component of the controller fails in the indicated traction motor controller.              | Traction is disabled.                                                            | 1. Replace and program the traction motor controller (contact an Authorized Toro Distributor for assistance).  
2. Cycle the key switch.  
3. Use the InfoCenter to calibrate the traction motor controller.  
   For SC5, calibrate the traction pedal first, then the traction motors.  
   For SC6, calibrate the traction motors. |
| P156D    | Traction Controller - Internal Software Failure  | SC5, SC6               | An unexpected software error occurs in the indicated traction motor controller.                        | Traction is disabled.                                                            | 1. Replace and program the traction motor controller (contact an Authorized Toro Distributor for assistance).  
2. Cycle the key switch.  
3. Use the InfoCenter to calibrate the traction motor controller.  
   For SC5, calibrate the traction pedal first, then the traction motors.  
   For SC6, calibrate the traction motors. |
| P156E    | Traction Motor Software - Hardware Incompatibility| SC5, SC6               | The software is not compatible with the hardware in the indicated traction motor controller.           | Traction is disabled.                                                            | 1. Replace and program the traction motor controller (contact an Authorized Toro Distributor for assistance).  
2. Cycle the key switch.  
3. Use the InfoCenter to calibrate the traction motor controller.  
   For SC5, calibrate the traction pedal first, then the traction motors.  
   For SC6, calibrate the traction motors. |
| P1A01    | Battery Charging - High Temp Shutdown            | SC8                    | A Li-ion battery cell temperature is greater than 60° C (140° F).                                      | Battery contactor in Li-ion battery controller is opened.                         | 1. Allow the machine to cool before charging.  
2. Disconnect the charger for 5 seconds and then reconnect.  
3. Charge the machine in the shade or a cooler environment. |
| P1A02    | Battery Charging - Low Temp Shutdown             | SC8                    | A Li-ion battery cell temperature is less than -10° C (14° F).                                        | Battery contactor in Li-ion battery controller is opened.                         | 1. Allow the machine to warm before charging.  
2. Disconnect the charger for 5 seconds and then reconnect. |
| P1A11    | Battery Charging Voltage - High                  | SC8                    | A Li-ion battery cell voltage is greater than 4.2V.                                                   | Battery contactor in Li-ion battery controller is opened.                         | 1. Ensure the correct charger is being used.  
2. Check the charger for faults.  
3. Charge the machine with a known good charger or replace the charger. |
## Machine Faults (continued)

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</table>
| P1A21    | Battery Charging - Over Current                  | SC8                    | A Li-ion battery cell charging current is greater than 12.52A when the battery temperature is between 5° (41° F) and 45° C (113° F), or greater than 6.25A when the battery temperature is less than 5° C (41° F) or greater than 45° C (113° F). Note: This fault is likely due to cell imbalance in the battery pack. | Battery contactor in Li-ion battery controller is opened.                                              | 1. Ensure the correct charger is being used.  
2. Charge the machine with a known good charger or replace the charger.  
3. Check battery and charger harnesses for corrosion or damage.  
4. Forward a copy of the battery output file (.BDS) to Toro Service (contact an Authorized Toro Distributor for assistance). |
| P1B01    | Starter/Generator Motor - High Temp Shutdown      | T6                     | The starter/generator motor temperature is greater than 130° C (266° F).                              | PTO and starter/generator is disabled. Note: This fault is not produced by a bad sensor.                | 1. Clean the air intake screen on the back of the starter/generator. Be sure the starter/generator is pulling air through the air intake by feeling with your hand or by testing with a piece of paper.  
2. Let the machine cool.  
3. Reduce the cutting loads by reducing the reel speed or reducing mow speed.  
4. Replace the starter/generator motor.                                                                                   |
| P1B11    | Starter/Generator Controller - High Temp Shutdown | T6                     | The starter/generator controller temperature is greater than 100 °C (212 °F).                           | PTO and starter/generator is disabled. Note: This fault is not produced by a bad sensor.                | 1. Clean the air intake screen on the back of the starter/generator. Be sure the starter/generator is pulling air through the air intake by feeling with your hand or by testing with a piece of paper.  
2. Let the machine cool.  
3. Reduce the cutting loads by reducing the reel speed or reducing mow speed.  
4. Replace and program the starter/generator controller (contact an Authorized Toro Distributor for assistance). |
| P1B20    | Starter/Generator Motor Speed Sensor Out of Range | T6                     | The hall effect sensors in the starter/generator motor provide an invalid reading.                    | This fault will not disable any machine functionality.                                               | 1. Check the 6-pin wire harness between the starter/generator motor and controller.  
2. If the engine seems to be hunting or not reaching the desired speed, replace the starter/generator motor. |
| P1B21    | Starter/Generator Motor Speed - High              | T6                     | The speed of the starter/generator motor is greater than 3,600 RPM.                                   |                                                                                                       | 1. Check the engine governor if the engine RPM is consistently high.  
2. Check the 6-pin wire harness between the starter/generator motor and controller.  
3. Replace the starter/generator motor.                                                                                     |
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| P1B2C    | Starter/Generator Motor - Stall | T6                     | The starter/generator stalls for 3 seconds or more. | PTO and starter/generator is disabled. | 1. Verify that the starter/generator can spin freely.  
2. Remove the starter/generator from the machine and analyze the motor phase connections between the motor and controller.  
3. Inspect the 6-wire harness between the controller and motor.  
4. Replace and program the starter/generator controller (contact an Authorized Toro Distributor for assistance). |
| P1B31    | Starter/Generator Motor Internal Regulator Voltage - High | T6                     | The internal regulator voltage is greater than 18V. | PTO and starter/generator is disabled. | 1. Make sure the connections are all good.  
2. Check battery terminals.  
3. Replace and program the starter/generator controller (contact an Authorized Toro Distributor for assistance). |
| P1B41    | Starter/Generator Bus Voltage - High | T6                     | The starter/generator measures the 48V bus voltage at greater than 65V. | PTO and starter/generator is disabled.  
Note: If more than one Bus Voltage - High fault is reported, go to fault U1511 and follow the listed service actions. | 1. Test the 48V batteries.  
2. Verify that all starter/generator motor-to-controller connections are good.  
3. Replace and program the starter/generator controller (contact an Authorized Toro Distributor for assistance). |
| P1B42    | Starter/Generator Bus Voltage - Low | T6                     | The starter/generator measures the 48V bus voltage at less than 36V. | PTO and starter/generator is disabled.  
Note: If more than one Bus Voltage - Low fault is reported, go to fault U1512 and follow the listed service actions. | 1. Test the 100A BF1 style fuse for the 48V bus voltage (under the seat).  
2. Test the 48V batteries with the engine shut Off.  
3. Test the 48V logic relay.  
4. Verify that all starter/generator motor-to-controller connections are good.  
5. Test the starter/generator (test procedure pending).  
6. Replace and program the starter/generator controller (contact an Authorized Toro Distributor for assistance). |
| P1B4C    | Starter/Generator Hardware Over Voltage | T6                     | The voltage protection hardware inside the starter/generator trips. | PTO and starter/generator is disabled. | 1. Cycle the key switch.  
2. If the fault repeats, replace and program the starter/generator controller (contact an Authorized Toro Distributor for assistance). |
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</table>
| P1B51    | Starter/Generator Hardware Phase Over Current   | T6                     | The current sensor on phase current indicates an internal short. | PTO and starter/generator is disabled. | 1. Cycle the key switch.  
2. If the fault repeats, replace and program the starter/generator controller (contact an Authorized Toro Distributor for assistance). |
| P1B6C    | Starter/Generator Internal Hardware Failure      | T6                     | The hardware phase overcurrent and hardware overvoltage trip. | PTO and starter/generator is disabled. | 1. Cycle the key switch.  
2. If the fault repeats, replace and program the starter/generator controller (contact an Authorized Toro Distributor for assistance). |
| P210E    | Traction Pedal 1 Sensor/Switch Analog vs Analog conflict | SC5                   | The traction pedal sensors report different positions. | Traction is disabled. | 1. Use the InfoCenter Diagnostics > Traction > Inputs screen to observe the traction pedal position sensor operation.  
2. Check the wiring to the sensor connector (P36).  
3. Replace the traction pedal position sensor.  
4. Use the InfoCenter to calibrate the traction pedal. |
| P2503    | Alternator - Charging Too Low                   | T1                     | The TEC senses that the 12V charging system is less than 8.8V. | PTO is disabled. | 1. Test the 15A mini blade style fuse in the 12V fuse holder (under the right side cover).  
2. Test the circuit wiring and connector (P70).  
3. Test the alternator; refer to the Kawasaki FS481V Service Manual. |
| P2504    | Alternator - Charging Too High                  | T1                     | The TEC senses that the 12V charging system is greater than 16.3V. |                     | 1. Test the circuit wiring and connector (P70).  
2. Test the alternator; refer to the Kawasaki FS481V Service Manual. |
| P2530    | Key Start/Run Correlation Fault                 | T1                     | Key start input is active but the key run input is off. | Machine will shut down since key run input is inactive | 1. Use the InfoCenter Diagnostics > Engine > Inputs to verify the key run and key start circuit inputs.  
2. Check the key switch circuit wiring and connectors (P57, P01).  
3. Test the key switch. |
| P2BE8    | Traction Motor Contactor - Open                  | SC5                   | The wheel motor contactor is detected open when it should be closed. | Traction is disabled.  
**Note:** If this fault occurs concurrently with a starter/generator undervoltage fault or system undervoltage related fault, check the key switch. | 1. Check the voltage across the coil of the main contactor with the key On. It should be approximately 48V when the contactor is closed.  
2. Check the voltage across the contactor with the key On. It should be 0V when the contactor is closed.  
3. Test the main contactor. |
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| P2BE9    | Traction Motor Contactor - Closed                | SC5                    | The wheel motor contactor is detected closed when it should be open | Traction is disabled. | 1. Check the voltage across the coil of the main contactor with the key Off. It should be 0V when the contactor is open.  
2. Check the voltage across the contactor with the key Off. It should be 48V when the contactor is open.  
3. Test the main contactor. |
| P2BEA    | Traction Motor Precharge Failure                 | SC5, SC6               | There is a short on the 48V traction bus, too much resistance, or too much capacitance in the indicated traction motor controller. | Traction is disabled. | 1. Check if an external load is installed on the traction 48V bus. If there is, remove it.  
2. Unplug the bus voltage wire of one traction motor at a time (do the controller in charge of the precharge last).  
3. Replace and program the traction motor controller (contact an Authorized Toro Distributor for assistance).  
4. Cycle the key switch.  
5. Use the InfoCenter to calibrate the traction motor controller.  
For SC5, calibrate the traction pedal first, then the traction motors.  
For SC6, calibrate the traction motors. |
| U0110    | CAN Bus Communication Fault - Traction Motor 1   | T1                     | The primary controller never establishes or loses communication with the right side traction motor controller (SC5). | Traction is disabled. | 1. Test the wiring from the controller to the CAN bus.  
2. Verify power to the controller.  
3. Replace and program the traction motor controller (contact an Authorized Toro Distributor for assistance).  
4. Cycle the key switch.  
5. Use the InfoCenter to calibrate the traction pedal first, then the traction motors. |
| U0111    | CAN Bus Communication Fault - Li-ion Battery controller | T1                     | The primary controller never establishes or loses communication with the Li-ion battery controller (SC8). | Machine performance is limited | 1. Test the wiring from the controller to the CAN bus.  
2. Verify power to the controller.  
3. Replace and program the Li-ion battery controller (contact an Authorized Toro Distributor for assistance). |
| U0120    | CAN Bus Communication Fault - Starter/Generator  | T1                     | The primary controller never establishes or loses communication with the starter/generator controller (T6). | PTO and starter/generator is disabled. | 1. Test the wiring from the controller to the CAN bus.  
2. Verify power to the controller.  
3. Replace and program the starter/generator controller (contact an Authorized Toro Distributor for assistance). |
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<tbody>
<tr>
<td>U012A</td>
<td>CAN Bus Communication Fault - Precharge Controller</td>
<td>T1</td>
<td>The primary controller never establishes or loses communication with the precharge controller (T6).</td>
<td>One or more machine functions may be disabled.</td>
<td>1. Check the power supply (fused) to the controller.</td>
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<td></td>
<td>2. Test the CAN bus.</td>
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<td>3. Swap the T6: precharge controller with a known-good unit (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>U0131</td>
<td>CAN Bus Communication Fault - Steering</td>
<td>T1</td>
<td>The primary controller never establishes or loses communication with the steering motor (SC1).</td>
<td>Traction is disabled.</td>
<td>1. Test the wiring from the controller to the CAN bus.</td>
</tr>
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<td>2. Verify power to the controller.</td>
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<td>3. Replace and program the steering motor (contact an Authorized Toro Distributor for assistance).</td>
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<td>4. Cycle the key switch.</td>
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<td>5. Use the InfoCenter to calibrate the steering system – center first, then the steering system – range.</td>
</tr>
<tr>
<td>U0156</td>
<td>CAN Bus Communication Fault - InfoCenter</td>
<td>T1</td>
<td>The primary controller never establishes or loses communication with the InfoCenter (SC7).</td>
<td></td>
<td>1. Test the wiring from the controller to the CAN bus.</td>
</tr>
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<td>2. Check the power supply (fused) to the controller.</td>
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<td>3. Replace and program the InfoCenter (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>U0292</td>
<td>CAN Bus Communication Fault - Traction Motor 2</td>
<td>T1</td>
<td>The primary controller never establishes or loses communication with the left side traction motor controller (SC6).</td>
<td>Traction is disabled.</td>
<td>1. Test the wiring from the controller to the CAN bus.</td>
</tr>
<tr>
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<td>2. Check the power supply (fused) to the controller.</td>
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<td>3. Replace and program the traction motor controller (contact an Authorized Toro Distributor for assistance).</td>
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<td>4. Cycle the key switch.</td>
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<td>5. Use the InfoCenter to calibrate the traction motors.</td>
</tr>
<tr>
<td>U029B</td>
<td>CAN Bus Communication Fault - Traction Motor 3</td>
<td>T1</td>
<td>The primary controller never establishes or loses communication with the optional rear traction motor (T5).</td>
<td>Traction is disabled.</td>
<td>1. Test the wiring from the controller to the CAN bus.</td>
</tr>
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<td>2. Check the power supply (fused) to the controller.</td>
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<td>3. Replace and program the traction motor (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>U0320</td>
<td>Software Version Incompatibility - Steering</td>
<td>T1</td>
<td>The steering firmware is incompatible.</td>
<td>Machine is disabled.</td>
<td>Update machine software (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>U1011</td>
<td>Controller Logic Voltage - High</td>
<td>T1</td>
<td>12V logic circuit voltage is above 16.3V.</td>
<td></td>
<td>1. Check the power supply (fused) to the controller.</td>
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<td></td>
<td>2. Test the 48 VDC/12 VDC converter.</td>
</tr>
<tr>
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<td>Service Actions</td>
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</tbody>
</table>
| U1012   | Controller Logic Voltage - Low | T1, T6 | 12V logic circuit voltage is below 8.8V (T1), or 48V logic circuit voltage is below 32V (T6). | PTO is disabled. | 1. Check the power supply (fused) to the controller.  
2. If the fault is generated by the T1: primary controller, test the 48 VDC/12 VDC converter.  
If the fault is generated by the T6: precharge controller, test the Li-ion batteries. |
| U1025   | TEC (T1 Primary controller) Fuse 5 Failure | T1 | The fuse has failed for outputs 13–16 on the T1: Primary controller. | Connector P01, pin 38, output will not function. | 1. Test the 7.5A mini blade style fuse in the 12V fuse holder (under the right side cover).  
2. Check the fuse holder circuit wiring and connector (P68). |
| U110C   | Model Number Unknown | T1 | The model number not recognized. | Engine is disabled. | Update machine software (contact an Authorized Toro Distributor for assistance). |
| U1117   | Source Address Contention Fault | T1 | The primary controller receives a message from another controller on the CAN bus using the same source address. | Machine is disabled.  
**Note:** Most often, this fault is caused by installing a controller that was programmed while it was installed in another machine. | Update machine software (contact an Authorized Toro Distributor for assistance). |
| U111F   | Source ID - CU Motor ID Out of Range | T1 | Multiple cutting unit motors are reporting the same node ID or address. | PTO is disabled. | 1. Inspect for loose wire or connector.  
2. Test the resistance of the motor ID pin (pin 2 of the 4-pin motor connector). It should be 18k to 20k ohm.  
3. Test the resistance of the CAN ID module. |
| U1121   | 48V Devices Offline | T1 | CAN communication to all 48V devices is lost. | PTO and starter/generator is disabled. | 1. Verify that the 48V disconnect is plugged in.  
2. Test the 48V battery voltage.  
3. Test the CAN bus isolation module and wiring.  
4. Test the 48V logic relay and wiring. |
| U1122   | CAN Bus Communication Fault - CU Motor 1 | T1 | The T1: Primary controller never establishes or loses communication with cutting unit 1 (center). | PTO is disabled. | 1. Test the wiring from the cutting unit motor controller to the CAN bus.  
2. Verify power to the cutting unit.  
3. Swap cutting reel motors between cutting units. Replace and program the motor if the fault moves to the new position (contact an Authorized Toro Distributor for assistance). |
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</table>
| U1123    | CAN Bus Communication Fault - CU Motor 2        | T1                     | The T1: Primary controller never establishes or loses communication with cutting unit 2 (left). | PTO is disabled. | 1. Test the wiring from the cutting unit motor controller to the CAN bus.  
2. Verify power to the cutting unit.  
3. Swap cutting reel motors between cutting units. Replace and program the motor if the fault moves to the new position (contact an Authorized Toro Distributor for assistance). |
| U1124    | CAN Bus Communication Fault - CU Motor 3        | T1                     | The T1: Primary controller never establishes or loses communication with cutting unit 3 (right). | PTO is disabled. | 1. Test the wiring from the cutting unit motor controller to the CAN bus.  
2. Verify power to the cutting unit.  
3. Swap cutting reel motors between cutting units. Replace and program the motor if the fault moves to the new position (contact an Authorized Toro Distributor for assistance). |
| U1128    | CAN Bus Communication Fault - Lift/Lower Motor 1| T1                     | The T1: Primary controller never establishes or loses communication with lift/lower actuator 1 (center). | PTO is disabled. | 1. Test the wiring from the actuator to the CAN bus.  
2. Verify power to the actuator.  
3. Replace and program the actuator (contact an Authorized Toro Distributor).  
4. Cycle the key switch.  
5. Use the InfoCenter to calibrate the lift/lower actuator. |
| U1129    | CAN Bus Communication Fault - Lift/Lower Motor 2| T1                     | The T1: Primary controller never establishes or loses communication with lift/lower actuator 2 (left). | PTO is disabled. | 1. Test the wiring from the actuator to the CAN bus.  
2. Verify power to the actuator.  
3. Replace and program the actuator (contact an Authorized Toro Distributor).  
4. Cycle the key switch.  
5. Use the InfoCenter to calibrate the lift/lower actuator. |
| U112A    | CAN Bus Communication Fault - Lift/Lower Motor 3| T1                     | The T1: Primary controller never establishes or loses communication with lift/lower actuator 3 (right). | PTO is disabled. | 1. Test the wiring from the actuator to the CAN bus.  
2. Verify power to the actuator.  
3. Replace and program the actuator (contact an Authorized Toro Distributor).  
4. Cycle the key switch.  
5. Use the InfoCenter to calibrate the lift/lower actuator. |
| U1140    | CAN Bus Communication Fault - Battery Cell Module| SC8                   | The SC8: Li-ion battery controller never establishes or loses communication with one of the Li-ion batteries. | Battery contactor in Li-ion battery controller is opened. | 1. Check the communication cable connections and harness between all batteries and the T6: Li-ion battery controller.  
2. One of the Li-ion batteries is damaged (contact your Authorized Toro Distributor for assistance). |
## Machine Faults (continued)

<table>
<thead>
<tr>
<th>Fault ID</th>
<th>Fault Title</th>
<th>Controller(s) Affected</th>
<th>Fault Condition/Circuit Description</th>
<th>Additional Notes</th>
<th>Service Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>U1301</td>
<td>Software Version Incompatibility - CU Motor 1</td>
<td>T1</td>
<td>The cutting unit 1 (center) software is incompatible.</td>
<td>Engine is disabled.</td>
<td>Update machine software (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>U1302</td>
<td>Software Version Incompatibility - CU Motor 2</td>
<td>T1</td>
<td>The cutting unit 2 (left) software is incompatible.</td>
<td>Engine is disabled.</td>
<td>Update machine software (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>U1303</td>
<td>Software Version Incompatibility - CU Motor 3</td>
<td>T1</td>
<td>The cutting unit 3 (right) software is incompatible.</td>
<td>Engine is disabled.</td>
<td>Update machine software (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>U1304</td>
<td>Software Version Incompatibility - Lift/Lower Motor 1</td>
<td>T1</td>
<td>The lift/lower actuator 1 (center) software is incompatible.</td>
<td>Engine is disabled.</td>
<td>Update machine software (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>U1305</td>
<td>Software Version Incompatibility - Lift/Lower Motor 2</td>
<td>T1</td>
<td>The lift/lower actuator 2 (left) software is incompatible.</td>
<td>Engine is disabled.</td>
<td>Update machine software (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>U1306</td>
<td>Software Version Incompatibility - Lift/Lower Motor 3</td>
<td>T1</td>
<td>The lift/lower actuator 3 (right) software is incompatible.</td>
<td>Engine is disabled.</td>
<td>Update machine software (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>U1307</td>
<td>Software Version Incompatibility - Starter/Generator</td>
<td>T1</td>
<td>The starter/generator software is incompatible.</td>
<td>Engine is disabled.</td>
<td>Update machine software (contact your Authorized Toro Distributor for assistance)</td>
</tr>
<tr>
<td>U1308</td>
<td>Software Version Incompatibility - Precharge Controller</td>
<td>T1</td>
<td>The precharge controller 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>T1</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>U130B</td>
<td>Software Version Incompatibility - Traction Motor 1</td>
<td>T1</td>
<td>The right side traction motor controller (SC5) firmware is incompatible</td>
<td>Machine is disabled.</td>
<td>Update machine software (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>U130C</td>
<td>Software Version Incompatibility - Traction Motor 2</td>
<td>T1</td>
<td>The left side traction motor controller (SC6) firmware is incompatible</td>
<td>Machine is disabled.</td>
<td>Update machine software (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>U130D</td>
<td>Software Version Incompatibility - Traction Motor 3</td>
<td>T1</td>
<td>The 3WD drive motor (T5) firmware is incompatible</td>
<td>Machine is disabled.</td>
<td>Update machine software (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>Fault ID</td>
<td>Fault Title</td>
<td>Controller(s) Affected</td>
<td>Fault Condition/Circuit Description</td>
<td>Additional Notes</td>
<td>Service Actions</td>
</tr>
<tr>
<td>---------</td>
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</tr>
<tr>
<td>U130E</td>
<td>Software Version Incompatibility - Processor Mismatch</td>
<td>SC5, SC6, SC7</td>
<td>The software is incompatible in the component indicated.</td>
<td>Traction is disabled.</td>
<td>Update machine software (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>U130F</td>
<td>Software Version Incompatibility - Unknown</td>
<td>T1</td>
<td>The T1: Primary controller has detected an incompatible software version.</td>
<td>Machine is disabled.</td>
<td>Update machine software (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>U1311</td>
<td>Software Version Incompatibility - Li-ion Battery Controller</td>
<td>T1</td>
<td>The Li-ion battery controller (SC8) software is incompatible.</td>
<td>Machine is disabled.</td>
<td>Update machine software (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>U1501</td>
<td>48V System Logic Voltage - High</td>
<td>T1</td>
<td>Three or more components on the machine are reporting a Logic Voltage - High fault.</td>
<td>PTO and the generator function of the starter/generator is disabled.</td>
<td>1. Test the 48V batteries. 2. Verify that all starter/generator motor-to-controller connections are good. 3. Test the starter/generator (test procedure pending). 4. Replace and program the starter/generator (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>U1502</td>
<td>48V System Logic Voltage - Low</td>
<td>T1</td>
<td>Three or more components on the machine are reporting a Logic Voltage - Low fault.</td>
<td>PTO and the generator function of the starter/generator is disabled.</td>
<td>1. Test the 48V batteries with the engine Off. 2. Test the 48V logic relay and wiring. 3. Verify that all starter/generator motor-to-controller connections are good. 4. Test the starter/generator (test procedure pending). 5. Replace and program the starter/generator (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>U1511</td>
<td>48V System Bus Voltage - High</td>
<td>T1</td>
<td>Three or more components on the machine are reporting a Bus Voltage - High fault.</td>
<td>PTO and the generator function of the starter/generator is disabled.</td>
<td>1. Test the 48V batteries. 2. Verify that all starter/generator motor-to-controller connections are good. 3. Test the starter/generator (test procedure pending). 4. Replace and program the starter/generator (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>Fault ID</td>
<td>Fault Title</td>
<td>Controller(s) Affected</td>
<td>Fault Condition/Circuit Description</td>
<td>Additional Notes</td>
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</tr>
<tr>
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</tr>
</tbody>
</table>
| U1512   | 48V System Bus Voltage - Low | T1                     | Three or more components on the machine are reporting a Bus Voltage - Low fault. | PTO and the generator function of the starter/generator is disabled.             | 1. Test the 100A, 58V fuse.  
2. Test the 48V batteries with the engine Off.  
3. Test the 48V logic relay and wiring.  
4. Verify that all starter/generator motor-to-controller connections are good.  
5. Test the starter/generator (test procedure pending).  
6. Replace and program the starter/generator (contact an Authorized Toro Distributor for assistance).                                                                 |
| U1700   | Board Internal Error - IPE   | T6                     | Inputs or outputs in the T6: precharge controller are not working correctly.   | Machine is disabled                                                              | 1. Test the power supply (fused) at the controller.  
2. Test the ground at the controller.  
3. Swap the T6: precharge controller with a known-good unit (contact an Authorized Toro Distributor for assistance).                                                                                           |
| U1701   | Board Internal Error - IPE   | T1                     | Inputs or outputs in the T1: primary controller are not working correctly.     | Machine is disabled                                                              | 1. Test the 12V battery voltage.  
2. Swap the T1: primary controller with a known-good unit (contact an Authorized Toro Distributor for assistance).                                                                                           |
Using the InfoCenter Display for Troubleshooting

The InfoCenter Splash Screen and Main Information Screen can be used to check the operation of various components. The neutral, parking brake, and seat icons represent the switch activity and can be used to verify the switch and its circuit wiring integrity. The battery icon can be used to check battery voltage and circuit wiring integrity.

The Diagnostics - Input and 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 screens prior to testing the component individually. The screens can show the current state of the inputs and the outputs required to allow a machine operation to proceed, or report electrical performance (voltage or current) of a specific component. Refer to InfoCenter (page 5–10) for a guide to the various InfoCenter screens.

⚠️ **CAUTION** ⚠️

It may be necessary to start and run the engine, raise and lower the cutting units, 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 the cutting units if possible and stop engine.
2. Set the key switch to the Run position and navigate to the InfoCenter Diagnostics > Input or Output Screen for the desired machine function.
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 operated. 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 Testing the Electrical Components (page 5–23) and Appendix A (page A–1).

**Note:** – – – means no signal from the input is available on the CAN bus and the input or the CAN bus 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 is reported. If the inputs are properly positioned and the output remains OFF or the control amperage is not as expected, a problem with controller output 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 Testing the Electrical Components (page 5–23) and Appendix A (page A–1).

**TRACTION (example):**

Using the Inputs Screen
TRACTION (example): (continued)

- Depress the traction pedal in the forward direction slowly. Pedal Fwd should change from OFF to ON, Pedal Sig 1 voltage should increase, and Pedal Sig 2 voltage should decrease as the pedal is depressed forward. If not, the traction pedal or its circuit wiring is faulty and should be tested.

- Depress the traction pedal in the reverse direction slowly. Pedal Rev should change from OFF to ON, Pedal Sig 1 voltage should decrease, and Pedal Sig 2 voltage should increase as the pedal is depressed rearward. If not, the traction pedal or its circuit wiring is faulty and should be tested.

- When the traction pedal is released, the pedal should return to neutral as indicated by both Pedal Fwd and Pedal Rev being OFF. If not, the traction pedal may require re-calibration.

- TRXN 1 Logic V, TRXN 2 Logic V, and TRXN 3 Logic V (if equipped with optional 3WD) should each display 48V system voltage. If not, an issue with the logic circuit wiring or the logic relay may exist.

- When the vehicle is stationary, TRXN 1 Speed, TRXN 2 Speed, and TRXN 3 Speed (if equipped with optional 3WD) should display 0.0 mph/kph. When the vehicle is traveling in a straight line, the traction speeds displayed should be approximately the same. If not, the traction motors may require re-calibration.

- TRXN 3 Bus V (if equipped with optional 3WD) should display 48V system voltage. If not, an issue with the power supply circuit wiring to the optional 3WD motor may exist.

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.

- Once the required conditions are satisfied (operator in the seat and manual parking brake disengaged), Pbrake Release should be ON, indicating the automatic parking brake is disengaged (brake actuator energized). If the operator raises out of the seat or the manual parking brake is engaged, Pbrake Release should be OFF, indicating the automatic parking brake is engaged (brake actuator de-energized). If the output reading is appropriate and the vehicle does not perform correctly, the brake actuator or its circuit wiring may be faulty and should be tested.
Troubleshooting

CAUTION

Remove all jewelry, especially rings and watches, before doing any electrical troubleshooting or testing. Disconnect the battery cables unless the test requires battery voltage. Model 04580 machines have a separate batteries for the 12 VDC system and the 48 VDC system.

For effective troubleshooting and repairs, you must have a good understanding of the electrical circuits and components that are used on this machine; refer to the Electrical Schematics in Appendix A (page A–1).

If the machine has any interlock switches that are bypassed, connect the switches for correct troubleshooting and safety.
General Operation Problems (Model 04580)

Many aspects of machine and component operation are visible using the InfoCenter; refer to Using the InfoCenter Display for Troubleshooting (page 3–39). Machine faults may also appear on the InfoCenter display to assist in troubleshooting.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nothing happens when the key switch is set to the ON position</td>
<td>A fuse or the circuit wiring is damaged.</td>
<td>Test the 15A fuse located in fuse holder 1 under the right side cover.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Test the 7.5A fuse located in fuse holder 2 under the right side cover.</td>
</tr>
<tr>
<td></td>
<td>The key switch or circuit wiring is damaged.</td>
<td>Test the key switch.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The battery cables are corroded or damage. Clean, repair, or replace the cables as necessary.</td>
</tr>
<tr>
<td></td>
<td>The 12V AGM battery is discharged or damaged.</td>
<td>Charge the battery and replace if necessary.</td>
</tr>
<tr>
<td>The engine cranks but does not start.</td>
<td>The fuel level is low.</td>
<td>Fill the fuel tank.</td>
</tr>
<tr>
<td></td>
<td>The fuel pump is damaged.</td>
<td>Test the fuel pump; refer to the Kawasaki engine Service Manual.</td>
</tr>
<tr>
<td></td>
<td>A fuel hose is restricted or damaged.</td>
<td>Repair, or replace the fuel hoses necessary.</td>
</tr>
<tr>
<td></td>
<td>The fuel solenoid or circuit wiring is damaged.</td>
<td>Test the fuel solenoid; refer to the Kawasaki engine Service Manual.</td>
</tr>
<tr>
<td></td>
<td>The engine relay or circuit wiring is damaged (ignition circuit remains grounded).</td>
<td>Test the engine relay and replace if necessary.</td>
</tr>
</tbody>
</table>
For eTriFlex 3370 (model 04590) machines, a series of events occur to power up the machine prior to operating the machine steering, traction, lift/lower, and cutting unit functions. The events are explained here to assist with troubleshooting a machine that does not power up correctly. Many aspects of machine operation are visible for troubleshooting using the InfoCenter; refer to Using the InfoCenter Display for Troubleshooting (page 3–39). Machine faults may also appear on the InfoCenter display to assist in troubleshooting. If a machine has an issue that prevents the InfoCenter from powering up, the InfoCenter will not be available to further troubleshoot the machine. The events in bold must occur to power up the InfoCenter display.

**Key Switch in the Off Position:**
- A signal wire from the SC8: Lithium-ion battery controller (BMS) Pack Sig+ terminal provides a low current 48 VDC signal to the key switch D terminal.
- With the exception of the lithium-ion battery cables, the Pack Sig+ signal wire carries the only live voltage on the machine when the key switch is in the Off position.

**Key Switch Set to the On position:**

1. **Key switch terminals D and E close:**
   - **The Pack Sig+ signal voltage passes through the key switch to the BMS Ignition terminal to wake the BMS.**
   - **The BMS quickly polls the lithium-ion batteries condition. If the batteries are within specification, the BMS energizes an internal contactor to supply 48V battery power through the supply cables to the 48V battery disconnect.** Listen for the “Click” from the BMS to quickly confirm internal contactor operation.

2. **The 48V battery disconnect must be connected:**
   - **48V power passes through the 175A mega fuse located below the battery disconnect.**
   - **48V should be available at the T6: precharge controller Logic input (connector P03 pin 6) to wake up the precharge controller.**
   - **48V should pass through the 5A fuse in the 48V fuse block under the operator’s seat and be available at terminal 30 of the logic relay (connector P47 pin 1).**
   - **48V bus should pass through the 30A fuse in the 48V fuse block under the operator’s seat and be available to power the SC7: steering motor (connector P46 pins 3, 4 and 5). This is the 48V bus power supply for the steering motor controller.**
   - **48V power should be available at the main contactor and the traction motor contactor E terminal (left side main terminal).**
   - **48V should pass through the 10A fuse in the 48V fuse block under the operator’s seat and be available at terminal 86 of the shutdown delay relay (connector P13 pin 5).**
   - **48V should pass through the 10A fuse in the 48V fuse block under the operator’s seat and be available at the 48 VDC/12 VDC converter input (connector P07 pin 4). If the converter is functioning properly, 12V should become available at the 48 VDC/12 VDC converter output (connector P07 pin 2).**
   - **12V should pass through the 15A fuse in 12V fuse holder 1 under the right side cover and be available at terminal 30 of the shutdown delay relay (connector P13 pin 1).**
   - **If the 15A fuse in 12V fuse holder 1 is functioning, 12V should pass through the 2V fuse in 12V fuse holder 1 and be available at the T1: primary controller Logic input (connector P01 pin 40) to wake up the primary controller.**

3. **Key switch terminals B and C close (creating a path to ground):**
   - **The key switch provides a path to ground for the T6: precharge controller Key Start and Key Run inputs (connector P02 pins 1 and 2). These connections allow the precharge controller to start the precharge function.**
   - **The key switch provides a path to ground for terminal 85 of the shutdown delay relay (connector P13 pin 2), energizing the relay coil.**
General Operation Problems (Model 04590) (continued)

Note: With the exception of 12V power to the T1: primary controller Logic input, 12V control system power is made available to the machine through the shutdown delay relay.

- 12V should pass through the 2A fuse in 12V fuse holder 2 under the right side cover and be available at the telematics connector (connector P71 pin 2).
- 12V should pass through the 10A fuse in 12V fuse holder 2 under the right side cover and be available at terminal 30 of the brake actuator relay (connector P75 pin 1).
- 12V should pass through the 7.5A fuse in 12V fuse holder 2 under the right side cover and be available at the InfoCenter Display (connector P52 pin 2), the CAN bus isolation module (connector P50 pin A), the parking brake switch (connector P06 pin A), the T1: primary controller PWR 2 and PWR 5 terminals (connector P01 pins 9 and 37), and the T1: primary controller Key Run input (connector P01 pin 25 and 37).

C. The T1: primary controller output OUT 1 supplies power to the logic relay. 12V should be available at terminal 86 of the logic relay (connector P47 pin 5) energizing the relay coil.

- 48V logic power should be available at the T2: cutting unit 1 (center) motor controller (connector P24 pin 1), T3: cutting unit 2 (left) motor controller (connector P26 pin 1), and T4: cutting unit 3 (right) motor controller (connector P22 pin 1).
- 48V logic power should be available at the optional T5: traction 3 motor controller (connector P19 pin 1).
- 48V logic power should be available at the SC2: lift/lower 1 (center) actuator controller (connector P62 pin 2), SC3: lift/lower 2 (left) actuator controller (connector P61 pin 2), and SC4: lift/lower 3 (right) actuator controller (connector PX59 pin 2).
- 48V logic power should be available at the SC7: steering motor/controller (connector P46 pin 15).
- 48V logic power should be available at the SC5: traction 1 (right) motor controller (connector P35 pin 10), and SC6: traction 2 (left) motor controller (connector P34 pins 10 and 32).
- 48V power should be available at the SC6: precharge controller Precharge input (connector P02 pin 6).
- 48V power should be available at the main contactor and the traction motor contactor H terminal (lower coil terminal).

D. The T6: precharge controller Precharge output supplies controller precharge power to the T2: cutting unit 1 (center) motor controller, T3: cutting unit 2 (left) motor controller, T4: cutting unit 3 (right) motor controller, and the optional T5: traction 3 motor controller.

E. If precharge is successful, the T1: primary controller sends a CAN message to the T6: precharge controller to close the main contactor. The precharge controller uses the output OUT 2 to provide a path to ground for the main contactor B terminal (right side main terminal) to energize the contactor coil. Listen for the “Click” from the main contactor to quickly confirm contactor operation. 48V bus power should be available at the cutting unit motor controllers, the optional 3WD traction motor controller, and at the lift/lower actuator controllers.

F. If the steering and traction systems are calibrated, the SC5: traction 1 (right) motor controller will close the traction motor contactor. The traction motor controller uses the output NMC to provide a path to ground for the traction motor contactor B terminal (right side main terminal) to energize the contactor coil. Listen for the “Click” from the traction motor contactor to quickly confirm contactor operation. 48V bus power should be available at each of the front traction motor controllers.
### General Operation Problems (Model 04590) (continued)

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nothing happens when the key switch is set to the ON position</td>
<td>The 48V battery disconnect is not connected or is connected to the battery charger.</td>
<td>Connect the 48V battery disconnect.</td>
</tr>
<tr>
<td></td>
<td>The lithium-ion battery controller (BMS) is not communicating with all of the lithium-ion batteries via the battery interface harness.</td>
<td>Ensure the battery interface harness is not damaged and that all battery interface harness connections are clean and secure.</td>
</tr>
<tr>
<td></td>
<td>The key switch or circuit wiring is damaged.</td>
<td>Test the key switch</td>
</tr>
<tr>
<td></td>
<td>The main fuse or circuit wiring is damaged.</td>
<td>Test the 175A mega fuse located below the battery disconnect.</td>
</tr>
<tr>
<td></td>
<td>The 48V shutdown delay relay fuse or circuit wiring is damaged.</td>
<td>Test the 10A fuse in the 48V fuse block under the operator’s seat.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check for 48 VDC at the shutdown delay relay (connector P13 pin 5).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check for ground at the shutdown delay relay (connector P13 pin 2).</td>
</tr>
<tr>
<td></td>
<td>The 48V 48 VDC/12 VDC converter fuse or circuit wiring is damaged.</td>
<td>Test the 10A fuse in the 48V fuse block under the operator’s seat.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check for 48 VDC at the 48 VDC/12 VDC converter (connector P07 pin 4).</td>
</tr>
<tr>
<td></td>
<td>The 12V shutdown delay relay fuse or circuit wiring is damaged.</td>
<td>Test the 15A fuse in the 12V fuse holder 1 under the right side cover.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check for 12 VDC at the shutdown delay relay (connector P13 pin 1).</td>
</tr>
<tr>
<td></td>
<td>The 12V control system fuse or circuit wiring is damaged.</td>
<td>Test the 7.5A fuse in the 12V fuse holder 2 under the right side cover.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check for 12 VDC at the InfoCenter Display (connector P52 pin 2).</td>
</tr>
<tr>
<td></td>
<td>The shutdown delay relay is damaged.</td>
<td>Test the shutdown delay relay and replace if necessary.</td>
</tr>
<tr>
<td></td>
<td>The 48 VDC/12 VDC converter is damaged.</td>
<td>Test the 48 VDC/12 VDC converter and replace if necessary.</td>
</tr>
<tr>
<td></td>
<td>The SC8: lithium-ion battery controller (BMS) is damaged.</td>
<td>Replace and reprogram the lithium-ion battery controller (contact an Authorized Toro Distributor for assistance).</td>
</tr>
</tbody>
</table>
Aftercut Appearance

There are a number of factors that can contribute to unsatisfactory quality of cut, some of which may be turf conditions. Turf conditions such as excessive thatch, “sponginess” or attempting to cut off too much grass height may not always be overcome by adjusting the cutting unit. It is important to remember that the lower the height-of-cut, the more critical these factors are.

Refer to the Cutting Unit Operator’s Manual detailed adjustment procedures. Refer to Chapter 7: DPA Cutting Units (page 7–1) for cutting unit repair information.

**Note:** For additional information regarding cutting unit troubleshooting, a number of Reel Mower and Aftercut Appearance General Training Books can be found on the Service Reference Set available from your Authorized Toro Distributor.

### Factors That Can Affect Quality of Cut

<table>
<thead>
<tr>
<th>Factor</th>
<th>Possible Problem/Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tire pressure</td>
<td>Check tire pressure of all traction unit tires. Adjust tire pressure as necessary.</td>
</tr>
<tr>
<td>Engine RPM and mow speed</td>
<td>For best cutting performance and appearance, the engine should be run at high idle speed while cutting. Check and adjust the high idle speed as necessary; refer to the Traction Unit Operator’s Manual. Use the traction pedal linkage to adjust the actual mow speed; refer to Traction Unit Operator’s Manual.</td>
</tr>
<tr>
<td>Reel speed</td>
<td>Use a non-contact tachometer (phototach) to verify reel speed. Make sure that the reel speed setting is correct for the number of blades and mow speed used; refer to the Traction Unit Operator’s Manual.</td>
</tr>
<tr>
<td>Bedknife to reel adjustment</td>
<td>Check the bedknife to reel contact daily. The bedknife must have light contact across the entire reel. No contact will dull the cutting edges. Excessive contact accelerates wear of both edges. Quality of cut is adversely affected by both conditions.</td>
</tr>
<tr>
<td>Reel and bedknife sharpness</td>
<td>A reel and/or bedknife that has rounded cutting edges or rifling (grooved or wavy appearance) cannot be corrected by tightening the bedknife to reel contact. Grind the reel to remove taper and/or rifling. Grind the bedknife to sharpen and/or remove rifling. The most common cause of rifling is bedknife to reel contact that is too tight. A new bedknife must be ground or backlapped after installation to the bedbar. Refer to Grinding the Bedknife (page 7–12) for grinding information or the Traction Unit Operator’s Manual for backlapping information.</td>
</tr>
<tr>
<td>Rear roller level</td>
<td>Reel and rear roller should be parallel for proper cutting performance; refer to Leveling the Rear Roller (page 7–4).</td>
</tr>
<tr>
<td>Height-of-cut</td>
<td>Effective or actual height-of-cut depends on the mower weight and turf conditions. Effective height-of-cut will be different than the bench set height-of-cut.</td>
</tr>
<tr>
<td>Proper bedknife for height-of-cut desired</td>
<td>If the bedknife is too thick for effective height-of-cut, poor quality of cut will result.</td>
</tr>
<tr>
<td>Stability of bedbar</td>
<td>Ensure that the bedbar pivot bolts are securely seated; refer to Bedbar Assembly (page 7–6).</td>
</tr>
<tr>
<td>Number of reel blades</td>
<td>Use correct number of blades for clip frequency and optimum height-of-cut range.</td>
</tr>
<tr>
<td>Reel bearing condition</td>
<td>Check and replace the reel bearings if necessary; refer to Reel Assembly (page 7–14).</td>
</tr>
</tbody>
</table>
Factors That Can Affect Quality of Cut (continued)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Possible Problem/Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutting unit alignment and ground following</td>
<td>Check cutting unit stabilizer springs and suspension ball joints for damage, binding condition, or wear. The ball joint base has a slip fit condition with reference to the suspension, and should be free to rotate. Repair if necessary.</td>
</tr>
<tr>
<td>Roller type and condition</td>
<td>A variety of cutting unit rollers are available. Refer to the Cutting Unit Parts Manual for a listing of available accessories, or contact your local Authorized Toro Distributor for additional information. Ensure that the rollers rotate freely. Repair the roller bearings if necessary; refer to Roller Assemblies (page 7–23).</td>
</tr>
<tr>
<td>Cutting unit accessories</td>
<td>A variety of cutting unit accessories are available that can be used to enhance aftercut appearance. Refer to the Cutting Unit Parts Manual for a listing of available accessories, or contact your local Authorized Toro Distributor for additional information.</td>
</tr>
</tbody>
</table>
Grooming Performance

There are a number of factors that can affect the performance of grooming. These factors vary for different golf courses and from green to green. It is important to inspect the turf frequently and vary the grooming practice with turf needs.

---

**IMPORTANT**

Improper or overaggressive use of the groomer (e.g., too deep or too frequent grooming) may cause unnecessary stress on the turf leading to severe turf damage. Use the groomer carefully. Read and understand the groomer operation instructions before operating or testing the groomer performance.

---

It is important to remember that the same factors that affect quality of cut also affect grooming performance.

**Variables that Affect the Use and Performance of the Groomer:**

1. The growing season and weather conditions.
2. General turf conditions.
3. The frequency of grooming/cutting—number of cuttings per week and how many passes per cutting.
4. The height-of-cut.
5. The grooming depth.
6. The type of grass.
7. The amount of time that a groomer reel has been in use on a particular turf area.
8. The amount of traffic on the turf.
9. The overall turf management program—irrigation, fertilizing, weed control, coring, over-seeding, sand dressing, disease control, and pest control.
10. Stress periods for turf—high temperatures, high humidity, and unusually high traffic.
<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>The groomer reel does not rotate.</td>
<td>The groomer drive is in neutral.</td>
<td>Engage the groomer drive to forward or reverse.</td>
</tr>
<tr>
<td></td>
<td>The groomer drive gears are damaged or seized.</td>
<td>Repair the groomer drive.</td>
</tr>
<tr>
<td></td>
<td>The drive between the groomer and the reel has separated.</td>
<td>Repair the groomer drive.</td>
</tr>
<tr>
<td>The turf is damaged or has uneven grooming.</td>
<td>The groomer is set too aggressively.</td>
<td>Refer to groomer Installation Instructions for groomer set-up information.</td>
</tr>
<tr>
<td></td>
<td>The groomer reel blades are bent, damaged, or missing.</td>
<td>Repair or replace the blades if necessary.</td>
</tr>
<tr>
<td></td>
<td>The groomer reel shaft is bent or damaged.</td>
<td>Replace the groomer reel shaft.</td>
</tr>
<tr>
<td></td>
<td>Grooming depth is not equal on both ends of the groomer reel.</td>
<td>Adjust the depth if necessary. Check and adjust the cutting unit set up (level bed knife to reel, level rear roller to reel, set the height-of-cut, etc.).</td>
</tr>
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</table>
Battery Charger Error and Fault Codes (Model 04590)

If a battery charger error or fault appears, additional information may be available by disconnecting the charger, connecting the batteries to the machine, and using the machine InfoCenter to check for any active machine faults.

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<tr>
<th>Problem</th>
<th>Possible Cause</th>
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</thead>
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<tr>
<td>Codes E-0-0-1, or E-0-4-7</td>
<td>Battery high voltage</td>
<td>Ensure that the battery voltage is correct and the cable connections are secure.</td>
</tr>
<tr>
<td>Code E-0-0-4</td>
<td>Lithium-ion battery controller (BMS) or battery fault detected</td>
<td>Forward a copy of the battery output file (.BDS) to Toro Service (contact an Authorized Toro Distributor for assistance).</td>
</tr>
<tr>
<td>Code E-0-0-7</td>
<td>Battery amp hour limit exceeded</td>
<td>Check all battery cable connections for corrosion or damage. Clean and repair battery connections as necessary.</td>
</tr>
<tr>
<td>Code E-0-1-2</td>
<td>Reverse polarity error</td>
<td>Ensure that the battery cables are connected correctly and that the cable connections are clean and secure.</td>
</tr>
<tr>
<td>Code E-0-2-3</td>
<td>High AC voltage error (greater than 270 VAC)</td>
<td>Connect the charger to an AC power source that provides stable AC power between 85 - 270 VAC at 45-65 Hz.</td>
</tr>
<tr>
<td>Code E-0-2-4</td>
<td>Charger failed to initialize</td>
<td>Disconnect the charger AC input and battery connections for 30 seconds, then reconnect the charger.</td>
</tr>
<tr>
<td>Code E-0-2-5</td>
<td>Low AC voltage oscillation error</td>
<td>The charger requires an AC power source that provides stable AC power between 85 - 270 VAC at 45-65 Hz. Confirm the AC power supply capacity and verify AC input cable gauge.</td>
</tr>
<tr>
<td>Code E-0-3-7</td>
<td>Re-programming failed</td>
<td>Software upgrade failure or script operation failure. Ensure that the new software is correct.</td>
</tr>
<tr>
<td>Codes E-0-2-9, E-0-3-0, E-0-3-2, E-0-4-6, or E-0-6-0</td>
<td>Communication error with battery</td>
<td>Ensure that the connection of the signal wires to each battery is clean and secure.</td>
</tr>
<tr>
<td>Codes F-0-0-1, F-0-0-2, F-0-0-3, F-0-0-4, F-0-0-5, F-0-0-6, or F-0-0-7</td>
<td>Internal charger fault</td>
<td>Remove the charger AC connection and battery connection for a minimum of 30 seconds, then reconnect the charger.</td>
</tr>
</tbody>
</table>

The battery charger may require replacement (contact an Authorized Toro Distributor for assistance).
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Additional Reference Materials

Kawasaki FS481V Service Manual
This chapter provides information about the gasoline engine used in the Greensmaster eTriFlex machine. The general maintenance procedures are described in the engine Operator’s Manual. Detailed information on engine troubleshooting, testing, disassembly, and assembly is identified in the Kawasaki FS481V Service Manual.

Most repairs and adjustments require tools which are commonly available in many service shops. Special tools are described in the Kawasaki FS481V 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 Kawasaki FS481V engines are supplied through your local Toro Distributor. If no parts list is available, be sure to provide your distributor with the Toro model and serial number along with the engine model and serial number.

**Traction Unit Operator’s Manual**

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

**Kawasaki Owner’s Manual**

The engine that powers the Greensmaster eTriFlex machine is a Kawasaki Model FS481V engine. A copy of the Kawasaki FS481V Owner’s Manual is supplied with the machine. Additional copies of the engine Owner’s Manual are available for download at www.kawasakienginesusa.com.

**Kawasaki Service Manual**

The engine that powers the Greensmaster eTriFlex machine is a Kawasaki Model FS481V engine. The Kawasaki FS481V Service Manual is available for this engine. Ensure that the correct engine manual is used when servicing the engine on your machine.
Service and Repairs

Fuel Tank

1. Clamp (4 each)  6. Stand pipe  11. Carriage bolt (4 each)
2. Flange nut (4 each)  7. Cap screw  12. Foam pad (4 each)
5. Vent fitting  10. Hose clamp (2 each)  15. Push nut (4 each)
DANGER

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

CAUTION

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

Removing the Fuel Tank

Refer to Figure 9 for this procedure.

1. Park the machine on a level surface, lower the cutting units, shut off the engine, remove the key from the key switch and unplug the 48V battery disconnect.
2. Open or remove the hood; refer to Removing and Installing the Hood Assembly (page 6–43).
3. Close the fuel shut-off valve.
4. Allow the engine to completely cool.
5. Use a siphon or pump to empty the fuel tank.
6. Disconnect the fuel vent hose and fuel supply hose from the top of the fuel tank.
7. Lift the evaporative control system carbon canister from its bracket on the fuel tank.
8. Remove the four flange nuts and clamps securing the fuel tank to the vehicle frame and remove the fuel tank.
9. Inspect the foam pads at the fuel tank mounts and replace them if damaged.

Installing the Fuel Tank

Refer to Figure 9 for this procedure.

1. Secure the fuel tank to the vehicle frame with the clamps and flange nuts previously removed.
2. Secure the evaporative control system carbon canister in its bracket on the fuel tank.
3. Connect the fuel supply hose to the top of the fuel tank and secure with the hose clamp.
4. Connect the fuel vent hose to the top of the fuel tank and secure with the hose clamp. Make sure that the hose is not kinked or obstructed.
Installing the Fuel Tank (continued)

5. Check the fuel tank position and adjust if necessary:
   A. Install and lower the hood.
   B. The fuel tank should be aligned (square) with the front edge of the hood.
   C. Loosen the fuel tank clamps and adjust the tank position if necessary.
   D. Ensure the engine does not contact the back of the fuel tank and tighten the fuel tank clamp fasteners.

6. Fill the fuel tank with fuel and open the fuel shut-off valve.

7. Connect the 48V battery disconnect.

8. Start the engine and check the fuel system for leaks. Repair any leaks as necessary before returning the machine to service.

Checking the Fuel Lines and Connections

Figure 10
(shown with evaporative control system removed)

1. Fuel shut-off valve  
2. Fuel filter  
3. Fuel pump  
4. Clamp

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.
Evaporative Control System

Greensmaster eTriFlex model 04580 machines are equipped with a fuel evaporative control system designed to collect and store evaporative emissions from the fuel tank. The evaporative control system uses a carbon canister and a series of vent hoses to collect these evaporative emissions. The fuel tank uses a non-vented fuel cap. A fuel tank vent fitting is positioned in the top of the tank that allows tank venting through a carbon canister mounted on the fuel tank. Fuel vapors from the fuel tank are vented to the canister and consumed by the engine when the engine is running.

A vacuum control valve located near the air intake tube is used to control evaporative emission flow through the system. The carbon canister is connected to both the fuel tank vent and the vacuum control valve. When the engine is running, engine intake vacuum unseats the vacuum control valve which then allows vapors from the canister to flow to the engine air intake tube. These vapors are then consumed during engine operation. When the engine is not running, evaporative vapors remain in the fuel tank and carbon canister.

**Note:** If there is restriction in the carbon canister, the fuel tank vent fitting or the vent hose, the fuel tank may distort due to venting issues. If the fuel tank returns to it’s normal shape when the fuel cap is removed, restriction in the evaporative control system is likely.

1. Inspect the carbon canister and attached hoses for damage or leaks. A damaged or leaking canister should be replaced.
2. Ensure the fresh air filter below the carbon canister is not blocked.
3. Ensure all evaporative control system hoses are not kinked or pinched and are secured at each end with hose clamps.

|-----------|------------------------|--------------|-------------------------------|-----------------|-------------|----------------------------------|-------------------|-----------|---------|
Evaporative Control System (continued)

4. Test the operation of the vacuum control valve. The valve should open (allow flow between ports A and B) when 21 to 29 mm Hg (0.8 to 1.1 inch Hg) vacuum is applied to port C.

5. Repair or replace evaporative system components as necessary.
Cooling System

Figure 12
1. Screen guard
2. Rotating screen (under screen guard)
3. Blower housing
4. Air ducts (in hood)
5. Air duct screen (in hood)

IMPORTANT

The engine that powers the eTriFlex model 04580 machine is air-cooled. Operating the engine with dirty or plugged cooling fins, a blocked screen guard or rotating screen, a plugged or dirty blower housing, or plugged intake screens or ducts in the hood may result in the engine overheating and cause engine damage.

To ensure proper engine cooling, make sure the screen guard, rotating screen, cooling fins and other external surfaces of the engine are kept clean at all times. Perform the following maintenance procedure at the interval specified in the traction unit Operator’s Manual.

1. Park the machine on a level surface, lower the cutting units, shut off the engine, remove the key from the key switch and unplug the 48V battery disconnect.
CAUTION

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

IMPORTANT

Never clean engine with pressurized water. Water could enter and contaminate the fuel system.

2. Carefully clean the area around the cooling fins on both cylinder heads.
3. Clean the screen guard and blower housing of dirt and debris
4. If necessary, remove the screen guard from the blower housing and clean the rotating screen that is attached to the flywheel.
5. If necessary, remove the blower housing from the engine for complete cooling system cleaning.

IMPORTANT

Never operate engine without the blower housing installed. Overheating and engine damage may result.

6. Make sure rotating screen, blower housing and screen guard are reinstalled to the engine if removed.
7. Clean any debris from the screens and air ducts in the hood.
Removing the Exhaust System

**CAUTION**

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

1. Park the machine on a level surface, lower the cutting units, shut off the engine, remove the key from the key switch and unplug the 48V battery disconnect.
Removing the Exhaust System (continued)

2. Remove the hood and rear wheel assembly for additional clearance if desired; refer to Removing and Installing the Hood Assembly (page 6–43) and Removing and Installing the Wheels (page 6–9).

3. Remove the fasteners securing the muffler to the engine frame.

4. Remove the fasteners securing the exhaust pipes to the cylinder heads, and remove the muffler assembly from the machine. Retrieve the two conical washers from the muffler brackets. Retrieve and discard the exhaust gaskets.

5. Continue to dismantle the muffler assembly as needed.

6. Remove any gasket material from the exhaust pipes or cylinder heads.

Installing the Exhaust System

1. Loosely assemble the muffler, exhaust pipes, clamps and heat shield.

2. Use new exhaust gaskets and fit the muffler assembly to the machine.

3. Install all the fasteners used to secure the muffler assembly loosely. Ensure the conical washer is installed between the muffler brackets and the engine frame brackets in the direction shown; refer to Figure 14.

4. Secure the muffler assembly to the machine:

   A. Tighten the fasteners at the cylinder heads from 12 to 17 N·m (9 to 13 ft-lb).
   B. Tighten the muffler clamp fasteners from 14 to 25 N·m (175 to 225 in-lb).
   C. Tighten the muffler bracket fasteners.

5. Install the rear wheel assembly; refer to Removing and Installing the Wheels (page 6–9)

6. Install the hood assembly; refer to Removing and Installing the Hood Assembly (page 6–43).
Removing the Engine

Refer to Figure 15 for this procedure.

1. Park the machine on a level surface, lower the cutting units, shut off the engine, remove the key from the key switch and unplug the 48V battery disconnect.

2. Disconnect the negative (–) battery cable at the 12V system battery; refer to Removing and Installing the 12V System Battery (Model 04580) (page 5–105).

3. Remove the exhaust system; refer to Removing the Exhaust System (page 4–10).

4. Remove the fuel tank; refer to Removing the Fuel Tank (page 4–4).

5. Remove the evaporative control system carbon canister from the machine.
Removing the Engine (continued)

6. Disconnect the electrical system wiring from the engine:
   • The engine wire harness connector at the main wire harness (left side of engine). Check the engine and the harness connector for damage or corrosion and clean or repair as necessary.
   • The wire harness ground at the engine (near front left engine mount).

7. Disconnect the choke cable from the engine.

8. Remove the clamp securing the engine oil drain hose to the right side battery tray.

9. If the engine is being removed from the machine separately, proceed to step 10 of this procedure. If the entire engine frame assembly (including the starter/generator) is being removed:
A. Disconnect the starter/generator from the machine wire harness. Check the starter/generator and the harness connector for damage or corrosion and clean or repair as necessary.

B. Remove the fasteners securing the engine frame assembly to the 3 isolating mounts.
Removing the Engine (continued)

**CAUTION**

The engine frame assembly weighs approximately 68 kg (150 lb). Use an appropriate lift to remove the engine frame assembly.

C. Remove the engine frame assembly from the machine.

10. Remove the fasteners securing the drip pan to the engine frame (item 3 and 4 in Figure 15).

11. Remove the starter/generator drive belt:
   
   A. Tilt the Operator seat forward and remove the pulley cover (item 6 in Figure 15).
   
   B. Loosen the hex nuts and extend the adjustment pin as far as possible to relax the extension spring.

![Diagram of engine components](image)

**Figure 17**

1. Generator drive belt  
2. Generator pulley  
3. Engine pulley  
4. Engine frame  
5. Hex nut (2 each)  
6. Adjustment pin  
7. Extension spring  
8. Cap screw (4 each)

C. Loosen the 4 cap screws (item 8) securing the starter/generator to the engine frame. Loosen the cap screws only enough to allow the starter/generator to rotate on the engine frame.

D. Rotate the starter/generator clockwise (when viewed from above) and slip the starter/generator drive belt off of the engine pulley.

**Note:** An engine lift lug is included in the machine loose parts kit.

12. Install an engine lift lug to the front of the engine.
Removing the Engine (continued)

![Figure 18](image)

1. Cap screw
2. Front engine lift lug

⚠️ **CAUTION** ⚠️

The engine assembly weighs approximately 42 kg (92 lb). Use an appropriate lift to remove the engine assembly.

13. Remove the 4 fasteners securing the engine to the engine frame and lift the engine from the machine.
14. Continue to disassemble the engine as necessary.

Installing the Engine

Refer to Figure 15 for this procedure.

**IMPORTANT**

Ensure that all parts removed from the engine during maintenance are installed.

1. If the engine pulley was removed:
   A. Apply anti-seize lubricant to the engine shaft and fit the square key and engine pulley onto the engine shaft. Position the pulley approximately 28 mm (1.1 inch) from the engine.

   B. Apply a high temperature medium strength thread locking compound (Loctite 2422 or equivalent) to the set screws and tighten from 14 to 18 N·m (120 to 140 in-lb).
Installing the Engine (continued)

1. Engine
2. Engine pulley
3. Set screw (2 each)
4. Square key

![Diagram of engine assembly with numbered parts]

**Figure 19**

**CAUTION**

The engine assembly weighs approximately 42 kg (92 lb). Use an appropriate lift to install the engine assembly.

**IMPORTANT**

Make sure to not damage the engine, fuel or vent hoses, oil drain hose, electrical harnesses, control cables or other parts while installing the engine.

2. Secure the engine to the engine frame with the 4 cap screws previously removed.
3. Remove the front engine lift lug and reinstall the fastener used to secure the lift lug to the engine; refer to Figure 18.
4. Secure the drip pan to the engine frame.
5. Fit the starter/generator drive belt over the engine pulley and adjust the drive belt tension; refer to Adjusting the Starter/Generator Drive Belt Tension (Model 04580) (page 5–20).
Installing the Engine (continued)

6. If the engine was removed from the machine separately, proceed to step 8 of this procedure. If the entire engine frame assembly (including the starter/generator) was removed:
   A. Secure the 3 engine frame assembly isolation mounts to the machine with the fasteners previously removed.
   B. Connect the machine wire harness to the starter/generator.

7. Install the clamp securing the engine oil drain hose to the right side battery tray.

8. Connect the choke control cable to the engine:
   A. Set the choke control at the operator control panel to the full choke position.
   B. Connect the choke control cable to the choke lever at the carburetor.
   C. Set the choke lever at the carburetor to the full closed position and secure the cable housing to the engine with the clamp and cap screw previously removed.

9. Connect the electrical system wiring to the engine:
   • The wire harness ground at the engine (near front left engine mount).
   • The engine wire harness connector at the main wire harness (left side of engine).

10. Connect the evaporative control system carbon canister to the engine vent hose.

11. Install the fuel tank; refer to Installing the Fuel Tank (page 4–4).

12. Install the exhaust system; refer to Installing the Exhaust System (page 4–11).

13. Ensure that all the hoses, tubes, and wires are clear of moving parts and secured to their original locations.

14. Connect the negative (−) battery cable at the 12V system battery (model 04580).

15. Check engine oil level and adjust if necessary; refer to traction unit Operator’s Manual.

16. Operate the machine. Check for proper engine operation. Check for fuel leaks and correct any issues before returning the machine to service.
# Chapter 5

## Electrical System

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General Information

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

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.

Kawasaki Engine Electrical Components

When servicing or troubleshooting the engine electrical components, use the correct engine service manual. Kawasaki engine service manuals are available online, on the Toro Service Reference flash drive, and in print from your authorized Toro Distributor.

Electrical Drawings

The electrical schematic and wire harness drawings for the eTriFlex machines are located in Appendix A (page A–1).
Electrical System Operation

The eTriFlex machines have 4 different functional subsystems. Each subsystem has components that operate on 12 VDC, and components that operate on 48 VDC. Many of the machine control functions operate on a typical 12 VDC system. The electric traction motors, electric steering motor, electric cutting unit lift/lower actuators, and the electric cutting unit motors operate on an 48 VDC electrical system. The 12 VDC and 48 VDC systems include circuits that support both the logic demands of the various controllers, and the power supply (bus) required for component operation. Refer to Testing the Electrical Components (page 5–23) for detailed information and testing procedures for all of the subsystem components.

Traction Subsystem

The traction subsystem and steering subsystem work together to steer the machine. The rear wheel (steering) sets the direction while the two front wheels turn the machine using the Radius Dependant Speed System (RDS). Each front traction motor speed is controlled independently by the RDS. The RDS also helps prevent the front wheels from scrubbing the turf in turns. For the subsystems to function properly, the front traction motors must be calibrated to each other by using the InfoCenter Service>Calibration screen.

The traction subsystem consists of the following components:

- Function Control Switch: A three position switch on the operator’s console that allows the operator to select between Neutral and Transport or Mow speed ranges.

- Traction Pedal Position Sensor: A dual hall effect sensor attached to the traction pedal that sends reciprocal signals to the SC5: Traction 1 controller for direction and speed. The two signals are part of a redundant traction safety circuit in the case that one signal fails. For the subsystem to function properly, the traction pedal position sensor must be calibrated for range of motion by using the InfoCenter Service>Calibration screen.

- Front Traction Motor Controllers (2): Each traction motor controller operates and its respective traction motor via a separate interconnect harness.

  SC5: Traction 1 (right side): Is considered the primary traction controller as it controls the precharge function for the traction subsystem, provides the ground path to energize the traction motor contactor, and receives traction pedal sensor signals for traction direction and speed, and reports any traction pedal sensor faults.

  SC6: Traction 2 (left side): Is considered the secondary traction controller as it receives traction pedal sensor signals for traction direction and speed from the SC5: Traction 1 controller.

- Front Traction Motors (2): Are 3 phase 48 VDC electric motors located behind each front wheel and include a separate reduction gear box and disc brake mechanism. The front traction motors receive all of their operation commands from their respective traction motor controller.

- Optional 3WD Traction Motor: Is designed to assist with traction demands in the forward direction only. The 3WD traction motor is attached to the rear wheel caster fork and includes an integrated controller and reduction gear box.
Steering Subsystem

The steering subsystem components work together to coordinate the position of the steering wheel with the position of the rear caster fork. The Radius Dependant Speed System (RDS) uses steering position information from the steering subsystem to control the traction and cutting unit drive subsystems. The steering subsystem and traction subsystem work together to steer the machine. The rear wheel (steering) sets the direction while the two front wheels turn the machine using the RDS; refer to Traction Subsystem (page 5–4) for additional information.

The steering subsystem consists of the following components:

- Steering Input Device: Connected to the steering wheel, the device converts steering wheel direction and speed of rotation information into reciprocal signals. Both signals are sent to the SC7: Steering motor controller. The two signals are part of a redundant steering safety circuit in the case that one signal fails. Tactile feedback (controlled by a PWM signal from the T1: primary controller) determines the amount of feedback the operator feels while turning the steering wheel. This feature of the steering input device produces a more natural power steering feel for the operator.

- SC7: Steering Motor: The SC7: Steering motor is attached to a reduction gear box and includes an integrated steering motor controller. The Steering motor receives all of its operation commands from the steering motor controller. The steering motor controller interprets steering position sensor data and broadcasts the information via the CAN bus to SC5: Traction 1 controller to manage front wheel speed, and to the steering input device to determine operator tactile feedback. The steering motor controller is responsible for reporting steering subsystem faults from the steering input device, steering motor, and steering position sensor.

- Steering Position Sensor: A dual hall effect sensor attached to the rear wheel caster fork sends reciprocal signals to the SC7: Steering motor controller. The two signals are part of a redundant steering safety circuit in the case that one signal fails. For the subsystems to function properly, the steering position sensor must be calibrated for center position, and for range of motion by using the InfoCenter Service>Calibration screen.
Lift/Lower Subsystem

The T1: Primary controller receives an input signal from the lift/lower switches and sends a CAN message to the lift/lower actuator controllers to lift or lower the cutting unit lift arms.

The lift/lower subsystem consists of the following components:

- Cutting Unit Lift and Lower Switches “Joystick”: The two identical lift/lower switches are mounted below the joystick and act as inputs to the T1: Primary controller.
- Lift/Lower Actuators (3): Each lift/lower actuator includes an integrated controller and is responsible for operating its respective cutting unit lift arm. The front actuators extend to lower and retract to lift the front lift arms, while the center actuator retracts to lower and extends to lift the center lift arm. Due to differences in mounting orientation and stroke length, each actuator is unique and their position on the machine is not interchangeable. For the subsystem to function properly, each lift/lower actuator must be calibrated separately for range of motion by using the InfoCenter Service>Calibration screen.

Cutting Unit Drive Subsystem

The cutting unit drive subsystem is also part of the Radius Dependant Speed System (RDS). Each cutting unit motor speed is controlled independently by the RDS to maintain a constant clip speed in turns.

The cutting unit drive subsystem consists of the following components:

- Location ID Module: Located under the right side cover, the location ID module is used to identify the three cutting unit motors individually based on the position of the cutting unit on the machine. Individual cutting unit motor location information is necessary for RDS operation, for cutting unit timing (starting and stopping the center cutting unit slightly later than the front cutting units), and for reporting cutting unit motor fault information individually.
- Cutting Unit Motors (3): The cutting unit motors are attached to the left side of each cutting unit and include an integrated controller. The cutting unit motor controllers receive CAN messages from the T1: Primary controller to start and stop the cutting unit motors, as well as set the cutting unit speed and direction of operation (mow or backlap).

12 VDC System Components

The engine electrical components, the machine operation switches, the T1: Primary controller, the InfoCenter display, the CAN bus isolation module, the electric brake actuator, the logic relay coil, and the operator feedback feature of the steering input device are all powered by the 12 VDC system on eTriFlex machines.

- On model 04580 machines, a single 12V AGM battery under the right side cover of the machine and the engine alternator provides the 12 VDC system electrical power. The 12 VDC system is an isolated system; each component has a separate wire leading to a ground provided by the engine block.
- On model 04590 machines, the 48V battery pack and a 48 VDC/12 VDC converter are used to provide the 12 VDC system electrical power. Circuit protection for the 12 VDC system includes two (2) fuse holders under the right side cover of the machine. The 12 VDC system is an isolated system; each component has a separate wire leading to a ground provided by the 48 VDC/12 VDC converter.
48 VDC System Components

The eTriFlex 48 VDC system includes a 48 VDC battery pack, an engine driven starter/generator (model 04580), two front traction motors, a steering input device and a steering motor, three cutting unit lift/lower actuators, three cutting unit motors, a main contactor and a traction motor contactor. An optional rear wheel traction motor and an LED light kit that runs on 48 VDC are also available. Circuit protection for the 48 VDC system includes fourteen fuses in a variety of styles and locations. The 48 VDC system is an isolated system so the vehicle frame is not used for any ground connections in this system. On model 04580 machines, each component has a separate wire leading to a ground bus located on the left side of the machine. On model 04590 machines, each component has a separate wire leading to the negative (-) terminal of the lithium-ion battery controller (BMS).

A 48V battery disconnect is located behind the left side cover of the machine. Use the 48V battery disconnect to make sure that 48 VDC components do not operate unexpectedly when performing service procedures.

• On model 04580 machines, the battery pack is composed of four 12 VDC sealed batteries connected in series to achieve the necessary 48 VDC system voltage. The batteries are maintenance free AGM, valve regulated lead acid batteries.

• On model 04590 machines, the battery pack is composed of eight 48 VDC lithium-ion batteries located in one center mounted and two side mounted assemblies. The batteries are connected in parallel and managed by a lithium–ion battery controller (SC8).

---

**IMPORTANT**

**When connecting the individual batteries in the 48 VDC system, make sure that battery polarity is correct. System damage can occur if the individual batteries are not connected correctly.**

---

A starter/generator is used on model 04580 machines only. The starter/generator is a 48 VDC, air cooled, brushless, permanent magnet device. The starter/generator has its own internal inverter and on-board controller. The InfoCenter Display can be used to monitor starter/generator activity during machine operation. The starter/generator also manages the precharge function for model 04580 machines.

Model 04590 machines include a Lithium-ion Battery Controller (SC8: Battery) to monitor the condition of the eight 48V lithium-ion batteries used to power the machine. The controller is also known as the Battery Management System (BMS). The BMS has the ability to connect the 48V lithium-ion batteries to the machine during power up, and disconnect the batteries from the machine during shut down.

A separate Precharge controller (T6: Precharge) manages the precharge function for model 04590 machines.

The main contactor exists in the 48 VDC system to connect the 48V battery pack with the starter/generator, and the cutting unit motor and optional rear traction motor controllers. The starter/generator controller determines when the main contactor is engaged.

The traction motor contactor exists in the 48 VDC system to connect the 48 VDC system with the 2 front traction motors. The controller for the right side traction motor determines when the traction motor contactor is engaged.
Control for the components in the 48 VDC system is handled by the front traction motor controllers (SC5: Traction 1 and SC6: Traction 2), a controller in the optional rear traction motor (T5: Traction 3), a controller in the steering motor (SC7: Steering), a controller in each lift/lower actuator (SC1: Lift/Lower 1, SC2: Lift/Lower 2, SC3: Lift/Lower 3), a controller in each cutting unit motor (T2: Cutting Unit 1, T2: Cutting Unit 2, T3: Cutting Unit 3), along with direction from the T1: Primary controller via the CAN bus system. Since the T1: Primary controller (a 12 VDC component) sends and receives information with the starter/generator, traction motors, and the remaining 48 VDC components, the CAN bus needs to communicate with both 12 VDC and 48 VDC systems. The CAN bus isolation module is included in the system to allow communication between the different voltage controllers while keeping the two electrical systems isolated. Also, the location ID module exists to identify the location of the three cutting unit controllers and the optional rear traction motor controller. The ID module enables machine operation features such as starting and stopping the center cutting unit slightly later than the front cutting units.

The two front traction motors are brushless permanent magnet motors. The motor controllers are separate from the motors and control each motor individually (RH controller controls RH motor and LH controller controls LH motor). The optional rear traction motor is a brushless, permanent magnet motor with its own on-board controller. The InfoCenter Display can be used to monitor the current draw for the traction motors during machine operation.

The steering motor is a brushless permanent magnet motor with its own on-board controller and integrated planetary gear box. The InfoCenter Display can be used to monitor the position of the steering motor during machine operation.

The three cutting unit lift/lower actuators are CAN controlled electric linear actuators with an integrated controller, brushless motor, and brake. The InfoCenter Display can be used to monitor the current draw for the lift/lower actuators during machine operation.

The three cutting unit motors are identical brushless, permanent magnet motors with an internal gear reduction feature. Each motor has its own on-board controller. The InfoCenter Display can be used to monitor the speed and current draw for the cutting unit motors during machine operation.
48V Battery Disconnect

CAUTION

Before installing, removing or servicing components in the 48 VDC system (e.g. cutting unit motors, starter/generator), separate the 48V battery disconnect. This will prevent unexpected operation of 48V system components.

The 48V battery disconnect is attached to a bracket behind the left side cover. Unplug the disconnect to make sure that 48 VDC components do not operate unexpectedly. Apply dielectric grease to the contact surfaces of the battery disconnect and plug the battery disconnect back in after service to the 48 VDC system is completed.

Figure 20

1. 48V power connectors
2. Left side cover
The InfoCenter Display is a three button LCD device located on the operator's console. 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 key switch is in the ON or START position. A 7.5 Amp fuse protects all of the key switched circuits, including the InfoCenter power circuit.

The InfoCenter communicates with the other machine controllers on a Controller Area Network (CAN) bus system; refer to CAN bus Communications (page 5–12) for additional information.

**Note:** If the InfoCenter display (SC1) is replaced for any reason, the machine software must be updated; contact an Authorized Toro Distributor for assistance.
Software Version 120-6394 Rev C Shown

* eTriFlex 3360 (model 04580) Only
** eTriFlex 3370 (model 04590) Only

Item not visible until PIN has been entered for Protect Settings, or Protect Settings is OFF
Item not visible until PIN has been entered for Protected Menus

Figure 22
InfoCenter Screens – Greensmaster 3360 eTriFlex
CAN bus Communications

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 access machine settings, calibrate various machine components, and assist with electrical system diagnostics. The key switch needs to be in the RUN or START position for the components on the network to be activated.

Controllers that operate on 12 VDC connect to the 12V side of the CAN bus (CAN A), while controllers that operate on 48 VDC connect to the 48V side of the CAN bus (CAN B). The two sides of the CAN bus communicate as one network through the use of a CAN bus Isolation Module.

---

**IMPORTANT**

Logic voltage must be present at the controller before communication with that controller can occur on the CAN bus.

---

The entire CAN bus is made up of two specially designed twisted wires. The engineering term for these wires are CAN High (yellow wire) and CAN Low (green wire). A 120 ohm CAN termination resistor is located at each end of CAN A, and at each end of CAN B (4 total). Refer to CAN bus (page 5–30) for CAN bus testing procedures.

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 part of the CAN bus and is located at the rear of the console armrest.

---

**Figure 23**

1. Console armrest
2. Toro DIAG connector
3. Connector cover
Figure 24

1. CAN bus isolation module
2. CAN A – 12V side
3. CAN B – 48V side
4. CAN bus terminator resistor (4 each)
5. T1: Primary controller
6. SC1: InfoCenter
7. CAN A diagnostic port
8. T2: Cutting Unit 1 motor controller (center)
9. T3: Cutting Unit 2 motor controller (left)
10. T4: Cutting Unit 3 motor controller (right)
11. T5: Traction 3 motor controller (optional)
12. T6: Starter/Generator controller (model 03580 only)
13. T6: Pre-charge controller (model 03590 only)
14. SC2: Lift/Lower 1 actuator controller (center)
15. SC2: Lift/Lower 2 actuator controller (left)
16. SC2: Lift/Lower 3 actuator controller (right)
17. SC5: Traction 1 motor controller (right)
18. SC6: Traction 2 motor controller (left)
19. SC7: Steering motor controller
20. SC8: Lithium-ion Battery controller (model 03590 only)
21. CAN B diagnostic port
22. Lithium-ion battery interface (model 03590 only)
23. Lithium-ion batteries (model 03590 only)

**Note:** For model 04590 machines, the SC8: Lithium-ion battery controller (BMS) exists on the CAN bus. Each of the eight lithium-ion batteries communicates with the BMS through a battery interface harness or sub-net. The BMS then forwards the battery information to the rest of the machine via the CAN bus.
The eTriFlex machines use a primary controller (T1) to manage machine electrical functions. The primary controller is a TEC 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 primary controller is directly responsible for managing the logic relay, the automatic parking brake relay, the operator feedback feature of the steering input device, and the fuel solenoid and engine relay on Greensmaster 3360 machines. The status of inputs to the controller as well as outputs from the controller can be monitored with the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–39). Refer to T1: Primary Controller (page 5–34) for T1: primary controller testing information.

The primary controller communicates with the other machine controllers on a Controller Area Network (CAN) bus system; refer to CAN bus Communications (page 5–12) for additional information.

**Note:** If the T1: Primary controller is replaced for any reason, the machine software must be updated; contact an Authorized Toro Distributor for assistance.
The eTriFlex 3370 uses a Lithium-ion battery controller or Battery Management System (BMS) to manage the lithium-ion batteries. Each of the eight lithium-ion batteries communicates with the BMS through a sub-net via the battery interface harness. The battery interface harness includes a 4-pin connector at each of the batteries and a 9-pin connector at the BMS. The BMS uses the sub-net to verify the presence and condition of each of the batteries before allowing battery power to the machine. The BMS is also connected to the CAN bus which allows it to forward battery information to the rest of the machine. The BMS is located under the hood attached to the back of the center mounted batteries.

The Lithium-ion battery controller:

- Monitors the batteries via a sub-net (battery interface harness).

  **Note:** All of the battery interface harness connections must be corrosion free and securely connected before machine operation can occur.

- Protects the batteries from operating (discharging and charging) outside their safe operating voltage, amperage, and temperature ranges.

- Operates an internal contactor to connect and disconnect the batteries from the machine and the battery charger.
SC8: Lithium-Ion Battery Controller (Model 04590) (continued)

**Note:** When the key switch is set to the Off position, the BMS delays disconnecting the batteries from the machine for approximately 3 seconds to allow time for all of the other machine controllers to shut down.

- Communicates battery information to the machine during operation via the CAN bus.
- Communicates battery information to the battery charger via the CAN bus.
- Supplies battery pack signal voltage to the key switch.

**Note:** With the exception of the lithium-ion battery cables, the only machine circuit with voltage when the key switch is in the Off position, is the low amperage signal voltage (Pack Sig+) from the BMS to the key switch.

Refer to SC8: Lithium-Ion Battery Controller (Model 04590) (page 5–40) for SC8: lithium-ion battery controller testing information.

---

**IMPORTANT**

Do not open the lithium-ion battery controller. There are no serviceable parts on or in the controller. If you open the controller, you will void the warranty. The controller is protected by tamper-alerting devices.

**Note:** If the SC8: Lithium-Ion Battery Controller is replaced for any reason, the machine software must be updated; contact an Authorized Toro Distributor for assistance.
The eTriFlex 3370 uses a TEC 2401 series microcontroller as a precharge controller (T6) to manage the precharge function. Precharge is a preliminary mode which limits the inrush of current during the power up procedure. This current, if not limited, can cause considerable stress or damage to the 48 VDC system components. Precharge occurs each time the key switch is set to the On position and lasts for less than a second. Precharging is implemented to increase the lifespan of the electronic components and increase reliability of the 48 VDC system.

When the key switch is set to the On position, the T1: primary controller energizes the logic relay and power is supplied to the precharge controller precharge input. The precharge controller then supplies a controlled precharge voltage to the reel motors, lift actuators, and optional 3WD traction motor via the precharge output. Once precharge is successful, the T1: primary controller commands the T6: precharge controller via a CAN message to provide a path to ground for the 48 VDC main contactor coil to energize the main contactor (48 VDC power bus). Refer to T6: Precharge Controller (Model 04590) (page 5–45) for T6: precharge controller testing information.

The precharge controller communicates with the other machine controllers on a Controller Area Network (CAN) bus system; refer to CAN bus Communications (page 5–12) for additional information.

Note: If the precharge controller (T6) is replaced for any reason, the machine software must be updated; contact an Authorized Toro Distributor for assistance.
Testing the 12V Charging System (Model 04580)

Battery Voltage Table

<table>
<thead>
<tr>
<th>At least 0.50 VDC over the initial battery voltage.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial battery voltage</td>
<td>= 12.30 VDC</td>
</tr>
<tr>
<td>Battery voltage after 3 minutes charge</td>
<td>= 12.85 VDC</td>
</tr>
<tr>
<td>Difference</td>
<td>= +0.55 VDC</td>
</tr>
</tbody>
</table>

This is a simple test that determines if the 12V charging system is functioning. It tells you if the 12V charging system has an output, but not its capacity.

Tool required: Digital multimeter to set the DC volts.

1. Connect the positive (+) multimeter lead to the positive battery post and negative (-) multimeter lead to the negative battery post of the 12V system battery and record the battery voltage.

2. Start the engine and allow the engine to run at 2400 rpm for a minimum time of 3 minutes.

3. Connect the positive (+) multimeter lead to the positive battery post and negative (-) multimeter lead to the negative battery post of the 12V system battery and record the battery voltage.

4. After running the engine for a minimum time of 3 minutes, the battery voltage must be at east 0.50V higher than that of the initial battery voltage.
Testing the 12V Charging System (Model 04580) (continued)

Note: Depending upon the condition of the battery, its current charge and the battery temperature, the battery voltage increases at different rates as the battery charges.

Refer to the Battery Voltage Table (page 5–18) for an example of a charging system that is functioning.

Checking the Interlock System Operation

**CAUTION**

The interlock system is for the operator’s protection; do not bypass any of the interlock system components. Check the operation of the interlock system daily to assure the system is operating correctly. If an interlock system component is out of adjustment or defective, replace it before operating the machine.

The purpose of the interlock system is to:

- Prevent the machine from moving if an operator is not in the seat, the manual parking brake is engaged, or the function control switch is in the NEUTRAL position.
- Shut off the reels if the function control switch is moved to NEUTRAL or TRANSPORT.

To test the interlock system:

1. Rise from the seat, start the engine, disengage the manual parking brake, move the function-control switch to the MOW or TRANSPORT position, and engage the traction pedal. The machine should not move, if you are not in the seat.
2. Sit in the seat, start the engine, engage the manual parking brake, move the function-control switch to the MOW or TRANSPORT position, and engage the traction pedal. The machine should not move, if the manual parking brake is engaged.
3. Sit in the seat, start the engine, disengage the manual parking brake, move the function control switch to the NEUTRAL position, and engage the traction pedal. The machine should not move, as the function control switch is in the NEUTRAL position.
4. Sit on the seat, move the traction pedal to the NEUTRAL position, move the function control switch to the NEUTRAL position, engage the manual parking brake, start the engine, and move the lift/lower joystick forward to lower the cutting units. The cutting units should lower but not start rotating.

**IMPORTANT**

Adjust or repair any of the interlock system components as necessary so all of the interlock system operations function correctly before operating the machine.
Adjustments

Adjusting the Starter/Generator Drive Belt Tension (Model 04580)

For additional starter/generator service information; refer to Generator Assembly (Model 04580) (page 5–120).

1. Remove the fuel tank; refer to Removing the Fuel Tank (page 4–4).
2. Tilt the operator seat forward and remove the starter/generator pulley cover.
3. Loosen the 4 cap screws (item 2) securing the starter/generator to the engine frame and allow the extension spring to pull the starter/generator counterclockwise to tension the drive belt.

4. Measure the extension spring length. To apply the correct amount of belt tension, the spring must be 108 to 110 mm (4.25 to 4.35 inch) when measured inside the spring hooks. Adjust the adjustment pin if necessary.

5. Tighten the 4 cap screws securing the starter/generator to the engine frame in the sequence shown.

6. Install the starter/generator pulley cover.

7. Install the fuel tank; refer to Installing the Fuel Tank (page 4–4).
Adjusting the Steering Position Sensor

The steering position sensor is a two-piece assembly located on top of the rear wheel caster fork shaft. The sensor portion includes 2 analog hall effect sensors. The second piece of the assembly is a bolt with a magnetic head threaded into the caster fork shaft. The steering position sensor follows the rear caster fork movement.

For steering position sensor testing information; refer to Steering Position Sensor (page 5–89).

1. Align the rear caster fork; refer to Aligning the Rear Wheel Caster Fork (page 6–8).
   
   **Note:** Be careful not to disturb the rear caster fork alignment while adjusting the steering position sensor.

2. Loosen the jam nut under the magnet bolt.

3. Adjust the magnetic bolt so the slot in the bolt aligns with the flat on the caster fork shaft (straight toward the rear of the machine) and the gap between the top of the bolt and the bottom of the sensor is **2.0 to 3.0 mm (0.08 to 0.12 inch)**.

4. Tighten the jam nut against the caster fork from **20 to 22 N·m (180 to 200 in-lb)** and recheck the gap between the top of the bolt and the bottom of the sensor. Adjust the gap if necessary.

5. Check the rear caster fork alignment and readjust the sensor if necessary.

6. Calibrate the steering system. Calibrate the steering system – center first, then calibrate the steering system – range; refer to Calibrating the Steering System – Center (page 5–91) and Calibrating the Steering System – Range (page 5–91).
Adjusting the Manual Parking Brake Switch

The manual parking brake switch is located directly under the brake pedal assembly. The manual parking brake switch is an input to the T1: primary controller. The switch is a normally open proximity switch that closes when the foot actuated parking brake is disengaged (the parking brake latch is in close proximity to the switch). The manual parking brake switch is part of the safety interlock system; refer to Checking the Interlock System Operation (page 5–19) for a better understanding of how the switch is used.

For manual parking brake switch testing information; refer to Manual Parking Brake Switch (page 5–77).

1. Park the machine on a level surface, lower the cutting units and set the key switch to the OFF position.

2. The gap between the manual parking brake switch and the latch should be from **3.0 to 4.6 mm (0.12 to 0.18 inch)**. If the distance is incorrect:
   A. Loosen the jam nuts that secure switch to the brake pedal support.
   B. Use the jam nuts to move the switch until the correct gap is obtained.
   C. Tighten the jam nuts from **18 to 22 N·m (13 to 16 ft-lb)**.
   D. Test the manual parking brake switch operation using the main information screen of the InfoCenter Display; refer to InfoCenter (page 5–10) (P) icon.
Testing the Electrical Components

The Greensmaster eTriFlex 3360 and 3370 machines have isolated electrical systems; they do not use the machine frame as ground. Use an unpainted surface of the engine block or an unpainted engine fastener as a ground for testing 12V components unless instructed otherwise. Use the B- terminal of the front traction motor controllers (SC5 or SC6) as a ground for testing 48V components unless instructed otherwise. Depending on which side of the machine is more convenient, remove the right side cover or the left side cover to access a front traction motor controller. Make sure the 48V battery disconnect must be connected.

For accurate resistance and/or continuity checks, electrically disconnect the component being tested from the circuit (e.g., unplug the key switch connector before doing a continuity check of the switch). Always check the item being tested and the harness connector for damage or corrosion and clean or repair as necessary.

IMPORTANT

When testing the electrical components for continuity with a multimeter (ohms setting), ensure that you disconnect the power to the circuit.

Note: For engine component testing information (fuel solenoid, alternator, ignition modules); refer to the Kawasaki FS481V Service Manual.

Fuses

A number of different style fuses are used on this machine in a variety of amperage and voltage ratings. Most fuses are color coded based on their amperage rating. Always replace fuses with the same style, amperage, and voltage as the original fuse.

<table>
<thead>
<tr>
<th></th>
<th>Micro blade fuse</th>
<th></th>
<th>Maxi blade fuse</th>
<th></th>
<th>Mega fuse</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>4</td>
<td></td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Mini blade fuse</td>
<td>5</td>
<td>BF1 fuse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Standard blade fuse</td>
<td>6</td>
<td>MIDI fuse</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 32

Identifying the 12 VDC System Fuses and their Functions

A group of fuses used to protect the 12 VDC system are located in 2 covered fuse holders under the right side cover. These are mini blade style fuses.

**Figure 33**
(right side cover removed)

1. 10A fuse – brake actuator relay  
2. 7.5A fuse – T1: Primary outputs  
3. 2A fuse – telematics connector  
4. 15A fuse – 12V system battery charging (model 04580)  
5. Open  
6. 15A fuse – main (model 04580)  
7. 2A fuse – T1: Primary logic  
8. 15A fuse – 48 VDC/12 VDC converter (model 04590)  
9. 7.5A fuse – spare  
10. 12V fuse holder 1  
11. 12V fuse holder 2
Identifying the 48 VDC System Fuses and their Functions

A group of fuses used to protect the 48 VDC system are located in an open fuse block under the operator’s seat. These are standard blade ATO style fuses.

1. 10A 80V fuse – SC2: Lift/Lower Actuator 1 (center) power bus
2. 10A 80V fuse – SC3: Lift/Lower Actuator 2 (left) power bus
3. 10A 80V fuse – SC4: Lift/Lower Actuator 3 (right) power bus
4. Open
5. 5A 80V fuse – 48V controller logic
6. 30A 80V fuse – SC7: Steering Motor power bus
7. 10A 80V fuse – Optional work lights (model 04580) or 48 VDC/12 VDC converter (model 04590)
8. 10A 80V fuse – Optional work lights (model 04590)

On model 04590 machines, an additional 48 VDC fuse located in its own holder on the machine wire harness to the left of the center (rear) battery set. The fuse is used to protect the T6: Precharge controller. This is a standard blade ATO style fuse.
Identifying the 48 VDC System Fuses and their Functions (continued)

Figure 35
(model 04590 only)

1. Cap
2. 3A 80V fuse – T6: Precharge controller
   (model 04590)
3. Fuse holder
Identifying the 48 VDC System Fuses and their Functions (continued)

Three fuses are used to protect the 48 VDC cutting unit motors. An additional fuse is used to protect the optional 48 VDC 3WD (rear) traction motor. These are Maxi blade fuses located in a covered fuse block under the left side cover.

1. 35A 58V fuse – T2: Cutting Unit 1 (center) power bus
2. 35A 58V fuse – T3: Cutting Unit 2 (left) power bus
3. 35A 58V fuse – T4: Cutting Unit 3 (right) power bus
4. 35A 58V fuse – T5: Traction 3 (optional 3WD) power bus

Figure 36
(left side cover removed)
Identifying the 48 VDC System Fuses and their Functions (continued)

Two fuses are used to protect the 48 VDC standard (front) traction motors. These are MIDI style fuses located in separate covered holders. The fuse holder for SC5:Traction 1 (right) is located under the operator seat. The fuse holder for SC6:Traction 2 (left) is located under the left side cover.

On machines with an engine/generator (model 04580), a single fuse is used to protect the starter/generator. This is a BF1 style fuse located in a separate covered holder under the operator seat.

If a MIDI or BF1 style fuse is removed:

1. Tighten the hex nuts that secure the fuse from **2.3 to 2.8 N·m (20 to 25 in-lb)**.
2. Coat the terminals with battery terminal protector Toro Part No. 107-0392 to reduce corrosion.
3. Install the fuse holder cover and secure it with a new cable tie.

![Figure 37](image)

(figure not provided)

**Figure 37**

(seat raised and left side cover removed)

1. 60A 70V fuse – SC5: Traction 1 (right) power bus
2. 60A 70V fuse – SC6: Traction 2 (left) power bus
3. 100A 58V fuse – T6: Starter/Generator power bus (model 04580)

For model 04580 machines, the four 12 VDC batteries that make up the 48 VDC battery power supply are protected by a 150A 70V Mega style fuse. For model 04590 machines, the lithium-ion battery pack is protected by a 175A 70V Mega style fuse. The fuse is located in a separate covered holder near the 48 VDC battery (main) power disconnect (behind the left side cover).
If a Mega style fuse is removed, tighten the hex nuts that secure the fuse from 12 to 17 N·m (9 to 13 ft-lb), then coat the terminals with battery terminal protector Toro Part No. 107-0392 to reduce corrosion.

Figure 38

1. 150A 70V fuse (model 04580) or 175A 70V fuse (model 04590)

Testing a Fuse

1. Turn the key switch to the RUN position (do not start the engine).
2. With the fuse installed in the fuse holder/block, use a multimeter to check that 12 VDC exists at both of the terminal test points on the fuse. If 12 VDC exists at 1 of the fuse test points but not at the other, the fuse is damaged.
3. Set the key switch to the OFF position and remove the key from the key switch. Remove the fuse from the fuse holder/block and use a multimeter (ohms setting) to check that the fuse has continuity across the fuse terminals.
4. If the fuse tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
The machine controllers communicate with each other on a Controller Area Network (CAN) bus system; refer to CAN bus Communications (page 5–12) for CAN bus operation notes. Controllers that operate on 12 VDC connect to the 12V side of the CAN bus (CAN A), while controllers that operate on 48 VDC connect to the 48V side of the CAN bus (CAN B). A 120 ohm CAN termination resistor is located at each end of CAN A, and at each end of CAN B (4 total); refer to CAN bus Terminator Resistors (page 5–101).

1. CAN bus isolation module
2. CAN A – 12 VDC side
3. CAN B – 48 VDC side
4. CAN bus terminator resistor (4 each)
5. T1: Primary controller
6. SC1: InfoCenter
7. CAN A diagnostic port
8. T2: Cutting Unit 1 motor controller (center)
9. T3: Cutting Unit 2 motor controller (left)
10. T4: Cutting Unit 3 motor controller (right)
11. T5: Traction 3 motor controller (optional)
12. T6: Starter/Generator controller (model 03580 only)
13. T6: Pre-charge controller (model 03590 only)
14. SC2: Lift/Lower 1 actuator controller (center)
15. SC2: Lift/Lower 2 actuator controller (left)
16. SC2: Lift/Lower 3 actuator controller (right)
17. SC5: Traction 1 motor controller (right)
18. SC6: Traction 2 motor controller (left)
19. SC7: Steering motor controller
20. SC8: Li-ion battery controller (model 04590 only)
21. CAN B diagnostic port
22. Lithium-ion battery interface (model 03590 only)
23. Lithium-ion batteries (model 03590 only)

Testing the CAN bus

1. Make sure that key switch is in the Off position.
2. Remove the right side cover.
Testing the CAN bus (continued)

3. Locate the CAN bus isolation module and disconnect it from the machine wire harness. Check the module and the harness connector for damage or corrosion and clean or repair as necessary.

4. Set the key switch to the ON position.

5. Use a multimeter (DC voltage setting) to check for 12 VDC across terminals A and B of the machine wire harness connector. If no voltage is present, check the wire harness for damage; refer to Appendix A (page A–1).

   **Note:** There is not a test procedure for the isolation module. Continue testing the remaining components of the CAN bus before replacing the isolation module.

6. Set the key switch to the OFF position.

7. Use a multimeter (ohms setting) to measure and record the resistance of CAN A across the machine wire harness connector terminals C and D, and CAN B across terminals E and F.
   - A reading of 0 to 50 ohms indicates one of the devices (nodes) on the CAN side being tested is faulty; refer to Testing Devices (Nodes) on the CAN bus (page 5–32).
   - A reading of 55 to 65 ohms indicates the CAN side being tested is intact.
   - A reading of 110 to 140 ohms indicates one of the CAN terminator resistors on the CAN side being tested is not connected or damaged; refer to CAN bus Terminator Resistors (page 5–101).
   - A reading of 100K to 200K ohms indicates both of the CAN terminator resistors on the CAN side being tested are not connected or damaged; refer to CAN bus Terminator Resistors (page 5–101).
Testing the CAN bus (continued)

- A reading of more than 500k ohms indicates damage to the wiring of the CAN side being tested; refer to Appendix A (page A–1).

8. Connect the CAN bus isolation module to the machine wire harness after testing.

Testing Devices (Nodes) on the CAN bus

<table>
<thead>
<tr>
<th>DEVICE ID</th>
<th>DESCRIPTION</th>
<th>NORMAL RESISTANCE (across CAN + (HI) and CAN – (LOW) terminals)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Primary controller (TEC 5004)</td>
<td>70k to 75k ohms</td>
</tr>
<tr>
<td>T2, T3, T4</td>
<td>Cutting Unit motor controllers</td>
<td>150k to 160k ohms</td>
</tr>
<tr>
<td>T5</td>
<td>Traction 3 motor controller (optional)</td>
<td>150k to 160k ohms</td>
</tr>
<tr>
<td>T6 (04580)</td>
<td>Generator controller (model 04580 only)</td>
<td>150k to 160k ohms</td>
</tr>
<tr>
<td>T6 (04590)</td>
<td>Pre–charge controller (model 04590 only)</td>
<td>155k to 165k ohms</td>
</tr>
<tr>
<td>SC1</td>
<td>InfoCenter (KanTrak 1700)</td>
<td>2.25k to 2.75k ohms</td>
</tr>
<tr>
<td>SC2, SC3, SC4</td>
<td>Lift/Lower actuator controllers</td>
<td>150k to 160k ohms</td>
</tr>
<tr>
<td>SC5, SC6</td>
<td>Front traction motor controllers</td>
<td>2.75k to 3.00k ohms</td>
</tr>
<tr>
<td>SC7</td>
<td>Steering motor controller</td>
<td>75k to 80k ohms</td>
</tr>
<tr>
<td>SC8</td>
<td>Li-ion battery controller (model 04590)</td>
<td>50k to 55k ohms</td>
</tr>
</tbody>
</table>

1. Disconnect the machine wire harness at the device being tested. Check the device and the harness connector for damage or corrosion and clean or repair as necessary.

2. Use a multimeter (ohms setting) to measure and record the resistance across the CAN + (HI) and CAN – (LOW) terminals of the device. Use to the appropriate electrical schematic or wire harness diagram for your machine in to determine the specific device terminals for testing; refer to Appendix A (page A–1).

   - A reading of 0 to 50 ohms indicates the CAN terminals or the CAN transceiver in the device have shorted together. Replace the device as necessary.
   - A reading of more than 500k ohms indicates the CAN terminals or the CAN transceiver in the device have failed (open circuit). Replace the device as necessary.
   - A reading that falls within the resistance range listed for the device should be tested further. Use a multimeter (ohms setting) to measure and record the resistance across the CAN + (HI) terminal and an unpainted surface of the metallic case of the device, and across the CAN – (LOW) terminal and an unpainted surface of the metallic case of the device.

   **Note:** Devices with a non-metallic case can only be tested across the CAN + (HI) and CAN – (LOW) terminals.

   - A reading of less than 500k ohms indicates the CAN circuit has shorted to ground. Replace the device as necessary.
   - A reading of more than 500k ohms indicates the CAN circuit is open and the device being tested is intact.

3. Connect the device to the machine wire harness after testing.
CAN bus Isolation Module

The CAN bus isolation module is part of the CAN bus. The isolation module brings both sides of the CAN (CAN A – 12 VDC and CAN B – 48 VDC) together so they can communicate as one network. Power for the isolation module is available when the key switch is in the ON or START position. A 7.5 Amp fuse protects all of the key switched circuits, including the CAN bus isolation module power circuit. The module plugs into the machine wire harness under the right side cover.

![Image](g287675)

Figure 41
(right side cover removed)

1. CAN bus isolation module 2. Wire harness connector

Testing the CAN bus Isolation Module

There is not a test procedure specifically for the CAN bus isolation module. Test the CAN bus before replacing the isolation module; refer to Testing the CAN bus (page 5–30).

InfoCenter Display

At the time of publication, only the InfoCenter CAN bus transceiver can be tested if necessary; refer to Testing Devices (Nodes) on the CAN bus (page 5–32). There is no additional testing procedure available for the InfoCenter display.

Note: If the InfoCenter display is replaced for any reason, the machine software must be updated; contact an Authorized Toro Distributor for assistance.
The eTriFlex machines use a primary controller (T1) to manage machine electrical functions; refer to T1: Primary Controller (page 5–14) for T1: primary controller operation notes. The primary controller is attached to the machine under the right side cover. The logic and memory circuit is protected by a 2 Amp fuse. Power for the primary controller outputs is available when the key switch is in the ON or START position. A 7.5 Amp fuse protects all of the key switched circuits, including the primary controller output circuits.

**Note:** If the primary controller (T1) is replaced for any reason, the machine software must be updated; contact an Authorized Toro Distributor for assistance.
## T1: Primary Controller (continued)

### T1: Primary Controller Inputs

<table>
<thead>
<tr>
<th>INPUT NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN 1</td>
<td>Not Used</td>
</tr>
<tr>
<td>IN 2</td>
<td>Cutting Unit Raise Switch</td>
</tr>
<tr>
<td>IN 3</td>
<td>Cutting Unit Lower Switch</td>
</tr>
<tr>
<td>IN 4</td>
<td>Manual Parking Brake Switch</td>
</tr>
<tr>
<td>IN 5</td>
<td>Seat Switch</td>
</tr>
<tr>
<td>IN 6</td>
<td>Engine Oil Pressure Switch (Model 04580)</td>
</tr>
<tr>
<td>IN 7</td>
<td>Function Control Switch – Neutral position</td>
</tr>
<tr>
<td>IN 8</td>
<td>Function Control Switch – Mow position</td>
</tr>
<tr>
<td>IN 9</td>
<td>Function Control Switch – Transport position</td>
</tr>
<tr>
<td>IN 10</td>
<td>Not Used</td>
</tr>
<tr>
<td>IN 11</td>
<td>Not Used</td>
</tr>
<tr>
<td>IN 12</td>
<td>Not Used</td>
</tr>
<tr>
<td>IN 13</td>
<td>Not Used</td>
</tr>
<tr>
<td>IN 14</td>
<td>Not Used</td>
</tr>
<tr>
<td>AIN1</td>
<td>Not Used</td>
</tr>
<tr>
<td>AIN2</td>
<td>Not Used</td>
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<tr>
<td>AIN3</td>
<td>Not Used</td>
</tr>
<tr>
<td>AIN4</td>
<td>Not Used</td>
</tr>
<tr>
<td>AIN5</td>
<td>Not Used</td>
</tr>
<tr>
<td>AIN6</td>
<td>Not Used</td>
</tr>
</tbody>
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### T1: Primary Controller Outputs

<table>
<thead>
<tr>
<th>OUTPUT NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUT 1</td>
<td>Logic Relay</td>
</tr>
<tr>
<td>OUT 2</td>
<td>Engine Control (Model 04580)</td>
</tr>
<tr>
<td>OUT 3</td>
<td>Automatic Parking Brake Relay</td>
</tr>
<tr>
<td>OUT 4</td>
<td>Not Used</td>
</tr>
<tr>
<td>OUT 5</td>
<td>Not Used</td>
</tr>
<tr>
<td>OUT 6</td>
<td>Not Used</td>
</tr>
<tr>
<td>OUT 7</td>
<td>Not Used</td>
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<tr>
<td>OUT 8</td>
<td>Not Used</td>
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<tr>
<td>OUT 9</td>
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<td>OUT 14</td>
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<tr>
<td>OUT 15</td>
<td>Not Used</td>
</tr>
<tr>
<td>OUT 16</td>
<td>Steering Feedback</td>
</tr>
<tr>
<td>OUT LS</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 relays).
T1: Primary Controller (continued)

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 43

1. Machine wire harness connector P01
2. Tab
3. T1: Primary controller

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: primary controller 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).
Starter/Generator (Model 04580)

The starter/generator is a 48 VDC, air cooled, brushless, permanent magnet device. To operate, the starter/generator requires 48V logic power (supplied by the logic relay). The starter/generator supplies power to all of the 48V components via the 48V power bus when the main contactor and traction motor contactor are energized. Since the 48V batteries are connected to the 48V power bus, the starter/generator also charges the 48V batteries.

The starter/generator has its own on-board controller. The starter/generator and the T6: starter/generator controller can be replaced separately if necessary. The InfoCenter can be used to monitor starter/generator activity during machine operation; refer to InfoCenter (page 5–10).

The starter/generator is not serviceable, and is best tested by using the information provided on the InfoCenter display as described in the following test procedure. Refer to Appendix A (page A–1) for circuit wiring information.

**Note:** If the starter/generator controller is replaced for any reason, the machine software must be updated; contact an Authorized Toro Distributor for assistance.

![Figure 44](image)

1. Engine
2. Generator

**Testing the Starter/Generator**

1. Park the machine on a level surface, lower the cutting units, set the key switch to the OFF position and remove the key from the key switch.
2. Engage the manual parking brake and set the function control switch to the NEUTRAL position.
3. Sit in the operator seat and set the key switch on the ON position.
4. Access the InfoCenter Diagnostics > Generator > Inputs screen.

48V system voltage should be present at the starter/generator logic circuit Gen Logic V and at the starter/generator power bus circuit Gen Bus V.

- If -- -- appears, the controller is not communicating on the CAN bus.
  
  Voltage must be present at the controller logic circuit before communication can occur on the CAN bus. If voltage is not present at the logic circuit, the logic circuit is damaged. The circuit wiring should be checked for corrosion or damage and cleaned or repaired as necessary.

  If logic voltage is present at the controller, and CAN bus communication is suspect, the CAN bus circuit is damaged. The CAN bus wiring should be checked for corrosion or damage and cleaned or repaired as necessary. The starter/generator controller CAN bus transceiver can also be tested if necessary; refer to Testing Devices (Nodes) on the CAN bus (page 5–32).

- If 00.0V is present at the starter/generator power bus circuit, the power bus circuit is damaged. The circuit wiring should be checked and repaired as necessary.

5. Sit in the operator’s seat and set the key switch on the On position.

6. Access the InfoCenter Diagnostics > Generator > Outputs screen.
A. **Gen Current** should read 0A while the engine is not running.

B. Start the engine. **Gen Current**: should read from 3A to 10A (depending on battery condition) while the engine is running at 2,400 rpm.

7. If the InfoCenter diagnostics inputs report normally and the starter/generator output is out of range, repair or replace the starter/generator or starter/generator controller; refer to *Generator Assembly (Model 04580)* (page 5–120). If the starter/generator controller is replaced, update the machine software; contact an Authorized Toro Distributor.
The eTriFlex 3370 uses a Lithium-ion battery controller or Battery Management System (BMS) to manage the lithium-ion batteries; refer to SC8: Lithium-Ion Battery Controller (Model 04590) (page 5–15) for SC8: lithium-ion battery controller operation notes. The BMS is located under the hood attached to the back of the center mounted batteries.

**Note:** If the SC8: Lithium-Ion Battery Controller is replaced for any reason, the machine software must be updated; contact an Authorized Toro Distributor for assistance.

**Testing the SC8: Lithium-Ion Battery Controller (Model 04590)**

Although there is no method to test the solid state circuitry built into the controller directly, some aspects of the lithium-ion battery controller operation can be tested as follows; refer to Figure 48.
**Testing the SC8: Lithium-Ion Battery Controller (Model 04590) (continued)**

**Figure 48**

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lithium-Ion battery controller (BMS)</td>
<td>4</td>
<td>M-S terminal (battery interface harness)</td>
<td>7</td>
<td>COM terminal (machine wire harness)</td>
</tr>
<tr>
<td>2</td>
<td>Positive (+) terminal (power supply positive (+) cable)</td>
<td>5</td>
<td>B- terminal (negative (-) battery cable)</td>
<td>8</td>
<td>Controller wire harness connector</td>
</tr>
<tr>
<td>3</td>
<td>B+ terminal (positive (+) battery cable)</td>
<td>6</td>
<td>Negative (-) terminal (power supply negative (-) cable)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- With he batteries connected to the BMS, the battery pack voltage can be tested across the BMS B+ and B- terminals.
- With the batteries connected to the BMS, signal voltage from the BMS to the key switch can be tested at the controller wire harness connector P12 pin 6 and the BMS B- terminal.
- An audible “Click” should come from the BMS shortly after the key switch is set to the On position. The “Click” sound indicates the contactor inside the BMS has closed and battery power should be available to the machine.
- Once the BMS internal contactor has closed, battery pack voltage can be tested across the BMS positive (+) and negative (−) terminals.
- If CAN bus communication with the controller is suspect, the CAN bus wiring should be checked for corrosion or damage and cleaned or repaired as necessary. The lithium-ion battery controller CAN bus transceiver can also be tested if necessary using the controller wire harness connector P12 pins 3 and 4; refer to **Testing Devices (Nodes) on the CAN bus** (page 5–32).

**Removing and Installing the SC8: Lithium-Ion Battery Controller (Model 04590)**

**IMPORTANT**

To prevent accidentally shorting a disconnected battery cable across other components or tools, insulate the battery cable terminal with a 76 mm (3 inch) length of 1/2 inch internal diameter rubber hose immediately after disconnecting the cable.
Removing and Installing the SC8: Lithium-Ion Battery Controller (Model 04590) (continued)

1. Battery cable terminal (typical)  2. 1/2 inch ID rubber hose

---

**IMPORTANT**

Do not open the lithium-Ion battery controller. There are no serviceable parts on or in the controller. If you open the controller, you will void the warranty. The controller is protected by tamper-alerting devices.

1. Park the machine on a level surface, lower the cutting units, set the key switch to the OFF position and remove the key.
2. Unplug the 48V battery disconnect; refer to 48V Battery Disconnect (page 5–9).
3. Label and disconnect the negative (-) battery cable, positive (+) battery cable from the lithium-ion battery controller B- and B+ terminals.
4. Label and disconnect the battery interface harness and the machine wire harness connector from the lithium-ion battery controller.

5. Label and disconnect the machine wire harness negative (-) and positive (+) cables from the lithium-ion battery controller negative (–) and positive (+) terminals.

6. Label and remove the power supply negative (-) and positive (+) cables from the lithium-ion battery controller negative (–) and positive (+) terminals.

7. Remove the controller bracket and T6: precharge controller assembly from the battery tray.

8. Remove the SC8: lithium-ion battery controller from the machine.

9. Check the foam strips for damage or wear and replace them if necessary.
Removing and Installing the SC8: Lithium-Ion Battery Controller (Model 04590) (continued)

**IMPORTANT**

Pay close attention to the lithium-ion battery controller orientation during installation. Install the controller with the positive (+) terminals upward; refer to Figure 50.

10. Install the lithium-ion battery controller in reverse order.

11. Tighten the power supply and battery cable fasteners from **8.5 to 9.5 N·m (75 to 85 in-lb)**, then apply battery terminal protector Toro Part No. 107-0392 or a light layer of grease to the battery terminals and cable connectors to reduce corrosion.
The eTriFlex 3370 uses a TEC 2401 series microcontroller as a precharge controller (T6) to manage the precharge function; refer to T6: Precharge Controller (Model 04590) (page 5–17) for T6: precharge controller operation notes. The precharge controller is located under the hood attached to the back of the center mounted battery assembly. Power for the precharge controller logic circuit is available when the key switch is set to the ON position (switched). The logic circuit is protected by a 3 Amp fuse. Power for the precharge controller outputs is available when the logic relay is energized.

Note: If the precharge controller (T6) is replaced for any reason, the machine software must be updated; contact an Authorized Toro Distributor for assistance.

Testing the T6: Precharge Controller (Model 04590)

Although there is no method to test the solid state circuitry built into the controller directly, some aspects of the precharge controller operation are visible using the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–39).

1. Park the machine on a level surface, lower the cutting units and set the key switch to the OFF position.
2. Set the function control switch to the NEUTRAL position.
3. Sit in the operator seat and set the key switch on the ON position.
4. Access the InfoCenter Diagnostics > Precharge > Inputs screen.

![Figure 52: Precharge screen](image)

**Logic V**
- If 48V system voltage is present, the T1: primary controller has energized the logic relay and power is being supplied to the precharge controller precharge input (connector P02 pin 6).
- If – – – appears, the controller is not communicating on the CAN bus. Voltage must be present at the controller logic circuit (connector P03 pin 6) before communication can occur on the CAN bus.

  If voltage is not present at the logic circuit, the logic circuit fuse or logic circuit wiring is damaged. The fuse and circuit wiring should be checked for corrosion or damage and cleaned, repaired, or replaced as necessary.

  If logic voltage is present at the controller, and CAN bus communication is suspect, the CAN bus circuit is damaged. The CAN bus wiring should be checked for corrosion or damage and cleaned or repaired as necessary. The precharge controller CAN bus transceiver can also be tested if necessary; refer to Testing Devices (Nodes) on the CAN bus (page 5–32).

- If 00.0V is present, the logic relay or logic circuit wiring is damaged. The relay and circuit wiring should be checked for corrosion or damage and cleaned, repaired, or replaced as necessary.

**Bus V**
- If 48V system voltage is present, the main contactor has closed and 48V bus voltage is present at the precharge controller precharge output (connector P02 pin 3). To achieve this, the T1: primary controller has commanded the T6: precharge controller via a CAN message to provide a path to ground (precharge controller OUT 2) for the 48 VDC main contactor coil to energize and close the main contactor. Precharge was successful.

- If 00.0V is present, the main contactor or circuit wiring (including the precharge controller OUT 2 circuit) is damaged. The contactor and circuit wiring should be checked for corrosion or damage and cleaned, repaired, or replaced as necessary.

**T6: Precharge Controller Inputs**
### Testing the T6: Precharge Controller (Model 04590) (continued)

#### T6: Precharge Controller Inputs (continued)

<table>
<thead>
<tr>
<th>INPUT NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precharge</td>
<td>Logic Relay Switch On</td>
</tr>
<tr>
<td>IN 1</td>
<td>Not Used</td>
</tr>
<tr>
<td>IN 2</td>
<td>Not Used</td>
</tr>
<tr>
<td>IN 3</td>
<td>Not Used</td>
</tr>
<tr>
<td>IN 4</td>
<td>Not Used</td>
</tr>
<tr>
<td>IN 5</td>
<td>Not Used</td>
</tr>
<tr>
<td>IN 6</td>
<td>Not Used</td>
</tr>
<tr>
<td>IN 7</td>
<td>Not Used</td>
</tr>
<tr>
<td>IN 8</td>
<td>Not Used</td>
</tr>
<tr>
<td>AIN1</td>
<td>Not Used</td>
</tr>
</tbody>
</table>

#### T6: Precharge Controller 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>Main Contactor Coil (ground)</td>
</tr>
<tr>
<td>N/C 1</td>
<td>Not Used</td>
</tr>
<tr>
<td>N/C 2</td>
<td>Not Used</td>
</tr>
<tr>
<td>Precharge</td>
<td>Precharge Voltage to Reel Motors, Lift Actuators, 3WD Traction (opt)</td>
</tr>
<tr>
<td>5 VDC OUT</td>
<td>Not Used</td>
</tr>
<tr>
<td>12 VDC OUT</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 relays).

---

**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.
Testing the T6: Precharge Controller (Model 04590) (continued)

Two 12 pin wire harness connectors are attached to the controller. The connection terminal function for the controller and the wire harness connector pins are shown above. The connectors are keyed the same. Pay close attention to the wire harness connector color and the controller connector color (gray wire harness connector attaches to gray controller connector).

Figure 53

1. Machine wire harness connector P02 (gray)
2. Machine wire harness connector P03 (black)
3. T6: Precharge controller
The 48V battery pack and the 48 VDC/12 VDC converter are used to supply the 12 VDC electrical system with power. The 48 VDC/12 VDC converter is located under the right side cover below the T1: primary controller.

Testing the 48 VDC/12 VDC Converter

The 48 VDC/12 VDC converter and its circuit wiring can be tested using the InfoCenter splash screen (battery icon); refer to Using the InfoCenter Display for Troubleshooting (page 3–39). If testing determines that the converter and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower the cutting units, set the key switch to the OFF position and remove the key from the switch.

2. Remove the right side cover.

3. Disconnect the 48 VDC/12 VDC converter from the machine wire harness. Check the harness connectors for damage or corrosion and clean or repair as necessary. Use a multimeter (VDC setting) to check the machine wire harness connector.

<table>
<thead>
<tr>
<th>Location</th>
<th>Harness</th>
<th>Connector</th>
<th>Pin</th>
<th>Wire Color</th>
<th>Expected Reading</th>
<th>Connector Graphic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Main</td>
<td>P07</td>
<td>3</td>
<td>Black/White</td>
<td>48 VDC (nominal)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Main</td>
<td>P07</td>
<td>4</td>
<td>Tan</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Connect the 48 VDC/12 VDC converter to the machine wire harness. Use a multimeter (VDC setting) to check the machine wire harness connector (from the back of the connector).
### Testing the 48 VDC/12 VDC Converter (continued)

<table>
<thead>
<tr>
<th>Location</th>
<th>Harness</th>
<th>Connector</th>
<th>Pin</th>
<th>Wire Color</th>
<th>Expected Reading</th>
<th>Connector Graphic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main P07</td>
<td>1</td>
<td>Black</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main P07</td>
<td>2</td>
<td>Red</td>
<td>2</td>
<td></td>
<td>12 VDC (nominal)</td>
<td></td>
</tr>
</tbody>
</table>

5. If testing determines the converter is faulty, replace the converter.

6. If the converter tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
Front Traction Motor Controllers

The traction motor controllers are separate from the motors and control each motor individually. The right side controller (SC5: Traction 1) is located under the right side cover and controls the right side traction motor. The left side controller (SC6: Traction 2) is located under the left side cover and controls the left side traction motor. To operate, the front traction motor controllers require 48V logic power (supplied by the logic relay) and a connection to the 48V power bus (supplied by the traction motor contactor when energized). The traction motor controllers communicate with the remainder of the machine via the CAN bus. Each front traction motor controller passes 48V power along to its respective traction motor as needed. The traction motors themselves are not directly on the CAN bus.

The traction motor controller is not serviceable, and is best tested by using the information provided on the InfoCenter display as described in the following test procedure. Refer to Appendix A (page A–1) for circuit wiring information.

Note: If a front traction motor controller (SC5 or SC6) is replaced for any reason, the machine software must be updated and the front traction motors must be calibrated; contact an Authorized Toro Distributor for assistance.

![Diagram of front traction motor controllers](image)

Figure 55

1. SC5: Traction 1 (right side)  
2. SC6: Traction 2 (left side)

Testing the Front Traction Motor Controllers

The InfoCenter Display can also be used to monitor the current draw for the traction motors during machine operation. During operation, some variance in the traction motor current draw is expected even when driving straight.
Testing the Front Traction Motor Controllers (continued)

1. Park the machine on a level surface, lower the cutting units and set the key switch to the Off position.
2. Set the function control switch to the Neutral position.
3. Sit in the operator seat and set the key switch on the On position.
4. Access the InfoCenter Diagnostics > Traction > Inputs screen.

5. 48V system voltage should be present at the traction motor controller logic circuit TRXN # Logic V.
   - If – – – appears, the controller is not communicating on the CAN bus. Voltage must be present at the controller logic circuit before communication can occur on the CAN bus.
     - If voltage is not present at the logic circuit, the logic circuit is damaged. The circuit wiring should be checked for corrosion or damage and cleaned or repaired as necessary.
     - If logic voltage is present at the controller, and CAN bus communication is suspect, the CAN bus circuit is damaged. The CAN bus wiring should be checked for corrosion or damage and cleaned or repaired as necessary. The traction motor controller CAN bus transceiver can also be tested if necessary; refer to Testing Devices (Nodes) on the CAN bus (page 5–32).
   - Traction motor speed should be displayed while the traction motors are engaged TRXN # Speed. Individual traction motor speed is related to the current turning radius (RDS).

6. Locate the front traction motor controller and disconnect it from the machine wire harness. Check the controller connector and the harness connector for damage or corrosion and clean or repair as necessary. Ensure all the connector pins are equally seated in the connector body.
Testing the Front Traction Motor Controllers (continued)

7. Inspect the front traction motor controller cable connections for damage or corrosion and clean or repair as necessary. Tighten the cable connections from **7.9 to 8.3 N·m (70 to 74 in-lb)**.

8. If the InfoCenter diagnostics inputs report normally and traction motor operation is an issue, test the traction motor; refer to Front Traction Motor (page 5–55).

9. If replacing the traction motor controller is necessary:
   A. Disconnect the 48V battery disconnect; refer to 48V Battery Disconnect (page 5–9).
   B. Disconnect the harness connector from the front traction motor controller.
   C. Label and disconnect the cables from the front traction motor controller.
   D. Remove the controller assembly from the machine.
   E. Secure the new controller to the machine with the previously removed fasteners and connect the cables to the controller. Tighten the cable connections from **7.9 to 8.3 N·m (70 to 74 in-lb)**.
   F. Connect the wire harness connector to the front traction motor controller.
Testing the Front Traction Motor Controllers (continued)

**IMPORTANT**

Do not allow aerosol protectant to spray into the front traction motor controller multi-pin connector. Install the wire harness connector or cover the connector before applying spray protectant. Spray protectant can adversely effect the precise fit of a multi-pin connector.

---

G. Lift the rubber boots from the cable terminals and coat the terminals with battery terminal protector Toro Part No. 107-0392 to reduce corrosion. Fit the rubber boots securely over the terminals.

H. Update the machine software; contact an Authorized Toro Distributor for assistance.

10. Calibrate the front traction motors before returning the machine to service; refer to Calibrating the Front Traction Motors (page 5–56).
Front Traction Motor

The two front traction motors are brushless permanent magnet motors located directly behind the front wheels. Each motor is attached to an oil filled gear box with an internal disc brake. Each motor includes a rotary encoder to recognize the motor speed. The motor controllers are separate from the motors and control each motor individually. The right side controller (SC5: Traction 1) controls the right side traction motor and the left side controller (SC6: Traction 2) controls the left side traction motor. The traction motors receive operation power from their respective motor controllers. The traction motors are not directly connected to the CAN bus.

**Note:** If a front traction motor is removed or replaced for any reason, the front traction motors must be calibrated.

---

**Figure 58**
(right side traction motor shown)

1. Traction Motor
2. Wire harness connector
3. Motor terminal – U (black)
4. Motor terminal – W (red)
5. Motor terminal – V (orange)

---

**Testing the Front Traction Motors**

The InfoCenter Display can be used to monitor the current draw for the traction motors during machine operation. During operation, some variance in the traction motor current draw is expected even when driving straight.

If traction motor performance is suspect, do the following before testing the traction motor:

- Ensure the tire pressures are in balance.
- Ensure the rear caster fork is in alignment; Aligning the Rear Wheel Caster Fork (page 6–8).
- Ensure the brake system is not engaging (dragging) during operation; refer to Adjusting the Brakes (page 6–3).
- Try to calibrate the traction motors; refer to Calibrating the Front Traction Motors (page 5–56).
Testing the Front Traction Motors (continued)

Refer to Figure 58 for this procedure.

1. Park the machine on a level surface, lower the cutting units and set the key switch to the OFF position.

2. Set the function control switch to the NEUTRAL position.

3. Check the machine wire harness at the traction motor connector:
   A. Locate and disconnect the multi-pin machine wire harness connector from the traction motor. Check the motor and the harness connector for damage or corrosion and clean or repair as necessary.
   B. Set the key switch to the ON position.
   C. Use a multimeter (DC voltage setting) to confirm 12 VDC is present at the wire harness connector terminal 1.
   D. Set the key switch to the OFF position.
   E. Use a multimeter (ohms setting) to confirm continuity to the 48V ground bus at the machine wire harness connector pins 4, 6 and 7.
   F. Repair the machine wire harness if necessary; refer to Appendix A (page A–1).

4. Disconnect the 48V battery disconnect; refer to 48V Battery Disconnect (page 5–9).

5. Label and disconnect the 3 traction motor power cables at the traction motor.

6. Use a multimeter (ohms setting) to confirm continuity across each combination of the motor terminals (black to red, black to orange, orange to red).

7. Replace the front traction motor as necessary; refer to Front Traction Motor (page 5–131).

8. Calibrate the front traction motors before returning the machine to service; refer to Calibrating the Front Traction Motors (page 5–56).

Calibrating the Front Traction Motors

1. Sit in the operator seat and set the key switch on the ON position.

2. Access the InfoCenter Settings > Protected Menus > Enter PIN screen and enter the machine PIN.

3. Access the InfoCenter Service > Calibration screen.

4. Select Traction Motor and follow the on-screen calibration instructions.

   Note: If the calibration procedure fails, try calibrating the item again before continuing to troubleshoot the system.
Rear Wheel Traction Motor (Optional 3WD)

The rear wheel traction motor is a 48 VDC, brushless, permanent magnet motor. The rear wheel traction motor has its own on-board controller (T5). If a problem exists with the rear wheel traction motor, a fault may have occurred that would be indicated by a fault code on the InfoCenter Display. Before considering that rear wheel traction motor service work is necessary, check for any existing fault codes that indicate problems with the rear wheel traction motor; refer to Machine Faults (page 3–7). If the rear wheel traction motor is faulty, there will likely be numerous fault codes that are listed by the InfoCenter display.

To operate, the rear wheel traction motor requires 48V logic power (supplied by the logic relay) and a connection to the 48V power bus (supplied by the main contactor when energized).

The traction motor controller is not serviceable, and is best tested by using the information provided on the InfoCenter display as described in the following test procedure. Refer to Appendix A (page A–1) for circuit wiring information.

**Note:** If the rear wheel traction motor is replaced for any reason, the machine software must be updated; contact an Authorized Toro Distributor for assistance.

**Testing the Rear Wheel Traction Motor**

The InfoCenter Display can also be used to monitor the current draw for the traction motors during machine operation. During operation, some variance in the traction motor current draw is expected even when driving straight.

1. Park the machine on a level surface, lower the cutting units and set the key switch to the OFF position.
2. Set the function control switch to the NEUTRAL position.
3. Sit in the operator seat and set the key switch on the ON position.
4. Access the InfoCenter **Diagnostics > Traction > Inputs** screen.

![Figure 59](g202169)

5. 48V system voltage should be present at the traction motor controller logic circuit **TRXN 3 Logic V** and at the rear wheel traction motor power bus circuit **TRXN 3 Bus V**.

   - If —— appears, the controller is not communicating on the CAN bus. Voltage must be present at the controller logic circuit before communication can occur on the CAN bus.

     If voltage is not present at the logic circuit, the logic circuit is damaged. The circuit wiring should be checked for corrosion or damage and cleaned or repaired as necessary.
Testing the Rear Wheel Traction Motor (continued)

If logic voltage is present at the controller, and CAN bus communication is suspect, the CAN bus circuit is damaged. The CAN bus wiring should be checked for corrosion or damage and cleaned or repaired as necessary. The rear wheel traction motor controller CAN bus transceiver can also be tested if necessary; refer to Testing Devices (Nodes) on the CAN bus (page 5–32).

- If 00.0V is present at the rear wheel traction motor power bus circuit, the circuit is damaged. The circuit wiring should be checked and repaired as necessary.
- Rear wheel traction motor speed should be displayed while the traction motor is engaged TRXN 3 Speed.

6. Unplug the 48V battery disconnect; refer to 48V Battery Disconnect (page 5–9).

7. Locate and disconnect the rear wheel traction motor cable electrical connections at the machine wire harness. Check the motor and the harness connector for damage or corrosion and clean or repair as necessary.

8. Use a multimeter (ohms setting) measure the resistance between the ground terminal (blank wire) and the location ID terminal (pink wire). Resistance should be approximately 18.8 K-ohms.

9. If rear wheel traction motor removal, installation, disassembly or assembly is required; refer to Rear Traction Motor (Optional) (page 5–133).

10. If the motor tests correctly and a problem still exits, check the rear wheel traction motor circuit wiring; refer to Appendix A (page A–1).

11. After testing is complete, secure the rear wheel traction motor wire harness connectors and connect the 48V battery disconnect.
The steering input device is mounted to the steering arm behind the steering wheel. The steering input device includes a hall effect sensor that reports the steering wheel position to the SC7: Steering Motor. The steering input device sensors operate on 5 VDC supplied by the steering motor. The steering input device is not directly connected to the CAN bus.

The steering input device also includes a brake coil which creates drag (feedback) for a more “natural” feel when turning the steering wheel. The brake coil is controlled by a pulse width modulated (PWM) signal from the T1: Primary controller.

The steering input device is not serviceable, and is best tested by using the information provided on the InfoCenter display as described in the following test procedure. Refer to Appendix A (page A–1) for circuit wiring information.

**Note:** If the steering input device is removed or replaced for any reason, the steering system – center must be calibrated; refer to Calibrating the Steering System – Center (page 5–91).

### Testing the Steering Input Device

1. Park the machine on a level surface, lower the cutting units and set the key switch to the OFF position.
2. Engage the manual parking brake and set the function control switch to the NEUTRAL position.
Testing the Steering Input Device (continued)

3. Sit in the operator seat and set the key switch to the ON position.
4. Access the InfoCenter Diagnostics > Steering > Inputs screen.

![Figure 62](Image)

5. The steering input device sensor signal voltage characteristics are:
   - **St Wheel Sig 1** and **St Wheel Sig 2** voltages should decrease as you turn the steering wheel to the right (clockwise).
   - **St Wheel Sig 1** and **St Wheel Sig 2** voltages should increase as you turn the steering wheel to the left (counterclockwise).
   - The signal voltage range should be from 0.2V to 4.7V.
   - When the signal voltage reaches either end of the voltage range, the voltage will reset and continue to increase or decrease as you continue to turn the steering wheel.
   - The signal voltage should change from minimum to maximum in approximately one complete revolution of the steering wheel.
   - The difference between the 2 signal voltages should always be approximately 2.5V.

6. Access the InfoCenter Diagnostics > Steering > Outputs screen.

![Figure 63](Image)

(steering wheel at rest)
Testing the Steering Input Device (continued)

7. **St Wheel Feel** is the amount of current being sent by the T1: Primary controller to the steering input device brake coil, and not necessarily what is being received by the coil. The steering input device brake coil amperage characteristics are:
   - **St Wheel Feel** should be approximately 220 mA when the steering wheel is at rest or turned slowly in either direction.
   - **St Wheel Feel** should be approximately 600 mA when the steering wheel reaches the end of its turning range in either direction.
   - **St Wheel Feel** should vary between 220 and 480 mA when the steering wheel is turned quickly in either direction.

8. Remove the cover from the steering mount.

9. Disconnect the steering input device from the machine wire harness. Check both connectors for corrosion or damage and clean or repair as necessary.

10. Use a multimeter (ohms setting) to measure the resistance of the brake coil across the steering input device connector pins 5 and 6. Resistance should be approximately **10 ohms at 20° C** (68° F).

11. If the InfoCenter diagnostics inputs and outputs report normally, the brake coil resistance measures correctly, and the steering input device does not function properly, replace the device; refer to **Steering Arm Assembly** (page 6–35).

12. If the steering input device tests correctly and a circuit problem still exists, check the machine wire harness; refer to **Appendix A** (page A–1).

13. After testing, connect the machine wire harness, install the cover and calibrate the steering system – center: refer to **Calibrating the Steering System – Center** (page 5–91).
Steering Motor

The steering motor is mounted to the steering gear box housing over the rear wheel caster fork. The steering motor has its own on-board controller (SC7). To operate, the steering motor requires 48V logic power (supplied by the logic relay), a connection to the 48V power bus, and a connection to the CAN bus to send and receive control messages. The steering motor is connected to the 48V power bus at all times and is not controlled by the main contactor.

The steering motor is not serviceable, and is best tested by using the information provided on the InfoCenter display as described in the following test procedure. Refer to Appendix A (page A–1) for circuit wiring information.

**Note:** If the steering motor (SC7) is replaced for any reason, the machine software must be updated; contact an Authorized Toro Distributor for assistance. If the steering motor is replaced or removed for any reason, the steering system must be calibrated. Calibrate the steering system – center first, then calibrate the steering system – range; refer to Calibrating the Steering System – Center (page 5–91) and Calibrating the Steering System – Range (page 5–91).

**Testing the Steering Motor**

1. Park the machine on a level surface, lower the cutting units and set the key switch to the OFF position.
2. Set the function control switch to the NEUTRAL position.
3. Sit in the operator seat and set the key switch on the On position.
4. Access the InfoCenter Diagnostics > Steering > Inputs screen.
5. 48V system voltage should be present at the steering motor controller logic circuit **Logic Voltage**.
   - If – – – appears, the controller is not communicating on the CAN bus. Voltage must be present at the controller logic circuit before communication can occur on the CAN bus.
   
   If voltage is not present at the logic circuit, the logic circuit is damaged. The circuit wiring should be checked for corrosion or damage and cleaned or repaired as necessary.
   
   If logic voltage is present at the controller, and CAN bus communication is suspect, the CAN bus circuit is damaged. The CAN bus wiring should be checked for corrosion or damage and cleaned or repaired as necessary. The steering motor controller CAN bus transceiver can also be tested if necessary; refer to **Testing Devices (Nodes) on the CAN bus** (page 5–32).

6. Sit in the operator seat and set the key switch on the **ON** position.

7. Access the InfoCenter **Diagnostics > Steering > Outputs** screen.

   - **Mtr Current** should read 0A while the steering motor is stationary.
Testing the Steering Motor (continued)

• Turning the steering wheel in both directions. The current required to move the rear caster wheel should appear next to Mtr Current while the steering motor is moving.

• The amount of current required to turn the rear caster wheel should not exceed 6A.

8. Locate the steering motor and disconnect it from the machine wire harness. Check the motor connector and the harness connector for damage or corrosion and clean or repair as necessary. Ensure all the connector pins are equally seated in the connector body.

9. If the InfoCenter diagnostics inputs and outputs report normally and the steering motor does not function properly, replace the steering motor; refer to Figure 64.
   A. Record the orientation of the steering motor prior to removal.
   B. Remove the fasteners securing the steering motor to the upper steering housing and remove the steering motor. Locate and discard the steering motor gasket.
   C. Remove and replace the retaining ring and the pinion gear from the motor shaft if necessary. Apply a light coating of high temperature grease (Mobil XHP-222 or equivalent) to the pinion gear teeth.
   D. Use a new steering motor gasket, orient the steering motor as previously recorded, and install the steering motor.
   E. Update the machine software; contact an Authorized Toro Distributor.

10. Calibrate the steering system. Calibrate the steering system – center first, then calibrate the steering system – range; refer to Calibrating the Steering System – Center (page 5–91) and Calibrating the Steering System – Range (page 5–91).
Location ID Module

The location ID module is part of the 48 VDC electrical circuit, and is used to identify the 3 cutting unit motors and the optional rear wheel traction motor individually. The ID module enables machine operation features such as starting and stopping the center cutting unit slightly later than the front cutting units. The location ID module plugs into the main wire harness under the right side cover.

![Diagram of location ID module](g287609)

**Figure 67**
(right side cover removed)

1. Location ID module
2. ID module connector
3. Machine wire harness connector

Testing the Location ID Module

1. Park the machine on a level surface, lower the cutting units, set the key switch to the OFF position and remove the key from the key switch.
2. Remove the right side cover.
3. Unplug the 48V battery disconnect; refer to 48V Battery Disconnect (page 5–9)
4. Locate the location ID module and disconnect it from the machine wire harness. Check the module and the harness connector for damage or corrosion and clean or repair as necessary.
5. Use a multimeter (ohms setting) to measure and record the resistance across the ID module connector terminals.

<table>
<thead>
<tr>
<th>CONNECTOR TERMINALS</th>
<th>NORMAL RESISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>F and A</td>
<td>14k to 16k ohms</td>
</tr>
<tr>
<td>F and B</td>
<td>9k to 11k ohms</td>
</tr>
<tr>
<td>F and C</td>
<td>6k to 7k ohms</td>
</tr>
<tr>
<td>F and D</td>
<td>3.5k to 4.5k ohms</td>
</tr>
<tr>
<td>F and E</td>
<td>1.4k to 1.8k ohms</td>
</tr>
</tbody>
</table>

6. Replace ID module if testing determines that it is faulty.
Testing the Location ID Module (continued)

7. If the ID module tests correctly and a circuit problem still exists, check the wire harness:
   A. Use a multimeter (ohms setting) to measure and record the resistance across the disconnected machine wire harness connector terminals.

   ![Figure 68](image)

   **Figure 68**

   1. Machine wire harness connector

   B. The resistance across connector terminal F (black/white wire) and each of the terminals C, D, and E should be 18k to 20k ohms. If the machine is equipped with an optional rear wheel traction motor, resistance across connector terminal F and B should also be 18k to 20k ohms.

   C. An incorrect resistance measurement across a pair of terminals indicates damage to the wire harness for that motor circuit. Repair or replace the wiring as necessary; refer to Appendix A (page A–1).

8. Connect the location ID module to the machine wire harness after testing.

9. Connect the 48V battery disconnect.
Cutting Unit Motors

The three cutting unit motors are identical 48 VDC, brushless, permanent magnet motors. Each motor has its own on-board controller (T1: center cutting unit, T2: left cutting unit, T3: right cutting unit). If a problem exists with any cutting unit motor, a fault may have occurred that would be indicated by a fault code on the InfoCenter Display. Before considering that cutting unit motor service work is necessary, check for any existing fault codes that indicate problems with a cutting unit motor; refer to Machine Faults (page 3–7). If a cutting unit motor is faulty, there will likely be numerous fault codes that are listed by the InfoCenter display.

Because all the cutting unit motors used on the machine are the same, the motors can be exchanged to help troubleshoot a problem. If the problem follows the motor to the new cutting unit, the motor is likely the issue. If the problem remains with the cutting unit, the issue is likely due to the cutting unit or electrical components or wiring specific to that cutting unit.

To operate, the cutting unit motors require 48V logic power (supplied by the logic relay) and a connection to the 48V power bus (supplied by the main contactor when energized).

The cutting unit motor controller is not serviceable, and is best tested by using the information provided on the InfoCenter display as described in the following test procedure. Refer to Appendix A (page A–1) for circuit wiring information.

**Note:** If a cutting unit motor is replaced for any reason, the machine software must be updated; contact an Authorized Toro Distributor for assistance.

Testing the Cutting Unit Motors

The InfoCenter Display can be used to monitor the speed and current draw for the cutting unit motors during machine operation; refer to InfoCenter (page 5–10).

1. Park the machine on a level surface, lower the cutting units and set the key switch to the OFF position.
2. Set the function control switch to the NEUTRAL position.
3. Sit in the operator seat and set the key switch on the ON position.
4. Access the InfoCenter **Diagnostics > PTO > Inputs** screen.

![Figure 69](g202911)

5. 48V system voltage should be present at the cutting unit motor controller logic circuit **MTR # Logic V** and at the cutting unit motor power bus circuit **MTR # Bus V**.
Testing the Cutting Unit Motors (continued)

- If – – – appears, the controller is not communicating on the CAN bus. Voltage must be present at the controller logic circuit before communication can occur on the CAN bus.

  If voltage is not present at the logic circuit, the logic circuit is damaged. The circuit wiring should be checked for corrosion or damage and cleaned or repaired as necessary.

  If logic voltage is present at the controller, and CAN bus communication is suspect, the CAN bus circuit is damaged. The CAN bus wiring should be checked for corrosion or damage and cleaned or repaired as necessary. The cutting unit motor controller CAN bus transceiver can also be tested if necessary; refer to Testing Devices (Nodes) on the CAN bus (page 5–32).

- If 00.0V is present at the cutting unit motor power bus circuit, the circuit is damaged. The circuit wiring should be checked and repaired as necessary.

6. Unplug the 48V battery disconnect; refer to 48V Battery Disconnect (page 5–9).

7. Locate and disconnect the cutting unit motor cable electrical connections at the machine wire harness for the motor being tested. Check the motor and the harness connector for damage or corrosion and clean or repair as necessary.

8. Use a multimeter (ohms setting) and measure the resistance between the ground terminal (blank wire) and the location ID terminal (T1 = blue wire, T2 = yellow wire, T3 = tan wire). Resistance should be approximately 18.8 K-ohms.

   ![Figure 70](image)

   1. Cutting unit motor connector – 2 pin  
   2. Ground terminal  
   3. Cutting unit motor connector – 4 pin  
   4. Location ID terminal

9. If cutting unit motor removal, installation, disassembly or assembly is required; refer to Cutting Unit Motor (page 5–137).

10. If the motor tests correctly and a problem still exits, check the cutting unit motor circuit wiring; refer to Appendix A (page A–1).

11. After testing is complete, secure the cutting unit motor wire harness connectors and connect the 48V battery disconnect.
Key Switch (Model 04580)

<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: Primary controller to manage various machine functions.

Testing the Key Switch

The key switch and its circuit wiring can be tested using the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–39) Diagnostics > Engine > Inputs. 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 the cutting units and set the key switch to the Off position.
2. Disconnect the battery negative (-) cable at the 12V system battery; refer to Removing and Installing the 12V System Battery (Model 04580) (page 5–105).
3. Remove the console cover.
4. Disconnect the wire harness connector from the switch. Check the switch and the harness connector for damage or corrosion and clean or repair as necessary. Remove the switch from the console 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 main wire harness; refer to Appendix A (page A–1).
8. Install the switch, connect the wire harness and install the console cover after testing.
9. Connect the battery negative (-) cable at the 12V system battery.
The key switch on the console has three (3) positions – Off, Run and Start. The Start position is not used on this machine. The key switch is used to energize the T6: Precharge controller and the SC8: 48V Battery Controller.

Testing the Key Switch

1. Park the machine on a level surface, lower the cutting units and set the key switch to the Off position.
2. Unplug the 48V battery disconnect; refer to 48V Battery Disconnect (page 5–9).
3. Remove the console cover.
4. Disconnect the wire harness connector from the switch. Check the switch and the harness connector for damage or corrosion and clean or repair as necessary. Remove the switch from the console 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 main wire harness; refer to Appendix A (page A–1).
8. Install the switch, connect the wire harness and install the console cover after testing.
9. Connect the 48V battery disconnect before returning the machine to service.
Function Control Switch

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

The function control switch is located on the operator console. The function control switch allows the operator to select between NEUTRAL (also used for backlapping), MOW (low speed range), and TRANSPORT (high speed range). The function control switch is part of the safety interlock system; refer to Checking the Interlock System Operation (page 5–19) for a better understanding of how the switch is used.

Testing the Function Control Switch

The function control switch and its circuit wiring can be tested using the main information screen of the InfoCenter Display; refer to InfoCenter (page 5–10). 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 the cutting units, set the key switch to the OFF position and remove the key from the key switch.

2. Disconnect the battery negative (-) cable at the 12V system battery (model 04580); refer to Removing and Installing the 12V System Battery (Model 04580) (page 5–105), or unplug the 48V battery disconnect (model 04590); refer to 48V Battery Disconnect (page 5–9).

3. Remove the console cover.

4. Disconnect the wire harness connector from the switch. Check the switch and the harness connector for damage or corrosion and clean or repair as necessary. Remove the switch from the console 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 main wire harness; refer to Appendix A (page A–1).

8. Install the switch with the flat portion of the rocker toward the rear of the machine. Connect the wire harness and install the console cover after testing.

9. Connect the battery negative (-) cable at the 12V system battery (model 04580), or connect the 48V battery disconnect (model 04590). Test the switch functionality before returning the machine to service.
Light Switch (Optional)

<table>
<thead>
<tr>
<th>POSITION</th>
<th>CLOSED CIRCUITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRONT AND REAR FACING LIGHTS ON</td>
<td>1 + 2, 4 + 5</td>
</tr>
<tr>
<td>OFF</td>
<td>NONE</td>
</tr>
<tr>
<td>REAR FACING LIGHT ON</td>
<td>2 + 3, 5 + 6</td>
</tr>
</tbody>
</table>

The light switch is located on the operator console. Pushing down on the right side of the switch energizes the front and rear facing lights. Pushing down on the left side of the switch energizes the rear facing light.

Testing the Light Switch

1. Park the machine on a level surface, lower the cutting units, set the key switch to the Off position and remove the key from the key switch.

2. Disconnect the battery negative (-) cable at the 12V system battery (model 04580); refer to Removing and Installing the 12V System Battery (Model 04580) (page 5–105), or unplug the 48V battery disconnect (model 04590); refer to 48V Battery Disconnect (page 5–9).

3. Remove the console cover.

4. Disconnect the wire harness connector from the switch. Check the switch and the harness connector for damage or corrosion and clean or repair as necessary. Remove the switch from the console 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 main wire harness; refer to Appendix A (page A–1).

8. Install the switch with the flat portion of the rocker toward the right side of the machine. Connect the wire harness and install the console cover after testing.

9. Connect the battery negative (-) cable at the 12V system battery (model 04580), or connect the 48V battery disconnect (model 04590) before returning the machine to service.
Seat Switch

The seat switch is a normally open switch that closes when the operator is on the seat. The seat switch and its electrical connector are located directly under the seat. The seat switch is part of the safety interlock system; refer to Checking the Interlock System Operation (page 5–19) for a better understanding of how the switch is used.

Testing the Seat Switch

The seat switch and its circuit wiring can be tested using the main information screen of the InfoCenter Display; refer to InfoCenter (page 5–10). 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 the cutting units, set the key switch to the OFF position and remove the key from the key switch.

2. Raise the seat and disconnect the wire harness connector from the seat switch harness. Check the harness connectors for damage or corrosion and clean or repair as necessary.

3. Check the continuity of the switch by connecting a multimeter (ohms setting) across the switch harness terminals.
   A. With no operator in the seat, there should be no continuity between the terminals.
   B. Press directly onto the seat switch through the seat cushion. There should be continuity as the seat cushion approaches the bottom of its travel.

4. Disconnect the seat switch harness from the seat switch and test the seat switch separately if necessary. Check the switch and the harness connector for damage or corrosion and clean or repair as necessary.

5. Replace the switch or switch harness if necessary. To replace the seat switch:
   A. Detach the rear of the seat base fabric cover.
Testing the Seat Switch (continued)

B. Access the top of the switch by slipping between the seat frame and the seat base foam.
C. Release the switch from underneath and remove the switch.
D. Install the seat switch in the reverse order.

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

7. Connect the wire harnesses to the switch before returning the machine to service.
Brake Actuator

The eTriFlex machines use a single mechanical brake assembly that can be used as a service brake, a manual parking brake, and an automatic parking brake. The service brake and manual parking brake are controlled by a cable connected to pedals at the operator’s left foot, while the automatic parking brake is controlled by an 12 VDC electric brake actuator.

When the brake actuator is de-energized, an extension spring extends the actuator and engages the brakes. When the brake actuator is energized, the actuator retracts and disengages the brakes. The brake actuator is energized by the parking brake relay which is controlled by the T1: Primary controller.

![Diagram of brake actuator components]

Figure 72

1. Brake actuator
2. Cylinder pin
3. Hair pin (2 each)
4. Extension spring
5. Eye bolt
6. Cotter pin
7. link plate (2 each)
8. Clevis pin
9. Brake actuator connector

Testing the Brake Actuator

The brake actuator and its circuit wiring can be tested using the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–39)

Diagnostics > Traction > Outputs. If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park machine on a level surface, lower the cutting units, set the key switch to the OFF position and remove the key from the key switch.
2. Ensure the parking brake relay is operating correctly; refer to Relays (page 5–92).
3. Engage the manual parking brake.
Testing the Brake Actuator (continued)

4. Disconnect the brake actuator from the machine harness. Check the actuator and the harness connector for damage or corrosion and clean or repair as necessary.

5. Remove the actuator from the machine.

6. Use the cylinder pin to clamp the body of the actuator securely in a vise, and manually extend and retract the actuator rod. The actuator rod should travel approximately 32 mm (1.25 inch) in each direction smoothly.

7. Connect the brake actuator B terminal (green wire) to a 12 VDC power supply, and connect the A terminal (black wire) to ground. The actuator should retract.

8. Connect the brake actuator A terminal (black wire) to a 12 VDC power supply, and connect the B terminal (green wire) to ground. The actuator should extend.

9. Replace the actuator if necessary.

10. If the actuator tests correctly and a circuit problem still exists, check the main wire harness; refer to Appendix A (page A–1).

   **Note:** 12 VDC should be present at the wire harness connector when the manual parking brake is disengaged, an operator is sitting in the seat, and the key switch is set to the Run position.

11. Install the actuator and adjust the brakes before returning the machine to service; refer to Adjusting the Brakes (page 6–3).
Manual Parking Brake Switch

The switch is located directly under the brake pedal assembly. The manual parking brake switch is an input to the T1: primary controller. The switch is a normally open proximity switch that closes when the foot actuated parking brake is disengaged (the parking brake latch is in close proximity to the switch). The manual parking brake switch is part of the safety interlock system; refer to Checking the Interlock System Operation (page 5–19) for a better understanding of how the switch is used.

Testing the Manual Parking Brake Switch

The manual parking brake switch and its circuit wiring can be tested using the main information screen of the InfoCenter Display; refer to InfoCenter Display (page 5–33) (P) icon. 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 the cutting units and set the key switch to the OFF position.

2. Set the key switch to the On position and check LED on the cable end of the manual parking brake switch. The LED should be illuminated when the manual parking brake is disengaged. The LED should not be illuminated when the manual parking brake is engaged. Set the key switch to the OFF position.

3. If the switch LED does not function correctly:
   A. Check the manual parking brake switch adjustment and adjust if necessary; refer to Adjusting the Manual Parking Brake Switch (page 5–22).
Testing the Manual Parking Brake Switch (continued)

B. Disconnect the machine wire harness from the parking brake switch. Check the switch and the harness connector for damage or corrosion and clean or repair as necessary.

C. Set the key switch to the On position (do not start the engine) and use a multimeter (DC voltage setting) to verify that the machine wire harness pink wire has system voltage (12 VDC) present. Set the key switch to the Off position.

D. Use a multimeter (ohms setting) and verify that the machine wire harness black wire is closed to ground (has continuity).

E. Use a multimeter (ohms setting) and verify that the machine wire harness blue wire has continuity at the T1: primary controller connector; refer to Appendix A (page A–1).

4. If the wire harness tests correctly and the switch LED does not function as desired, replace and adjust the manual parking brake switch; refer to Adjusting the Manual Parking Brake Switch (page 5–22).

5. Connect the machine wire harness to the switch before returning the machine to service.
Cutting Unit Lift/Lower Switches

Figure 74

1. Console
2. Knob
3. Jam nut (2 each)
4. Stem
5. Joystick assembly
6. Lower switch
7. Lift switch
8. Cap screw (2 each)
9. Hex nut (2 each)

Raise/Lower Switch Testing Reference

<table>
<thead>
<tr>
<th>JOYSTICK POSITION</th>
<th>RAISE SWITCH CIRCUIT</th>
<th>LOWER SWITCH CIRCUIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIFT</td>
<td>1 + 2</td>
<td>1 + 3</td>
</tr>
<tr>
<td>CENTER</td>
<td>1 + 3</td>
<td>1 + 3</td>
</tr>
<tr>
<td>LOWER</td>
<td>1 + 3</td>
<td>1 + 2</td>
</tr>
</tbody>
</table>

The 2 cutting unit lift/lower switches are located on the joystick bracket attached to the operator console. The rear switch is used to lower the cutting units and the front switch is used to lift the cutting units. The switches are identical. Each switch includes a common terminal, a normally open terminal and a normally closed terminal. The cutting unit lift/lower switches are part of the safety interlock system; refer to Checking the Interlock System Operation (page 5–19) for a better understanding of how the switches are used.

Testing the Cutting Unit Lift/Lower Switches

The cutting unit lift/lower switches and their circuit wiring can be tested using the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–39). If testing determines that either switch or the circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower the cutting units, set the key switch is in the OFF position and remove the key.
Testing the Cutting Unit Lift/Lower Switches (continued)

2. Disconnect the battery negative (-) cable at the 12V system battery (model 04580); refer to Removing and Installing the 12V System Battery (Model 04580) (page 5–105), or unplug the 48V battery disconnect (model 04590); refer to 48V Battery Disconnect (page 5–9).

3. Remove the console cover; refer to Removing and Installing the Control Console (page 6–38).

4. Disconnect the wire harness from the switch. Check the switch and the harness connector for damage or corrosion and clean or repair as necessary.

5. Use a multimeter (ohms setting) to determine whether continuity exists between the various terminals for each switch position: refer to the Raise/Lower Switch Testing Reference (page 5–79).

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 to the switch and install the console cover.

9. Connect the battery negative (-) cable at the 12V system battery (model 04580), or connect the 48V battery disconnect (model 04590) before returning the machine to service.
Lift/Lower Actuators

Three electric linear actuators are used on eTriFlex machines to lift and lower the cutting units. Each lift/lower actuator is unique and cannot be interchanged with each other. The lift/lower actuators may be referred to by number: #1 = center (rear), #2 = left, #3 = right. The front lift/lower actuators retract to lift the cutting units, while the center (rear) lift/lower actuator extends to lift the cutting unit. Each lift/lower actuator has its own on-board controller. To operate, the lift/lower actuators require 48V logic power (supplied by the logic relay), a connection to the 48V power bus (supplied by the main contactor when energized), and a connection to the CAN bus to send and receive control messages.

The lift/lower actuators are not serviceable, and are best tested by using the information provided on the InfoCenter display as described in the following test procedure. Refer to Appendix A (page A–1) for circuit wiring information.

**Note:** If a lift/lower actuator (SC2, SC3, or SC4) is replaced for any reason, the machine software must be updated; contact an Authorized Toro Distributor for assistance. If the lift/lower actuator is removed for any reason, the lift/lower actuator must be calibrated; refer to Calibrating the Lift/Lower Actuators (page 5–83).

![Diagram of Lift/Lower Actuators](g292103)

**Figure 75**

- 1. Lift/Lower actuator #3 (right)
- 2. Retaining ring (3 each)
- 3. Flat washer (3 each)
- 4. Clevis pin (3 each)
- 5. Flat washer (3 each)
- 6. Cotter pin (3 each)
- 7. Lift/Lower actuator #1 (center/rear)
- 8. Cap screw
- 9. Pivot pin
- 10. Lift/Lower actuator #2 (left)
Testing the Lift/Lower Actuators

1. Park the machine on a level surface, lower the cutting units and set the key switch to the OFF position.

2. Engage the manual parking brake and set the function control switch to the NEUTRAL position.

3. Sit in the operator seat and set the key switch to the ON position.

4. Access the InfoCenter Diagnostics > Lift/Lower > Inputs screen.

A. Move the joystick to the LOWER position. A check mark should appear next to JS_Lower.

B. Move the joystick to the RAISE position. A check mark should appear next to JS_Raise.

C. Test the cutting unit raise and lower switches and their circuit wiring if necessary; refer to Cutting Unit Lift/Lower Switches (page 5–79).

D. 48V system voltage should be present at the actuator logic circuit Act # Logic V and at the actuator power bus circuit Act # Bus V.

   • If – – – appears, the actuator is not communicating on the CAN bus.

   Voltage must be present at the controller logic circuit before communication can occur on the CAN bus. If voltage is not present at the logic circuit, the logic circuit is damaged. The circuit wiring should be checked for corrosion or damage and cleaned or repaired as necessary.

   If logic voltage is present at the controller, and CAN bus communication is suspect, the CAN bus circuit is damaged. The CAN bus wiring should be checked for corrosion or damage and cleaned or repaired as necessary. The lift/lower controller CAN bus transceiver can also be tested if necessary; refer to Testing Devices (Nodes) on the CAN bus (page 5–32).

   • If 00.0V is present at the actuator power bus circuit, the circuit is damaged. The circuit wiring should be checked and repaired as necessary.

5. Sit in the operator’s seat set the key switch to the ON position.

6. Access the InfoCenter Diagnostics > Lift/Lower > Outputs screen.
Testing the Lift/Lower Actuators (continued)

- **Act # Mode** should read Off while the actuator is stationary.
- **Act # Current** should read 0A while the actuator is stationary.
- Move the joystick to the LOWER position. Lower should appear next to **Act # Mode** while the actuator is moving. The current required to move the actuator should appear next to **Act # Current** while the actuator is moving.
- Move the joystick to the RAISE position. Raise should appear next to **Act # Mode** while the actuator is moving. The current required to move the actuator should appear next to **Act # Current** while the actuator is moving.

7. If the InfoCenter diagnostics inputs and outputs report normally and the actuator does not function properly, replace the actuator and update the machine software; contact an Authorized Toro Distributor.

8. Calibrate the lift/lower actuator: refer to Calibrating the Lift/Lower Actuators (page 5–83).

**Calibrating the Lift/Lower Actuators**

1. Sit in the operator seat and set the key switch on the ON position.
2. Access the InfoCenter **Settings > Protected Menus > Enter PIN** screen and enter the machine PIN.
3. Access the InfoCenter **Service > Calibration** screen.
4. Select **Lift-lower** for the actuator being calibrated and follow the on-screen calibration instructions.

**Note:** If the calibration procedure fails, try calibrating the item again before continuing to troubleshoot the system.
The engine oil pressure switch is located on the right side of the engine near the oil filter. The oil pressure switch is a normally open switch that closes under engine oil pressure.

The condition of the engine oil pressure switch is monitored by the T1: Primary controller. If the oil pressure opens (low oil pressure) for more than 10 seconds while the engine is running, the controller will de-energize the engine control circuit to stop the engine.

**Testing the Engine Oil Pressure Switch**

Refer to the *Kawasaki FS481V Service Manual* for information regarding engine lubrication system testing.

The engine oil pressure switch and its circuit wiring can be tested as a T1: Primary input using the InfoCenter Display; refer to *Using the InfoCenter Display for Troubleshooting* (page 3–39). 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 the cutting units, set the key switch to the OFF position and remove the key from the key switch.
2. Locate the engine oil pressure switch on the engine and disconnect the wire harness connector from the switch. Check the switch and the harness connector for damage or corrosion and clean or repair as necessary.
3. Connect a multimeter (ohms setting) to check the continuity of the switch:
   A. With the engine off, there should be no continuity between the switch terminal and the metal switch body.
   B. With the engine running, there should be continuity between the switch terminal and the metal switch body.
Testing the Engine Oil Pressure Switch (continued)

4. Replace the switch as necessary.

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

6. After testing, connect the engine wire harness to the switch before returning the machine to service.
The traction pedal position sensor is a separate component in the traction pedal assembly. The sensor includes 2 analog hall effect sensors. The traction pedal sensor follows the traction pedal movement.

The sensor operates on 5VDC supplied by the SC5: Traction 1 motor controller (right side). Signal voltage from the pedal sensor (along with information from additional inputs) is used to determine the appropriate current flow to operate the traction motors. The traction pedal position sensor is connected directly to the SC5: Traction 1 motor controller. Traction control messages are sent to the remainder of the traction system motors (including machines with optional 3WD) from the SC5: Traction 1 motor controller via the CAB bus.

The sensor signals are constantly monitored for traction fault detection. If a traction pedal position sensor fault occurs while the machine is moving, the machine will slowly come to a stop. The brake pedal can be used to stop the machine sooner if necessary. A traction pedal position sensor fault will disable traction control until the ignition key is cycled OFF and ON.

The traction pedal position sensor is part of the safety interlock system; refer to Checking the Interlock System Operation (page 5–19) for a better understanding of how the sensor is used.

**Note:** If a the traction pedal position sensor is replaced or removed for any reason, the sensor must be calibrated; refer to Calibrating the Traction Pedal Position Sensor (page 5–88).

**Testing the Traction Pedal Position Sensor**

1. Park the machine on a level surface, lower the cutting units and set the key switch to the OFF position.
Testing the Traction Pedal Position Sensor (continued)

2. Ensure the traction pedal assembly is able to move from full forward stop to full rearward stop.

3. Use the InfoCenter to view the sensor signal voltage:
   A. Sit in the operator seat and set the key switch to the ON position.
   B. Set the function control switch to the NEUTRAL position.
   C. From the InfoCenter Main Menu, select Diagnostics > Traction > Inputs.

   ![Figure 80](image_url)

   (shown with traction pedal fully forward)

   D. Move the traction pedal forward. Pedal Fwd should be checked.
   E. Move the traction pedal fully forward. Pedal Sig 1 should be 3.75 – 4.50 V and Pedal Sig 2 should be 0.50 – 2.55 V.
   F. Move the traction pedal rearward. Pedal Rev should be checked.
   G. Move the traction pedal fully rearward. Pedal Sig 1 should be 0.50 – 2.55 V and Pedal Sig 2 should be 2.55 – 3.20 V.
   H. Allow the traction pedal to return to the NEUTRAL position. Pedal Sig 1 and Pedal Sig 2 should be 2.55 – 3.20 V.
   I. Set the key switch to the OFF position.

4. If any of the sensor readings are out of range, test the traction position sensor:
   A. Disconnect the machine wire harness from the traction pedal position sensor. Check the sensor and the harness connector for damage or corrosion and clean or repair as necessary.
   B. Connect the sensor pins C and D to a 5 VDC power supply, and connect pins B and E to ground.
   C. Using a multimeter (DC voltage setting) with the traction pedal in the NEUTRAL position, 2.55 – 3.20 VDC should be present at both sensor pins A and F.
   D. Using a multimeter (DC voltage setting) with the traction pedal depressed fully forward, 3.75 – 4.50 VDC should be present at sensor pin A and 0.50 – 2.55 VDC should be present at sensor pin F.
   E. Using a multimeter (DC voltage setting) with the traction pedal depressed fully rearward, 0.50 – 2.55 VDC should be present at sensor pin A and 2.55 – 3.20 VDC should be present at sensor pin F.
Testing the Traction Pedal Position Sensor (continued)

5. Replace the traction pedal position sensor if necessary. Ensure the sensor drive is aligned with the tab on the pedal shaft before tightening the mounting fasteners.

6. If the traction pedal position sensor tests correctly and a circuit problem still exists, check the machine wire harness; refer to Appendix A (page A–1).

7. After testing, connect the machine wire harness and calibrate the traction pedal position sensor; refer to Calibrating the Traction Pedal Position Sensor (page 5–88).

Calibrating the Traction Pedal Position Sensor

1. Sit in the operator seat and set the key switch on the ON position.

2. Access the InfoCenter Settings > Protected Menus > Enter PIN screen and enter the machine PIN.

3. Access the InfoCenter Service > Calibration screen.

4. Select Traction Pedal and follow the on-screen calibration instructions.

Note: If the calibration procedure fails, try calibrating the item again before continuing to troubleshoot the system.
Steering Position Sensor

The steering position sensor is a two-piece assembly located on top of the rear wheel caster fork shaft. The sensor portion includes 2 analog hall effect sensors. The second piece of the assembly is a bolt with a magnetic head threaded into the caster fork shaft. The steering position sensor follows the rear caster fork movement.

The sensor operates on 5VDC supplied by the SC7: Steering motor. Signal voltage from the steering position sensor (along with information from the steering input device) is used by the SC7: Steering motor to determine the appropriate direction and current flow to operate the steering motor. The steering position sensor signals are constantly monitored for steering fault detection. If a steering position sensor fault occurs while the machine is moving, the machine will slowly come to a stop. The brake pedal can be used to stop the machine sooner if necessary. A steering sensor fault will disable the traction system until the ignition key is cycled OFF and ON.

The InfoCenter Display can be used to monitor the direction of the steering position sensor during machine operation.

Note: If a the steering position sensor is removed for any reason, the steering system must be calibrated. Calibrate the steering system – center first, then calibrate the steering system – range; refer to Calibrating the Steering System – Center (page 5–91) and Calibrating the Steering System – Range (page 5–91).

Testing the Steering Position Sensor

The steering position sensor and its circuit wiring can be tested using the InfoCenter Display; refer to Using the InfoCenter Display for Troubleshooting (page 3–39). If testing determines that the sensor and circuit wiring are not functioning correctly, proceed with the following test procedure:
Testing the Steering Position Sensor (continued)

1. Park the machine on a level surface, lower the cutting units, set the key switch to the OFF position and remove the key.

2. Raise and support the rear of the machine; refer to Jacking Instructions (page 1–6).

3. Ensure the rear wheel assembly is able to move from full right stop to full left stop (approximately 50° in either direction).

4. Check the rear caster fork alignment and steering position sensor air gap and adjust if necessary; refer to Adjusting the Steering Position Sensor (page 5–21).

5. **Rear Angle Sig 1** and **Rear Angle Sig 2** report the amount of signal voltage being received from the position sensor at the steering motor. Use the InfoCenter to view the sensor signal voltage:
   A. Sit in the operator seat and set the key switch to the ON position.
   B. Set the function control switch to the NEUTRAL position.
   C. From the InfoCenter Main Menu, select Diagnostics > Steering > Inputs.

   ![Figure 82](shown with caster fork turned to the left)

<table>
<thead>
<tr>
<th>Steering</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rear Angle Sig 1:</td>
<td>3.6V</td>
</tr>
<tr>
<td>Rear Angle Sig 2:</td>
<td>1.4V</td>
</tr>
<tr>
<td>Logic Voltage:</td>
<td>50.1V</td>
</tr>
</tbody>
</table>

   D. Turn the caster fork by hand until it is square with the machine (straight). **Rear Angle Sig 1** and **Rear Angle Sig 2** should be 2.0 – 3.0 V.

   E. Turn the rear caster fork by hand fully to the left (counterclockwise). **Rear Angle Sig 1** should be 3.5 – 4.0 V and **Rear Angle Sig 2** should be 1.0 – 1.5 V.

   F. Turn the rear caster fork by hand fully to the right (clockwise). **Rear Angle Sig 1** should be 1.0 – 1.5 V and **Rear Angle Sig 2** should be 3.5 – 4.0 V.

   G. Set the key switch to the OFF position.

6. If any of the sensor readings are out of range, test the steering position sensor:
   A. Disconnect the machine wire harness from the steering position sensor. Check the sensor and the harness connector for damage or corrosion and clean or repair as necessary.

   B. Connect sensor connector pins 2 and 5 to a 5 VDC power supply, and connect pins 1 and 4 to ground.
Testing the Steering Position Sensor (continued)

C. Turn the caster fork by hand until it is square with the machine (straight). Using a multimeter (DC voltage setting), 2.0 – 3.0 VDC should be present at both sensor connector pins 3 and 6.

D. Turn the rear caster fork by hand fully to the left (counterclockwise). Using a multimeter (DC voltage setting), 3.7 – 3.9 VDC should be present at sensor connector pin 3 and 1.1 – 1.3 VDC should be present at sensor connector pin 6.

E. Turn the rear caster fork by hand fully to the right (clockwise). Using a multimeter (DC voltage setting), 1.1 – 1.3 VDC should be present at sensor connector pin 3 and 3.7 – 3.9 VDC should be present at sensor connector pin 6.

7. Replace the steering position sensor if necessary. The sensor and the magnetic bolt are matched by the manufacturer and must be replaced as a set.

8. Align the rear caster fork and adjust the sensor air gap; refer to Aligning the Rear Wheel Caster Fork (page 6–8).

9. If the steering position sensor tests correctly and a circuit problem still exists, check the machine wire harness; refer to Appendix A (page A–1).

10. After testing, connect the machine wire harness and calibrate the steering system. Calibrate the steering system – center first, then calibrate the steering system – range; refer to Calibrating the Steering System – Center (page 5–91) and Calibrating the Steering System – Range (page 5–91).

Calibrating the Steering System – Center

1. Sit in the operator seat and set the key switch on the ON position.

2. Access the InfoCenter Settings > Protected Menus > Enter PIN screen and enter the machine PIN.

3. Access the InfoCenter Service > Calibration screen.

4. Select Steering Center and follow the on-screen calibration instructions.

   Note: If the calibration procedure fails, try calibrating the item again before continuing to troubleshoot the system.

Calibrating the Steering System – Range

1. Sit in the operator seat and set the key switch on the ON position.

2. Access the InfoCenter Settings > Protected Menus > Enter PIN screen and enter the machine PIN.

3. Access the InfoCenter Service > Calibration screen.

4. Select Steering Range and follow the on-screen calibration instructions.

   Note: If the calibration procedure fails, try calibrating the item again before continuing to troubleshoot the system.
Greensmaster eTriFlex machines use a number of electrical relays. Some of the relays have four (4) terminals and some have five (5) terminals. The number of terminals the relay has determines how the relay should be tested. A tag near the wire harness relay connector can be used to identify each relay.

**Figure 83**

eTriFlex 3360 Model 04580

1. Logic relay  
2. Brake actuator relay  
3. Engine relay (model 04580)
Identifying the Relays and their Functions

**Note:** Refer to the Electrical Schematics and Wire Harnesses in Appendix A (page A–1) for additional relay circuit information.

**Logic Relay** When energized by the T1: primary controller, the logic relay provides 48V power to the logic circuits of all of the 48 volt controllers (T2 – T6 and SC2 – SC8). T1 and SC1 operate on 12V logic power.

**Brake Actuator Relay** When energized by the T1: primary controller, the brake actuator relay supplies 12V power to the electric brake actuator to retract. The automatic parking brake disengages when the brake actuator retracts.

**Engine Relay (Model 04580)** When energized by the T1: primary controller, the engine relay opens the path to ground which allows the engine ignition circuit to function. When de-energized, the engine relay closes the path to ground which interrupts the engine ignition circuit and stops the engine.
Identifying the Relays and their Functions (continued)

Shutdown Delay Relay (Model 04590) The shutdown delay relay is energized when the key switch is set to the Run position. When energized, the shutdown delay relay supplies power to the 12V control circuits (manual parking brake switch, T1: primary controller outputs, InfoCenter display, CAN bus isolation module, brake actuator relay switch terminal).

The shutdown delay relay is also used to de-energize the 12V control circuits before the SC8: lithium-ion battery controller (BMS) takes the 48 VDC lithium-ion batteries off-line.

Testing Relays with 4 Terminals

1. Park the machine on a level surface, lower the cutting units, set the key switch to the Off position and remove the key.

2. Disconnect the battery negative (-) cable at the 12V system battery (model 04580); refer to Removing and Installing the 12V System Battery (Model 04580) (page 5–105), or unplug the 48V battery disconnect (model 04590); refer to 48V Battery Disconnect (page 5–9).

3. Remove the right side cover.

4. Disconnect the wire harness connector from the relay being tested. Check the relay and the harness connector for damage or corrosion and clean or repair as necessary. Remove the relay from the mounting panel.

   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.

5. Using a multimeter (ohms setting), measure the coil resistance between terminals 85 and 86.

<table>
<thead>
<tr>
<th>RELAY</th>
<th>COIL RESISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic Relay</td>
<td>12V coil – 68 to 82 ohm</td>
</tr>
<tr>
<td>Shutdown Delay Relay (Model 04590)</td>
<td>48V coil – 990 to 1210 ohms</td>
</tr>
</tbody>
</table>

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

7. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85 of the logic relay (12V coil), or +48 VDC to terminal 85 of the shutdown delay relay (48V coil).
Testing Relays with 4 Terminals (continued)

relay should make and break continuity between terminals 30 and 87 as +voltage is applied and removed from terminal 85.

8. Replace the relay as necessary.
9. If the relay tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
10. Install the relay and connect the wire harness.
11. Connect the battery negative (-) cable at the 12V system battery (model 04580), or connect the 48V battery disconnect (model 04590) before returning the machine to service.

Testing Relays with 5 Terminals

1. Park the machine on a level surface, lower the cutting units, set the key switch to the OFF position and remove the key.
2. Disconnect the battery negative (-) cable at the 12V system battery (model 04580); refer to Removing and Installing the 12V System Battery (Model 04580) (page 5–105), or unplug the 48V battery disconnect (model 04590); refer to 48V Battery Disconnect (page 5–9).
3. Remove the right side cover.
4. Disconnect the wire harness connector from the relay being tested. Check the relay and the harness connector for damage or corrosion and clean or repair as necessary. Remove the relay from the mounting panel.

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.

5. Using a multimeter, verify that coil resistance between terminals 85 and 86 is from 71 to 88 ohms.

6. Verify infinite resistance (no continuity) exists between terminals 30 and 87.
Testing Relays with 5 Terminals (continued)

7. 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 +voltage is applied and removed from terminal 85.

8. 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.

9. Replace the relay as necessary.

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

11. Install the relay and connect the wire harness.

12. Connect the battery negative (-) cable at the 12V system battery (model 04580), or connect the 48V battery disconnect (model 04590) before returning the machine to service.
Contactors

Two contactors are used on eTriFlex machines. Both contactors are located under the left side cover. The main contactor connects the 48V batteries to the 48V power bus for the lift/lower actuators, cutting unit motors, the optional 3WD traction motor, and the starter/generator (model 04580). The steering motor is connected to the 48V power bus at all times and is not controlled by the main contactor. The main contactor is energized by the logic relay.

The traction motor contactor connects the 48V batteries to the 48V power bus for the front traction motor controllers. Each front traction motor controller passes 48V power along to its specific traction motor as needed. The traction motor contactor is energized by the logic relay.

![Diagram of contactors and their locations](image)

Figure 87

1. Main contactor 3. Left side battery box 5. Main terminals
2. Traction motor contactor 4. Coil terminals

Testing the Contactors

1. Park the machine on a level surface, lower the cutting units, set the key switch to the OFF position and remove the key.

2. Unplug the 48V battery disconnect; refer to 48V Battery Disconnect (page 5–9). On model 04580 machines, disconnect the battery negative (-) cable at the 12V system battery; refer to Removing and Installing the 12V System Battery (Model 04580) (page 5–105).

3. Remove the left side cover.

4. Record the wire connector locations on the contactor being tested for assembly purposes, and disconnect the harness electrical connectors from contactor. Check the contactor and the harness connectors for damage or corrosion and clean or repair as necessary.
Testing the Contactors (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 for the tested component.

5. Apply 48 VDC directly across the contactor coil terminals. The contactor should produce an audible “click”. With the contactor coil energized, resistance across the contactor main terminals should be less than 1 ohm.

6. Remove the voltage from the contactor coil terminals. The contactor should produce an audible “click”. With the contactor coil not energized, resistance across the contactor main terminals should be infinite ohms.

7. Measure the resistance across the contactor coil terminals. Resistance of the coil should be approximately 195 ohms.

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

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

10. After testing, connect the harness electrical connectors to the contactor. Secure the main terminal connectors with flange nuts and tighten the nuts from **4.5 to 5.6 N·m (40 to 50 in-lb)**. Secure the coil terminal connectors with keps nuts and tighten the nuts from **1.5 to 1.7 N·m (13 to 15 in-lb)**. Apply battery terminal protector Toro Part No. 107-0392 or a light layer of grease to the contactor terminals and cable connectors to reduce corrosion.

11. On model 04580 machines, connect the battery negative (-) cable at the 12V system battery. Connect the 48V battery disconnect before returning the machine to service.
Two different diodes are used on the eTriFlex 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 is used for circuit protection from voltage spikes that occur when the main contactor is de-energized. The diode plugs into the machine wire harness near the wire harness connectors for the center cutting unit motor on the left side of the machine.
- A diode assembly is used for circuit protection from voltage spikes that occur when the traction motor contactor is de-energized. The diode plugs into the machine wire harness near the wire harness connectors for the center cutting unit motor on the left side of the machine.

Testing the Diode Assemblies

1. Locate and remove the diode from the wire harness. Check the diode and the harness connector for damage or corrosion and clean or repair as necessary.
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.

---

<table>
<thead>
<tr>
<th>Diode Terminal A</th>
<th>Diode Terminal B</th>
<th>Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red (+) Lead</td>
<td>Black (-) Lead</td>
<td>Very Low</td>
</tr>
<tr>
<td>Black (-) Lead</td>
<td>Red (+) Lead</td>
<td>Very High</td>
</tr>
</tbody>
</table>

Figure 88

1. Main contactor diode
2. Traction motor contactor diode
3. Center cutting unit motor connectors
Testing the Diode Assemblies (continued)

4. If the diode tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
CAN bus Terminator Resistors

The machine controllers communicate with each other on a Controller Area Network (CAN) bus system. Controllers that operate on 12 VDC connect to the 12V side of the CAN bus (CAN A), while controllers that operate on 48 VDC connect to the 48V side of the CAN bus (CAN B). The two sides of the CAN bus communicate as one network through the use of a CAN bus Isolation Module. The entire CAN bus is made up of two specially designed twisted wires. The engineering term for these wires are CAN High (yellow wire) and CAN Low (green wire). A 120 ohm CAN termination resistor is located at each end of CAN A, and at each end of CAN B (4 total). Refer to CAN bus (page 5–30) for CAN bus testing procedures.

Figure 89

1. CAN B termination resistor at connector P60
2. CAN A termination resistor at connector P66
3. CAN B termination resistor at connector P58
4. CAN A termination resistor at connector P65

The CAN bus and the termination resistors are part of the machine wire harness.

- One of the CAN A termination resistors is located to the left of the brake actuator. This resistor is secured to the wire harness at connector P65.
- The second CAN A termination resistor is located in the operator’s console under the InfoCenter display. This resistor is secured to the wire harness at connector P66.
- One of the CAN B termination resistors is located under the right side cover below the relays. This resistor is secured to the wire harness at connector P58.
- The second CAN B termination resistor is located behind the step on the left side of the machine. This resistor is secured to the wire harness at connector P60.

Note: Refer to Appendix A (page A–1) for additional information on the CAN bus wiring.
All 4 terminator resistors are required for proper CAN bus operation.

Testing the CAN bus Terminator Resistors

1. Park the machine on a level surface, lower the cutting units, set the key switch to the OFF position and remove the key.
2. Unplug the 48V battery disconnect; refer to 48V Battery Disconnect (page 5–9). On model 04580 machines, disconnect the battery negative (-) cable at the 12V system battery; refer to Removing and Installing the 12V System Battery (Model 04580) (page 5–105).
3. Locate the CAN bus termination resistor and unplug it from the machine wire harness for testing. Check the resistor and the harness connector for damage or corrosion and clean or repair as necessary.
4. Use a digital multimeter (ohms setting) and measure the resistance across the pins of the CAN bus termination resistor. There should be 120 ohms resistance between terminals 1 and 2.

![Figure 90](image)

5. If testing determines the termination resistor is faulty, replace the resistor.
6. After testing is complete, make sure the external termination resistor is fully installed into the connector and secured to the wire harness.
7. If the resistors test correctly and a circuit problem still exists, check the remainder of the CAN–bus; refer to Testing the CAN bus (page 5–30), Appendix A (page A–1), or contact an Authorized Toro Distributor for assistance.
Batteries (Model 04580)

Caring for the Batteries (Model 04580)

**WARNING**

The battery gases are explosive; also, they can cause nausea.

- Wear safety goggles and rubber gloves when working with electrolyte. Charge the battery in a well ventilated place so that the gasses produced while charging can dissipate.
- Keep open flames and electrical sparks away from the battery; do not smoke.
- Disconnect the charger from the electrical outlet before connecting or disconnecting charger leads to or from the battery posts.

---

**IMPORTANT**

Do not remove fill caps while cleaning.

---

1. Clean the top of the battery by washing at the terminals with a brush dipped in ammonia or bicarbonate of soda solution. Flush the top surface with water after cleaning.

2. If corrosion occurs at the battery terminals, disconnect the battery cables. Always disconnect the negative (-) cable first. Clean the cable clamps and terminals separately.

3. Tighten the battery cables on the battery terminals to provide a good electrical contact. Apply a coating of Toro Part No. 107-0392 battery terminal protector or a light coat of grease to the terminals to reduce corrosion after you make the connections; refer to Special Tools (page 2–13).

---

**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.
Storing the Batteries (Model 04580)

If you store the machine for more than 30 days:

1. Ensure that the key switch is in the OFF position.
2. Unplug the 48V battery disconnect; refer to 48V Battery Disconnect (page 5–9).
3. Disconnect the ground (-) cable from the 12V battery; refer to Removing and Installing the 12V System Battery (Model 04580) (page 5–105).
4. Charge the batteries fully before storage; refer to Charging the Batteries (Model 04580) (page 5–110).
5. Store the battery in the appropriate environment:
   - Recommended storage temperatures should be between 10°C to 25°C (50°F and 77°F).
   - Storage at elevated temperatures will result in accelerated rates of self discharge.
   - If temperatures are expected to drop well below freezing for an extended period, remove the batteries from the machine and store the batteries in a warmer environment.
Servicing the Batteries (Model 04580)

Battery Specifications

<table>
<thead>
<tr>
<th>12V system battery</th>
<th>Type: absorbed glass mat (AGM), valve regulated lead acid (VRLA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nominal voltage: 12</td>
</tr>
<tr>
<td></td>
<td>AH rating: 16.5</td>
</tr>
<tr>
<td></td>
<td>Length: 15.0 cm (5.9 inches)</td>
</tr>
<tr>
<td></td>
<td>Width: 6.6 cm (2.6 inches)</td>
</tr>
<tr>
<td></td>
<td>Height including terminal posts: 10.7 cm (4.2 inches)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>48V system batteries – 4 each</th>
<th>Type: absorbed glass mat (AGM), valve regulated lead acid (VRLA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nominal voltage: 12</td>
</tr>
<tr>
<td></td>
<td>AH rating: 9.0</td>
</tr>
<tr>
<td></td>
<td>Length: 19.6 cm (7.7 inches)</td>
</tr>
<tr>
<td></td>
<td>Width: 13.2 cm (5.1 inches)</td>
</tr>
<tr>
<td></td>
<td>Height including terminal posts: 18.3 cm (6.6 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.

Removing and Installing the 12V System Battery (Model 04580)

Figure 91

1. Shoulder screw
2. Front right side cover
3. Battery cover
4. 12V battery
5. Negative (-) terminal
Removing and Installing the 12V System Battery (Model 04580) (continued)

**IMPORTANT**

Be careful when removing the battery cables and ensure that you do not damage the terminal posts or cable connectors.

1. Remove the right side cover.
2. Remove the battery cover.
3. Disconnect the ground (-) cable from the battery terminal, then disconnect the positive (+) cable from the battery terminal.
4. Remove the lock nuts, carriage bolts, and the battery clamp.
5. Install the battery in reverse order.
6. Tighten the battery terminal fasteners from **3.8 to 4.1 N·m (34 to 37 in-lb)**, then apply battery terminal protector Toro Part No. 107-0392 or a light layer of grease to the battery terminals and cable connectors to reduce corrosion.
Removing and Installing the 48V System Batteries (Model 04580)

Figure 92

1. Battery (4 each)
2. Battery cover – RH
3. Battery cover – LH
4. Flat washer (4 each)
5. Flange head screw (4 each)
6. Flange nut (4 each)
7. Carriage bolt (2 each)
8. Push nut (2 each)
9. Battery hold down (2 each)
10. Lock nut (2 each)
11. Jumper cable (2 each)
12. Lock washer (8 each)
13. Retaining ring
14. Carriage bolt
15. Clamp (10 each)
16. Flat washer
17. Flange nut
18. Battery cable assembly
19. Battery cable
20. Battery cable
WARNING

The battery terminals, metal tools and metal vehicle parts could short together and cause sparks during battery removal and installation. Damaged cables could short against metal vehicle parts and cause sparks. Sparks can cause battery gasses to explode. When removing or installing the batteries, do not allow the battery terminals to short against metal parts of the vehicle. Do not allow metal tools or metal vehicle parts to short between the battery terminals or battery cables. Always keep the battery hold downs in place to protect and secure the batteries.

1. Ensure that the key switch is in the Off position.
2. Unplug the 48V battery disconnect; refer to 48V Battery Disconnect (page 5–9).
3. Remove the battery covers.
4. Carefully remove the battery jumper cables from each pair of batteries to open the battery circuit. Do not allow tools or vehicle components to complete the battery circuit during cable removal.
5. Remove the remaining cables from the battery terminals. Position the battery cables away from the battery terminals.
6. Remove the hex nuts and battery hold downs that secure the batteries to the battery trays.
7. Carefully remove the batteries from the machine.
8. If battery cable removal is needed, record the routing of the cables for installation purposes before removing the cables from the machine.
9. Make sure the battery cables, battery terminals and all fasteners are free of corrosion and in good condition.
10. If the battery cables were removed, install the cables as recorded during disassembly. Ensure that the cables are correctly routed through the clamps and that the clamps are secured to the machine.

11. Tighten the battery terminal fasteners from 5.2 to 6.1 N·m (46 to 54 in-lb), then apply battery terminal protector Toro Part No. 107-0392 or a light layer of grease to the battery terminals and cable connectors to reduce corrosion.
12. Secure each pair of batteries with a battery hold down and hex nut.

IMPORTANT

When connecting the batteries in the 48 volt system, make sure that battery polarity is carefully checked. Damage to fuses or other system components can occur if batteries are not connected correctly.

13. Install all of the battery cables except the battery jumper cables (item 11). Make sure that the cables are connected to correct battery terminal noting the battery polarity. Tighten the battery terminal cap screws from 5.2 to 4.5 N·m (46 to 54 in-lb).
Removing and Installing the 48V System Batteries (Model 04580) (continued)

14. Carefully install the battery jumper cables (item 11)-. Do not allow tools or vehicle components to complete the battery circuit during cable installation. Tighten the battery terminal cap screws from 5.2 to 4.5 N·m (46 to 54 in-lb).

15. After you make the connections, apply battery terminal protector Toro Part No. 107-0392 or a light layer of grease to the battery terminals and cable connectors to reduce corrosion; refer to Battery Terminal Protector (page 2–13). Make sure that all terminal boots are positioned over all cable connections.

16. Install the battery covers before returning the machine to service.

Inspecting, Maintaining, and Testing the Batteries (Model 04580)

1. Clean the batteries with clean water and a towel. Do not use solvents or chemicals to clean the batteries.

2. Check the battery case for cracks. Replace the battery if cracked or leaking.

3. Check the battery terminals and cables for corrosion and clean them as necessary. Use a battery terminal protector to reduce corrosion; refer to Battery Terminal Protector (page 2–13).

4. If the 48V system battery voltage drops below 50 VDC, battery inspection and/or charging may be necessary.

5. Use a digital multimeter (VDC) to measure the voltage of each battery individually.

   **Note:** This test provides a relative condition of the battery. Load testing of the battery provides additional and more accurate information.

   A. Disconnect the cables from the terminals of the battery being tested.

   B. Measure and record the battery voltage. Refer to the following table to determine charge level of the battery.

**Battery Test Table**

<table>
<thead>
<tr>
<th>Voltage Measured</th>
<th>Battery Charge Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.68 VDC (or higher)</td>
<td>Fully charged (100%)</td>
</tr>
<tr>
<td>12.45 VDC</td>
<td>75% charged</td>
</tr>
<tr>
<td>12.24 VDC</td>
<td>50% charged</td>
</tr>
<tr>
<td>12.06 VDC</td>
<td>25% charged</td>
</tr>
<tr>
<td>11.89 VDC</td>
<td>0% charged</td>
</tr>
</tbody>
</table>

   **Note:** When testing the 48V system batteries, the voltage should be consistent across all 4 batteries. If the voltage of any of the batteries varies by more than 10%, it indicates a problem with the battery that has the lower voltage.

6. A battery load tester can be used to test individual batteries.

   ![CAUTION](image)

   **CAUTION**

   **Follow the manufacturer's instructions when using a battery load tester.**
Inspecting, Maintaining, and Testing the Batteries (Model 04580) (continued)

IMPORTANT

Many locally available battery load testers do not, have any adjustment on the load that is put on the battery. Results received from using load testers should follow the recommendations of the load tester manufacturer.

Charging the Batteries (Model 04580)

The batteries may be individually charged with a 12V charger rated for operation with absorbed glass mat (AGM), valve regulated lead acid (VRLA) batteries. The voltage of this battery type is slightly lower than flooded lead acid batteries. Maximum charge voltage should be limited to 14.8 VDC. Maximum charge current should be limited to 2.4 amps.

IMPORTANT

Follow the manufacturer's instructions when using a battery charger.

Operating the machine should charge the 12V system and the 48V system batteries.
Batteries (Model 04590)

The Greensmaster 3370 is powered by eight maintenance free lithium-ion batteries. Two batteries are located under a cover on the right side of the machine, two batteries are located under a cover on the left side of the machine, and Four batteries are located in the center of the machine under the hood. Each battery consists of numerous cells. The batteries are connected in parallel and managed by the SC8: Lithium-Ion battery controller (also known as the Battery Management System or BMS); refer to SC8: Lithium-Ion Battery Controller (Model 04590) (page 5–15) for additional information.

**WARNING**

Battery terminals, battery cables, or metal tools could short against metal components causing sparks. Sparks can cause the battery damage and high heat, resulting in personal injury.

- When removing or installing the batteries, do not allow the battery terminals or battery cables to touch any metal parts of the machine.
- Do not allow metal tools to short between the battery terminals or battery cables and metal parts of the machine.
- Do not attach anything to the battery terminal other than the battery cable or wire harness connector that came with the product.
- Always keep the battery retainers and covers in place to protect and secure the batteries.

**IMPORTANT**

A used or damaged lithium-ion battery must be disposed of or recycled in accordance with local and federal regulations. For information on how to properly dispose of lithium-ion batteries, contact your local municipality or recycling facility.

Caring for the Lithium-Ion Batteries (Model 04590)

When mowing, use the InfoCenter to monitor the state of charge of the lithium-ion battery pack. Consistently operating the machine with a very low state of charge will adversely affect the life of the batteries.

If problems with the batteries exist, an advisory or fault may be identified on the InfoCenter; refer to InfoCenter (page 5–10).

When done using the machine for the day, park the machine in a clean and dry area that is away from direct sunlight and other heat sources. Do not store the machine in a location where the battery temperature could rise above 45°C (113°F). If the battery is regularly subjected to excessive temperatures, the life of the batteries will be reduced.

Charge the batteries when you are finished mowing for the day to ensure that the batteries are fully charged for the next mowing. Lithium-ion batteries do not have a charge memory issue and do not need to be fully discharged before charging them. Ensure that the battery pack is charged with the Toro lithium-ion battery charger that is specially designed for the batteries. For best battery life, connect the machine to the battery charger any time the machine is not in use.
Caring for the Lithium-Ion Batteries (Model 04590) (continued)

Keep the battery covers clean. A dirty battery cover will increase the heat in the battery and will reduce the energy capacity and life of the battery.

Storing the Lithium-Ion Batteries (Model 04590)

If the mower will be stored for more than 10 days, ensure that the machine is connected to the lithium-ion battery charger. If the battery is not connected to the charger during storage, the battery life may be reduced.

Do not store the machine in a location where the temperature will drop below -25°C (-13°F) or rise above 45°C (113°F). Because storage temperature will affect the life of the battery pack, avoid storing the machine in temperatures outside of this range. Storage for long periods of time at high temperatures will reduce the life of the battery pack, especially if the pack is stored with a high charge. Where possible, store the machine in a cool (not below freezing) location.

Shipping and Transporting the Lithium-Ion Batteries (Model 04590)

The US Department of Transportation and international transportation authorities require that lithium-ion batteries be shipped using special packaging and only be handled by carriers certified to haul them. Use the original packaging whenever possible when shipping lithium-ion batteries in the USA. If the original packaging is damaged or not available, use a Battery Shipping Kit; refer to Lithium-Ion Battery Shipping Kit (page 2–14). Contact the appropriate government body in your country for detailed regulations on shipping the lithium-ion batteries.

In the USA, you are allowed to transport the battery when it is installed on the machine as battery powered equipment, with some regulatory requirements. Contact US Department of Transportation or the appropriate government body in your country for detailed regulations on transporting a machine with lithium batteries installed.

__________________________

IMPORTANT

Ship a lithium-ion battery in its original packaging or a specially designed Battery Shipping Kit. Failure to ship a lithium-ion battery correctly may result in substantial penalties.

__________________________
Charging the Lithium-Ion Batteries (Model 04590)

Refer to the Traction Unit Operator’s Manual for battery charging and battery charger operation information. Refer to Battery Charger Error and Fault Codes in this manual for battery charger troubleshooting information.

Note: A record of battery charger operation data can be downloaded by inserting a flash drive into the USB port on the battery charger. Forward a copy of the battery charger data file to Toro Service (contact an Authorized Toro Distributor for assistance).

Servicing the Lithium-Ion Batteries (Model 04590)

IMPORTANT

To prevent accidentally shorting a disconnected battery cable across other components or tools, insulate the battery cable terminal with a 76 mm (3 inch) length of 1/2 inch internal diameter rubber hose immediately after disconnecting the cable.

Figure 93

1. Battery cable terminal (typical) 2. 1/2 inch ID rubber hose

IMPORTANT

Do not open the lithium-ion batteries. There are no serviceable parts on or in the battery pack. If you open the battery, you will void the warranty. The battery is protected by tamper-alerting devices.

Removing and Installing the Lithium-Ion Batteries (Model 04590)

1. Park the machine on a level surface, lower the cutting units, set the key switch to the OFF position and remove the key.
2. Unplug the 48V battery disconnect; refer to 48V Battery Disconnect (page 5–9).
3. Open the hood, and remove both side battery covers.
4. Label and disconnect the positive (+) battery cable at the center mounted batteries, and at each set of side mounted batteries; refer to Figure 94.
Removing and Installing the Lithium-Ion Batteries (Model 04590) (continued)

Figure 94

1. Positive (+) battery cable – center
2. Washer
3. Hex nut
4. Positive (+) battery cable – left side
5. Positive (+) battery cable – right side

Electrical System: Batteries (Model 04590)
Removing and Installing the Lithium-Ion Batteries (Model 04590) (continued)

5. To remove the side mounted batteries:
   A. Label and disconnect the negative (-) battery cable, positive (+) battery cable, and battery interface harness from both lithium-ion batteries.
   B. Remove the 4 nuts, washers and bolts that secure the batteries to the battery tray.

   **CAUTION**

   Each battery weighs approximately 11 kg (24 lbs). Remove the 2 side mounted batteries as an assembly.

   Support the battery assembly to prevent it from falling and causing personal injury or damage to the batteries.

   C. Carefully remove the side mounted batteries from the battery tray as an assembly.
6. To remove one or more of the center mounted batteries:
   A. Remove the hood; refer to Removing and Installing the Hood Assembly (page 6–43).
   B. Remove the center battery cover.
   C. Label and disconnect the negative (–) battery cable and negative (–) wire harness terminal, and the positive (+) battery cable and the positive (+) wire harness terminal from the SC8: lithium-Ion battery controller (BMS) negative (–) and positive (+) terminals; refer to connections B and C in Figure 96.
   D. Label and disconnect the battery interface harness connectors from each of the center mounted batteries and from the lithium-Ion battery controller (BMS) M-S terminal.
   E. Label and disconnect the machine wire harness connector from the lithium-Ion battery controller (BMS) COM terminal.
Removing and Installing the Lithium-Ion Batteries (Model 04590) (continued)

F. Label and disconnect the machine wire harness connectors from the T6: precharge controller.

G. Remove the 4 fasteners securing the center mounted battery try to the machine.

⚠️ CAUTION ⚠️

The center mounted battery assembly weighs approximately 67 kg (148 lbs). Use an appropriate lift and the lift points provided to remove the center mounted battery assembly.

H. Raise the center mounted battery assembly approximately 7.5 cm (3 inch). Label and disconnect the negative (–) battery cable from the bottom of the forward most battery before completely removing the assembly from the machine; refer to connection D in Figure 96.

I. Continue to dismantle the center mounted battery assembly as necessary.

J. Check the foam strips for damage or wear and replace them if necessary.
Removing and Installing the Lithium-Ion Batteries (Model 04590) (continued)

Pay close attention to the battery orientation during installation. Install the right side mounted batteries with the positive (+) terminals rearward. Install the left side mounted batteries with the positive (+) terminals forward. Install the center mounted batteries with the positive (+) terminals upward. Refer to Figure 95 and Figure 97 for additional information.
Removing and Installing the Lithium-Ion Batteries (Model 04590) (continued)

7. Install the batteries in reverse order.

8. Tighten the battery clamp nuts from **2.8 to 3.9 N·m (25 to 35 in-lb)**.

9. Connect the positive (+) battery cable at the center mounted batteries, and at each set of side mounted batteries; refer to Figure 94.

10. Tighten the battery cable fasteners from **8.5 to 9.5 N·m (75 to 85 in-lb)**, then apply battery terminal protector Toro Part No. 107-0392 or a light layer of grease to the battery terminals and cable connectors to reduce corrosion.

11. Install the side mounted battery covers.
Service and Repairs

Generator Assembly (Model 04580)

Note: If the starter/generator controller is replaced for any reason, the machine software must be updated; contact an Authorized Toro Distributor for assistance.

Replacing the Starter/Generator Drive Belt

1. Remove the fuel tank; refer to Removing the Fuel Tank (page 4–4).
2. Tilt the operator seat forward and remove the starter/generator pulley cover.
3. Loosen the hex nuts and extend the adjustment pin as far as possible to relax the extension spring. Remove the extension spring from the starter/generator spring bracket if necessary.

![Diagram of generator assembly](image)

**Figure 98**

1. Generator drive belt
2. Generator pulley
3. Engine pulley
4. Engine frame
5. Hex nut (2 each)
6. Adjustment pin
7. Extension spring
8. Cap screw (4 each)

4. Loosen the 4 cap screws (item 8) securing the starter/generator to the engine frame, then rotate the starter/generator clockwise to loosen and remove the starter/generator drive belt.

5. Install a new starter/generator drive belt. Ensure that the drive belt cogs engage with the teeth in the engine and starter/generator pulleys.

6. Adjust the starter/generator belt tension; refer to Adjusting the Starter/Generator Drive Belt Tension (Model 04580) (page 5–20).
Removing the Starter/Generator Assembly

Refer to Figure 99 for this procedure

1. Park the machine on a level surface, lower the cutting units, set the key switch to the OFF position and remove the key from the key switch.

2. Unplug the 48V battery disconnect; refer to 48V Battery Disconnect (page 5–9).

3. Disconnect the negative (−) battery cable from the 12V system battery; refer to Removing and Installing the 12V System Battery (Model 04580) (page 5–105).

4. Remove the exhaust system; refer to Removing the Exhaust System (page 4–10).
Removing the Starter/Generator Assembly (continued)

5. Remove the fuel tank; refer to Removing the Fuel Tank (page 4–4).
6. Remove the evaporative control system carbon canister from the machine.
7. Disconnect the electrical system wiring from the engine:
   • The engine wire harness connector at the main wire harness (left side of engine). Check the engine and wire harness connector for damage or corrosion and clean or repair as necessary.
   • The wire harness ground at the engine (near front left engine mount).
8. Disconnect the choke cable from the engine.
9. Remove the clamp securing the engine oil drain hose to the right side battery tray.
10. Disconnect the starter/generator from the machine wire harness. Check the starter/generator and the harness connector for damage or corrosion and clean or repair as necessary.
11. Tilt the operator seat forward and remove the starter/generator pulley cover.
12. Remove the fasteners securing the engine frame assembly to the 3 isolating mounts.

**CAUTION**

The engine frame assembly weighs approximately 68 kg (150 lb). Use an appropriate lift to remove the engine frame assembly.

13. Remove the engine frame assembly from the machine.
14. Loosen the hex nuts and extend the adjustment pin as far as possible to relax the extension spring. Remove the extension spring from the starter/generator spring bracket.

![Figure 100](image_url)

1. Generator drive belt
2. Generator pulley
3. Engine pulley
4. Engine frame
5. Hex nut (2 each)
6. Adjustment pin
7. Extension spring
8. Cap screw (4 each)
Removing the Starter/Generator Assembly (continued)

15. Loosen the 4 cap screws (item 8) securing the starter/generator to the engine frame, then rotate the starter/generator clockwise to loosen the starter/generator drive belt.

16. Remove the fasteners and the starter/generator from the engine frame.
Disassembling the Starter/Generator

Refer to Figure 101 for this procedure.

1. Remove the starter/generator cover from the starter/generator assembly.
2. Remove rotating screen from the starter/generator fan.
Disassembling the Starter/Generator (continued)

3. Remove the access cover (item 9) and the cover gasket from the controller. Discard the cover gasket.

4. Record the position of the connectors and the wire harnesses for assembly purposes. Carefully remove the starter/generator and controller harness connectors from the controller opening and unplug the connectors.

5. Remove the three flange head screws (item 11) that secure the starter/generator stator conductors to the controller connectors.

6. Remove the fasteners that secure the controller to the starter/generator assembly. Lift the controller from the starter/generator. Remove and discard the O-ring (item 20).

Note: If controller damage exists, controller replacement is necessary. Internal controller components are not available separately. If the starter/generator controller is replaced, the machine software must be updated; contact an Authorized Toro Distributor for assistance.

7. Remove the starter/generator fan:

A. Remove the flange head screw and the collar from the starter/generator shaft.

B. To prevent damage to the starter/generator shaft threads, install a plain washer in the center hole of the starter/generator fan to protect the starter/generator shaft threads before removing the starter/generator fan.

C. Install the collar on the starter/generator fan with three of the rotating screen screws previously removed.

D. Thread a 3/8-16 x 1 cap screw into the collar.

E. Support fan to prevent it from falling and tighten the cap screw to remove the fan.

F. Locate and retrieve the woodruff key.

8. Remove the starter/generator pulley. Locate and retrieve the square key.
Disassembling the Starter/Generator (continued)

9. Remove the spring bracket from the starter/generator housing.

**Note:** If the starter/generator housing/stator requires replacement, the starter/generator assembly must be replaced. The starter/generator housing/stator is not available separately.

10. Continue to disassemble the starter/generator if necessary:

![Diagram of Starter/Generator Components]

**Figure 103**

1. Housing/stator assembly  8. O-ring
2. O-ring  9. Cover
3. Bearing  10. Flange screw (6 each)
4. Rotor assembly  11. Lip seal
5. Bearing  12. Screw (2 each)
6. Wave washer  13. Isolator

Use of the starter/generator rotor tool part number TOR6029 is recommended for this procedure; refer to Generator Rotor Tool (page 2–14).

**IMPORTANT**

When servicing the starter/generator, use a clean work space with a non-metal surface. The starter/generator rotor includes very powerful magnets that can cause the rotor to move unexpectedly if working on a metal surface. Also, any metallic debris that gets attracted to the rotor can damage the starter/generator after assembly.
Disassembling the Starter/Generator (continued)

A. Remove the six flange head screws that secure the cover to the housing/stator assembly. Do not remove the cover at this time.

B. Secure the base plate of the starter/generator rotor tool (part number TOR6029) to the drive side of the starter/generator housing/stator with three 3/8–16 X 3 inch cap screws.

C. Install the rotor tool shaft into the base plate and turn it in against the rotor shaft.

**CAUTION**

The rotor magnets are very powerful and can cause the rotor to shift position very rapidly during removal. Be cautious during rotor removal to prevent component damage or personal injury.

D. Turn the rotor tool shaft to push the rotor and cover assembly from the housing/stator assembly. Support the rotor to prevent it from falling during removal.

E. Remove the cover from the rotor assembly. Remove the O-rings and the wave washer from the cover. Discard the O-rings.

F. Remove and discard the O-ring and lip seal from the bearing bore in the housing.

G. If necessary, remove and discard the bearings from the rotor.

H. If necessary, remove the isolator and gasket from the housing/stator assembly. Discard the gasket.

11. Inspect the starter/generator components for wear or damage. Replace components or complete starter/generator assembly if necessary.
Assembling the Starter/Generator

Refer to Figure 101 for this procedure.

1. Make sure that all the starter/generator components are clean before assembly.

2. Assembly the starter/generator internal components:
   A. If the bearings were removed from the rotor assembly, install new bearings onto the rotor shaft. Make sure the new bearings are fully pressed onto rotor shaft.
   B. If the isolator was removed, lubricate a new gasket with dielectric lubricant and install it to the isolator. Fit the isolator to the housing assembly so the stator conductors and stator harness pass through the isolator.
   C. Lubricate a new O-ring with dielectric lubricant and install it into the groove in the housing/stator bearing bore.
   D. Apply a light coating of grease to the inside of a new lip seal and install the seal in the housing/stator.
   E. Lubricate the new O-rings with dielectric lubricant and install the O-rings into the grooves in the cover. Place the wave washer in the cover bearing bore and fit the rotor assembly into the cover.
   F. Secure the base plate of the starter/generator rotor tool to the drive side of the starter/generator housing/stator with three 3/8–16 X 3 inch cap screws.
   G. Install the rotor tool shaft into the base plate and turn it in so the end of the shaft prevents the rotor body from entering the housing/stator assembly.

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**IMPORTANT**

The rotor magnets are very powerful and can cause the rotor to shift position very rapidly during installation. Be cautious during rotor installation to prevent component damage or personal injury.

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H. While supporting the rotor and cover assembly, slowly turn the rotor tool shaft to allow the rotor to be drawn into the housing/stator assembly. Once the rotor and cover assembly is fully seated in the housing/stator assembly, remove the rotor tool base plate.

I. Secure the cover to the housing with the six flange head screws and tighten the screws from 19 to 21 N·m (170 to 190 in–lb).

J. Make sure that rotor rotates before continuing with starter/generator assembly.

3. Install the spring bracket (item 26).

4. Install the starter/generator pulley:
   A. Apply anti-seize lubricant to the rotor shaft and fit the square key and starter/generator pulley onto the rotor shaft.
   B. Install the flat washer and cap screw (item 24) and tighten the screw from 36 to 42 N·m (27 to 31 ft–lb).
   C. Apply a high temperature medium strength thread locking compound (Loctite 2422 or equivalent) and tighten the square head set screws (item 25) from 14 to 16 N·m (120 to 140 in–lb).

5. Install the starter/generator fan:
Assembling the Starter/Generator (continued)

A. Make sure that tapered surfaces of the rotor shaft and the fan are thoroughly clean.
B. Position the woodruff key into the rotor shaft and install the starter/generator fan.

C. Install the collar and flange head screw (item 13). Tighten the screw from 19 to 21 N·m (170 to 190 in−lb).

6. Lubricate a new O-ring (item 20) with dielectric lubricant and install it into the groove on the isolator.
7. Install the controller:
   A. Lower the controller onto the starter/generator and route both controller and starter/generator harness connectors out the opening in the controller.
   B. Loosely install the three flange head screws that secure the starter/generator stator conductors to the controller connectors. Make sure that the flange head screws do not pinch the electrical harnesses.
   C. Secure the controller to the starter/generator housing with the fasteners previously removed.

D. Tighten the three flange head screws (item 11) to 8 to 9 N·m (70 to 80 in−lb).

E. Apply dielectric lubricant to the harness connectors and plug the starter/generator connector into the controller connector. Insert harnesses and connectors to the side of the three terminals in the controller.

8. Lubricate a new cover gasket (item 8) with dielectric lubricant and install the gasket into the groove in the access cover. Secure the cover to the controller and tighten the screws from 8 to 9 N·m (70 to 80 in−lb).

9. Install the rotating screen and tighten the screws from 2 to 3 N·m (15 to 25 in−lb).
10. Install the starter/generator cover and tighten the cover screws from 8 to 9 N·m (70 to 80 in−lb).

Installing the Starter/Generator Assembly

Note: If the starter/generator controller (T6) is replaced for any reason, system software needs to be reloaded; contact an Authorized Toro Distributor for assistance.

Refer to Figure 99 for this procedure.
1. Secure the starter/generator to the engine frame assembly with the 4 cap screws previously removed. Do not tighten the cap screws at this time.
2. Install the starter/generator drive belt over the starter/generator and engine pulleys.
3. Connect the extension spring to the starter/generator spring bracket and the adjustment pin.
4. Adjust the starter/generator belt tension; refer to Adjusting the Starter/Generator Drive Belt Tension (Model 04580) (page 5–20).
5. Secure the 3 engine frame assembly isolation mounts to the machine with the fasteners previously removed.
6. Connect the machine wire harness to the starter/generator.
7. Install the clamp securing the engine oil drain hose to the right side battery tray.

8. Connect the choke control cable to the engine:
   A. Set the choke control at the operator control panel to the full choke position.
   B. Connect the choke control cable to the choke lever at the carburetor.
   C. Set the choke lever at the carburetor to the full closed position and secure the cable housing to the engine with the clamp and cap screw previously removed.

9. Connect the electrical system wiring to the engine:
   • The wire harness ground at the engine (near front left engine mount).
   • The engine wire harness connector at the main wire harness (left side of engine).

10. Connect the evaporative control system carbon canister to the engine vent hose.

11. Install the fuel tank; refer to Installing the Fuel Tank (page 4–4).

12. Install the exhaust system; refer to Installing the Exhaust System (page 4–11).

13. Ensure that all the hoses, tubes, and wires are clear of moving parts and secured to their original locations.

14. Connect the negative (–) battery cable at the 12V system battery.

15. Check engine oil level and adjust if necessary; refer to traction unit Operator’s Manual.

16. If the starter/generator controller is new, update the machine software; contact an Authorized Toro Distributor for assistance.

17. Operate the machine. Check for proper starter/generator operation. Check for fuel leaks and correct any issues before returning the machine to service.
Front Traction Motor

The front traction motors can be replaced separate from the front traction gear box. The front traction gear box can be removed or installed before or after the motor is removed from the machine; refer to Front Traction Gear Box (page 6–11).

If the front traction motor is replaced for any reason, the traction motors must be calibrated; refer to Calibrating the Front Traction Motors (page 5–56).

For front traction motor testing information; refer to Front Traction Motor (page 5–55).

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**Figure 105**

(shown with front traction gear box attached)

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Traction motor and gear box assembly</td>
</tr>
<tr>
<td>2.</td>
<td>Button head cap screw (2 each)</td>
</tr>
<tr>
<td>3.</td>
<td>Arm – LH</td>
</tr>
<tr>
<td>4.</td>
<td>Button head cap screw (2 each)</td>
</tr>
<tr>
<td>5.</td>
<td>Brake lever – LH</td>
</tr>
<tr>
<td>6.</td>
<td>Shoulder bolt</td>
</tr>
<tr>
<td>7.</td>
<td>Button head screw</td>
</tr>
<tr>
<td>8.</td>
<td>Washer</td>
</tr>
<tr>
<td>9.</td>
<td>Extension spring</td>
</tr>
<tr>
<td>10.</td>
<td>Cap screw (6 each)</td>
</tr>
<tr>
<td>11.</td>
<td>Thrust washer (6 each)</td>
</tr>
<tr>
<td>12.</td>
<td>Support link</td>
</tr>
<tr>
<td>13.</td>
<td>Clevis pin</td>
</tr>
<tr>
<td>14.</td>
<td>Cotter pin</td>
</tr>
</tbody>
</table>

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Removing and Installing the Front Traction Motor

Refer to Figure 105 for this procedure.

1. Remove the front wheel; refer to Removing and Installing the Wheels (page 6–9).
2. Unplug the 48V battery; refer to 48V Battery Disconnect (page 5–9).
3. Disconnect the multi-pin wire harness connector and the 3 power cables from the motor. Check the motor, harness connector and cable terminals for damage or corrosion and clean or repair as necessary.
Removing and Installing the Front Traction Motor (continued)

4. Remove the cotter pin and clevis pin securing the brake linkage to the brake lever. Discard the cotter pin.
5. Remove the extension spring from the brake lever.
6. Remove the brake lever from the traction motor assembly.
7. Remove the fasteners securing the arm (item 3) to the frame and the traction motor and remove the arm.
8. Remove the support link.
9. Remove the 4 fasteners securing the traction motor to the frame and remove the traction motor.
10. Install the traction motor assembly in the reverse order.
11. Calibrate the traction motors before returning the machine to service; refer to Calibrating the Front Traction Motors (page 5–56).
The optional rear traction motor is attached to the rear wheel gear box cover. The rear wheel gear box must be removed and disassembled to access the motor mounting fasteners.

If the rear traction motor is replaced for any reason, the machine software must be updated; contact an Authorized Toro Distributor for assistance.

**Figure 106**

1. 3WD traction motor
2. O-ring
3. Gasket
4. Gear box cover
5. Socket head screw (6 each)
6. Square key
7. Set screw
8. Spur gear
9. Socket head cap screw

**Removing the Rear Traction Motor**

Refer to Figure 106 for this procedure.

1. Remove and disassemble the 3WD gear box assembly; refer to Rear Wheel Gear Box (Optional 3WD) (page 6–19).
2. Remove the 6 fasteners securing the motor to the cover and remove the motor.
3. Remove and discard the motor gasket and O-ring.
4. Remove the spur gear and square key from the motor shaft if necessary.
Disassembling the Rear Traction Motor

Figure 107

1. Cap screw (6 each) 7. Bearing
2. Motor cover 8. O-ring
3. O-ring 9. Housing assembly
4. Wave washer 10. Lip seal
5. Bearing 11. O-ring
6. Rotor

Note: If the motor housing, stator, controller or cable is damaged, 3WD traction motor replacement is necessary as these components are not available separately.

Use of the motor rotor tool part number TOR6028 is recommended for this procedure; refer to Cutting Unit Motor Rotor Tool (page 2–18).

IMPORTANT

When servicing the 3WD traction motor, use a clean work space with a non-metal surface. The motor rotor includes very powerful magnets that can cause the rotor to move unexpectedly if working on a metal surface. Also, any metallic debris that gets attracted to the rotor can damage the motor after assembly.

Refer to Figure 107 for this procedure.

1. Inspect the 3WD traction motor cable for wear or damage. replace cable components or complete 3WD traction motor assembly if necessary.
2. Carefully remove and discard the lip seal from the housing assembly.
3. Remove the six cap screws that secure the motor cover to rear of motor housing. Do not remove the motor cover at this time.
4. Secure the base plate of the motor rotor tool (Toro part number 139–8420) to the housing with four M6 – 1.0 X 50 cap screws.
Disassembling the Rear Traction Motor (continued)

1. 3WD traction motor housing
2. Motor rotor tool base plate
3. Motor rotor tool shaft

5. Install the rotor tool shaft into the base plate and turn it in against the rotor shaft.

**CAUTION**
The rotor magnets are very powerful and can cause the rotor to shift position very rapidly during removal. Be cautious during rotor removal to prevent component damage or personal injury.

6. Turn the rotor tool shaft to push the rotor and cover assembly from the housing assembly. Support the rotor to prevent it from falling during removal.
7. Remove the motor cover and wave washer from the rotor assembly.
8. Remove and discard the O-rings from the motor cover.
9. Remove and discard the O-ring from the motor housing.
10. If necessary, remove and discard the bearings from the rotor.
11. Inspect the 3WD traction motor components for wear or damage. Replace components or complete 3WD traction motor assembly if necessary.

Assembling the Rear Traction Motor

Refer to Figure 107 or this procedure.
1. Make sure that motor components are cleaned before assembly.
2. If the bearings were removed from the rotor, install new bearings. Make sure the new bearings are fully pressed onto the rotor shaft.
3. Lubricate a new O-ring with dielectric lubricant and install it into the groove in the housing bearing bore.
Assembling the Rear Traction Motor (continued)

4. Lubricate new O-rings with dielectric lubricant and install the O-rings into the grooves in the motor cover. Place the wave washer in the cover bearing bore and fit the rotor assembly into the cover.

5. Secure the base plate of the motor rotor tool to the housing with four M6 – 1.0 X 50 cap screws.

6. Install the rotor tool shaft into the base plate and turn it in so the end of the shaft prevents the rotor body from entering the housing assembly.

7. While supporting the rotor and cover assembly, slowly turn the rotor tool shaft to allow the rotor to be drawn into the housing assembly. Once the rotor and cover assembly is fully seated in the housing, remove the rotor tool base plate.

8. Secure the cover to the housing with the six cap screws and tighten the screws from 8 to 9 N·m (70 to 80 in–lb).

9. Make sure that rotor rotates without binding before installing the motor assembly.

### Installing the Rear Traction Motor

Refer to Figure 106 for this procedure.

1. If previously removed, install the square key and spur gear on the motor shaft.

   A. Apply medium strength thread locking compound (Loctite 243 or equivalent) to the socket head cap screw (item 9) and tighten the screw to 15 N·m (11 ft-lb).

   B. Apply medium strength thread locking compound (Loctite 243 or equivalent) to the set screw (item 7) and tighten the set screw.

2. Use a new O-ring and new gasket and fit the 3WD traction motor to the gear box cover.

3. Install the fasteners securing the motor to the cover and tighten the fasteners from 11 to 12 N·m (8 to 9 ft-lb).

4. Assemble and install the 3WD gear box assembly; refer to Rear Wheel Gear Box (Optional 3WD) (page 6–19).

5. If the 3WD traction motor was replaced, update the machine software; contact an Authorized Toro Distributor for assistance.
Cutting Unit Motor

If a cutting unit motor is replaced for any reason, the machine software must be updated; contact an Authorized Toro Distributor for assistance.

Removing the Cutting Unit Motor

1. Park the machine on a level surface, lower the cutting units, set the key switch to the OFF position and remove key from the key switch.
2. Unplug the 48V battery disconnect; refer to 48V Battery Disconnect (page 5–9).

---

**IMPORTANT**

When removing the cutting unit motor, take care to not damage the cable. The cable is not available as a replacement part.

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3. Remove the cutting unit motor from the cutting unit; refer to the traction unit Operators Manual.
4. Remove and discard the O-ring from the cutting unit motor flange.
5. Inspect the cutting unit threaded insert splines for wear. Replace the inserts if necessary; refer to Reel Assembly (page 7–14).
6. Locate the cutting unit motor cable connections at the machine wire harness for the motor that is to be removed, and disconnect the 2 connectors. Check the motor and the harness connector for damage or corrosion and clean or repair as necessary.
7. Locate and loosen the bulkhead nuts (2 per motor cable) that secure the cutting unit motor cable to the bulkhead brackets on the machine.
8. Loosen the motor cable bulkhead nuts and remove the cable bulkheads from the bulkhead brackets (2 per motor cable).
9. Remove the cutting unit motor and cable from the machine.
Disassembling the Cutting Unit Motor

Figure 109

4. Wave washer (2 each)  9. Housing assembly  14. O-ring
5. Bearing (2 each)  10. O-ring

Note: If the motor housing, stator, controller or cable is damaged, cutting reel motor replacement is necessary as these components are not available separately.

Use of the cutting unit motor rotor tool part number TOR6028 is recommended for this procedure; refer to Cutting Unit Motor Rotor Tool (page 2–18).

IMPORTANT

When servicing the cutting unit motor, use a clean work space with a non-metal surface. The motor rotor includes very powerful magnets that can cause the rotor to move unexpectedly if working on a metal surface. Also, any metallic debris that gets attracted to the rotor can damage the motor after assembly.

Refer to Figure 109 for this procedure.
Disassembling the Cutting Unit Motor (continued)

1. Inspect the cutting unit motor cable for wear or damage. Replace cable components or complete cutting unit motor assembly if necessary.

2. Remove the 6 cap screws that secure the gear box cover to the front of the motor housing.

3. Carefully slide the gear box cover from the front of the motor.

4. Remove and discard the O-rings from the gear box cover.

5. Carefully remove and discard the lip seal from the gear box cover.

6. Slide the output gear assembly from the motor housing and retrieve the wave washer.

7. Remove the six cap screws that secure the motor cover to rear of motor housing. Do not remove the motor cover at this time.

8. Secure the base plate of the cutting unit motor rotor tool (part number TOR6028) to the gear box side of the motor with four M6 – 1.0 X 16 cap screws.

Figure 110

1. O-ring
2. Barb fitting
3. Hose
4. Convoluted tubing – 0.88 inch
5. Bulkhead fitting
6. Bulkhead nut (2 each)
7. Bulkhead fitting
8. Ferrule
9. Ferrule nut
10. Connector – 2 pin
11. Wedge – 2 pin
12. Convoluted tubing – 0.63 inch
13. Cable tie (4 each)
14. Connector – 4 pin
15. Wedge – 4 pin
Disassembling the Cutting Unit Motor (continued)

Figure 111

1. Cutting unit motor housing (gear box side)  
2. Motor rotor tool base plate

9. Install the rotor tool shaft into the base plate and turn it in against the rotor shaft.

⚠️ CAUTION ⚠️

The rotor magnets are very powerful and can cause the rotor to shift position very rapidly during removal. Be cautious during rotor removal to prevent component damage or personal injury.

10. Turn the rotor tool shaft to push the rotor and cover assembly from the housing assembly. Support the rotor to prevent it from falling during removal.
11. Remove the motor cover and wave washer from the rotor assembly.
12. Remove and discard the O-rings from the motor cover.
13. Remove and discard the O-ring from the motor housing.
14. If necessary, remove and discard the bearings from the output gear and rotor.
15. Inspect the cutting unit motor components for wear or damage. Replace components or complete cutting unit motor assembly if necessary.

Assembling the Cutting Unit Motor

Refer to Figure 109 or this procedure.

1. Make sure that motor components are cleaned before assembly.
2. If the bearings were removed from the rotor or the output gear, install new bearings. Make sure the new bearings are fully pressed onto rotor or output gear shaft.
3. Lubricate a new O-ring with dielectric lubricant and install it into the groove in the housing bearing bore.
4. Lubricate new O-rings with dielectric lubricant and install the O-rings into the grooves in the motor cover. Place the wave washer in the cover bearing bore and fit the rotor assembly into the cover.
Assembling the Cutting Unit Motor (continued)

5. Secure the base plate of the cutting unit motor rotor tool to the gear box side of the housing with four M6 – 1.0 X 16 cap screws.

6. Install the rotor tool shaft into the base plate and turn it in so the end of the shaft prevents the rotor body from entering the housing assembly.

---

**IMPORTANT**

The rotor magnets are very powerful and can cause the rotor to shift position very rapidly during installation. Be cautious during rotor installation to prevent component damage or personal injury.

---

7. While supporting the rotor and cover assembly, slowly turn the rotor tool shaft to allow the rotor to be drawn into the housing assembly. Once the rotor and cover assembly is fully seated in the housing, remove the rotor tool base plate.

8. Secure the cover to the housing with the six cap screws and tighten the screws from 8 to 9 N·m (70 to 80 in-lb).

9. Make sure that rotor rotates without binding before continuing with motor assembly.

10. Place the wave washer into the housing bore for output gear bearing.

11. Fill the output gear area of the motor housing with 15 ml (0.5 oz) of NLGI grade 00 grease.

12. Slide the output gear assembly into the housing. Make sure that output gear teeth mesh with rotor gear.

13. Apply a light coating of grease to the inside of a new lip seal and install the seal in the gear box cover. Press the lip seal into the gear box cover until it is flush with the cover surface. The inner lip of the seal should be toward the inside of the motor.
Assembling the Cutting Unit Motor (continued)

14. Lubricate new O-rings with dielectric lubricant and install the O-rings into the grooves in the gear box cover.

**IMPORTANT**

The output shaft splines can be sharp; be careful not to damage the lip seal when installing the gear box cover.

15. Carefully install the gear box cover and secure it with the six cap screws previously removed. Tighten the screws from 8 to 9 N·m (70 to 80 in-lb).

Installing the Cutting Unit Motor

1. Install a new O-ring to the flange of the cutting unit motor.
2. Coat the splines of the cutting unit motor shaft with No. 2 multipurpose lithium base grease.
3. Install the cutting unit motor to the cutting unit; refer to the traction unit Operators Manual.
4. Position the cutting unit motor cable into the bulkhead brackets on the machine (2 per motor cable) and tighten the bulkhead nuts.
5. Connect the two cutting unit motor cable connectors to the machine wire harness and connect the 48V battery.
6. If the cutting unit motor is new, update the machine software; contact an Authorized Toro Distributor for assistance.
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General Information

The traction unit Operator’s Manual and optional accessory Installation Instructions provide information regarding the operation, general maintenance procedures, and maintenance intervals for your machine. Refer to the traction unit Operator’s Manual and optional accessory Installation Instructions for additional information when servicing the machine.
Adjustments

Adjusting the Brakes

The eTriFlex machines use a single mechanical brake assembly that can be used as a service brake, a manual parking brake, and an automatic parking brake. The service brake and manual parking brake are controlled by a cable connected to pedals at the operator’s left foot, while the automatic parking brake is controlled by an 12 VDC electric brake actuator. The brake system engages 2 brake calipers (located between each front traction motor and front traction gear box).

Checking the Brake Adjustment

1. Park the machine on a level surface, set the key switch to the OFF position and disengage the manual parking brake.
2. Check each brake rod assembly for a gap between the washer and the brake rod. A gap indicates the electric brake actuator has fully engaged each brake. The gap should be approximately 3.3 mm (0.13 inch). If no gap exists at one or both brake rod assemblies, adjust the brake linkage; refer to Adjusting the Brake Linkage (page 6–4).

3. Have an assistant sit in the operator’s seat and set the key switch to the ON position.
4. Ensure the brake lever (item 3 in Figure 113) at each wheel motor can be moved by hand. A small amount of brake lever movement indicates the actuator has fully released each brake. If no movement exists at one or both brake levers, adjust the brake linkage; refer to Adjusting the Brake Linkage (page 6–4).
5. Set the key switch to the OFF position.
6. Observe each brake rod assembly while engaging the manual parking brake. The gap between the washer and the brake rod should increase when the manual parking brake is applied. The increased gap indicates the manual parking brake is creating slightly move brake holding force than the automatic
Checking the Brake Adjustment (continued)

parking brake. If the gaps do not increase when the manual parking brake is engaged, adjust the brake cable: refer to Adjusting the Brake Cable (page 6–6).

Adjusting the Brake Linkage

1. Park the machine on a level surface, set the key switch to the OFF position and remove the key.
2. Loosen the hex nuts and adjust the eye bolt as far as possible to relax the extension spring. Remove the spring.

3. Use the 3/8 inch square drive hole in the right side upper brake arm to fully retract the brake actuator.
4. If either brake rod assembly was removed, repaired, or replaced:
   A. Check the brake rod assembly and adjust as necessary:
      B. Set the spring length to 36 to 40 mm (1.44 to 1.56 inch) and tighten the jam nuts.
      C. Set the overall length to 282 to 285 mm (11.11 to 11.23 inch) and tighten the clevis nut.

Figure 114

1. Front traction motor – RH  4. Extension spring
2. Hex nut (2 each)  5. Upper brake arm – RH
3. Eye bolt  6. Brake rod assembly

19239SL Rev B
Adjusting the Brake Linkage (continued)

1. Brake rod
2. Brake rod spring
3. Jam nut (2 each)
4. Upper brake rod clevis
5. Clevis nut
6. Washer
7. Lower brake rod clevis
8. Clevis pin

D. Use new cotter pins and install the brake rod assembly to the upper brake arms only.

5. Remove the cotter pin and clevis pin from the lower brake rod clevis. Discard the cotter pin.

**IMPORTANT**

Adjust each brake rod individually.

6. Loosen the hex nut at the upper brake rod clevis and adjust the brake rod so the hole in the lower brake rod clevis is just below the top of the slot in the brake lever.

**Figure 115**

**Figure 116**
(view from rear)

1. Front traction motor – RH
2. Lower brake rod clevis
3. Brake lever
Adjusting the Brake Linkage (continued)

7. Ensure the flat side of the lower brake rod clevis is toward the traction motor and install the clevis pin with a new cotter pin.

8. Adjust the brake cable; refer to Adjusting the Brake Cable (page 6–6).

Adjusting the Brake Cable

1. Park the machine on a level surface, set the key switch to the Off position and remove the key.
2. Loosen the hex nuts and adjust the eye bolt as far as possible to relax the extension spring. Remove the spring.

3. Use the 3/8 inch square drive hole in the right side upper brake arm to fully retract the brake actuator.

IMPORTANT

The brake cable must not restrict the brake actuator from fully retracting.

4. Loosen the brake cable adjuster jam nuts and adjust the cable until only a small amount of free play exists in the brake pedal. Tighten the adjuster jam nuts.
Adjusting the Brake Cable (continued)

5. Use the 3/8 inch square drive hole in the right side upper brake arm to fully extend the brake actuator.

6. The gap between the brake actuator rod nut and the actuator clevis nut should be 3.3 to 3.8 mm (0.13 to 0.15 inch) and the clevis pin holes should be parallel to the ground. Loosen the clevis nut and adjust the clevis if necessary.

7. Install the extension spring and adjust the eye bolt until the extension spring is 114 to 117 mm (4.50 to 4.63 inch) inside the spring hooks. Tighten the eye bolt hex nuts.

8. Check the brake adjustment; refer to Checking the Brake Adjustment (page 6–3).
Aligning the Rear Wheel Caster Fork

1. Rear caster fork
2. Wheel Hub
3. Straight edge
4. Center (rear) cutting unit suspension mount plate

1. Remove the rear wheel; refer to Removing and Installing the Wheels (page 6–9).
2. Clamp a straight edge to the rear wheel hub flange.
3. Rotate the caster fork by hand until the straight edge aligns with the lower mounting bolt on the center (rear) cutting unit suspension mount plate.
4. Adjust the steering position sensor; refer to Adjusting the Steering Position Sensor (page 5–21).
Service and Repairs

Wheels and Tires

1. Front wheel assembly (2 each)
2. Rear wheel assembly
3. Lug nut (4 each wheel)

Removing and Installing the Wheels

1. Raise the machine off the ground; refer to Jacking Instructions (page 1–6).
2. Remove and install the wheel and tire assemblies as necessary.
3. Tighten the wheel lug nuts in a crossing pattern from 95 to 122 N·m (70 to 90 ft-lb).

Figure 120
Front Wheel Hubs

Removing and Installing the Front Wheel Hubs

1. Lock nut
2. Hardened washer
3. Hub
4. Drive stud (4 each hub)
5. Woodruff key

1. Loosen but do not remove the front hub nut.
2. Raise the machine and remove the front wheel; refer to Jacking Instructions (page 1–6).

IMPORTANT

DO NOT hit the front wheel hub or gear box assembly with a hammer during front hub removal. Hammering the assembly may damage to the gear box.

3. Make sure that the front hub lock nut is loosened at least two revolutions. Use a 3-jaw puller to loosen the front hub assembly from the gear box shaft.
4. Remove the wheel hub lock nut, hardened washer, and the wheel hub. Locate and retrieve the woodruff key.
5. Use a press to replace the drive studs as necessary. Ensure that the drive stud flange is pressed fully to the hub surface.
6. Clean the hub and motor shaft tapers.
7. Install the woodruff key, front hub, hardened washer, and lock nut.
8. Lower the machine to the ground and tighten the front hub nut from 237 to 305 N·m (175 to 225 ft-lb).
Front Traction Gear Box

Removing the Front Traction Gear Box

Refer to Figure 122 for this procedure.

1. Remove the front wheel; refer to Removing and Installing the Wheels (page 6–9).
2. Remove the front wheel hub; refer to Removing and Installing the Front Wheel Hubs (page 6–10).
3. Remove the drain plug (item 12) and allow the gear box to drain. Remove and discard the drain plug O-ring.
4. Remove the plug (item 3). Remove and discard the O-ring.
5. Remove the cap screw (item 5) and the washer.
6. Remove the 10 cap screws securing the gear box to the motor assembly. Remove the gear box and discard the gasket.
Removing the Front Traction Gear Box (continued)

7. Locate and retrieve the 2 dowel pins.
8. Use a new O-ring and install the drain plug.

Installing the Front Traction Gear Box

Refer to Figure 122 for this procedure.

1. Remove any residual gasket material from the gear box and wheel motor gasket surfaces.
2. Fit the dowel pins and a new gasket in position and install the gear box.
3. Apply a medium strength thread locking compound (Loctite 243 or equivalent) to the 10 cap screws (item 7) and install them loosely.
   A. Tighten the cap screws in a crossing pattern from 10 to 12 N·m (90 to 110 in-lb).
   B. Tighten the cap screws in a crossing pattern from 18 to 22 N·m (160 to 200 in-lb).
   C. Retighten the cap screws in a clockwise pattern from 18 to 22 N·m (160 to 200 in-lb).
4. Apply a medium strength thread locking compound (Loctite 243 or equivalent) to the cap screw (item 5). Install the washer and cap screw, then tighten the cap screw from 23 to 28 N·m (17 to 21 ft-lb).
5. Apply a light coating of grease to a new O-ring and install it on the plug (item 3), then install the plug.
6. Remove the vent fitting (item 13) and fill the gear box with 385 cc (13 ounces) of 80W-90 gear oil (Mobilube HD Plus 80W-90 or equivalent). Install the vent fitting.
7. Install the front wheel hub; refer to Removing and Installing the Front Wheel Hubs (page 6–10).
8. Install the front wheel; refer to Removing and Installing the Front Wheel Hubs (page 6–10).
9. Test traction operation and check for leaks before returning the machine to service.
Front Traction Gear Box Service

![Diagram of Front Traction Gear Box with numbers and parts]

Figure 123

<table>
<thead>
<tr>
<th></th>
<th>Part Description</th>
<th></th>
<th>Part Description</th>
<th></th>
<th>Part Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gear box housing</td>
<td>6</td>
<td>Jam nut (2 each)</td>
<td>11</td>
<td>Countershaft assembly</td>
</tr>
<tr>
<td>2</td>
<td>Nose cover</td>
<td>7</td>
<td>Tab washer (2 each)</td>
<td>12</td>
<td>O-ring</td>
</tr>
<tr>
<td>3</td>
<td>Cap screw (4 each)</td>
<td>8</td>
<td>Bearing cone (2 each)</td>
<td>13</td>
<td>Output shaft assembly</td>
</tr>
<tr>
<td>4</td>
<td>Lip seal</td>
<td>9</td>
<td>Bearing cup (2 each)</td>
<td>14</td>
<td>Wheel hub lock nut</td>
</tr>
<tr>
<td>5</td>
<td>O-ring</td>
<td>10</td>
<td>Roller bearing (2 each)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Servicing the Front Traction Gear Box

1. Remove the front wheel gear box from the machine; refer to Removing the Front Traction Gear Box (page 6–11).
2. Remove the brake caliper; refer to Servicing the Brake Caliper (page 6–28).
3. Remove the nose cover. Discard the lip seal and O-ring.
4. Loosen and remove the jam nuts and tab washers from the output shaft assembly.
5. Remove the output shaft from the gear box housing and retrieve the outer bearing cone.
6. Press the bearing cups, and roller bearing from the gear box housing. Press the inner bearing cone from the output shaft assembly. Press the roller bearing from the countershaft assembly.
7. Clean and inspect all parts for wear or damage.
8. Press new bearing cups (item 9) into the housing. Ensure each bearing cup is fully seated in the housing bore.
9. Press a new countershaft roller bearing (item 10) into the housing. Ensure the bearing is fully seated in the housing bore.
10. Press a new inner bearing cone onto the output shaft. Ensure the bearing cone is flush against the output gear.

11. Press a new roller bearing onto the countershaft assembly behind the countershaft gear. Ensure the bearing is flush against the countershaft gear.

12. Install the output shaft assembly.
   A. Position the output shaft assembly in the gear box housing and install the outer bearing cone.
   B. Apply medium strength thread locking compound (Loctite 243 or equivalent) to the shaft threads and install one tab washer and the inner jam nut.
   
   **Note:** Temporarily install the front wheel hub lock nut on the end of the output shaft, and use an accurate torque wrench to install the output shaft.
   C. Tighten the inner jam nut until 0.5 to 1.0 N·m (5 to 9 in-lb) is required to rotate the output shaft.
   D. Apply medium strength thread locking compound (Loctite 243 or equivalent) to the shaft threads and install the second tab washer and the outer jam nut.
   E. Hold the inner jam nut and tighten the outer jam nut from 190 to 217 N·m (140 to 160 ft-lb).
   F. Ensure the torque required to rotate the output shaft is still 0.5 to 1.0 N·m (5 to 9 in-lb). Loosen and reset the jam nuts if necessary.

13. Install a new lip seal in the nose cover and apply a light coating of grease to the seal lip.

14. Apply a light coating of grease to a new O-ring and install it on the nose cover.

15. Install the nose cover.

16. Apply medium strength thread locking compound (Loctite 243 or equivalent) to the cap screws (item 3). Install the nose cover and cap screws, then tighten the cap screws from 10 to 12 N·m (90 to 105 in-lb).

17. Install a new O-ring (item 12) in the countershaft bearing bore of the motor assembly and install the countershaft assembly.

18. Install the brake caliper; refer to **Servicing the Brake Caliper (page 6–28).**

19. Install the front wheel gear box to the machine; refer to **Installing the Front Traction Gear Box (page 6–12).**
Disassembling the Rear Wheel Hub and Bearings (Standard)

Refer to Figure 124 for the following procedure.

1. Raise the machine and remove the rear wheel; refer to Jacking Instructions (page 1–6).
2. Carefully remove the dust cap from the wheel hub.
3. Remove and discard the cotter pin from the axle spindle.
4. Remove the nut retainer, nut, and spindle washer that secure the wheel hub to the spindle. Slide the wheel hub with the bearings from the spindle.
5. Disassemble the wheel hub as follows:

   **Note:** Ensure that you do not damage the hub bore.

   A. Remove and discard the oil seal from the wheel hub.
   B. Remove the bearing cones from both sides of the wheel hub. Clean the inner surface of the wheel hub.
   C. Clean and inspect the wheel bearing cups and cones. Check the bearing cones and cups for wear, pitting, or other damage. Replace the parts that are worn or damaged.
   D. Use a press to replace the drive studs as necessary. Ensure that the drive stud flange is pressed fully to the hub surface.
Disassembling the Rear Wheel Hub and Bearings (Standard) (continued)

6. Clean and inspect the axle spindle for wear or damage. Replace the spindle if necessary.

Assembling the Rear Wheel Hub and Bearings (Standard)

Refer to Figure 124 for the following procedure.

1. Assemble the wheel hub as follows:
   A. If the bearing cups were removed from the wheel hub, press the inner and outer cups into the wheel hub until they seat against the wheel hub shoulder.
      
      **Note:** Use high temperature grease (Mobil XHP-222 or equivalent).
   B. Fill the wheel hub approximately 50% full of grease.
   C. Pack both bearing cones with grease. Install greased inner bearing cone into the cup on inboard side of the wheel hub.

2. **IMPORTANT**

The oil seal should be pressed in so that it is flush with the end of the wheel hub. The lip of the oil seal must be toward the inner bearing.

D. Lubricate the inside of new oil seal and press it into the wheel hub.
   
   **Note:** Ensure that you do not damage the oil seal in the wheel hub.

2. Install the wheel hub onto the axle spindle.

3. Install greased outer bearing cone, spindle washer, and nut onto the spindle shaft.

4. While rotating the wheel hub by hand, torque the nut to 8.5 to 20.3 N·m (75 to 180 in-lb) to seat bearings. Loosen the nut until it is away from the spindle washer and the wheel hub has end-play. Finally, while rotating the wheel hub, tighten the nut to 1.7 to 2.3 N·m (15 to 20 in-lb).

5. Install the nut retainer and a new cotter pin to secure the nut. Install the dust cap.

6. Install the wheel assembly; refer to Removing and Installing the Wheels (page 6–9).
Rear Wheel Hub (Optional 3WD)

![Diagram of rear wheel hub components]

**Figure 125**

1. Dust plug  
2. O-ring  
3. Retaining ring  
4. Thrust washer (4 each)  
5. Thrust bearing (2 each)  
6. Roller clutch (3 each)  
7. Hub  
8. Grease fitting  
9. Drive stud (4 each)  
10. Wave washer  
11. Lip seal

### Removing and Installing the Rear Wheel Hub

1. Remove the rear wheel; refer to Removing and Installing the Wheels (page 6–9).
2. Remove the dust plug from the hub assembly. Inspect the dust plug O-ring and replace as necessary.
3. Remove the retaining ring and twist the hub assembly off the shaft in a counterclockwise (forward) direction.
4. Install the rear wheel hub in the reverse order.
5. When properly installed, the hub should rotate freely in the counterclockwise (forward) direction, and engage with the rear wheel gear box shaft when rotated in the clockwise (reverse) direction.
6. Grease the hub fitting with high temperature grease (Mobil XHP-222 or equivalent) before returning the machine to service.

### Servicing the Rear Wheel Hub

1. Remove the inner lip seal, thrust washers, thrust bearings, and wave washer from the hub assembly.
2. Clean and inspect all of the hub components and replace then as necessary.
3. If bearing replacement is necessary:

   **IMPORTANT**

   The roller clutches are designed to roll in one direction and lock in the other (unidirectional). Pay attention to the roller clutch orientation when replacing the roller clutches. The roller clutches must be installed with the white roller cage of the roller clutch toward the inside (lip seal) of the hub.
Servicing the Rear Wheel Hub (continued)

Figure 126

1. Dust cap (outside of hub) 3. Lip seal (inside of hub)
2. Grease fitting and passage 4. Roller clutch – white roller cage

A. Press the old roller clutches from the hub.

B. Press one new roller clutch from the inside of the hub. The white roller cage of the roller clutch must be toward the inside (lip seal) of the hub. The roller clutch should rest just below the inner shoulder of the hub and not block the grease passage.

C. Press two new roller clutches from the outside of the hub. The white roller cage of each roller clutch must be toward the inside (lip seal) of the hub. The roller clutches should rest just below the inner shoulder of the hub and not block the grease passage.

D. Apply a thin layer of high temperature grease (Mobil XHP-222 or equivalent) to the inside of each roller clutch.

4. Install the wave washer in the inner hub bore.

5. Apply a thin layer of high temperature grease (Mobil XHP-222 or equivalent) to the thrust bearings and install the thrust bearings and thrust washers as shown in Figure 125.

6. Install the inner lip seal in the inner hub bore. Apply a thin layer of grease to the lip of the seal.
Rear Wheel Gear Box (Optional 3WD)

![Diagram of Rear Wheel Gear Box](image)

**Figure 127**

1. Rear wheel gear box and motor assembly
2. Rear wheel hub assembly
3. Vent hose
4. Vent fitting
5. O-ring
6. Flange head screw (4 each)
7. Flange nut (2 each)
8. Spacer (2 each)
9. Harness bracket
10. Flat washer (2 each)
11. Cap screw (2 each)

---

**Removing and Installing the Rear Wheel Gear Box**

Refer to Figure 127 for this procedure.

1. Remove the rear wheel; refer to Removing and Installing the Wheels (page 6–9).
2. Remove the lower plug and drain the oil from the gear box. Inspect the plug O-ring and replace as necessary.
3. Unplug the 48V battery; refer to 48V Battery Disconnect (page 5–9).
4. Locate the 3WD traction motor connections to the machine wire harness and disconnect the 2 connectors. Check the motor and the harness connector for damage or corrosion and clean or repair as necessary.
5. Remove the rear wheel hub from the 3WD traction motor; refer to Rear Wheel Hub (Optional 3WD) (page 6–17).
6. Remove the vent hose and fitting from the motor and gear box assembly. Inspect the vent fitting O-ring and replace as necessary.
7. Remove the 4 fasteners securing the gear box to the caster fork and remove the motor and gear box assembly.
8. Install the motor and gear box assembly in reverse order.
9. Fill the gear box with approximately **1,200 cc (40 oz)** of 80W-90 gear oil (to the bottom of the level plug) before returning the machine to service.
### Servicing the Rear Wheel Gear Box

#### Figure 128

<table>
<thead>
<tr>
<th>No.</th>
<th>Part Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Rear traction motor</td>
</tr>
<tr>
<td>2.</td>
<td>Gasket</td>
</tr>
<tr>
<td>3.</td>
<td>Plug – drain</td>
</tr>
<tr>
<td>4.</td>
<td>Plug – level</td>
</tr>
<tr>
<td>5.</td>
<td>O-ring</td>
</tr>
<tr>
<td>6.</td>
<td>Socket head screw (17 each)</td>
</tr>
<tr>
<td>7.</td>
<td>Gear box cover</td>
</tr>
<tr>
<td>8.</td>
<td>Gasket</td>
</tr>
<tr>
<td>9.</td>
<td>Bearing (2 each)</td>
</tr>
<tr>
<td>10.</td>
<td>Gear – 137 T</td>
</tr>
<tr>
<td>11.</td>
<td>Key</td>
</tr>
<tr>
<td>12.</td>
<td>Spur gear</td>
</tr>
<tr>
<td>13.</td>
<td>Wave washer</td>
</tr>
<tr>
<td>14.</td>
<td>Dowel pin (2 each)</td>
</tr>
<tr>
<td>15.</td>
<td>Gear box housing</td>
</tr>
<tr>
<td>16.</td>
<td>Plug – fill</td>
</tr>
<tr>
<td>17.</td>
<td>Bearing (2 each)</td>
</tr>
<tr>
<td>18.</td>
<td>Retaining ring</td>
</tr>
<tr>
<td>19.</td>
<td>Lip seal</td>
</tr>
<tr>
<td>20.</td>
<td>Retaining ring</td>
</tr>
<tr>
<td>21.</td>
<td>Axle shaft</td>
</tr>
<tr>
<td>22.</td>
<td>Key</td>
</tr>
<tr>
<td>23.</td>
<td>Gear 133 T</td>
</tr>
<tr>
<td>24.</td>
<td>Washer</td>
</tr>
<tr>
<td>25.</td>
<td>Set screw</td>
</tr>
<tr>
<td>26.</td>
<td>Dowel pin</td>
</tr>
<tr>
<td>27.</td>
<td>Socket head screw</td>
</tr>
<tr>
<td>28.</td>
<td>Gear 23 T</td>
</tr>
<tr>
<td>29.</td>
<td>Square key</td>
</tr>
</tbody>
</table>

**Note:** The drive shaft seal can be replaced without removing or disassembling the gear box.

1. Remove the rear wheel gear box from the machine; refer to *Removing and Installing the Rear Wheel Gear Box (page 6–19)*.
2. Remove the fasteners and separate the gear box cover and motor assembly from the gear box housing.
3. Remove and discard the gear box housing gasket. Locate and retrieve the 2 dowel pins.
4. Remove the spur gear assembly from the housing. Locate and retrieve the wave washer.
5. Remove the retaining ring and lip seal from the housing. Discard the lip seal.
6. Remove the retaining ring from the axle shaft and remove the axle shaft assembly from the housing. Locate and retrieve the wave washer.
Servicing the Rear Wheel Gear Box (continued)

7. Remove the rear traction motor if necessary; refer to Rear Traction Motor (Optional) (page 5–133).

8. Inspect and replace all of the gear box components as necessary. Ensure all bearings are pressed fully against their respective shoulders.

9. Assemble the gear box in reverse order. Use a new axle shaft seal and housing gasket. Tighten the gear box cover fasteners in a crossing pattern to 15 N·m (11 ft-lb).
Traction Pedal Assembly

Figure 129

1. Flange nut (2 each)
2. Washer (4 each)
3. Connecting link
4. Bearing spacer (4 each)
5. Bearing (2 each)
6. Roll pin
7. Pedal – forward
8. Pad – forward
9. Pad – reverse
10. Flange head screw (2 each)
11. Motion control bracket
12. Screw (2 each)
13. Sensor shield
14. Traction position sensor
15. Retaining ring
16. Washer (2 each)
17. Bushing (2 each)
18. Platform support – RH
19. Flange head screw (2 each)
20. Pedal shaft
21. Flange nut (2 each)
22. Traction pedal
23. Flange head screw
24. Extension spring
25. Spacer (2 each)
26. Flange head screw (2 each)

Remove, repair, or replace the traction pedal components as necessary.

IMPORTANT

Ensure the traction pedal moves freely from stop to stop, and returns to the NEUTRAL position when released. Calibrate the traction pedal position sensor after assembly; refer to Calibrating the Traction Pedal Position Sensor (page 5–88).

For traction pedal position sensor testing information; refer to Traction Pedal Position Sensor (page 5–86).
Brake Assembly

The eTriFlex machines use a single mechanical brake assembly that can be used as a service brake, a manual parking brake, and an automatic parking brake. The service brake and manual parking brake are controlled by a cable connected to pedals at the operator’s left foot, while the automatic parking brake is controlled by a 12 VDC electric brake actuator. The brake system engages 2 brake calipers (located between each front traction motor and front traction gear box).

Automatic Parking Brake: When the key switch is in the Off position, or when the key switch is in the Run or Start position and the operator is not in the operator seat, a large extension spring keeps the brakes engaged. When the key switch is in the Run or Start position and the operator is in the operator seat, the electric brake actuator pulls against the spring (retracts) and disengages the brakes.

For brake actuator testing information; refer to Brake Actuator (page 5–75).

Replacing the Brake Cable

1. Park the machine on a level surface, set the key switch to the Off position and remove the key.
2. Ensure the manual parking brake is released.
3. Disconnect the brake cable from the brake pedal and pedal support (remove 2 retaining rings).

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Brake cable</td>
<td>4</td>
<td>Retaining ring</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>Brake pedal</td>
<td>5</td>
<td>Adjuster bracket</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Retaining ring</td>
<td>6</td>
<td>Adjuster jam nut (2 each)</td>
<td></td>
</tr>
</tbody>
</table>

Figure 130
Replacing the Brake Cable (continued)

4. Loosen the 2 adjuster jam nuts at the brake adjuster and remove the cable from the adjuster bracket.
5. Disconnect the brake cable from the left side brake arm.
6. Install the new cable in the reverse order.
7. Adjust the brake cable; refer to Adjusting the Brake Cable (page 6–6).

Removing and Installing the Brake Linkage

![Image of brake linkage diagram]

**Figure 131**

1. Hex nut (2 each) 11. Cotter pin (5 each) 21. Clevis pin
3. Hair pin (2 each) 13. Clevis pin (2 each rod) 23. Brake cable
5. Bearing (2 each) 15. Hex nut (3 each rod) 25. Electric brake actuator
7. Roll pin (2 each) 17. Washer (2 each rod) 27. Link
10. Upper brake arm – LH 20. Brake rod assembly (2 each)
Removing and Installing the Brake Linkage (continued)

1. Park the machine on a level surface, set the key switch to the OFF position and remove the key.
2. Loosen the hex nuts and adjust the eye bolt as far as possible to relax the extension spring. Remove the spring.
3. Use the 3/8 inch square drive hole in the right side upper brake arm (item 8) to fully retract the brake actuator.
4. Disconnect the actuator clevis (item 12) from the link and brake shaft assembly. Discard the cotter pin.
5. Remove the brake rod assemblies (item 20) from the machine. Discard the cotter pins.
6. Disconnect the brake cable from the left side brake arm.
7. Remove the fasteners securing the brake shaft bearings (item 5) to the machine, and remove the bearings and shaft as an assembly.
8. Repair or replace the brake linkage components as necessary.
9. Secure the brake shaft and bearing assembly to the machine.
10. Connect the brake cable to the left side brake arm.
11. Use a new cotter pin and connect the actuator clevis to the link and brake shaft assembly.
12. Use new cotter pins and install the brake rod assemblies to the brake arms only.
13. Adjust the brake linkage; refer to Adjusting the Brake Linkage (page 6–4).
Removing and Installing the Brake Pedals

1. Park the machine on a level surface, set the key switch to the OFF position and remove the key.
Removing and Installing the Brake Pedals (continued)

2. Disconnect the brake cable from the brake pedal and pedal support (remove 2 retaining rings).

   **Note:** Record the location of any cable ties securing the wire harness to the machine, and replace them during assembly.

3. Disconnect the manual parking brake switch from the machine wire harness. Check the switch and the harness connector for damage or corrosion and clean or repair as necessary.

4. Remove the 3 fasteners securing the brake pedal support to the left platform, and remove the assembly from the machine.

5. Repair or replace the brake pedal components as necessary.

6. Ensure the park pedal (item 12) moves freely with the torsion spring.

7. Check and adjust the manual parking brake switch if necessary; refer to *Adjusting the Manual Parking Brake Switch (page 5–22).*

8. Secure the brake pedal assembly to the platform.

9. Connect the brake switch to the machine wire harness and secure the wiring to the machine.

10. Install the brake cable with the 2 retaining rings previously removed. Adjust the brake cable; refer to *Adjusting the Brake Cable (page 6–6).*
1. Remove the front traction gear box; refer to Removing the Front Traction Gear Box (page 6–11).

2. Loosen the hex nuts and adjust the eye bolt as far as possible to relax the extension spring. Remove the spring.

3. Use the 3/8 inch square drive hole in the right side upper brake arm (item 8) to fully retract the brake actuator.

4. Remove the support link (item 1).

5. Remove the brake return spring.

6. Remove the cotter pin and the clevis pin from the clevis to disconnect the brake linkage from the brake lever. Discard the cotter pin.

7. Remove the shoulder bolt (item 8) securing the brake lever to the wheel motor housing.

8. Remove the brake lever and shaft from the wheel motor housing.

9. Slide the brake rotor and brake caliper assembly from the motor housing.

10. Clean and inspect the parts for wear or damage.

- The minimum brake pad thickness is 2.8 mm (0.110 inch).
Servicing the Brake Caliper (continued)

- The minimum brake rotor thickness is 4.6 mm (0.180 inch).

11. Inspect the lever shaft seal (item 10) and replace it if necessary. Apply a coating of grease to the seal lip.

12. Assemble and install the brake caliper and rotor into the motor housing as an assembly.

13. Install the brake lever and shaft, then secure the assembly in position with the shoulder bolt.

14. Fit the brake linkage clevis over the brake lever. Use a new cotter pin and install the clevis pin and cotter pin to secure the brake linkage.

15. Install the brake return spring.

16. Install the link support.

17. Install the front traction gear box; refer to Installing the Front Traction Gear Box (page 6–12).

18. Adjust the brake linkage; refer to Adjusting the Brake Linkage (page 6–4).
Rear Wheel Caster Fork

1. Cap screw (2 each) 12. Upper steering housing
2. Steering position sensor and bracket 13. Sector gear
4. Jam nut 15. Dowel pin (2 each)
5. Castle nut 16. Lower steering housing
6. Tang washer 17. Lip seal
7. Washer 18. Caster fork
8. Bearing cone (2 each) 19. Flange head screw
9. Bearing cup (2 each) 20. Rear wheel spindle
10. Plug 21. Hex hut (4 each)
11. Flange head screw (9 each)

For steering position sensor testing information; refer to Steering Position Sensor (page 5–89).
Removing the Rear Wheel Caster Fork

Refer to Figure 134 for this procedure.

1. Park the machine on a level surface, set the key switch to the OFF position and remove the key.
2. Remove the rear wheel; refer to Removing and Installing the Wheels (page 6–9).
3. Remove the 4 fasteners securing the rear wheel spindle or the rear wheel gear box to the castor fork; refer to Removing and Installing the Rear Wheel Gear Box (page 6–19) for 3WD machines.
4. Remove the hood; refer to Removing and Installing the Hood Assembly (page 6–43).
5. Remove the steering position sensor bracket with the sensor attached.
6. Remove the magnetic carrier bolt and jam nut from the caster shaft.
7. Remove the 9 flange head screws (item 11) that secure the lower steering housing.
8. Fold the locking tang (item 6) free of the castle nut.
9. Support the caster fork and remove the castle nut, tang washer, and washer. Discard the tang washer.
10. Lower the caster fork from the machine with the lower steering housing and sector gear attached.
11. Remove the lower bearing cone, sector gear, and lower steering housing from the castor fork. Locate and retrieve the upper bearing cone.
12. Locate and discard the steering housing gasket. Remove any gasket material from the upper or lower steering housing. Remove and discard the seal in the lower steering housing.
13. Inspect the upper and lower bearing cups in the frame for wear or damage and replace them if necessary.

Installing the Rear Wheel Caster Fork

Refer to Figure 134 for this procedure.

1. If the bearing cups were removed from the frame, press new cups into the frame making sure that they are fully seated against the shoulder of the frame housing.
2. Press a new seal in the lower steering housing. Apply a small amount of grease on the inner lip of the new seal.
3. Being careful not to damage the new seal, fit the lower steering housing over the caster shaft.

   **Note:** Use a high temperature grease (Mobil XHP-222 or equivalent) for the caster fork bearings and the steering housing.
4. Fit the sector gear over the caster shaft and coat the sector gear and steering motor pinion gear teeth with grease.
5. Carefully fill the lower housing with **88 to 118 cc (3 to 4 ounces)** of grease. Clean any grease from the housing gasket surface with solvent if necessary.
6. Pack the bearing cones with grease and fit the lower bearing cone over the caster shaft.
7. Verify the location of the 2 dowel pins and place a new housing gasket in position.
8. Support the caster assembly and raise it into position against the upper steering housing. Secure the lower steering housing with the 9 flange head screws previously removed.
Installing the Rear Wheel Caster Fork (continued)

9. Install the upper bearing cone, washer, a new tang washer, and the castle nut on the caster shaft.

10. Remove the caster support and while rotating the caster fork by hand, torque the castle nut to **8.5 to 20.3 N·m (75 to 180 in-lb)** to seat the bearings. Support the caster fork and loosen the nut until it is away from the washer and the caster shaft has end-play. Finally, remove the caster support and while rotating the caster fork, tighten the castle nut to **1.7 to 2.3 N·m (15 to 20 in-lb)**.

11. Secure the castle nut by bending the washer tang into the castle nut.

12. Remove plug (item 10) from upper steering housing and install a grease fitting (Toro part 302–5 or equivalent). Lubricate the steering housing until grease is seen at the upper bearing. Wipe up any excess grease.

13. Install the magnetic carrier bolt and jam nut all the way into the caster shaft finger tight.

14. Install the steering position sensor bracket with the sensor attached.

15. Install the 4 fasteners securing the rear wheel spindle or the rear wheel gear box to the caster fork; refer to Removing and Installing the Rear Wheel Gear Box (page 6–19) for 3WD machines.

16. Align the caster fork and adjust the steering position sensor; refer to Aligning the Rear Wheel Caster Fork (page 6–8).

17. Install the rear wheel; refer to Removing and Installing the Wheels (page 6–9).

18. Install the hood; refer to Removing and Installing the Hood Assembly (page 6–43).
Removing and Installing the Steering Gear Box

Refer to Figure 135 for this procedure.

1. Remove the caster fork; refer to Rear Wheel Caster Fork (page 6–30).
2. Record the orientation of the steering motor prior to removal. Remove the fasteners securing the steering motor to the upper steering housing and remove the steering motor. Locate and discard the steering motor gasket.
Removing and Installing the Steering Gear Box (continued)

3. Remove the lock nut, cap screw (item 20) and washer from the center of the rear engine frame mount.

4. Support the rear of the engine frame and remove the upper steering housing from the machine frame.

5. Remove additional items from the upper steering housing as needed.

6. Install the upper steering housing in reverse order. Tighten the fasteners securing the upper steering housing to the machine frame from **102 to 115 N·m (75 to 85 ft-lb)**.

7. Use a new steering motor gasket, orient the steering motor as previously recorded (as shown), and install the steering motor.
Steering Arm Assembly

Figure 136

5. Speed nut (6 each) 16. Steering wheel
6. Steering mount 17. Set screw (2 each) 27. Retaining ring
7. Steering arm  18. Flange head screw (4 each) 28. Flange head screw (3 each)
9. Button head screw (6 each) 20. Lock nut (4 each) 30. Pivot lever
18. Carriage bolt 24. Jam nut
25. Retaining ring
26. Bushing
28. Flange head screw (3 each)
29. Platform support – RH
30. Pivot lever
31. Flange bushing
32. Pivot pedal
33. Pedal pad

If the steering input device is replaced, the steering system – center must be calibrated; refer to Calibrating the Steering System – Center (page 5–91).

For steering input device testing information; refer to Testing the Steering Input Device (page 5–59).

Removing the Steering Arm

Refer to Figure 136 for this procedure.
Removing the Steering Arm (continued)

1. Park the machine on a level surface, set the key switch to the Off position and remove the key.

2. Remove the cover (item 21) and disconnect the steering input device from the machine wire harness. Check the steering input device and the harness connector for damage or corrosion and clean or repair as necessary.

   **Note:** The steering wheel, steering input device, and steering mount may be removed from the steering arm as an assembly if desired. Record the position of the steering mount for assembly.

3. Remove the steering input device if necessary:
   A. Remove the screw securing the cap to the steering wheel.
   B. Remove the hex nut and flat washer securing the steering wheel to the shaft.
   C. Use a suitable puller to remove the steering wheel from the steering input device.
   D. Remove the fasteners securing the steering input device to the steering mount and remove the steering input device.

   **Note:** If the steering input device is being replaced, remove or replace the shaft adapter (item 11). The shaft adapter is secured to the steering input device with a roll pin and 2 set screws. Discard the roll pin.

4. Record the position of the steering mount (item 6) for assembly and remove if necessary.

   **CAUTION**

   The gas cylinder is under high pressure at all times. Avoid pressing the gas cylinder release pin while either end of the cylinder is not secured to the machine. Do not open the gas cylinder.

5. Remove the gas cylinder:
   A. Remove the retaining ring and the pivot pedal (item 32).
   B. Support the steering arm assembly.
   C. Remove the fasteners securing the gas cylinder at the steering arm.
   D. Remove the retaining ring (item 27) then remove the pivot lever and gas cylinder as an assembly.
   E. Loosen the jam nut and separate the gas cylinder from the pivot lever if necessary.

6. Remove the fasteners securing the steering arm to the chassis and remove the steering arm.

7. Inspect the steering arm pivot spacer (item 2) and the pivot lever bushings (item 26) and (item 31) the for wear and replace if necessary.

Installing the Steering Arm

Refer to Figure 136 for this procedure.

1. If the right side platform support (item 29) was removed from the machine, tighten the support fasteners from 102 to 115 N·m (75 to 85 ft-lb).

2. Secure the steering arm to the chassis.
Installing the Steering Arm (continued)

**CAUTION**

The gas cylinder is under high pressure at all times. Avoid pressing the gas cylinder release pin while either end of the cylinder is not secured to the machine. Do not open the gas cylinder.

---

3. Install the gas cylinder:
   - A. If previously removed, fully thread the end of the gas cylinder into the pivot lever.
   - B. Install the pivot lever and gas cylinder as an assembly then install the retaining ring (item 27).
   - C. Install the fasteners securing the gas cylinder at the steering arm, then tighten the gas cylinder jam nut to **20 N·m (14 ft-lbs)**.
   - D. Install the pivot pedal (item 32) and the retaining ring.

4. If previously removed, install the steering mount in the position recorded.

5. Install the steering input device:
   - A. If previously removed, install the shaft adapter (item 11) to the steering input device by pressing a new roll pin and installing 2 set screws. Tighten each set screw from **8 to 10 N·m (70 to 90 in-lb)**.
   - B. Install the steering input device using the fasteners previously removed.
   - C. Apply a light coating of anti-seize lubricant to the splines of the shaft adapter and install the steering wheel.
   - D. Install the flat washer and lock nut, then tighten the lock nut from **27 to 35 N·m (20 to 26 ft-lb)**.
   - E. Install the steering wheel cap and screw.

6. Connect the steering input device to the machine wire harness and install the cover (item 21).

7. Calibrate the steering system – center; refer to Calibrating the Steering System – Center (page 5–91).
Removing and Installing the Control Console

Refer to Figure 137 for this procedure.

1. Park the machine on a level surface, set the key switch to the OFF position and remove the key.
2. Remove the 10 button head screws (item 11) from the console and remove the console cover.
3. Record the location of any cable ties and disconnect the machine wire harness connector to remove the InfoCenter or any switches as necessary.
Removing and Installing the Control Console (continued)

Check the InfoCenter, switches, and the harness connectors for damage or corrosion and clean or repair as necessary.

4. Record the location of any cable ties and disconnect the choke control cable at the engine. Remove the choke control knob before removing the choke control.

5. Remove the 2 fasteners securing the console to the support and remove the console.

6. Install the console and console components in reverse order.

Note: Orient joystick stem toward seat during assembly. Install function control switch as shown in Figure 137.
Platform Assembly

1. Align the platforms with each other before tightening the fasteners.

2. If the right side platform support (item 6) was removed from the machine, tighten the support fasteners from **102 to 115 N·m (75 to 85 ft-lb)**.

3. Ensure the left platform can open and close without interference before returning the machine to service.
A standard seat (model 04508) and a premium seat (model 04729) is available for the Greensmaster 3360/3370 machines. Refer to the specific seat *Installation Instructions* and *Parts Catalog* available at [www.Toro.com](http://www.Toro.com) for additional information.
Figure 140

1. Side casting – RH
2. Jack bracket
3. Bushing (2 each)
4. Cap screw (8 each)
5. Step
6. Step bracket
7. Side casting – LH
8. Bushing (2 each)

If the side castings were removed from the machine, tighten the cap screws (Item 4) from **102 to 115 N·m (75 to 85 ft-lb)**.
Hood Assembly

The hood brackets and hinge brackets are adjustable upward, downward, forward and rearward individually. Adjust the hood brackets as needed to allow the hood to rest squarely on the fuel tank.

Removing and Installing the Hood Assembly

Refer to Figure 141 for this procedure.

1. Park the machine on a level surface, set the key switch to the Off position and remove the key.

2. Open the hood and mark the location of the hood brackets (item 10) on the upper steering housing.

3. Close the hood and remove the 4 fasteners securing the hood brackets to the upper steering housing (item 15). Remove the hood.

4. To install the hood:
   A. Place the hood in position on the machine.
   B. Install the hood bracket fasteners (item 15) finger tight.
Removing and Installing the Hood Assembly (continued)

C. Open the hood and align the brackets with the markings made during removal, or, adjust the hood brackets as needed to allow the hood to rest squarely along the top and sides of the fuel tank.

D. Tighten the bracket fasteners.
Cutting Unit Suspension Assembly

Figure 142

1. Suspension assembly (3 each)  7. Motor cable bulkhead (3 each)  13. Flange head screw (6 each)
2. Flange screw (3 each suspension)  8. Spring retainer – left (3 each)  14. Spring retainer – right (3 each)
3. Cotter pin (3 each)  9. Stabilizer spring – left (3 each)  15. Stabilizer spring – right (3 each)
4. Washer (3 each)  10. Spacer (6 each)  16. Socket head screw (6 each)
5. Lift/Lower actuator  11. Cap screw (6 each)  17. Cable bracket – front (2 each)
6. Clevis pin (3 each)  12. Flange nut (6 each)

Three (3) identical cutting unit suspension assemblies are used on Greensmaster eTriFlex machines. The cutting unit attaches to the crossarm assembly which is attached to the front of the cutting unit suspension assembly. The crossarm assembly can be serviced with the suspension assembly attached to the machine; refer to Cutting Unit Suspension Crossarm Assembly (page 6–51).

For additional lift/lower actuator information; refer to Lift/Lower Actuators (page 5–81).

Removing the Cutting Unit Suspension Assembly

Refer to Figure 142 for this procedure.

1. Park the machine on a level surface, lower the cutting units, set the key switch to the OFF position and remove the key.
2. Remove the grass basket.
3. Remove the cutting unit; refer to the traction unit Operator’s Manual.
Removing the Cutting Unit Suspension Assembly (continued)

4. If a front suspension assembly will be removed from the machine, remove the front wheel; refer to Wheels and Tires (page 6–9).

5. Loosen the bulkhead nut that secures the cutting unit motor cable to the bracket on the suspension assembly, and separate the cable from the bracket.

6. Remove the fasteners securing the lift/lower actuator to the cutting unit suspension.

7. Support the cutting unit motor away from the suspension assembly.

8. Support the suspension assembly when removing it to prevent it from falling and causing personal injury. The suspension assembly weighs approximately 30 kg (65 lbs).

8. Support the suspension assembly and remove the 3 flange head screws that secure the assembly to the machine. Remove the suspension assembly.
Servicing the Cutting Unit Suspension Assembly

1. Pivot mount
2. Lower A-arm
3. Ball joint (6 each)
4. Retaining ring (6 each)
5. Striker plate
6. Pop rivet (2 each)
7. Steering stop
8. Flange head screw (5 each)
9. Ball joint clamp (6 each)
10. Flange head screw (8 each)
11. Upper A-arm
12. Lift plate
13. Flange head screw (2 each)
14. Cap screw (4 each)
15. Counterbalance tensioner
16. Flange nut (4 each)
17. Steering head
18. Grommet
19. Counterbalance bracket
20. Counterbalance spring (3 each)
21. Cotter pin
22. Clevis pin

Figure 143

The cutting unit suspension assembly can be serviced on or off the machine.

1. Park the machine on a level surface, lower the cutting units, set the key switch to the OFF position and remove the key.

2. Remove the grass basket.

3. Remove the cutting unit; refer to the traction unit Operator’s Manual.
CAUTION

Be careful when disassembling the counterbalance mechanism. The counterbalance springs are under heavy load and may cause personal injury.

4. Remove tension from the counterbalance mechanism:
   A. Use 3/8 inch drive breaker bar in the square hole of the counterbalance tensioner to hold tensioner in place.
   B. Record the position of the clevis pin (item 22), then remove the cotter pin and clevis pin from the counterbalance bracket and allow the tensioner to relax.

5. Replace worn or damaged components as necessary:
   A. The ball joints were installed in the A-arms with a medium strength retaining compound (Loctite 609 or equivalent). It may be necessary to heat the A-arm around the ball joint for removal. Clean the ball joint housing and the A-arm bore with solvent and allow to dry. Apply a medium strength retaining compound to the ball joint housing before installation.
   B. If a ball joint clamp (item 9) is removed, ensure the raised boss in the clamp bore fits in the groove of the ball joint stud before securing the clamp.
   C. If the lift plate (item 12) is removed, tighten the lift plate mounting fasteners from 91 to 112 N·m (67 to 83 ft·lb).

CAUTION

Be careful when assembling the counterbalance mechanism. The counterbalance springs are under heavy load and may cause personal injury.

6. Use a 3/8 inch drive breaker bar in the square hole of the counterbalance tensioner to raise the tensioner. Install the clevis in the position recorded during disassembly. Install the cotter pin, relax the tensioner, and remove the breaker bar.

Note: The default counterbalance setting for eTriFlex machines has the clevis pin passing under the counterbalance tensioner and the middle hole of the counterbalance bracket.
Servicing the Cutting Unit Suspension Assembly (continued)

![Diagram](image)

Figure 144

1. Lower A arm
2. Counterbalance bracket
3. Counterbalance tensioner
4. Clevis pin

7. Install the cutting unit; refer to the traction unit *Operators Manual*.
8. Install the grass basket.

Installing the Cutting Unit Suspension Assembly

Refer to Figure 142 for this procedure.

1. Ensure all suspension components are correctly assembled.

2. Secure the suspension assembly to the machine with the 3 flange head screws previously removed. Tighten the screws from **102 to 115 N·m (75 to 85 ft-lb)**.

3. Install the front wheel if previously removed; refer to Removing and Installing the Wheels (page 6–9).

4. If the stabilizer springs are removed, support the suspension assembly so the spring bracket mounting hole is centered in the spring bracket slot **approximately 145 mm (5.72 inch)** from the rear of the pivot mount (this is the cutting unit transport position). Then, position the bracket so the center of the spring end is **222 mm (8.74 inch)** from the rear of the pivot mount. Secure the spring bracket in position with the flange head screw.
1. Stabilizer spring
2. Spring bracket
3. Rear of pivot mount

**Note:** To reduce the chance of turf damage when the cutting unit is lowered, properly adjusted stabilizer springs should square the cutting unit with the machine as the cutting unit is raised. Adjust the stabilizer springs if necessary.

5. Move the cutting unit motor to its storage location at the front of the suspension assembly.

6. Fit the cutting unit motor cable into the bracket on the suspension assembly, and secure the cable with the bulkhead nut.

7. Install the cutting unit; refer to the traction unit *Operators Manual*.

8. Install the grass basket.
Three (3) identical cutting unit suspension assemblies are used on Greensmaster eTriFlex machines. The cutting unit attaches to the crossarm assembly which is attached to the front of the cutting unit suspension assembly.

Remove the cutting unit before servicing the crossarm assembly; refer to the traction unit Operator’s Manual.
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General Information

Cutting Unit Operator's Manual

The Cutting Unit Operator’s Manual provides information regarding the operation, general maintenance, and maintenance intervals for the cutting units on your machine. Additionally, if optional kits have been installed on the cutting units (e.g. groomer or rear roller brush), the Installation Instructions for the kit includes set-up, operation and maintenance information. Refer to the Cutting Unit Operator’s Manual and the kit Installation Instructions for additional information when servicing the cutting units.

Supporting the Cutting Unit when Servicing

Whenever the cutting unit has to be tipped to expose the bedknife or cutting reel, support the rear of the cutting unit making sure the back of the bedbar adjuster screws are not resting on the work surface.
Adjustments

DPA Cutting Unit Characteristics

Never install or work on or near a cutting unit or cutting unit suspension with the engine running. Always set the key switch to the Off position and remove the key before working on or near a cutting unit.

The dual point adjust (DBA) bedknife-to-reel adjustment system incorporated in this cutting unit simplifies the adjustment procedure needed to deliver optimum mowing performance. The precise adjustment possible with this design gives the necessary control to provide a continual self-sharpening action. This feature maintains sharp cutting edges, assures good quality of cut and greatly reduces the need for routine backlapping. In addition, the rear roller positioning system allows for various height-of-cut ranges and aggressiveness of cut selections.

If a cutting unit is determined to be out of adjustment, complete the following procedures in the specified order to adjust the cutting unit properly.

1. Adjust the bedknife to reel contact; refer to the Cutting Unit Operator’s Manual.

   **Note:** If one of the cutting unit side plates is removed during cutting unit service or maintenance, check to make sure the rear roller is level (parallel to the reel) before adjusting the rear roller; refer to Leveling the Rear Roller (page 7–4).

2. Determine desired height-of-cut range and adjust the rear roller accordingly; refer to the Cutting Unit Operator’s Manual.

3. Adjust the height-of-cut; refer to the Cutting Unit Operator’s Manual.

4. Adjust the cut-off bar; refer to the Cutting Unit Operator’s Manual.
Leveling the Rear Roller

The precision machined components of the cutting unit frame keep the rear roller and cutting reel in alignment (parallel). If the side plates are disassembled a limited amount of side plate adjustment is possible to make sure that the rear roller and cutting reel remain parallel.

Note: Use a pie tape to measure the reel diameter taper; service limit 0.25 mm (0.01 inch). Leveling the rear roller of a cutting unit with a reel that exceeds the reel diameter taper limit is not recommended.

1. Make sure the cutting unit bedknife is properly adjusted to the reel; refer to the Cutting Unit Operator’s Manual.

2. Place the assembled cutting unit on a cutting unit bench plate so at least three of the reel blades contact the bench plate rib.

3. Check if the rear roller is parallel to the cutting reel by trying to fit a 0.13 mm (0.005 in) shim between the rear roller and the bench plate at each end of rear roller. Rotate the roller and recheck the clearance at each end a few times to account for any roller run-out. If the shim will pass under the roller through the rollers entire rotation, the rear roller is not parallel to the reel or is high on one side and an adjustment should be made.

Note: If the cutting unit has an optional rear roller adjustment kit (eccentric roller shaft bushing), loosening the cutting unit side plate should not be necessary. Adjust the rear roller by loosening the rear roller clamp fasteners and rotating the eccentric bushing as necessary; refer to the kit Installation Instructions for additional information.

4. Loosen, but do not remove, the two shoulder bolts that secure the side plate to the frame on the side of the cutting unit where the rear roller is high (not contacting the bench plate).

Note: It may be necessary to remove the upper counterweight to access the shoulder bolts for the left side plate.
5. Adjust the position of the side plate so the rear roller contacts the bench plate at both ends, making the rear roller parallel to the reel. Tighten the shoulder bolts from **24 to 27 N·m (210 to 240 in-lb)**.

6. Recheck the clearance between the rear roller and the bench plate. If necessary, loosen and adjust second side plate on the side of the cutting unit where the rear roller is low (contacting the bench plate).

7. Complete the cutting unit set-up and adjustment procedure.
Removing the Bedbar

Refer to Figure 150 for this procedure.

1. Remove the cutting unit from the machine and place the cutting unit on a flat work surface.

2. Loosen the lock nuts (item 4) on the end of each bedbar adjuster screw until the washers (item 2) are loose.
Removing the Bedbar (continued)

3. Tip the cutting unit to expose the bedknife and support the rear of the cutting unit; refer to Supporting the Cutting Unit when Servicing (page 7–2).
4. Loosen the lock nuts (item 7) on each bedbar pivot bolt.
5. Remove the two bedbar pivot bolts, two metal washers and four plastic washers from the cutting unit side plates.

**CAUTION**

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when handling the bedbar.

6. Remove the bedbar assembly from the cutting unit.
7. Inspect the nylon bushings and rubber bushings in the side plates for wear or damage. Replace the bushings if necessary.

Installing the Bedbar

Refer to Figure 151 for this procedure.

1. If rubber bushing was removed from either side plate, apply grease to outside surface of new bushing and install into side plate. The bushing should be installed flush with the inside surface of the side plate.
2. If removed, install the nylon bushings with flange facing outward.
3. Apply anti-seize lubricant to the threads and shank of each bedbar pivot bolt.
Installing the Bedbar (continued)

**CAUTION**

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when handling the bedbar.

**Note:** If a new bedknife is attached to the bedbar, there may be interference between the bedknife and the reel when installing the bedbar. Turn the bedbar adjusting screws counterclockwise to increase bedknife clearance if necessary.

4. Position the bedbar into the cutting unit. Make sure that the top of each bedbar arm is between the washer and adjuster screw flange.

**IMPORTANT**

When installing the washers, make sure that the plastic washers are positioned against the side plate.

5. Slide one metal washer and then one plastic washer onto each bedbar pivot bolt.

6. Position one plastic washer between the bedbar and the inside of each side plate.

7. Install the bedbar pivot bolt assemblies. Make sure the washers are not caught on the threads of the pivot bolts. Tighten each bedbar pivot bolt from 22 to 27 N·m (190 to 240 in-lb).

**IMPORTANT**

Do not over tighten the lock nuts as this can distort the side plates and affect reel bearing alignment. When the lock nut is correctly tightened, the inside washers may be loose.

8. Tighten both lock nuts (item 8 in Figure 151) until outside washers do not have any end play and can still be rotated.

9. Tighten the lock nut (item 4 in Figure 150) on each bedbar adjuster assembly until the adjuster spring is fully compressed, then loosen the lock nut 1/2 turn.

10. Adjust the bedknife to reel contact; refer to the Cutting Unit Operator’s Manual.
Removing the Bedbar Adjuster

1. Lock nut
2. Compression spring
3. Washer
4. Bedbar adjuster screw
5. Retaining ring
6. Wave washer
7. Flange bushing (2 each)
8. Bedbar adjuster shaft
9. Detent
10. Cap screw

1. Remove bedbar; refer to Removing the Bedbar (page 7–6).
2. Remove the lock nut, compression spring and washer from the bedbar adjuster screw.
   Note: The bedbar adjuster shaft has left-hand threads.
3. Unscrew the bedbar adjuster shaft from the bedbar adjuster screw.
4. Remove the retaining ring and wave washer from the adjuster shaft and remove the adjuster shaft.
5. Inspect the flange bushings in the cutting unit side plate and replace them if necessary.
6. Inspect the detent and replace it if necessary.

Installing the Bedbar Adjuster

1. If previously removed, secure the detent to the side plate.
2. If previously removed, align the key on the flange bushings to the slots in the cutting unit frame and install.
3. Slide adjuster shaft into flange bushings and secure with wave a washer and a retaining ring.
   Note: The bedbar adjuster shaft has left-hand threads.
4. Apply anti-seize lubricant to the threads of the bedbar adjuster screw that fit into adjuster shaft (the left hand threads) and thread the bedbar adjuster screw into the adjuster shaft.
Installing the Bedbar Adjuster (continued)

5. Install the washer, spring and lock nut onto the adjuster screw.
6. Install the bedbar; refer to Installing the Bedbar (page 7–7).
Bedknife

Removing the Bedknife

1. Bedknife screw (13 used)  3. Bedknife
2. Bedbar

1. Remove the bedbar from the cutting unit; refer to Removing the Bedbar (page 7–6).
2. Remove screws from bedbar using a socket wrench and bedknife screw tool; refer to Bedknife Screw Tool (page 2–17). Discard the screws. Remove bedknife from the bedbar.
3. Refer to Grinding the Bedknife (page 7–12) for additional information.

Installing the Bedknife

1. Use a scraper to remove all rust, scale and corrosion from the bedbar surface under the bedknife. Lightly oil the bedbar surface before installing the bedknife.
2. Make sure that screw threads in bedbar (5/16-18 UNC-2A) are clean.
3. Use new screws to secure bedknife to bedbar. Apply anti-seize lubricant to the threads of new screws. Do not apply anti-seize lubricant to the taper of the screw heads.
4. Install all screws but do not tighten.

**IMPORTANT**

Do not use an impact wrench to tighten screws into the bedbar.

5. Using a torque wrench and bedknife screw tool, tighten the 2 outer screws to 1 N-m (10 in-lb).
Installing the Bedknife (continued)

6. Working from the center of the bedknife toward each end, tighten screws from 23 to 28 N-m (200 to 250 in-lb).

7. After installing the bedknife to bedbar, grind the bedknife.

Grinding the Bedknife

**Bedknife Grinding Specifications**

<table>
<thead>
<tr>
<th>Standard Bedknife Relief Angle</th>
<th>3° minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fairway Bedknife Relief Angle</td>
<td>3° minimum</td>
</tr>
<tr>
<td>Extended Bedknife Relief Angle</td>
<td>7° minimum</td>
</tr>
<tr>
<td>Front Angle Range</td>
<td>13° to 17°</td>
</tr>
</tbody>
</table>

Since there can be variations in the mounting surface of the bedbar, it is necessary to grind the bedknife after installing it to the bedbar. Follow the bedknife grinding specifications provided; refer to Bedknife Grinding Specifications (page 7–12). Grind only enough so the top surface of the bedknife is true; refer to Figure 155.
Grinding the Bedknife (continued)

**IMPORTANT**

Do Not grind the bedknife below it's service limit. Operating the cutting unit with the bedknife below the service limit may result in poor after-cut appearance and reduce the structural integrity of the bedknife.

The bedknife service limit occurs when the reel contacts the back of the bedknife scallop during operation; refer to Figure 156. Check for reel contact marks at the back of the bedknife scallop prior to grinding. The bedknife service limit may also occur when the bottom of the bedknife scallop is reached when grinding the bedknife.

![Figure 156](g227152)

1. Service limit (reel contacts back of bedknife scallop during operation)
2. Service limit (bottom of bedknife scallop reached when grinding)

When grinding the bedknife, be careful to not overheat the bedknife. Remove small amounts of material with each pass of the grinder. **Also, clean and dress grinding stone often during the grinding process.**

**IMPORTANT**

EdgeMax® bedknives are extremely hard. Using a diamond grinding wheel is recommended to prevent overheating or damaging the bedknife edge while grinding.

Because the top grind angle on bedknives is critical for edge retention, and therefore after-cut appearance, Toro has developed special service tools for accurately measuring the top grind angle on all bedknives; refer to Angle Indicator and Magnetic Mount (page 2–16).

1. Use Toro General Service Training Book, Reel Mower Basics (part no. 09168SL) and grinder manufacturer's instructions for bedknife grinding information.
2. After grinding the bedknife, install the bedbar assembly in the cutting unit; refer to Installing the Bedbar (page 7–7).

**Note:** Always adjust the cutting unit after grinding the reel and/or bedknife; refer to the Cutting Unit Operator's Manual. If a properly adjusted cutting unit does not cut paper cleanly after grinding, the grind angle may be incorrect. To extend the cutting unit performance by allowing the reel and the bedknife to hold their edge longer, an additional adjustment may be required after the first few minutes of operation as the reel and bedknife conform to each other.
Removal of the cutting reel requires removal of the left or right side plate from the cutting unit frame. The opposite side plate does not have to be removed from the frame to service the cutting reel.

Removing the Reel Assembly

Refer to Figure 157 for this procedure.

1. Remove the cutting unit from the machine and place the cutting unit on a flat work surface.
Removing the Reel Assembly (continued)

2. If the cutting unit is equipped with an optional groomer or rear roller brush, remove the drive components for those options from cutting unit. Refer to Removing the Gear Box Assembly (page 8–4), and/or Rear Roller Brush (Optional) (page 7–30) for additional information.

3. Remove the fasteners that secure the counterweights to the left side plate, and remove the counterweights. Remove and discard the O-ring.

**CAUTION**

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when removing the cutting reel.

**IMPORTANT**

If the reel bearings or seals are being replaced, the reel nuts must be removed. Use the following procedure to restrain the reel and loosen the reel nuts before removing the rollers.

4. Loosen the reel nuts:
   A. Tip up the cutting unit to access the bottom of the reel.

![Diagram of reel assembly](image)

**Figure 158**

1. Reel nut (right end shown)  
2. Reel shaft  
3. Weld side of reel support plate  
4. Pry bar
Removing the Reel Assembly (continued)

B. Insert a long-handled pry bar (3/8 x 12 inch with screwdriver handle recommended) through the bottom of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move.

**IMPORTANT**

To avoid grinding the reel, do not contact the cutting edge of any blade with the pry bar as this may damage the cutting edge and/or cause a high blade.

C. Move the pry bar against the weld side of the reel support plate closest to the reel nut being loosened.

**IMPORTANT**

The reel nut on the left end of the cutting reel has a black finish and has left-hand threads. The reel nut on the right end of the cutting reel has a silver finish and has right-hand threads.

D. Rest the handle of the pry bar against the front roller and loosen the reel nut closest to the pry bar.

E. Position the pry bar in the same manner on the opposite end of the reel and loosen the remaining reel nut.

F. Tip the cutting unit back onto its rollers.

5. Remove the bedbar; refer to Removing the Bedbar (page 7–6).

6. Remove the front roller; refer to Removing the Front Roller (page 7–23).

7. Remove the rear roller; refer to Removing the Rear Roller (page 7–24).

8. Remove the fasteners that secure the crosslink (item 15) to pitch arms and remove the crosslink.

9. Support the cutting reel to prevent it from shifting or falling and remove the two shoulder bolts and two flange nuts that secure either side plate to the cutting unit frame. Remove the side plate from the cutting unit.

10. Carefully slide the cutting reel assembly (with seals, bearings and reel nuts) from the opposite side plate. Retrieve the flat wire spring from the reel bearing bore of the left side plate.

11. Thoroughly clean any grease and corrosion from the reel bearing bores in the side plates. Inspect side plates and pitch arms for wear or damage and replace components if needed.

12. Inspect the remaining cutting unit components for corrosion, wear, or damage and replace the components as necessary.
Inspecting the Reel Assembly

1. Cutting reel 6. Reel nut (black – left hand thread)
2. Flocked seal (2 each) 7. Groove indication left hand threads
3. Bearing (2 each) 8. Left-most reel spider
4. Plug (2 each) 9. Bearing shoulder
5. reel nut (right hand thread)

1. Remove the reel nuts from the cutting reel. Check the splines in the reel nuts for excessive wear or distortion and replace them if necessary.

**Note:** Reels+™ is a line of replacement reels (with the seals and bearings pre-assembled) that arrive ready for installation into the cutting unit. Contact your local Toro Distributor for additional information.

2. Press the bearings and slide the seals from the reel shaft. Discard the seals and inspect the reel bearings to insure that they spin freely and have a minimal amount of axial play.

3. Inspect the reel:
   A. Place the reel shaft ends in V-blocks and check the reel shaft for distortion.
   B. Check the threads in the ends of the reel shaft. A right-hand thread and left-hand thread tap is available to clean or repair the threads if necessary; refer to Reel Thread Repair Taps (page 2–15).
   C. Check the reel blades for bending or cracking.
   D. Check the service limit of the reel diameter; refer to Preparing the Reel for Grinding (page 7–20).
   E. Replace the reel if damage is evident.
Inspecting the Reel Assembly (continued)

**IMPORTANT**

The seal must be installed with the flocked side of the seal toward the bearing.

4. Slide the new flocked seals and press the bearings onto the reel shaft until they contact the shoulder of the reel shaft.

   **Note:** The reel nut on the left end of the cutting reel has a black finish and has left-hand threads. The left end of the cutting reel shaft is identified with a groove cut just inside of the left-most reel spider. The reel nut on the right end of the cutting reel has a silver finish and has right-hand threads.

5. Install the reel nuts finger tight.

**Installing the Reel Assembly**

Refer to Figure 157 for this procedure.

1. Position the cutting unit on a flat work area.

2. If previously removed; attach the right side plate to the cutting unit frame. Tighten the shoulder bolts from 24 to 27 N·m (18 to 20 ft-lb).

3. Install the right side pitch arm.

**CAUTION**

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when installing the cutting reel.

4. Apply a thin coat of grease to the outside of the cutting reel bearings and carefully slide the cutting reel assembly into the right side plate. Make sure that the reel bearing is fully seated in the side plate, and that the real nut on the left (exposed) end of the cutting reel has a black finish.

5. Place the flat wire spring into the bearing bore of the left side plate. Install the left side pitch arm and carefully slide the left side plate and pitch arm onto the cutting reel assembly as far as possible.

6. Install the shoulder bolts and flange nuts that secure the left side plate to the cutting unit frame. Tighten the shoulder bolts from 24 to 27 N·m (18 to 20 ft-lb).

7. Install the rear roller; refer to Installing the Rear Roller (page 7–25).

8. Install the front roller; refer to Installing the Front Roller (page 7–23).

9. Install the bedbar assembly; refer to Installing the Bedbar (page 7–7).

10. Tighten the reel nuts:
    A. Insert a long-handled pry bar (3/8 x 12 inch with a screwdriver handle recommended) through the front of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move.
Installing the Reel Assembly (continued)

**IMPORTANT**

To avoid grinding the reel, do not contact the cutting edge of any blade with the pry bar as this may damage the cutting edge and/or cause a high blade.

![Figure 160](image)

**Figure 160**

1. Reel nut (right end shown)  
2. Reel shaft  
3. Weld side of reel support plate  
4. Pry bar  

B. Move the pry bar against the weld side of the reel support plate closest to the reel nut being tightened.

**IMPORTANT**

The reel nut on the left end of the cutting reel has a black finish and has left-hand threads. The reel nut on the right end of the cutting reel has a silver finish and has right-hand threads.

C. Rest the handle of the pry bar against the front roller and tighten the reel nut closest to the pry bar. Tighten the reel nut from **123 to 149 N-m** (**90 to 110 ft-lb**).

D. Position the pry bar in the same manner on the opposite end of the reel and tighten the remaining reel nut.

E. Fill the reel nut splines with high temp Mobil XHP–222 grease or equivalent.

11. Check to make sure the rear roller and cutting reel are parallel; refer to Leveling the Rear Roller (page 7–4).

12. Install a new O-ring on the counterweight assembly and secure the counterweights to the right side plate with the fasteners previously removed.
Installing the Reel Assembly (continued)

13. If the cutting unit is equipped with an optional groomer or optional rear roller brush, install the components for those options. Refer to Installing the Gear Box Assembly (page 8–10), and Rear Roller Brush (Optional) (page 7–30) for additional information.

Preparing the Reel for Grinding

Reel Grinding Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reel Diameter New (D)</td>
<td>128.5 mm (5.06 inch)</td>
</tr>
<tr>
<td>Reel Diameter Service Limit</td>
<td>114.3 mm (4.50 inch)</td>
</tr>
<tr>
<td>Reel Diameter Taper Limit (D1 – D2)</td>
<td>0.25 mm (0.01 inch)</td>
</tr>
<tr>
<td>Blade Land Width</td>
<td>0.8 to 1.2 mm (0.03 to 0.05 inch)</td>
</tr>
<tr>
<td>Blade Relief Angle</td>
<td>30° ± 2°</td>
</tr>
<tr>
<td>Reel Shaft Diameter</td>
<td>34.9 mm (1.375 inch)</td>
</tr>
</tbody>
</table>

Before grinding a cutting reel, make sure that all the cutting unit components are in good condition. Depending on the type of grinder used, faulty cutting unit components can affect the grinding results. When grinding, be careful to not overheat the cutting reel blades. Remove small amounts of material with each pass of the grinder.

Follow reel grinder manufacturer’s instructions to grind cutting reel to Toro specifications; refer to Reel Grinding Specifications (page 7–20). Additional reel grinding information can be found in the Cutting Unit Operator’s Manual. An additional resource is the Toro Basics Series Training Book, Reel Mower
Preparing the Reel for Grinding (continued)

Basics (part no. 09168SL) found on the Service Reference Set available from your Authorized Toro Distributor.

Relief grind the reel blades to the minimum blade land width if the reel blade land width exceeds the service limit. Spin grind the reel to establish the specified blade land width or to restore the reel’s cylindrical shape.

**Note:** Always adjust the cutting unit after grinding the reel and/or bedknife; refer to the *Cutting Unit Operator’s Manual*. To extend the cutting unit performance by allowing the reel and the bedknife to hold their edge longer, an additional adjustment may be required after the first few minutes of operation as the reel and bedknife conform to each other.
Electric Cutting Unit Motor Adapter

Diagram showing the parts labeled as follows:

1. Hex nut (2 each)
2. Motor adapter
3. Socket head screw (2 each)
4. Motor clamp
5. O-ring
6. O-ring (2 each)

Removing and Installing the Cutting Unit Motor Adapter

Refer to Figure 162 for this procedure.

1. Remove the electric motor from the cutting unit and move it to the storage location at the front of the cutting unit suspension.
2. Remove the motor adapter from the cutting unit side plate.
   
   **Note:** The lock nuts are captured in the back side of the side plate.
3. Remove the large O-ring and the 2 small O-rings from the motor adapter. Discard the large O-ring.
4. Lubricate a new large O-ring with grease and install in on the motor adapter.
5. Install the 2 small O-rings in the motor adapter without lubrication. Ensure the O-rings are correctly positioned in the motor adapter grooves.
6. Install the motor adapter to the cutting unit side plate and install the electric cutting unit motor.
Roller Assemblies

Removing the Front Roller

Refer to Figure 163 for this procedure.

1. Remove the cutting unit from the machine and place it on a level work surface. Use an appropriate support to raise the front roller off the work surface.

2. Loosen the pinch bolts that secure the front roller shaft to the front height-of-cut arms.

3. Remove the lock nut, height-of-cut washer and plow bolt that secures one of the height-of-cut arms to the cutting unit side plate and remove the height-of-cut arm.

4. Slide the front roller assembly from the remaining height-of-cut arm.

5. Remove the remaining height-of-cut arm from the cutting unit if necessary.

Installing the Front Roller

Refer to Figure 163 for this procedure.

1. Place the cutting unit on a level work surface. Use an appropriate support to raise the front of the cutting unit off of the work surface.

2. Inspect the condition of both height-of-cut screws and replace them if necessary. Apply anti-seize lubricant to the threads of a new height-of-cut screw.

Note: When installing the height-of-cut arms, make sure tab of the side plate fits between the head and the washer of the height-of-cut screw.
Installing the Front Roller (continued)

3. Secure one of the height-of-cut arms to the side plate with a plow bolt, height-of-cut washer and lock nut. The tab on the height-of-cut washer should be oriented downward and fit into the slot of the height-of-cut arm.

4. Slide the front roller shaft into the height-of-cut arm attached to the cutting unit.

5. Slide the remaining height-of-cut arm onto the other end of roller shaft. Secure the remaining height-of-cut arm to the side plate with a plow bolt, height-of-cut washer and lock nut.

6. Center the front roller in the cutting unit and tighten the pinch bolts that secure the front roller shaft to the height-of-cut arms.

7. Adjust the cutting unit height-of-cut; refer to the Cutting Unit Operator’s Manual.

Removing the Rear Roller

Refer to Figure 164 for this procedure.

1. Remove the cutting unit from the machine and place it on a level work surface. Place blocks under the bedbar to raise the rear roller off of the work surface.
Removing the Rear Roller (continued)

2. Loosen the flange nuts that secure the rear roller retainer assemblies (flange nuts, socket head screws, shaft retainer, spacer and shims) to the cutting unit.

   **Note:** On cutting units equipped with the optional High Height-of-Cut Kit, there will be additional roller shims installed between the rear roller and the cutting unit side plate.

3. Remove one of the rear roller retainer assemblies.

4. Slide the rear roller assembly from the remaining retainer assembly.

5. Remove the remaining retainer assembly from the cutting unit if necessary.

Installing the Rear Roller

Refer to Figure 164 for this procedure.

1. Place the cutting unit on a level work surface. Place blocks under the bedbar to raise the rear of the cutting unit off of the work surface.

   **Note:** Refer to the Cutting Unit Operator’s Manual to determine the number of shims required for the desired height-of-cut range.

2. If previously removed, install one of the rear roller retainer assemblies (flange nuts, socket head screws, shaft retainer, spacer and shims) to the cutting unit.

3. Slide the rear roller shaft into the retainer assembly attached to the cutting unit.

4. Install the remaining rear roller retainer assembly.

5. Center the rear roller in the cutting unit and tighten the flange nuts at each of the retainer assemblies.

6. Check to make sure the rear roller and the cutting reel are parallel; refer to Leveling the Rear Roller (page 7–4).
Disassembling the Roller

1. Bearing lock nut
2. V-ring
3. Seal
4. Ball bearing
5. Wiehle roller
6. Smooth roller
7. Roller shaft

1. To hold the roller shaft stationary while removing the bearing lock nut, install a 3/8-24 UNF 2B screw with a jam nut into the threaded end of the roller shaft and tighten the jam nut against the roller shaft. Remove the bearing lock nuts.

2. Carefully inspect the seating surface and threads of the bearing lock nuts and replace them if damaged.

3. Remove and discard the V-rings.

4. Loosely secure the roller assembly in a bench vise and lightly tap on the roller shaft to remove the seals and bearings. Discard the seals.

5. Clean and carefully remove any corrosion from the bearing cavities of the roller.
Assembling the Roller

Figure 166

1. Roller
2. Ball bearing
3. Seal
4. V-ring
5. Bearing lock nut
6. Roller shaft

**Note:** Special tools are required to assemble the rollers; refer to **Roller Rebuilding Tools (page 2–17)**. The following procedure describes the assembling the rollers using the set of assembly washers and spacers.

1. Place the roller shaft into the roller.

**IMPORTANT**

If the bearing lock nuts are being replaced, use the original lock nuts for installing the bearings and seals, if possible, to preserve the patch lock feature of the new lock nuts. Use the new nuts only after the bearings and seals have been installed.

2. Position a new bearing, black assembly washer and a bearing lock nut onto each end of the roller shaft.

3. Tighten the bearing lock nuts until both bearings are seated in the roller.

4. Remove the bearing lock nuts and the black assembly washers.
Assembling the Roller (continued)

IMPORTANT

Failure to grease bearing lock nut before seal installation may result in seal damage.

5. Fill the seal 75 to 90% full with #2 grease and apply a coating of grease to the underside of the bearing lock nut to prevent damaging the seal during installation. Carefully fit a seal onto each bearing lock nut.

![Figure 168]

1. Seal  
2. Bearing lock nut

6. Install a bearing lock nut with seal onto each end of the roller shaft. Tighten the bearing lock nuts until they bottom against the bearings. Remove the bearing lock nuts and clean away any grease.

![Figure 169]

1. Seal  
2. Bearing lock nut

7. Position an assembly spacer and yellow assembly washer on each end of the roller shaft.
Assembling the Roller (continued)

1. Seal  
2. Assembly spacer  
3. Yellow assembly washer  
4. Bearing lock nut

8. Tighten the bearing lock nuts until the yellow assembly washers bottom out against the roller housing. Remove the bearing lock nuts, assembly washers, and assembly spacers.

   **Note:** The V-rings should be installed without any lubrication.

9. Carefully fit a dry V-ring onto each bearing lock nut.

10. Lubricate the lips of the installed seals with #2 general purpose grease.

   **Note:** If an original bearing lock nut is being used, apply a medium strength thread locker (Loctite #242 or equivalent) to the threads of the lock nut.

11. Install the bearing lock nut with V-ring onto each end of the roller shaft. Tighten the lock nuts to **34 to 41 N·m (25 to 30 ft-lb)**.
Rear Roller Brush (Optional)

Figure 172
(shown with Universal Groomer installed)

1. Rear roller brush assembly

Note: The Installation Instructions for the rear roller brush kit has detailed information regarding assembly and adjustment. Use the Installation Instructions along with this Service Manual when servicing the rear roller brush.

For eTriFlex machines, the drive components for the rear roller brush are located on the right side of the cutting unit (opposite from the electric cutting unit motor).
Figure 173
(shown without Universal Groomer installed)

1. Lock nut (2 each)
2. Brush shaft
3. J-bolt (2 each)
4. Brush element
5. O-ring (2 each)
6. Lock nut (2 each)
7. Cover
8. Bearing bracket RH
9. Socket head screw (4 each)
10. Flocked seal (3 each)
11. O-ring (2 each)
12. Bearing (2 each)
13. Retaining ring
14. Collar
15. Retaining ring (2 each)
16. Bearing bracket LH
17. Drive housing
18. Spacer (as required)
19. Driven pulley
20. Lock nut
21. Torsion spring
22. Idler bushing
23. Socket head screw
24. Socket head screw (3 each)
25. Cover
26. Drive belt
27. Socket head screw (2 each)
28. Retaining ring
29. bearing
30. Idler pulley
31. Drive pulley
32. Retaining ring
33. Flange nut (4 each)
34. Flange head screw (4 each)
35. Flange head screw
36. Adapter housing (used without groomer)
37. O-ring
38. Cap screw (2 each)
39. Counterweight assembly
40. Drive shaft (used without groomer)
41. Drive adapter – silver (used without groomer)
42. Lock nut (2 each)
43. Direction of brush rotation
Contact with the reel or other cutting unit parts can result in personal injury. Use heavy gloves when handling the cutting reel.

Replacing the Roller Brush Element

Refer to Figure 173 for this procedure.

1. Remove the cutting unit from the machine and place it on a level work surface.
2. Remove the RH bearing bracket assembly.
3. Remove the brush element from the shaft.
4. Slide the new brush element onto the shaft while rotating the brush.
5. Install the J-bolts and lock nuts making sure the threaded portion of the J-bolts are installed on the outside of the brush element. Tighten the lock nuts from 2.3 to 2.8 N·m (20 to 25 in-lb).
6. Apply a thin coating of grease to the O-rings on the brush shaft and install the RH bearing bracket.

IMPORTANT

If brush to roller contact is incorrect, brush operation will be adversely affected.

7. Check that the roller brush is parallel to the rear roller within 0.25 mm (0.010 inch) clearance to light contact. Adjust the bearing brackets as necessary.

Drive and Support Components

Refer to Figure 173 for this procedure.

1. Disassemble the roller brush components as necessary. Retrieve and discard the adapter housing O-ring (machines without a universal groomer).
2. Clean and inspect all components for wear or damage and replace as necessary.
3. If the drive shaft and drive adapter (items 40 or 41) require replacement (machines without a universal groomer):
   A. Tip up the cutting unit to access the bottom of the reel to remove the drive shaft assembly.
Drive and Support Components (continued)

B. Insert a long-handed pry bar (3/8 x 12 inch with screwdriver handle recommended) through the bottom of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move.

IMPORTANT

To avoid grinding the reel, do not contact the cutting edge of any blade with the pry bar as this may damage the cutting edge and/or cause a high blade.

C. Move the pry bar against the weld side of the reel support plate closest to the rear roller brush drive shaft.

D. Rest the handle of the pry bar against the front roller and use the large hex (1.375 inch) to loosen the drive shaft assembly.

E. Tip the cutting unit back onto its rollers.

F. Clean the threads in the end of the reel shaft. A right-hand thread and left-hand thread tap is available to clean or repair the threads if necessary; refer to Reel Thread Repair Taps (page 2–15).
Drive and Support Components (continued)

G. Assemble the drive shaft and drive adapter (machines without a universal groomer) with a medium strength thread locking compound (Loctite 243 or equivalent) and tighten from 150 to 163 N·m (110 to 120 ft-lb).

H. Insert a long-handled pry bar through the front of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move.

![Diagram](image)

**Figure 175**

1. Drive shaft assembly  
2. Reel shaft  
3. Weld side of reel support plate  
4. Pry bar

I. Move the pry bar against the weld side of the reel support plate closest to the drive shaft assembly.

J. Rest the handle of the pry bar against the front roller. Use the large hex (1.375 inch) and tighten the drive shaft from 135 to 150 N·m (100 to 110 ft-lb).

4. Apply a light coating of grease to a new O-ring and install the adapter housing (machines without a universal groomer).

**Note:** The screw used to secure the adapter housing has a locking feature to prevent the screw from loosening. If the original screw is being re-used, apply a medium strength thread locker (Loctite #242 or equivalent).

5. Install the drive housing and LH bearing bracket.

6. Apply a thin coating of grease to the O-rings on the brush shaft and fit the RH bearing bracket over the brush shaft.

**Note:** Install all flocked seals with the flocked surface against the bearing.

7. Install a flocked seal and the retaining ring onto the brush shaft.

8. Install the brush and RH bearing bracket assembly.

9. Install the drive pulley.
Drive and Support Components (continued)

**IMPORTANT**

The brush drive belt may fail prematurely if the pulleys are not properly aligned.

10. Using a straight edge, determine the number of spacers necessary under the driven pulley to align the pulleys. Tighten the lock nut securing the driven pulley from **20 to 26 N·m (15 to 19 ft-lb)**.

11. Install and adjust the drive belt and install the cover.

**IMPORTANT**

If brush to roller contact is incorrect, brush operation will be adversely affected.

12. Check that the roller brush is parallel to the rear roller within **0.25 mm (0.010 inch)** clearance to light contact. Adjust the bearing brackets as necessary.
# Universal Groomer (Optional)

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General Information

Installation Instructions

The *Installation Instructions* for the groomer provides information regarding the set-up, operation, general maintenance procedures, and maintenance intervals for the groomer assembly on your Greensmaster machine. Refer to the *Installation Instructions* for additional information when servicing the groomer assembly.
CAUTION

Never work on the groomer with the key switch in the RUN or START position. Always set the key switch to the OFF position, remove the key from the switch and wait for all machine movement to stop before working on the groomer.
The groomer gear box assembly is located on the opposite side of the cutting unit from the cutting unit motor. The groomer gear boxes for eTriFlex machines are installed on the right side of the cutting unit.

Removing the Gear Box Assembly

Refer to Figure 178 for this procedure.

1. Remove the cutting unit from the machine and place it on a level work surface.
2. Remove the groomer reel assembly; refer to Removing the Groomer Reel (page 8–14).
3. Remove the drive shield, or, if the cutting unit is equipped with an optional powered rear roller brush, remove the rear roller brush drive assembly to service the groomer drive; refer to Rear Roller Brush (Optional) (page 7–30).

4. Install a 5/16–18 X 5/8 inch square head set screw (Toro p/n 1-803022) in the end of the drive shaft and tighten to 13 N·m (120 in-lb); refer to Figure 179.

5. Remove the cotter pin and clevis pin from the height adjustment rod at the front of the groomer gear box. Discard the cotter pin.
6. Tip up the cutting unit to access the bottom of the reel to remove the drive shaft assembly.
Removing the Gear Box Assembly (continued)

1. 5/16–18 X 5/8 inch square head set screw  4. Reel shaft
2. Input shaft assembly  5. Weld side of reel support plate
3. Groomer gear box assembly  6. Pry bar

7. Insert a long-handled pry bar (3/8 x 12 inch with screwdriver handle recommended) through the bottom of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move.

---

**IMPORTANT**

To avoid grinding the reel, do not contact the cutting edge of any blade with the pry bar as this may damage the cutting edge and/or cause a high blade.

8. Move the pry bar against the weld side of the reel support plate closest to the groomer gear box.

---

**IMPORTANT**

You must use a 6-point socket with a heavy wall to remove the gear box from the reel. Do not use an impact wrench. Groomer gear boxes installed on the right side of the cutting unit use a standard right hand thread; turn the drive shaft counterclockwise to remove the gear box.
Removing the Gear Box Assembly (continued)

9. Rest the handle of the pry bar against the front roller and turn the drive shaft counterclockwise to loosen it from the reel. Continue to unscrew the drive shaft and remove the gear box from the cutting unit.

10. If the hex head on the end of the drive shaft is damaged during removal:
   A. Remove the drain/fill plug and drain the oil from the gear box.

<table>
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<th>Figure 180</th>
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<td>1. Socket head screw (4 each)</td>
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</table>

B. Remove the 4 socket-head screws and remove the gear box cover assembly and driven gear. Remove and discard the cover gasket.

C. Slide the thrust washer, ring gear and bushing from the gear box housing.

D. Slide the sun gear, and planet gears and bushings from the pins on the gear box housing.

E. Remove the retaining ring from the drive shaft.

F. Slide the groomer housing assembly from the drive shaft.

G. Tip up the cutting unit to access the bottom of the reel to remove the drive shaft assembly.
Removing the Gear Box Assembly (continued)

H. Insert a long-handled pry bar (3/8 x 12 inch with screwdriver handle recommended) through the bottom of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move.

IMPORTANT

To avoid grinding the reel, do not contact the cutting edge of any blade with the pry bar as this may damage the cutting edge and/or cause a high blade.

I. Move the pry bar against the weld side of the reel support plate closest to the drive shaft assembly.

J. Use the drive shaft removal tool on the large flats of the drive shaft assembly; refer to Drive Shaft Removal Tool (page 2–18).

K. Rest the handle of the pry bar against the front roller and turn the drive shaft counterclockwise to loosen it from the reel.

11. Tip the cutting unit back onto its rollers.

12. Clean the threads in the end of the reel shaft. A right-hand thread and left-hand thread tap is available to clean or repair the threads if necessary; refer to Reel Thread Repair Taps (page 2–15).
Servicing the Gear Box

Figure 182

1. Drive adapter – silver
2. Input shaft
3. O-ring (3 each)
4. V-ring
5. Oil seal
6. Groomer housing
7. Ball bearing (2 each)
8. Retaining ring
9. Driven gear
10. Actuator shaft
11. Pin
12. O-ring
13. Knob
14. Retaining ring
15. Thrust washer
16. O-ring
17. O-ring
18. Dowel pin (2 each)
19. Drain/fill plug (4 each)
20. Straight bushing (2 each)
21. Detent ball
22. Detent spring
23. Oil seal
24. Socket-head screw (4 each)
25. Groomer cover
26. Cover gasket
27. Thrust washer
28. Ball bearing
29. Ring gear
30. Flange bushing
31. Sun gear
32. Bearing
33. Planet gear (3 each)
34. Flange bushing (3 each)
35. Locknut
36. Driver gear
37. Bearing (2 each)
38. Oil seal
39. Driven shaft
40. Shield
Servicing the Gear Box (continued)

1. Remove the drain/fill plug and drain the oil from the gear box.
2. Remove the 4 socket-head screws and separate the gear box cover and housing. Remove and discard the cover gasket.
3. Slide the sun gear, ring gear, and planet gears from the pins on the gear box housing.
4. Continue to disassemble the gear box as necessary.
5. If the drive adapter requires replacement, apply medium strength thread locking compound (Loctite 243 or equivalent) to the internal threads of the drive shaft and the larger threads of the drive adapter (reel end). Allow the thread locking compound to cure for 15 minutes before continuing this procedure.

### CAUTION

Use the large 1.375 inch flats on the drive shaft to prevent the drive shaft from rotating during drive adapter removal and installation. DO NOT use the 0.5 inch hex head on the drive shaft for drive adapter removal or installation as drive shaft damage may occur.

---

**Note:** A special tool is available to hold the drive shaft if necessary; refer to Adapter Wrench (page 2–18).

6. Tighten the drive adapter from 150 to 163 N·m (110 to 120 ft-lb).
7. Carefully clean all the gasket material from the gear box housing and cover.
8. Inspect the V-ring, seals, bearings, gears, and bushings in the gear box assembly. Replace the damaged or worn components as necessary.
9. If the sun gear, ring gear, or the gear box housing bearings are replaced, press the bearings all the way to shoulder into the part.
10. If the flange bushings are replaced, ensure that the flange bushing is fully seated against the part.
11. Assembly the gear box.
   - Ensure that all the retaining rings and O-rings are fully seated in the ring groove during assembly.
   - Lubricate the seal lips and O-rings before installing the shafts.
   - Lubricate the planet gear and sun gear pins in the gear box housing with the gear oil prior to installing the gears.
12. Clean the gasket surface on the gear box housing and cover with the solvent and install new gasket.
13. Fit the gear box cover over dowel pins and install the 4 socket-head screws. Tighten the screws from 1.7 to 4.5 N·m (15 to 40 in-lb). In an alternating cross pattern, tighten the screws from 8.4 to 9.6 N·m (75 to 85 in-lb).
14. Fill the gear box with 80W−90 gear oil and tighten the drain/fill plug from 4 to 5 N·m (32 to 42 in-lb).
   The gear box oil capacity is 50 ml (1.7 fluid ounces).
15. Operate the groomer gear box by hand to check for proper operation prior to installation.
Installing the Gear Box Assembly

Refer to Figure 178 for this procedure.

1. Apply medium strength thread locking compound (Loctite 243 or equivalent) to the threads in the reel and allow the thread locking compound to cure for 15 minutes before continuing this procedure.

2. Insert a long-handled pry bar through the front of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move.

3. Move the pry bar against the weld side of the reel support plate closest to the gear box assembly and rest the handle of the pry bar against the front roller.

4. Position the gear box assembly against the cutting unit and turn the drive shaft assembly clockwise until it is seated against the reel.

**IMPORTANT**

You must use a 6-point socket with a heavy wall to install the gear box to the reel. Do not use an impact wrench. Groomer gear boxes installed on the right side of the cutting unit use a standard right hand thread; turn the drive shaft clockwise to install the gear box.

5. Tighten the drive shaft assembly from 135 to 150 N·m (100 to 110 ft-lb).

6. Remove the square head set screw from the end of the drive shaft.

7. Install the clevis pin and a new cotter pin to secure the height adjustment rod to the front of the groomer gear box.
8. Apply a retaining compound (Loctite 609 or equivalent) to the lip of the drive housing and install the drive shield, or, if the cutting unit is equipped with an optional powered rear roller brush, install the rear roller brush drive assembly; refer to Rear Roller Brush (Optional) (page 7–30).

9. Install the groomer reel assembly; refer to Installing the Groomer Reel (page 8–16).
The groomer idler assembly is located on the opposite side of the groomer gear box.

Removing the Idler Assembly

1. Remove the cutting unit from the machine and place it on a level work surface.
2. Remove the groomer reel assembly; refer to Removing the Groomer Reel (page 8–14).
3. Remove the cotter pin and clevis pin from the height adjustment rod at the front of the idler arm. Discard the cotter pin.
4. Remove the two socket-head screws that secure the motor adapter to the cutting unit, and remove the adapter and idler assembly. Retrieve and discard the O-ring and lock nuts.
5. Inspect the shields, bearing, and bushing in the idler assembly. Replace any components that are worn or damaged.

Installing the Idler Assembly

1. If the shields, bearing, or bushing was removed from the idler arm:
   A. Press the bushing into a groomer plate until the bushing is centered in the idler arm bore.
Installing the Idler Assembly (continued)

B. Press the bearing into the idler arm so that the bearing contacts the shoulder in idler arm bore and install the bearing retaining ring.

C. Install the bearing shields with the flocked side of the shield toward the bearing.

D. Insert the stub shaft through the shields and bearing. Use the through hole in the shaft to prevent the shaft from rotating and tighten the flange nut from 37 to 45 N·m (27 to 33 ft-lb).

E. If the collar was removed from the idler arm, install the collar and tighten from 33 to 41 N·m (24 to 30 ft-lb).

2. Fit a new O-ring to the motor adapter.

3. Apply anti-seize lubricant to the outside diameter of the motor adapter and position the idler arm over the adapter.

4. Use new lock nuts and secure the motor adapter and idler arm to the cutting unit side plate.

5. Install the clevis pin and a new cotter pin to secure the height adjustment rod to the front of the idler arm.
The Groomer Reel

Figure 185

1. Shaft clamp (4 each)  
2. Jam nut (4 each)  
3. Bolt (4 each)  
4. Groomer reel

Remove the groomer reel to replace individual groomer blades or replace the shaft. The groomer reel can be reversed to provide additional blade life.

Removing the Groomer Reel

1. Park the machine on a clean and level surface, lower the cutting units, set the key switch to the OFF position and remove the key from the key switch.

CAUTION

Contact with the reel or other cutting unit parts can result in personal injury.

Use heavy gloves when handling the groomer reel.

2. Carefully remove the 4 jam nuts, 4 bolts, and 4 shaft clamps that secure the groomer reel to the output and stub shafts.
3. Lift the groomer reel from the cutting unit.
4. Inspect the shields, stub shaft, driven shaft and shaft bearings for wear or damage and replace components as necessary; refer to The Gear Box Assembly (page 8–4) and The Idler Assembly (page 8–12).

Servicing the Groomer Reel

Inspect the groomer reel blades frequently for any damage and wear. Straighten the bent blades. Either replace the worn blades or reverse the individual
Servicing the Groomer Reel (continued)

blades to put the sharpest blade edge forward. The blades that are rounded to the midpoint of the blade tip must be reversed or replaced for best groomer performance.

Figure 186

1. Groomer reel shaft  
2. Groomer blade (40 each)  
3. Spacer (39 each)  
4. Locknut (2 each)  
5. Rounded edge  
6. Midpoint  
7. Centered on shaft

1. Park the machine on a clean and level surface, lower the cutting unit, set the key switch to the OFF position and remove the key from the key switch.
2. Remove the groomer reel from the cutting unit; refer to Removing the Groomer Reel (page 8–14).
3. Remove the lock nut from either end of the groomer reel shaft.
4. Remove the blades and from the groomer shaft. If necessary, remove second lock nut from the shaft.
5. Inspect and replace worn or damaged components.
6. Assemble the groomer reel as follows:

   Note: New lock nuts have an adhesive patch to prevent the lock nut from loosening. If a used lock nut is being installed, apply a medium strength thread locker (Loctite #242 or equivalent) to the threads of the lock nut.

   A. Install a lock nut on one end of the groomer reel shaft.
   B. Install a groomer blade against the lock nut.
   C. Install the remaining spacers and blades in an alternating manner making sure that all blades are separated by a spacer.
   D. When all the blades have been installed, install the second lock nut onto the shaft. Center the blades and spacers on the shaft by adjusting the lock nuts.
   E. Use the through holes in shaft to prevent the shaft from rotating and tighten the second lock nut to 42 to 48 N·m (31 to 35 ft-lb). After
Servicing the Groomer Reel (continued)

tightening the lock nut, spacers should not be free to rotate and the
groomer blades should be centered on the shaft.

7. Install the groomer reel back onto the cutting unit; refer to Installing the
   Groomer Reel (page 8–16).

Installing the Groomer Reel

1. Position the cutting unit on a level surface. If the cutting unit is attached to
   the traction unit, lower the cutting unit, set the key switch to the OFF position
   and remove the key from the key switch.

2. Position the groomer reel between the groomer driven and stub shafts.

3. Secure the groomer reel to the cutting unit with the 4 jam nuts, 4 bolts, and 4
   shaft clamps. Tighten the bolts from 5 to 7 N·m (45 to 60 in-lb).

4. Check the groomer reel height and mower height-of-cut settings and adjust
   as necessary.
The Height Adjuster Assembly

1. Clevis pin  
2. Cotter pin  
3. Tabbed washer  
4. Lock nut  
5. Bumper  
6. Plow bolt  
7. Height adjustment rod  
8. Flange nut  
9. Washer (2 each)  
10. Compression spring  
11. Pinch bolt  
12. Height-of-cut bracket  
13. Quick up lever  
14. Groomer pin  
15. Quick up cover  
16. Detent spring  
17. Button-head screw  
18. Height adjuster knob  
19. Height adjustment bolt

Note: Early universal groomers used 2 compression springs on non-adjustable height adjustment rods. Retrofitting the assemblies on each side of the cutting unit with new compression springs, height adjustment rods, and adding flange nuts to enable spring adjustment is recommended.

Disassembling the Height Adjuster

1. Remove the cutting unit from the machine.
2. Remove the cotter pins and clevis pins that secure the height adjustment rods to the groomer gear box and idler arm. Discard the cotter pins.
3. Loosen the pinch bolts that secure the front roller to the height-of-cut brackets.
4. Remove the hex nuts, tabbed washers and plow bolts that secure the height-of-cut brackets to the cutting unit side plates, and remove the height adjusters and front roller from the cutting unit.
5. Disassemble the height adjuster assembly as necessary.
6. Replace components that are worn or damaged.

Assembling the Height Adjuster

1. Apply anti-seize lubricant to the upper threads of the adjustment rod and lower threads of the height adjusters. Assemble the height adjuster assembly.
Assembling the Height Adjuster (continued)

2. If both the height adjusters are removed, fit 1 height adjuster assembly to the cutting unit side plate and secure it with a plow bolt, tabbed washer and lock nut. Tighten the lock nut finger tight.

3. Position front roller between the height adjuster assemblies and secure the remaining height adjuster assembly to the cutting unit side plate with a plow bolt, tabbed washer and lock nut. Tighten the lock nut finger tight.

4. Center the front roller between the height-of-cut brackets and tighten the front roller pinch bolts.

5. Install new cotter pins and clevis pins and secure the height adjustment rods to the groomer gear box and idler arm.

6. Adjust the cutting unit height-of-cut; refer to Cutting Unit Operators Manual.

7. Check the groomer reel height and adjust as necessary.

8. Adjust the flange nuts on the groomer height adjustment rods until the springs are compressed to 16 mm (0.625 inch).

![Diagram of height adjuster assembly](g285732)

Figure 188
The optional grooming brush attaches to the groomer in place of the groomer reel. The grooming brush is removed and installed from the groomer in the same manner as the groomer reel; refer to \textit{The Groomer Reel (page 8–14)}.

The grooming brush element or shaft can be serviced separately.

To remove the spiral grooming brush from the shaft, remove the lock nut and J-bolt from both ends of the brush assembly and slide the brush from the shaft. When assembling the spiral brush to the shaft, make sure that the J-bolts are installed with the threaded portion on the outside of the brush and tighten the lock nuts from \textit{2.3 to 2.8 N\cdot m (20 to 25 in-lb)}. 
# Appendix A

**Foldout Drawings**

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<td>Wire Harness Diagram – 3370 (continued)</td>
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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>
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<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>
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</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>AWG Equivalents for Metric Wire</th>
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<tbody>
<tr>
<td>Diagram Label</td>
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<tr>
<td>----------------</td>
</tr>
<tr>
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Wire Harness Diagram – 3370 (continued)
Count on it.