Greensmaster® e1021/e1026
(Model 04831 and 04841)
## Revision History

<table>
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<tr>
<th>Revision</th>
<th>Date</th>
<th>Description</th>
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<tr>
<td>A</td>
<td>06/2021</td>
<td>Initial issue.</td>
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</table>
Reader Comments

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Preface

The purpose of this publication is to provide the service technician with the information for troubleshooting, testing, and repair of the major systems and components on the Greensmaster e1021/e1026 (Models 04831 and 04841).


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

⚠️ DANGER

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

⚠️ WARNING

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

⚠️ CAUTION

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

---

**IMPORTANT**

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

**Note:** A Note will give the general information about the correct operation, maintenance, service, testing, or repair of the machine.
Figure 1
Model 04831 shown
Service Procedure Icons

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

Critical Process

This icon is used to highlight:

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

Critical Torque

This icon is used to highlight an assembly torque requirement that is different than what is recommended in the Standard Torque Tables; refer to Torque Specifications (page 2–5).

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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Chapter 1
Safety

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Safety Instructions

The Greensmaster e1021/e1026 machine is tested and certified by Toro for compliance with existing safety standards and specifications. Although hazard control and accident prevention are partially dependent upon the design and configuration of the machine, these factors are also dependent on the awareness, concern, and proper training of the personnel involved in the operation, transport, maintenance, and storage of the machine. The improper use or maintenance 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 Materials found on www.toro.com.

- **Avoid unexpected starting of the machine**…
  Always turn off the machine, 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. Allow the engine, muffler, and other components to cool before working near them.

- **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 lithium-ion battery**…
  - Immediately discontinue use of the battery if the battery emits an unusual smell, feels hot, changes color or shape, or appears abnormal in any other way. Move the product or battery to a safe outdoor area away from any building, vehicle, or combustible material. Observe the battery for at least 1 hour to ensure that any reaction has stopped. If the reaction continues, or if any smoke is observed, call your local emergency services immediately.
Use only Toro-specified lithium-ion battery packs designed for your machine. Do not mix battery of any brand or type in Toro products.

Use only the Toro-specified lithium-ion charger designed to charge your machine. Do not attempt to use any other battery charger.

Do not over-charge or over-discharge lithium-ion battery.

Do not heat, puncture, or open the battery case.

Always disconnect the battery at the battery disconnect provided when servicing products with lithium-ion batteries.

Always service lithium-ion battery with the machine parked near a service door large enough to move the product or battery outside in case of an emergency and keep a fire blanket nearby. Do not use a fire extinguisher on lithium-ion batteries.

• **Avoid injury due to inferior parts…**
  Use only original equipment parts to ensure that important safety criteria are met.

• **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 any debris that could be picked up and thrown by the powered equipment.

• **Avoid modifications…**
  Do not alter or modify any part unless it is a factory approved procedure.

• **Avoid unsafe machine operation…**
  Always test the safety interlock system after making adjustments or repairs on the machine. Refer to the Chapter 5: Electrical System (page 5–1) 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.
  – Do not wear metal jewelry when working on or near electrical components or wiring.

• **Use personal protective equipment…**
  – Tie back long hair, and do not wear loose clothing or jewelry.
  – 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.

⚠️ WARNING ⚠️

Do not use a fire extinguisher on lithium-ion batteries. If any smoke is observed, move the product or battery to a safe outdoor area away from any building, vehicle, or combustible material if possible and call your local emergency services immediately. Failure to do so may result in personal injury and property damage.

– **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).

– **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.
Safety and Instructional Decals

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

Overall Dimensions

Figure 2
### Traction and Reel Drive Systems

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<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Transmission</td>
<td>Electric motor to transmission</td>
</tr>
<tr>
<td></td>
<td>Transmission drive uses spur gears</td>
</tr>
<tr>
<td>Traction Drive</td>
<td>Transmission to traction drive uses a series of spur gears</td>
</tr>
<tr>
<td>Differential</td>
<td>Spur gear planetary differential</td>
</tr>
<tr>
<td>Parking Brake</td>
<td>Band style (at differential shaft drive)</td>
</tr>
<tr>
<td>Traction Drum</td>
<td>Dual aluminium, 19.1 cm (7.5 inch) diameter</td>
</tr>
<tr>
<td>Cutting Reel Drive</td>
<td>Transmission reel output shaft with disconnect and sliding coupler</td>
</tr>
<tr>
<td></td>
<td>Final reel drive has 2 pulleys with positive drive belt</td>
</tr>
<tr>
<td></td>
<td>Belt tension maintained by an idler</td>
</tr>
</tbody>
</table>

### Controls, Wheels and Accessories

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport Wheel (Optional) Tire</td>
<td>83 to 103 kPa (12 to 15 PSI)</td>
</tr>
<tr>
<td>Pressure</td>
<td></td>
</tr>
</tbody>
</table>

### DPA Cutting Units

<table>
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<tr>
<th>Frame construction:</th>
<th>Precision machined die cast aluminum crossmember with 2 bolt-on die-cast aluminum side plates.</th>
</tr>
</thead>
<tbody>
<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>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 16 mm (0.062 to 0.625 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 30 mm (0.438 to 1.2 inch). Effective HOC may vary depending on turf conditions, type of bedknife, rollers, attachments installed and rear drum position.</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 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.</td>
</tr>
<tr>
<td>Grass shield:</td>
<td>Adjustable shield to improve grass discharge from reel in varying moisture conditions.</td>
</tr>
<tr>
<td>Counterbalance weight:</td>
<td>A cast iron weight mounted on left end of the cutting unit.</td>
</tr>
</tbody>
</table>
DPA Cutting Units (continued)

Cutting unit weight (approximate):

<table>
<thead>
<tr>
<th>Blade</th>
<th>21 inch</th>
<th>26 inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 blade</td>
<td>23.6 kg (52 lbs)</td>
<td>26.7 kg (59 lbs)</td>
</tr>
<tr>
<td>11 blade</td>
<td>25 kg (55 lbs)</td>
<td>28.6 kg (63 lbs)</td>
</tr>
<tr>
<td>14 blade</td>
<td>26.3 kg (58 lbs)</td>
<td>-</td>
</tr>
</tbody>
</table>

**Options:** Refer to the *Cutting Unit Parts Catalog* or contact your local Authorized Toro Distributor for available cutting unit options.

### Universal Groomer

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<th>Item</th>
<th>Description</th>
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<tr>
<td>Grooming reel diameter</td>
<td>6 cm (2.375 inches)</td>
</tr>
<tr>
<td>Groomer mounting</td>
<td>The drive assembly for the grooming reel is located on the opposite side of the cutting unit from the belt drive.</td>
</tr>
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</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. |
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., Nylocknut), hardness of the surface underneath the head of the fastener, or similar condition which affects the installation.

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

The standard method of checking the torque can be performed by marking a line on the fastener (head or nut) and mating part, then back off the fastener 1/4 of a turn. Measure the torque necessary to tighten the fastener until the lines match up.
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 3) 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 3](image-url)

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 4](image1)

Inch Series Bolts and Screws

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

![Figure 5](image2)

Metric Bolts and Screws

1. Class 8.8
2. Class 10.9

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 ± 26</td>
<td>15 ± 2</td>
<td>169 ± 23</td>
</tr>
<tr>
<td># 6 - 40 UNF</td>
<td>13 ± 2</td>
<td>17 ± 2</td>
<td>192 ± 23</td>
<td>25 ± 3</td>
</tr>
<tr>
<td># 8 - 32 UNC</td>
<td>13 ± 2</td>
<td>25 ± 5</td>
<td>29 ± 3</td>
<td>328 ± 34</td>
</tr>
<tr>
<td># 8 - 36 UNF</td>
<td>31 ± 4</td>
<td>350 ± 45</td>
<td>43 ± 5</td>
<td>486 ± 56</td>
</tr>
<tr>
<td># 10 - 24 UNC</td>
<td>18 ± 2</td>
<td>30 ± 5</td>
<td>42 ± 5</td>
<td>475 ± 56</td>
</tr>
<tr>
<td># 10 - 32 UNF</td>
<td>48 ± 5</td>
<td>542 ± 56</td>
<td>68 ± 7</td>
<td>768 ± 79</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>ft-lb</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 UNF</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 sealant, such as Loctite.

**Note:** The torque values must be reduced when installing the fasteners into threaded aluminum or brass. The specified torque value should be determined based on the aluminum or base material strength, fastener size, length of thread engagement, etc.

**Note:** The nominal torque values listed above for Grade 5 and 8 fasteners are based on 75% of the minimum proof load specified in SAE J429. The tolerance is approximately ±10% of the nominal torque value. The thin height nuts include jam nuts.
## Standard Torque for Dry, Zinc Plated, and Steel Fasteners (Metric Fasteners)

<table>
<thead>
<tr>
<th>Thread Size</th>
<th>Class 8.8 Bolts, Screws, and Studs with Regular Height Nuts (Class 8 or Stronger Nuts)</th>
<th>Class 10.9 Bolts, Screws, and Studs with Regular Height Nuts (Class 10 or Stronger Nuts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M5 X 0.8</td>
<td>57 ± 6 in-lb</td>
<td>78 ± 8 in-lb</td>
</tr>
<tr>
<td>M6 X 1.0</td>
<td>96 ± 10 in-lb</td>
<td>133 ± 14 in-lb</td>
</tr>
<tr>
<td>M8 X 1.25</td>
<td>19 ± 2 ft-lb</td>
<td>28 ± 3 ft-lb</td>
</tr>
<tr>
<td>M10 X 1.5</td>
<td>38 ± 4 ft-lb</td>
<td>54 ± 6 ft-lb</td>
</tr>
<tr>
<td>M12 X 1.75</td>
<td>66 ± 7 ft-lb</td>
<td>93 ± 10 ft-lb</td>
</tr>
<tr>
<td>M16 X 2.0</td>
<td>166 ± 17 ft-lb</td>
<td>229 ± 23 ft-lb</td>
</tr>
<tr>
<td>M20 X 2.5</td>
<td>325 ± 33 ft-lb</td>
<td>450 ± 46 ft-lb</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>Square Head</th>
<th>Hex Socket</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4 - 20 UNC</td>
<td>140 ± 20 in-lb</td>
<td>73 ± 12 in-lb</td>
</tr>
<tr>
<td>5/16 - 18 UNC</td>
<td>215 ± 35 in-lb</td>
<td>145 ± 20 in-lb</td>
</tr>
<tr>
<td>3/8 - 16 UNC</td>
<td>35 ± 10 ft-lb</td>
<td>18 ± 3 ft-lb</td>
</tr>
<tr>
<td>1/2 - 13 UNC</td>
<td>75 ± 15 ft-lb</td>
<td>50 ± 10 ft-lb</td>
</tr>
</tbody>
</table>

### Thread Cutting Screws (Zinc Plated Steel)

#### Type 1, Type 23 or Type F

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

### Wheel Bolts and Lug Nuts

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

*For steel wheels and non-lubricated fasteners

### Thread Cutting Screws (Zinc Plated Steel)

<table>
<thead>
<tr>
<th>Thread Size</th>
<th>Threads per Inch</th>
<th>Baseline Torque**</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 6</td>
<td>18</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.

<table>
<thead>
<tr>
<th><strong>ANTI-SEIZE LUBRICANT</strong></th>
<th>![Can]</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>![Grease Can]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can be used to pre-fill (pack) bearings, boots and seals prior to assembly, ease installation of components during assembly, or fill cavities between moving parts through grease fittings after assembly. Unless otherwise noted, refer to the machine Operator’s Manual or Installation Instructions for grease specifications.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>THREAD LOCKING COMPOUND (Thread Locker)</strong></th>
<th>![Thread Locker]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used to lock threaded fasteners in position. Available in low, medium and high strength for various size fasteners and applications. Most thread locking compounds are applied immediately prior to fastener installation. Some thread locking compounds use a “Wicking” feature, and can be applied after fastener installation. Most thread locking compounds allow the fastener to be removed with standard tools once cured. High strength thread locking compounds may require applying heat to the fastener and the surrounding area to allow fastener removal.</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Some fasteners have a dry thread locking compound pre-applied (Patch-Loc) so no additional thread locking compound is necessary when installing a “new” fastener. These fasteners are designed to be removed and re-installed only once before applying additional thread locking compound is necessary.

<table>
<thead>
<tr>
<th><strong>RETAINING COMPOUND (bearings and sleeves)</strong></th>
<th>![Retaining Compound]</th>
</tr>
</thead>
<tbody>
<tr>
<td>An adhesive used to secure bearings, bushings and cylindrical parts into housings or onto shafts. When cured, bearing and sleeve retaining compound fills the gap between mating parts with a hard resin that increases load distribution and protects against corrosion.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>ADHESIVE</strong></th>
<th>![Adhesive]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used to secure a variety of components immediately prior to assembly. May be recommended for installing new components or when reusing a component that had a pre-applied adhesive such as hood seals, mouldings and weather-stripping.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>THREAD SEALANT</strong></th>
<th>![Thread Sealant]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used to seal threaded fittings and sensors from air, fuel and oil pressure leaks and prevent galling and seizure between threaded parts. A thread sealant in paste form is preferred over sealant tape. The sealant should remain semi-pliable to allow for component removal with standard tools. Some thread sealants may require the use of a cleaner or primer prior to use.</td>
<td></td>
</tr>
</tbody>
</table>
### GASKET COMPOUND

Used to create a seal between mating parts. Gasket compounds may be used with or without the presence of a pre-formed gasket. Gasket compounds may be solvent or silicone based, and cure when exposed to air or designed to cure in an air-less environment (anaerobic). Most gasket compounds are designed to be applied to clean surfaces free of oil, chemical residue and previously used gaskets or gasket compounds.

### SILICONE SEALANT

Designed for a broad variety of sealing and bonding requirements, silicone sealants are usually room temperature vulcanizing (RTV) which form a flexible silicone rubber that bonds to a wide variety of smooth or porous materials when cured. Standard silicone sealants are designed to perform in temperatures from -51°F to 232°C (-60°F to 400°F), while high temperature variants can preform in temperatures up to 343°C (650°F).
Special Tools

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.

Dielectric Gel

Toro Part No. 107-0342

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

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

Gauge Bar Assembly

K Line Part No. 94–9010

Use 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.

Backlapping Brush Assembly

**K Line 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

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.

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 develop 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.

Bedknife Screw Tool
Bedknife Screw Tool (continued)

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

K Line 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 your local authorized Toro Distributor.

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.
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.

Electric Motor Rotor Tool

Toro Part No. 139–8420

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

Lithium-Ion Battery Service Wire Harness

Toro Part No. 122–1947

Use to identify a failing battery, or determine if the lithium-ion battery controller or battery interface harness is working correctly.

1. Disconnect the battery interface harness from the BMS and the battery.
2. Connect the battery service wire harness to the BMS and the battery.

Figure 8

1. 4-Pin battery connector
2. 9–Pin controller (BMS) connector
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GEARS – The Systematic Approach to Defining, Diagnosing and Solving Problems

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

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

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

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

Solution Confirmation
• Did the issue go away
• Was the root cause of the issue correctly repaired
• Are there any other new symptoms
Operator advisories are automatically displayed by the InfoCenter when a machine function requires additional action (Figure 9). An advisory will not be logged into the fault log.

The InfoCenter advisories include the following:

**#201 (System Shutdown):** This advisory notifies the operator that the machine is shutting down. Because the shutdown process takes some time, this advisory is displayed so that an operator is aware of the shutdown and machine operation is not available. The shutdown advisory will be displayed after the key switch is turned OFF.

**#202 (Low Battery Shutdown):** If the battery state of charge is too low for continued machine operation, the low battery shutdown advisory will notify the operator that the machine will automatically shutdown. Battery charging is necessary before returning the machine to normal operation.

**#203 (Energy Saving Mode Active):** If the battery state of charge is too low for normal machine operation, the energy saving mode active advisory will notify the operator that the machine is operating with reduced functionality (cutting unit disengaged and reduced traction speed). Battery charging is necessary before returning the machine to normal operation.

**#204 (Energy Saving Mode Warning):** If the battery state of charge is too low for normal machine operation, the energy saving mode warning advisory will notify the operator that the machine will start operating with reduced functionality (cutting unit disengaged and reduced traction speed) in approximately 30 seconds. Battery charging is necessary before returning the machine to normal operation.

**#207 (Motor Current Limit):** This advisory notifies the operator that the electric motor is already running at maximum current and cannot deliver any additional performance. For example, the motor current limit advisory would be displayed if the speed control was increased when the motor was already providing maximum performance.

**#208 (Motor Not Ready):** This advisory notifies the operator that the electric motor is not ready to deliver the performance.

**#210 (High Power Consumption Run Time Reduced):** The high power consumption identifies that electric motor draw is excessive and will reduce the run time of the machine. Excessive cutting unit bedknife contact or accessory use may generate this advisory.
#212 (Motor Disabled): The motor disabled advisory will identify that electric motor operation was stopped by the controller. A fault should have been generated that will provide additional information as to cause of the issue.

#213 (Disengage Traction): This advisory notifies the operator that the bail lever is engaged and needs to be released before operation can be continued. The disengage traction advisory will be displayed if the machine is turned on with the traction lever already engaged.

#214 (Battery Temperature Too Low): This advisory notifies that the battery operating temperature is too low and the controller was denied the motor operation.

#215 (Battery Temperature Too High): This advisory notifies that the battery operating temperature is too high and the controller was denied the motor operation.

#216 (Battery Voltage Too High): This advisory notifies that the battery operating voltage is too high and the controller was denied the motor operation.

#217 (Battery Draw Too High): This advisory notifies an over current situation and the controller was denied the motor operation.

#218 (Backlap Enabled): This advisory notifies the operator when the backlap is enabled.

#219 (Backlap Denied, Fault Active): This advisory notifies there is an active fault on the machine that won't allow the backlap.

#220 (Backlap Confirm Gearbox Neutral): An icon appears on the InfoCenter to inform the operator to move the gear box lever to Neutral position. Operator must confirm by clicking the right button on the InfoCenter.
Machine Faults

The faults screen (Figure 10) will list all the machine electrical faults that have occurred since the faults were last cleared from the InfoCenter. The faults will be identified by a number and when the fault occurred. The faults that might occur on the e1021/e1026 machine are listed in the Fault Table (page 3–5).

The InfoCenter fault log can be cleared by selecting the clear system faults menu item. The cleared faults will be removed from the InfoCenter but will be retained in the TEC memory.

If a fault occurs during machine use, there may be a change in machine functionality due to the fault. Should there be machine operation issues due to a fault, a first step to remedy the issue would be to move the traction lever to the NEUTRAL position, turn the key switch to the OFF position, and allow all the machine functions to stop. Then, attempt to restart the machine to see if operation has returned to normal. Some faults will be reset during the restart and will then allow normal function. If a fault continues to occur, further system evaluation and possible component repair or replacement will be necessary.

To return to the main menu screen from the faults screen, press the menu/back button (as indicated by the at the bottom of the screen).

Fault Table

<table>
<thead>
<tr>
<th>Fault Number</th>
<th>Fault Title</th>
<th>Controller Affected</th>
<th>Fault Condition/Circuit Description</th>
<th>Additional Notes</th>
<th>Service Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Internal TEC Fault</td>
<td>Primary</td>
<td>The 13.3 V regulator on the TEC is not able to maintain regulation at an acceptable voltage level.</td>
<td>This is an onboard power supply for the TEC.</td>
<td>1. Reboot the machine.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Disconnect and reconnect the battery.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3. Look for short circuits in the harness.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4. Replace the TEC.</td>
</tr>
<tr>
<td>2</td>
<td>12Vdc Supply Fault</td>
<td>Primary</td>
<td>The 12 V regulator on the TEC cannot maintain regulation at an acceptable voltage level.</td>
<td>Most likely there is a short circuit on the 12 V supply line that powers the</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>InfoCenter and the Slow-in-turn switch.</td>
<td></td>
</tr>
</tbody>
</table>
## Fault Table (continued)

<table>
<thead>
<tr>
<th>Fault Number</th>
<th>Fault Title</th>
<th>Controller Affected</th>
<th>Fault Condition/Circuit Description</th>
<th>Additional Notes</th>
<th>Service Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>5V Supply Fault</td>
<td>Primary</td>
<td>The 5 V regulator on the TEC cannot maintain regulation at an acceptable voltage level.</td>
<td></td>
<td>Most likely there is a short circuit on the 5 V supply line that powers the throttle sensor.</td>
</tr>
</tbody>
</table>
| 4            | Precharge Fault           | Primary             | The TEC checks and then monitors for proper voltage. The TEC confirms that the contactor voltage drops sufficiently during the discharge process and rises sufficiently during the pre-charge process. Failure of either process will trigger a fault. |                                                                                 | 1. Verify the battery is charged.  
2. Make sure the work lights are off, and check the wiring to the contactor for shorts.  
3. Replace the contactor. |
| 5            | Communication Fault       | Primary             | The primary has not received a message from the motor for more than 2.5 seconds, or from the battery for more than 1 second. |                                                                                 | Check the CAN bus for proper continuity and proper termination. |
| 7            | Motor Over Temperature    | Primary             | This fault is declared when the FET temperature or the motor temperature exceeds the design limit set point. When the overtemp region is entered, motor current is limited on a linear basis until the absolute overtemp value is reached. | A side effect of this fault is that the motor output torque will be limited. This will result in reduced reel speed and potential stall. | 1. Let machine cool. Note that this fault is not produced by a bad sensor.  
2. Open the rear discharge of the cutting unit.  
3. Reduce reel speed.  
4. Reduce mow speed. |
| 9            | Internal Motor Fault      | Motor               | The motor detected an internal fault condition.                                                     |                                                                                 | 1. Verify the battery is charged.  
2. Test for proper supply voltage at the motor and its controller.  
3. Test the main contactor coil.  
4. Replace the motor.  
5. Replace the TEC. |
| 10           | Motor Stalled             | Motor               | Motor at zero RPM for more than 3 seconds. Insufficient torque to rotate motor.                      | Can occur during heavy cutting conditions or cutting unit malfunction.           | 1. Check cutting unit and motor mechanical resistance.  
2. Check bedknife adjustment and condition of reel.  
3. Motor will likely need replacing if the fault continues. |
| 11           | Software Incompatible     |                     | One of the devices in the system has software that is incompatible.                                 |                                                                                 | Use Toro DIAG to reprogram the machine. |
| 12           | Key Stuck On              | Primary             | The battery has detected the keyswitch in the ON position for longer than allowed.                  |                                                                                 | 1. Verify the battery is charged.  
2. Test the key switch wiring.  
3. Test the key switch. |
| 13           | Internal Battery Fault    | Battery Management System | Internal BMS detected fault.                                                                        |                                                                                 | 1. Reboot the machine.  
2. Disconnect and reconnect the battery.  
3. Recharge the battery.  
4. Replace the battery. |
<table>
<thead>
<tr>
<th>Fault Number</th>
<th>Fault Title</th>
<th>Controller Affected</th>
<th>Fault Condition/Circuit Description</th>
<th>Additional Notes</th>
<th>Service Actions</th>
</tr>
</thead>
</table>
| 15           | Software Error               | Primary             | The software has detected an issue with reading the throttle sensor.                                  |                  | 1. Try rebooting machine, disconnect and reconnect the battery, look for short circuits in the harness.  
 |              |                              |                     |                                                                                                      |                  | 2. Replace the TEC.                                                             |
| 16           | Contactor Fault              | Primary             | The bus voltage was high enough at power up to require a discharge before precharge. The bus failed to discharge below threshold in the required amount of time.  
 |              |                              |                     | At shutdown, the contactor is opened and the bus discharged before shutting the machine down. This discharge failed to go below the threshold in the required amount of time. |                  | Most likely cause is a shorted contactor.                                      |
| 17           | Throttle Sensor Fault        | Primary             | The sensor signals are outside the expected range.                                                   | Traction is disabled. | 1. Test the throttle sensor.  
 |              |                              |                     |                                                                                                      |                  | 2. Test the throttle sensor circuit wiring and connector P05.  
 |              |                              |                     |                                                                                                      |                  | 3. Replace throttle sensor.                                                     |
| 18           | Traction Bail Sensor Fault   | Primary             | The sensor signals are outside the expected range.                                                   | Traction is disabled. | 1. Test the traction bail sensor.  
 |              |                              |                     |                                                                                                      |                  | 2. Test the traction bail sensor circuit wiring and connector P26.              |
|              |                              |                     |                                                                                                      |                  | 3. Replace traction bail sensor.                                                |
If a battery charger error or fault appears, additional information may be available by disconnecting the charger, connecting the battery to the machine, and using the machine InfoCenter to check for any active machine faults.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<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. Ensure that the battery is in good condition.</td>
</tr>
<tr>
<td>Code E-0-0-4</td>
<td>Lithium-ion battery controller (BMS) or battery fault detected</td>
<td>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. Batteries may be deeply discharged. Battery replacement may be necessary. Disconnect and connect the charger to the battery to reset this error.</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. The battery charger may require replacement (contact an Authorized Toro Distributor for assistance).</td>
</tr>
</tbody>
</table>
Electrical System Problems

CAUTION

Remove all the jewelry, especially rings and watches, before doing any electrical troubleshooting or testing.

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

Note: Check the InfoCenter display for possible operator advisories or faults whenever diagnosing machine electrical problems.

InfoCenter Does Not Start-Up

<table>
<thead>
<tr>
<th>Possible Causes</th>
<th>Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>The key switch was not rotated to the ON position.</td>
<td>Turn the key switch to the ON position and wait for the InfoCenter to start.</td>
</tr>
<tr>
<td>The lithium battery pack is disconnected from the machine wire harness.</td>
<td>Connect the battery pack to the machine wire harness.</td>
</tr>
<tr>
<td>The lithium battery pack is discharged.</td>
<td>Charge the battery pack.</td>
</tr>
<tr>
<td>Machine F1-1 (30 A) or F1-2 (3 A) fuse is damaged.</td>
<td>Check the fuses and replace if they are damaged.</td>
</tr>
<tr>
<td>The key switch is damaged.</td>
<td>Check the key switch and circuit wires. Repair as necessary.</td>
</tr>
<tr>
<td>The main contactor is damaged.</td>
<td>Check the main contactor and circuit wires. Repair as necessary.</td>
</tr>
<tr>
<td>The wire harness connections or wires are loose or damaged.</td>
<td>Check the electrical connections. Repair the wire harness as necessary.</td>
</tr>
<tr>
<td>The TEC is damaged.</td>
<td>Replace the TEC.</td>
</tr>
</tbody>
</table>

Traction Circuit is Inoperative

<table>
<thead>
<tr>
<th>Possible Causes</th>
<th>Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>The speed control potentiometer is damaged.</td>
<td>Use the InfoCenter Diagnostics screen to check the speed control potentiometer operation. Check and repair the speed control potentiometer and circuit wires if necessary.</td>
</tr>
<tr>
<td>The wire harness connections or wires are loose or damaged.</td>
<td>Check the electrical connections. Repair the wire harness as necessary.</td>
</tr>
<tr>
<td>A problem exists with the traction or reel drive system.</td>
<td>Refer to Chapter 4: Traction and Reel Drive Systems (page 4–1).</td>
</tr>
<tr>
<td>The electric motor is damaged.</td>
<td>Use the InfoCenter Faults and Diagnostics screens to check the reel circuit operation. Check the electric motor and circuit wires. Repair as necessary.</td>
</tr>
</tbody>
</table>

Note: Fault should be displayed on the InfoCenter if the electric motor is damaged.
Machine is Inoperative and InfoCenter Power Light Indicates That a Fault Has Occurred

<table>
<thead>
<tr>
<th>Possible Causes</th>
<th>Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>System fault has been detected by controller.</td>
<td>Use the Faults screen information in the InfoCenter section of this chapter to help identify source of problem.</td>
</tr>
<tr>
<td>An electrical fault occurred that can be reset by the controller.</td>
<td>Attempt to restart the machine to see if the machine operation has returned to normal. If the fault still remains, use the Faults screen information in the InfoCenter section of this chapter to help identify source of problem.</td>
</tr>
</tbody>
</table>

Machine Operates But InfoCenter Display is Not Working

<table>
<thead>
<tr>
<th>Possible Causes</th>
<th>Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>The wire harness connections or wires to the InfoCenter display are loose or damaged.</td>
<td>Check the electrical connections. Repair the wiring as necessary.</td>
</tr>
<tr>
<td>The InfoCenter display is damaged.</td>
<td>Replace the InfoCenter display.</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 Service and Repairs (page 7–6) 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>Reel bearing condition</td>
<td>Check and replace the reel bearings if necessary; refer to Reel Assembly (page 7–17).</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. A new bedknife must be ground or backlapped after installation to the bedbar. Refer to Grinding the Bedknife (page 7–13) for grinding information or the Traction Unit Operator’s Manual for backlapping information.</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 and washer free to rotate; 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>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 7–25).</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>
Factors Affecting Grooming

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 grooming reel, such as too deep or frequent grooming, may cause unnecessary stress on the turf leading to severe turf damage. Use the groomer carefully. Read and understand the installation instructions before operating or testing groomer performance.

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

**Variables that Affect the Use and Performance of Grooming Reels:**

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 blade spacing on the grooming reel.
5. The height-of-cut.
6. The grooming depth.
7. The type of grass on the green.
8. The amount of time that a grooming reel has been in use on a particular turf area.
9. The amount of traffic on the turf.
10. The overall turf management program (e.g., irrigation, fertilizing, weed control, coring, over-seeding, disease control, sand dressing, and pest control).
11. Stress periods for turf (e.g., high temperatures, high humidity, and unusually high traffic).
## Grooming Reel Mechanical Problems

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Causes</th>
<th>Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groomer not engaged.</td>
<td>Groomer drive gears are worn or damaged.</td>
<td>Inspect groomer drive assembly and replace damaged drive components.</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 grooming reel blades are bent, damaged or missing.</td>
<td>Repair or replace blades if necessary.</td>
</tr>
<tr>
<td></td>
<td>The grooming reel shaft is bent or damaged.</td>
<td>Replace grooming reel shaft.</td>
</tr>
<tr>
<td>Grooming depth is not equal on both ends of grooming reel.</td>
<td></td>
<td>Adjust depth if necessary. Check and adjust cutting unit set up (level bed knife to reel, set height-of-cut, etc.).</td>
</tr>
</tbody>
</table>
Chapter 4

Traction and Reel Drive Systems

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General Information

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.

Disengaging The Drum Drive From Transmission

The traction drum is driven by series of spur gears inside the transmission gear box assembly. To disengage the traction drum drive from the transmission, do the following procedure:

1. Park the machine on a level surface. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
2. Locate the traction engage/disengage lever on top of the transmission gear box assembly.
3. To disengage the drum drive, rotate the traction engage/disengage lever to clockwise direction (away from the center of transmission gear box assembly).
4. To engage the drum drive, rotate the traction engage/disengage lever to anti-clockwise direction (towards the center of the transmission gear box assembly).
5. Connect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
Adjustments

Adjusting the Reel Drive Belt

1. Park the machine on a level surface. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).

2. Remove the 3 socket head screws (7) that secures the reel drive cover (6) to the reel drive assembly (1) and remove the reel drive cover to expose the reel drive belt (2).

3. Check tension by depressing the belt (item 2 in Figure 12) at mid span between pulleys with **18 to 22 N (4 to 5 lbs)** of force. The belt should deflect **6.35 mm (0.25 inch)**. If deflection is incorrect, proceed to next step. If deflection is correct, continue operation.
Adjusting the Reel Drive Belt (continued)

4. Adjust belt tension (2) as follows:
   A. Loosen the bolt (4) and rotate the idler arm (3) to release the tension on the reel drive belt (2).

   B. Pivot the idler arm (3) clockwise against the backside of the belt and apply a torque \(3.9\) to \(4.5\) N\(\cdot\)m (\(35\) to \(40\) in-lb) to internal hex socket on the idler arm (3). Secure the idler arm with the bolt (4). Check the belt tension as per para 3.

   C. Ensure that the reel drive gasket (5) is in position and install the reel drive cover (6) to the reel drive assembly (1) and secure with the 3 socket head screws (7).

   D. Torque tighten the socket head screws to \(1.7\) to \(4.5\) N\(\cdot\)m (\(15\) to \(40\) in-lb). Use an alternation pattern and torque tighten the socket head screws to \(9.6\) to \(10.7\) N\(\cdot\)m (\(85\) to \(95\) in-lb).

5. Connect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
The greensmaster machines use a positive drive belt on the right side of the machine to operate the cutting unit.

Removing the Reel Drive Belt

Note: Refer to Figure 13 during this procedure.

1. Park the machine on a level surface. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).

2. Remove the 3 socket head screws (7) that secures the reel drive cover (6) to reel drive assembly (1) and remove the reel drive cover to expose the reel drive belt (2).
Removing the Reel Drive Belt (continued)

3. Remove and inspect the reel drive gasket (5) from the reel drive assembly (1). Discard the reel drive gasket (5), if damaged.

4. Loosen the bolt (4) and rotate the idler arm (3) to release the tension on the reel drive belt (2).

5. Remove the reel drive belt (2) from the pulleys.

Installing the Reel Drive Belt

1. Ensure that the bolt (4) is loose enough to move the idler arm (3) freely.

2. Place the new drive belt (2) onto the pulleys.

3. Adjust the reel belt tension; refer to Adjusting the Reel Drive Belt (page 4–3).

4. Ensure that the reel drive gasket (5) is in position and install the reel drive cover (6) to the reel drive assembly (1) and secure with the 3 socket head screws (7).

5. Torque tighten the socket head screws to 1.7 to 4.5 N·m (15 to 40 in-lb). Use an alternation pattern and torque tighten the socket head screws to 9.6 to 10.7 N·m (85 to 95 in-lb).

6. Connect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
Removing the Reel Drive Assembly

**Note:** Refer to Figure 14 during this procedure.

1. Park the machine on a level surface. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
2. Slide the telescopic coupler (item 8 in Figure 14) on the reel drive assembly (6) and disconnect the reel drive shaft from the transmission drive shaft (10).
3. Loosen and remove the 2 screws (1) and the nut (7) that secures the reel drive assembly (6) to RH side plate (9). Remove the reel drive assembly (6), flat washers (3), spring washers (4) and spacers (2 and 11) from the RH side plate (9).
4. Remove the V-ring seal (5) from the reel drive assembly (6).
Disassembling the Reel Drive Assembly

Note: Refer to Figure 15 during this procedure.

1. Remove the reel drive belt (16); refer to Removing the Reel Drive Belt (page 4–5).

2. Remove and discard the reel drive gasket (4) from the reel drive housing (22).

3. If necessary, remove the expansion plug (13) from the reel drive cover (14).

4. Remove the hex bolt (28) and plain washer (27) from the idler arm (26) and the nut (25) from the reel drive housing (22).

5. Loosen and remove the socket head screw (11) that secures the idler arm (26) to the reel drive housing (22). Remove the idler arm and nut (25) from the reel driving housing.

6. If necessary, remove the idler bushing (10) from the idler arm (26).

7. Remove the retaining ring (29) and use a press to remove 2 ball bearings (18) from the idler arm (26). Discard the ball bearings after removal.

8. Remove the lock nut (9), reel pulley (8), hipro key (20) and spacer (7) from the reel shaft-driven (1).
Disassembling the Reel Drive Assembly (continued)

9. Remove the retaining ring (6) from the reel drive housing (22).
10. Slide the reel shaft-driven from the bearings.
11. Use a press to remove the 2 ball bearings (5) and reel shaft-driven (1) from the reel drive housing (22). Discard the ball bearings after removal.
12. If necessary, remove the pivot sleeve (3) from the reel drive housing (22). Remove and discard the O-ring from the pilot sleeve.
13. Remove the nut (9), reel pulley (15), hipro key (20) and spacer (7) from the reel shaft-driver (21).
14. Remove the retaining ring (17) from the reel drive housing (22).
15. Slide the reel shaft-driver from the bearings.
16. Use a press to remove the 2 ball bearings (18), bearing shield (19) and reel shaft-driver (21) from the reel drive housing (22). Discard the ball bearings after removal.
17. Remove and discard the O-ring (23) from the bolt (24). If necessary, remove the bolt (24) from the reel drive housing (22).

Assembling the Reel Drive Assembly

1. If removed install the bolt (24) into the reel drive housing (22) and new O-ring (23) onto the bolt (24).
2. Use a press to install the 2 ball bearings (18) into the reel drive housing (22) and make sure that the reel shaft-driver pushes on bearing outer raceway.
3. Slide the bearing shield (19) onto the reel shaft-driver.
4. Install the reel shaft-driver (21) into the reel drive housing (22).
5. Install the retaining ring (17) to the reel drive housing (22).
6. Slide the spacer (7) onto the reel shaft-driver (21).
7. Install hipro key (20) to then reel shaft-driver (21). Apply anti-seize lubricant at the top of the key.
8. Install the reel pulley (15) onto the reel shaft-driver (21). Secure the reel pulley (15) with the lock nut (9).

9. Torque tighten the lock nut to 36.6 to 44.7 N·m (27 to 33 ft-lb).
10. If removed, install the O-ring (2) onto the pivot sleeve (3). Slide the pivot sleeve onto the reel drive housing (22).
11. Use a press to install the 2 ball bearings (5) into housing (22) outer raceway. Install the reel shaft-driven (1) to the reel drive housing (22).
12. Install the retaining ring (6) and spacer (7) o the reel drive housing (22).
13. Install the hipro key (20) onto the reel shaft-driven (1). Apply anti-seize lubricant at the top of the key.
14. Install the reel pulley (8) onto the reel shaft-driven (1). Secure the reel pulley with the lock nut (9).

15. Torque tighten the lock nut to 36.6 to 44.7 N·m (27 to 33 ft-lb).
16. If removed, install the bushing (10) into the idler arm (26).
17. Use a press to install the 2 ball bearings (18) to the idler arm (26) outer raceway and secure with a retaining ring (29).
18. Install and secure the idler arm into the reel driving housing with the socket head screw (11) and nut (10).
Assembling the Reel Drive Assembly (continued)

19. Install the bolt (28), washer (27) and nut (25) to the idler arm (26) and reel drive housing (22). Do not tighten the bolt (28).

![Figure 16](image_url)

1. Press flush

20. If removed, install the expansion plug (13) to the reel drive cover (14) and press flush to outer surface (refer to Figure 16) of the reel drive cover.

21. Install the reel drive belt; refer to Installing the Reel Drive Belt (page 4–6).

22. Adjust the reel drive belt tension; refer to Adjusting the Reel Drive Belt (page 4–3).

Installing the Reel Drive Assembly

**Note:** Refer to Figure 14 during this procedure.

1. Place the V-ring seal (5) into the reel drive assembly (6).
2. Install telescopic coupler (8) to the reel drive shaft.
3. Install the reel drive assembly (6), washers (3), spring washer (4) and spacers (2 and 11) to the RH side plate (9) and secure the reel drive assembly (6) with 2 screws (1) and nut (7).
4. Slide the telescopic coupler (8) to the transmission gear shaft (10).
5. Connect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
Drum Drive Gear Box Assembly

Removing the Drum Drive Gear Box Assembly

Note: Refer to Figure 17 during this procedure.

1. Park the machine on a level surface. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
2. Remove the transport wheel if attached; refer to Removing the Transport Wheel (page 6–22).
   
   Note: Support the machine on kickstand during this operation.
3. Move the traction engage/disengage lever to the disengage position to remove torque from the drum drive gears.
Removing the Drum Drive Gear Box Assembly (continued)

4. Remove the shoulder bolt (8) that secures the RH drum drive gear box assembly (5) to the frame assembly (7).

5. Remove the 3 shoulder bolts (3) that secures the RH drum drive gear box assembly (5) to the traction drum (2). Remove the RH drum drive gear box assembly from the frame assembly. Support the drum assembly.

6. If necessary, slide and remove the drive tube (6) from the transmission gear box assembly (1).

7. If necessary, remove the RH hexagonal shaft (4) from the RH drum drive gear box assembly (5).

8. Remove the truss screw (12), nut (9) and washer (11) that secures the 2 splined couplers (11) to the transmission gear box assembly (1) and LH drum drive gear box assembly (5).

9. Remove the shoulder bolt (8) that secures the LH drum drive gear box assembly (5) to the frame assembly (7).

10. Remove the 3 shoulder bolts (3) that secures the LH drum drive gear box assembly (5) to the traction drum (2). Remove the LH drum drive gear box assembly from the frame assembly. Support the drum assembly.

11. If necessary, remove the LH hexagonal shaft (13) from the LH drum drive gear box assembly (5).
Disassembling the Drum Drive Gear Box Assembly

Figure 18

1. Nut
2. Washer
3. Outer drum hub
4. V-ring seal
5. Drum drive shaft
6. Ball bearing (2 each)
7. Spacer
8. Drum driver gasket
9. Wire spring
10. Oil seal
11. Spur gear
12. Nut
13. Oil seal
14. Drum drive cover
15. Socket head screw (5 each)
16. Plug (2 each)
17. Flange nut
18. Retaining ring
19. Ball bearing (2 each)
20. Spur gear
21. Spur gear
22. Socket head screw
23. Ball bearing (2 each)
24. Wave washer
25. Drum drive housing
26. Retaining ring
27. Oil seal
28. Retaining ring
29. O-ring
30. Key
31. Short bearing pin
32. O-ring
33. Dowel pin (2 each)
34. Bearing spacer

Note: Refer to Figure 18 during this procedure.

1. Remove the 5 socket head screws (15) that secures the drum drive cover (14) to the drum drive housing (25).
2. Remove and discard the gasket (8) from the drum drive housing (25).
3. If necessary, remove the hollow plugs (16) from the drum drive cover (14).
4. If necessary, remove and discard the oil seal (13) from the drum drive cover (14).
Disassembling the Drum Drive Gear Box Assembly (continued)

5. Remove the nut (12) that secures the spur gear (11) to the drum drive shaft (5). Slide and remove the spur gear (11) from the drum drive shaft (5). Locate and retrieve the key (30) from the drum drive shaft (5).

6. Remove the nut (1) and washer (2) that secures the outer drum hub (3) to the drum drive shaft (5). Slide and remove the outer drum hub (3) and V-ring seal (4) from the drum drive shaft (5). Locate and retrieve the key (30) from the drum drive shaft (5).

7. If the ball bearings (6) are to be removed, use a press to remove the oil seal (10), ball bearings (6), bearing spacer (7), spring washer (9) and drum drive shaft (5) from the drum drive housing (25). Discard the ball bearings after removal.

8. Remove the nut (17) and bearing pin (31) that secures the spur gear (20) to the drum drive housing (25).

9. Remove the spur gear (20) and bearing spacer (34) from the drum drive housing (25).

10. Remove and discard the O-ring (32) from the bearing pin (31).

11. If the spur gear bearings (19) are to be removed, remove the retaining rings (18) and use a press to remove the ball bearings (19). Discard the bearings after removal.

12. Remove the retaining ring (28) and oil seal (27) from the drum drive housing (25). Discard the oil seal (27). Remove the retaining ring (26) from the spur gear (21).

13. Use a press to remove ball bearings (23), spur gear (21) and wave washer (24) from the drum drive housing (25). Discard the ball bearings after removal.

14. Remove and discard the O-ring (29) from the drum drive housing (25).
1. Install the ball bearings (23), wave washer (24) and spur gear (21) to the drum drive housing (25).

   **Note:** The outer diameter and inner diameter of the ball bearings (23) must be slip fit.

2. Install the retaining ring (26) to the spur gear (21). Apply a light coat of oil to the oil seal (27). Install the oil seal (27) and retaining ring (28) to the drum driving housing (25).

3. Use a press to install the ball bearings (19) to the spur gear (20). Install the retaining rings (18) to spur gear (20).

   **Note:** The inner diameter of the ball bearing (19) must be slip fit.

4. Apply a light coat of grease and install the O-ring (32) to the bearing pin (31). Install the bearing spacer (34), spur gear (20) onto the drum drive housing (25) and secure with the bearing pin (31) and nut (17).

5. Install the ball bearings (6), bearing spacer (7), spring washer (9) and drum drive shaft (5) to the drum drive housing (25).

   **Note:** The outer diameter and inner diameter of the ball bearings (6) must be slip fit.

6. Install the V-ring seal (4) onto the drum outer hub (3). Install the key (30) to the drum drive shaft (5) and apply anti-seize lubricant at the top of the key. Slide the drum outer hub (3) to the drum drive shaft (5) and secure with the washer (2) and nut (1).

7. Install the oil seal (10) into the drum drive housing (25). Install the key (30) to the drum drive shaft (5) and apply anti-seize lubricant at the top of the key. Slide the spur gear (11) to the drum drive shaft (5) and secure with the nut (12).

8. Torque tighten the nut (17) from **36.5 to 44.7 N·m (27 to 33 ft-lb)**.

9. Hold the nut (12) and torque tighten the nut (1) from **74.5 to 88 N·m (55 to 65 ft-lb)**.

10. If removed, install the oil seal (13) to the drum drive cover (14).

11. Install the gasket (8) to the drum drive housing.
Assembling the Drum Drive Gear Box Assembly (continued)

12. Install the drum drive cover (14) to the drum drive housing (25) and secure with 5 socket head screws (15). Torque tighten the socket head screws to **1.7 to 4.5 N·m (15 to 40 in-lb)**. Use an alternation pattern and torque tighten the socket head screws to **9.6 to 10.7 N·m (85 to 95 in-lb)**.

13. Fill the drum drive gear box assembly with **10 oz (0.56 lb)** of Mobil SCH007 grease.

14. Install the hollow plugs (16) to the drum drive cover (14). Lubricate the O-rings.

15. Torque tighten the hollow plugs (16) from **12.4 to 14.6 N·m (110 to 130 in-lb)**.

Installing the Drum Drive Gear Box Assembly

1. If removed, apply a coat of loctite (blue) to threads of the hexagonal shaft (4 and 13). Install the hexagonal shaft (item 4 and 13 in Figure 17) to the LH and RH drum drive gear box assemblies (5). Torque tighten the hexagonal shaft to **54 to 67.7 N·m (40 to 50 ft-lb)**.

2. Apply a light coat of grease and install the O-ring (29) to the drum drive housing (25).

3. If removed, slide the drive tube (item 6 in Figure 17) onto the transmission gear box assembly (1).

4. Install the LH and RH drum drive gear box assemblies (Item 5 in Figure 17) to the frame assembly (7) and secure with the shoulder bolts (8).

5. Install the LH and RH drum drive gear box assemblies (5) to the traction drum (2) and secure with the 3 shoulder bolts (3).

6. Install the 2 splined couplers onto the transmission gear box assembly (1) and LH drum drive gear box assembly (5) and secure with the truss screw (12), washer (10) and nut (9).

7. Torque tighten the truss screw (12) to **10 to 12.4 N·m (90 to 110 in-lb)**.

8. If required, install the transport wheels; refer to Installing the Transport Wheel (page 6–24).

9. Connect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
Drum Assembly

54 to 67.7 N-m
(40 to 50 ft-lb)

Figure 20

2. Traction drum 7. Frame assembly 12. Truss screw
3. Shoulder bolt (3 each) 8. Shoulder bolt 13. LH hex shaft
4. RH hex shaft 9. Nut
5. Drum drive gear box assembly 10. Washer

Removing the Drum Assembly

Note: Refer to Figure 20 during this procedure.

1. Park the machine on a level surface. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
2. Remove the LH and RH drum drive gear box assemblies (5); refer to Removing the Drum Drive Gear Box Assembly (page 4–11).
3. Remove the traction drum (2) from the frame assembly (7).
Disassembling the Drum Drive Assembly

Note: Refer to Figure 21 during this procedure.

1. Remove the 4 bolts (2) and lock washers (3) that secures the drum hub plate (4) to the drum spindle (5).

2. Remove the 4 bolts (2) and lock washers (3) that secures the drum hub plate (4) to the drum hub (10).

3. Remove the shoulder bolts (11) that secures the drum hub plate (4) to the traction drum (1).

4. Remove the lock nut (12) that secures the drum spindle (5) and drum hub (10) together. Carefully slide and remove the drum spindle (5) out of the drum hub (10).

5. Remove the 2 seals (6) from the drum hub (10). Use a press to remove the 2 ball bearings (7) and a bearing spacer (8) from the drum hub (10). Discard the ball bearings.

Figure 21

1. Traction drum (2 each)  5. Drum spindle  9. Spacer
2. Bolt (8 each)  6. Seal (2 each)  10. Drum hub
3. Lock washer (8 each)  7. Ball bearing (2 each)  11. Shoulder bolt (6 each)
4. Drum hub plate (2 each)  8. Spacer  12. Lock nut
Assembling the Drum Drive Assembly

![Diagram of Drum Drive Assembly](g258942)

**Figure 22**

1. Drum hub  
2. Spacer  
3. Lock nut  
4. Spacer  
5. Drum spindle  
6. Seal (2 each)  
7. Ball bearing (2 each)

**Note:** The seal side of each bearing (item 7 in Figure 22) should face inside of the drum hub; refer to Figure 22.

1. Use a press to install the bearings (7) and spacer (8) into the drum hub (10). Pack the bearings with grease. Fill outside space of the bearing with the grease.

2. Apply a coat of grease to the seals (6). Press the seals (6) into the drum hub (1) with its flat side facing outside; refer to Figure 22.

3. Apply grease to the shaft of the drum spindle (5). Carefully slide the drum spindle into the drum hub bearings (7). Secure the drum spindle and drum hub (1) with a spacer (2) and lock nut (3). Make sure that the drum spindle (5) can move axially relative to the drum hub (1).

**Note:** The lock nut (3) turns hard on the drum spindle (5) when tightened. Ensure that all rotation has stopped when tightening. A good solid sound indicates the nut is full tight.

4. Install the drum hub plate (4) into the traction drum (1) and secure with shoulder bolt (11).

**Note:** The fit between the drum hub plate (item 4 in Figure 21) and drum (1) is a close tolerance and can be easily jammed. The hub can be rotated when seated properly in the bore of the drum.

5. Secure the drum hub plate (4) to the drum hub (10) with the 4 bolts (2) and washers (3). Tighten the bolts using an alternating pattern. Repeat tightening sequence a second time.

6. Secure the drum hub plate (4) to the drum spindle (5) with the 4 bolts (2) and washers (3). Tighten the bolts using an alternating pattern. Repeat tightening sequence a second time.
Installing the Drum Drive Assembly

1. Park the machine on a level surface. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).

2. Position the LH and RH drum drive gear box assembly (item 5 in Figure 20) and traction drum (2) onto the frame assembly (7).

3. Secure the LH and RH drum drive gear box assembly (5) to the traction drum (2); refer to Installing the Drum Drive Gear Box Assembly (page 4–16).

4. Connect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
Figure 23

1. Truss screw (2 each)  8. Jam nut  15. Key
2. Splined coupler (4 each)  9. Bolt (2 each)  16. Electric motor
3. Washer (2 each)  10. Transmission gear box assembly  17. O-ring
4. Lock nut (2 each)  11. Socket head screw (4 each)  18. Reel drive coupling
6. Frame assembly  13. Socket head screw (3 each)
7. Slide adaptor  14. V-ring seal

Removal of transmission gear box assembly is necessary in order to service the internal components.
Removing the Transmission Gear Box Assembly

**Note:** Refer to Figure 23 during this procedure.

1. Park the machine on a level surface. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).

2. Disconnect the brake cable; refer to Removing the Brake Cable (page 6–4).

3. Disconnect the reel cable; refer to Removing the Reel Cable (page 6–7).

4. Remove the nuts (4), washers (3) and truss screws (1) that secures the splined couplers (2) to the drive shaft (5). Remove the splined couplers from the drive shaft.

5. Remove the socket head screw (13) that secures the motor adaptor (12) and transmission gear box assembly (10) to the frame assembly (6).

6. Remove the two flange head bolts (9) that secures the transmission gear box assembly (10) to the frame assembly (6). Remove the transmission gear box assembly with electric motor (16) from the frame assembly (6).

7. Remove the two socket head screws (13) that secures the motor adaptor (12) to the transmission gear box assembly (10). Remove the motor adaptor (12) and electric motor (16) from the transmission gear box assembly.
Disassembling the Transmission Gear Box Assembly

Figure 24

1. Retaining ring  
2. Spacer bushing  
3. O-ring  
4. Straight bushing (2 each)  
5. Retaining ring (2 each)  
6. Oil seal (2 each)  
7. Flange bushing (2 each)  
8. ORB plug  
9. Detent spring  
10. Detent ball  
11. Grease seal  
12. Ball bearing (2 each)  
13. Spacer  
14. Oil seal (2 each)  
15. Oil seal  
16. Sleeve bushing (2 each)  
17. Dowel pin  
18. O-ring seal  
19. Traction selector shaft  
20. Groomer pin  
21. Brake mount pin  
22. Transmission gasket  
23. Transmission cover  
24. Socket head screw (12 each)  
25. Ball bearing (2 each)  
26. Transmission housing  
27. Hollow hex plug  
28. E-ring  
29. Adapter-vent  
30. Breather-vent

Note: Refer to Figure 24 during this procedure.

1. Remove the hollow hex plug (item 27 in Figure 24), breather-vent (30) and adapter-vent (29) from the transmission gear box assembly (26).

2. Remove the 12 socket head screws (24) that secures the transmission cover assembly (23) to the transmission housing assembly (26). Remove the transmission cover assembly and transmission housing gasket (22) from the transmission housing assembly. Discard the transmission gasket (22).
Disassembling the Transmission Gear Box Assembly (continued)

3. Remove the oil seal (6), retaining ring (5) from the transmission cover (23). Use a press to remove the ball bearing (25) from the transmission cover (23). Discard the oil seals and ball bearing.

4. Remove the neutral spur gear assembly (item 5 in Figure 25) and wave washer (3) from the transmission housing assembly (23).

5. Use a press to remove the ball bearings (4) from the neutral slider shaft (6). Remove the square keys (7) from the neutral slider shaft (6). Discard the ball bearings.

6. Remove the differential assembly (14) from the transmission housing assembly (23).

7. Remove the 2 differential shafts (9) from the differential housing (14). Remove the retaining rings (11) and O-rings (10) from the differential shafts (9). Discard the O-rings.

8. Use a press to remove the 2 ball bearings (13) and 2 flange bearings (12) from the differential assembly (14). Discard the ball bearings (13).
Disassembling the Transmission Gear Box Assembly (continued)

9. If necessary, disassemble the differential assembly (14); refer to Disassembling the Differential Assembly (page 4–33).

10. Remove the bolt (25) that secures the cable brake lever (24) onto the brake lever (19). Slide and remove the cable brake lever (24) and external retaining ring (1) from the brake lever (19).

11. Remove the 2 bolts (8) that secures the retainer plate pin (15) and brake plate retainer (16) to the transmission housing assembly (23). Remove the retainer plate (15) from the transmission housing assembly (23).

12. Slide and remove the brake lever assembly (19) from the transmission housing assembly (23). Remove the flat wire spring (22) from the transmission housing assembly (23).

13. Disassemble the brake lever assembly (19) as follows:
   
   A. Remove the retaining ring (17) from the brake clevis pin (21).
   
   B. Slide and remove the brake clevis pin (21) from the brake band (18) and brake lever (19).
   
   C. Remove the brake lever (19) from the brake band (18).
   
   D. Remove and discard the O-ring (20) from the brake lever (19).
Disassembling the Transmission Gear Box Assembly (continued)

**Figure 26**
1. Short bearing pin
2. O-ring
3. Long bearing pin
4. Bearing spacer (2 each)
5. Retaining ring (4 each)
6. Ball bearing (5 each)
7. Spur gear
8. Flange nut (2 each)
9. Wave spring
10. Ball bearing (2 each)
11. Retaining ring (2 each)
12. Reel drive shaft
13. Square key (2 each)
14. Slider spur gear
15. Reel clutch shoe
16. Reel clutch actuator
17. Spur gear
18. Thin lock nut
19. Input shaft
20. Transmission housing assembly

14. Slide and remove the reel clutch actuator (item 16 in Figure 26) from the transmission housing assembly (20). If necessary, remove the reel clutch shoe (15) from the reel clutch actuator (16).

15. Remove the reel drive shaft assembly (12), ball bearing (10) and wave spring (9) from the transmission housing assembly (20). If necessary, disassemble the drive shaft assembly (12) as follows:

   A. Use a press to remove the ball bearings (10) from the reel drive shaft (12). Discard the bearings (10).

   B. Remove the retaining ring (11) from the reel drive shaft (12).
Disassembling the Transmission Gear Box Assembly (continued)

C. Slide and remove the slider spur gear (14) from the reel drive shaft (12).
D. Remove the two key squares (13) from the reel drive shaft (12).

16. Remove the nut (8) and long bearing pin (3) that secures the spur gear assembly (7) to the transmission housing assembly (20). Remove the spur gear (7) and bearing spacer (4) from the transmission housing assembly (20).

17. Remove and discard the O-ring (2) from the long bearing pin (3).

18. If necessary, disassemble the spur gear (7) as follows:
   A. Remove the 2 retaining rings (5) from the spur gear (7).
   B. Use a press and remove the 3 ball bearings (6) from the spur gear (7). Discard the ball bearings.

19. Remove the nut (8) and short bearing pin (1) that secures the spur gear assembly (17) to the transmission housing assembly (20). Remove the spur gear (17) and bearing spacer (4) from the transmission housing assembly (20).

20. Remove and discard the O-ring (2) from the short bearing pin (1).

21. If necessary, disassemble the spur gear (17) as follows:
   A. Remove the 2 retaining rings (5) from the spur gear (17).
   B. Use a press and remove the 2 ball bearings (6) from the spur gear (17). Discard the ball bearings (6).

22. Remove the thin lock nut (18) that secures the input shaft (19) to the transmission housing assembly (20). Slide and remove the input shaft.

23. Remove the ORB plug (item 8 in Figure 24), detent spring (9) and detent ball (10) from the transmission housing assembly (26).

24. Loosen and remove the groomer pin (item 20 in Figure 24) from the traction selector shaft (19).

25. Remove the retaining ring (item 1 in Figure 24), spacer bushing (2) and O-ring (3) from the traction selector shaft (19).

26. Slide and remove the traction selector shaft (item 19 in Figure 24) and O-ring (18) from the transmission housing assembly (26).

27. Remove oil seal (item 15 in Figure 24) and sleeve bushings (16) from the transmission housing (26). Discard the oil seal (15).

28. Remove the flange bushings (item 7 in Figure 24) from the transmission housing (26).

29. Remove the oil seals (item 6 in Figure 24), grease seals (11) and retaining ring (5) from the transmission housing (26). Discard the oil seals and grease seals.

30. Use a press and remove the ball bearings (items 12 and 25 in Figure 24) and spacer (13) from the transmission housing (26). Discard the ball bearings (12 and 25).
Assembling the Transmission Gear Box Assembly

1. Use a press to install the spacer (item 13 in Figure 24) and new ball bearings (12 and 25) into the transmission housing (26).

2. Install the retaining ring (item 5 in Figure 24) into the transmission housing (26).

3. Install the new grease seal (item 11 in Figure 24) into the transmission housing (26). Ensure that the seal lip is orientated toward the center of the transmission housing. Press the seal into the transmission housing bore so that the seal is flush to the edge of the transmission housing.

4. Install the new oil seal (item 6 in Figure 24) into the transmission housing. Ensure that the seal lip is orientated toward the center of the transmission housing. Press the seal into the transmission housing bore so that the seal is flush to the edge of the transmission housing.

5. Install the new oil seal (item 14 in Figure 24) into the transmission housing. Ensure that the seal lip is orientated toward the center of the transmission housing. Press the seal into the transmission housing bore so that the seal is flush to the edge of the transmission housing.

6. Press the flange bushings (item 7 in Figure 24) into the transmission housing (26).

7. Insert the sleeve bushing (Item 16 in Figure 24) into the transmission housing (26) until the sleeve bushing is flush with the transmission housing.

8. Press the oil seal (item 15 in Figure 24) into the transmission housing (26). Ensure that the oil seal lip is orientated toward the center of the transmission housing.

9. Apply a coat of grease to the O-ring seal (item 18 in Figure 24) and slide onto the groove of the traction selector shaft (19).

10. Insert the straight bushings (item 4 in Figure 24) into the transmission housing (26). Press the straight bushings into the transmission housing bore so that the bushings are recessed from the edge of the transmission housing.

11. Apply a coat of grease to the O-ring (item 18 in Figure 24) and slide onto the traction selector shaft (item 19 in Figure 24). Insert the traction selector shaft (item 19 in Figure 24) into the transmission housing (26).

12. Apply a coat of a grease to the O-ring (item 3 in Figure 24) and slide onto the groove of the traction selector shaft (19). Slide the spacer bushing (2) onto the traction selector shaft (19) and secure with a retaining ring (1).

13. Install the groomer pin (item 20 in Figure 24) onto the traction selector shaft (19).

14. Install the detent ball (item 10 in Figure 24), detent spring (9) and plug (8) into the transmission housing assembly (26).

15. Insert the input shaft (item 19 in Figure 26) into the transmission housing assembly (20) and secure with the thin lock nut (18). Torque tighten the thin lock nut to **47.5 to 61 N-m (35 to 45 ft-lbs)**.

16. Use a press to install the 2 new ball bearings (item 6 in Figure 26) into the spur gear (17) and secure with the 2 retaining rings (5).

17. Apply a coat of grease to the O-ring (item 2 in Figure 26) and slide the O-ring onto the short bearing pin (1). Install the spur gear assembly (17) and bearing spacer (4) onto the transmission housing assembly (20) and secure with the short bearing pin and nut (8).

18. Use a press to install the 3 new ball bearings (item 6 in Figure 26) into the spur gear (7) and secure with the 2 retaining rings (5).
Assembling the Transmission Gear Box Assembly (continued)

19. Apply a coat of grease to the O-ring (item 2 in Figure 26) and slide the O-ring onto the long bearing pin (3). Install the spur gear assembly (7) and bearing spacer (4) onto the transmission housing assembly (20) and secure with the long bearing pin (3) and nut (8).

20. Insert the square keys (item 13 in Figure 26) into the reel drive shaft (12) and apply a coat of grease to outside of the keys.

21. Slide the slider spur gear (item 14 in Figure 26) onto the reel drive shaft (12) and secure with the retaining rings (11). Press the new ball bearings (10) onto the reel drive shaft (12).

22. Install the wave spring (item 9 in Figure 26) and reel drive assembly (14) into the transmission housing assembly (20).

23. Insert the reel clutch shoe (item 15 in Figure 26) into the reel clutch actuator (16). Slide the reel clutch actuator (16) into the transmission housing assembly (20).

24. Assemble the brake lever assembly (item 19 in Figure 25) as follows:
   A. Apply a coat of grease to the O-ring (item 20 in Figure 25) and slide the O-ring onto the brake lever.
   B. Place the brake lever (item 19 in Figure 25) onto the brake band (18) and secure with the brake clevis pin (21) and retaining ring (17).

25. Slide and install the brake lever assembly (item 19 in Figure 25) into the transmission housing assembly (23).

26. If removed, insert the brake mount pin through brake band into the transmission housing assembly (item 23 in Figure 25), place the flat wire spring (22) and brake plate retainer (16) onto the transmission housing assembly.

27. Place the retainer plate pin (item 15 in Figure 25) onto the transmission housing assembly (23) and secure it with the 2 bolts (8).

28. Slide and install the external retaining ring (item 1 in Figure 25), cable brake lever (24) onto the brake lever (19) and secure it with the bolt (25).

29. If disassembled, assemble the differential assembly (item 14 in Figure 25); refer to Assembling the Differential Assembly (page 4–34).

30. Pack the differential assembly (item 14 in Figure 25) with grease and use a press to install the 2 ball bearing (13) and 2 flange bearings (12) into the differential assembly.

31. Apply a coat of grease to the 2 O-rings (item 10 in Figure 25) and slide the O-rings to the differential shafts (9). Install the retaining rings (11) onto the differential shaft (9).

32. Insert the 2 differential shafts (item 9 in Figure 25) into the differential housing (14).

33. Insert the differential housing assembly (item 14 in Figure 25) into the transmission housing assembly (23).

34. Insert the square keys (item 7 in Figure 25) into the neutral slider shaft (6). Apply a coat of grease to outer surface of the square keys (7).

35. Insert the neutral slider shaft (item 6 in Figure 25) into the neutral spur gear (5).

36. Use a press and insert the bearings (item 4 in Figure 25) onto the neutral slider shaft (6).
Assembling the Transmission Gear Box Assembly (continued)

37. Insert the wave washer (item 3 in Figure 25) and neutral spur gear assembly (5) into the transmission housing assembly (23). Make sure that the traction selector shaft (item 19 in Figure 24) is engaged in shift selection neutral spur gear (item 5 in Figure 25).

38. Apply a coat of grease to ORB plug (item 8 in Figure 24) and install the detent ball (10), detent spring (9) and ORB plug (8) into the transmission housing (26).

39. Torque tighten the ORB plug (8) from 3.6 to 4.7 N·m (32 to 42 in-lb).

40. Use a press and insert the ball bearing (item 25 in Figure 24) into the transmission cover (23). Install the retaining ring (5) and oil seal (6) into the transmission cover (23).

41. Ensure that the oil seal lip is orientated toward the center of the transmission housing. Press the seal into the transmission housing bore so that the seal is flush to the edge of the transmission housing.

42. Install the oil seal (item 14 in Figure 24) into the transmission cover (23).

43. Ensure that the oil seal lip is orientated toward the center of the transmission housing. Press the seal into the transmission housing bore so that the seal is flush to the edge of the transmission housing.

44. If removed, insert the 2 dowel pins (item 17 in Figure 24) into the transmission housing assembly (26).

45. Install the new transmission gasket (item 22 in Figure 24) and transmission cover assembly (23) onto the transmission housing (26) by aligning the holes. Secure the transmission cover assembly with 12 bolts (24) and torque tighten to 1.7 to 4.5 N·m (15 to 40 in-lb). Use an alternation pattern and torque tighten the bolts to 9.6 to 10.7 N·m (85 to 95 in-lb).

   Note: Transmission gear box assembly (26) must be leak free. Apply a pressure of 2.5 PSI for 30 seconds without dropping more than 1 PSI.

46. Fill the transmission gear box assembly (26) with 1 lb (16 oz) of Mobil AFT D/M oil.

47. Apply a coat of grease to the O-rings and insert onto the hollow hex plugs. Install the hollow hex plug (item 27 in Figure 24) into the transmission gear box assembly (26).

48. Torque tighten the hollow hex plug (27) from 12.4 to 14.7 N·m (110 to 130 in-lb).

49. Apply a coat of grease to the adapter-vent (29). Install the adapter-vent (29) into the transmission gear box assembly (26).

50. Torque tighten the adapter-vent (29) from 12.4 to 14.7 N·m (110 to 130 in-lb).

51. Install the breather-vent (30) into the adapter-vent (29). Tighten the breather-vent (30) until the gasket contacts the adapter-vent and then tighten an additional 75º to 85º turn.
Installing the Transmission Gear Box Assembly

**Note:** Refer to Figure 23 during this procedure.

1. Install the electric motor (22) and motor adaptor (18) onto the transmission gear box assembly (6) and secure with the two socket head screws (19).

2. Position the transmission gear box assembly (10) onto the frame assembly and secure with 2 bolts (9) and a socket head screw (19).

3. Install and adjust the slider adapter (7) until the neutral position is achieved and lock the position with jam nut (8) onto the transmission gear box assembly (10).

4. Install the splined couplers (2) to the drive shaft (5) and secure with truss screws (1), washers (3) and nuts (4). Torque tighten the truss screws to 10 to 12.4 N·m (90 to 110 in-lb).

5. If removed, install the reel cable; refer to Installing the Reel Cable (page 6–8).

6. Install the brake cable; refer to Installing the Brake Cable (page 6–5).

7. Connect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
Removing the Differential Assembly

To remove the differential assembly from the transmission gear box assembly; refer to Disassembling the Transmission Gear Box Assembly (page 4–23).
Disassembling the Differential Assembly

1. Remove the 6 socket head screws (item 5 in Figure 28) that secures the differential housing assembly (1) to the differential gear (4). Remove the differential gear from the differential housing assembly.

2. Place the differential housing assembly on workbench. Pull each differential housings (1) apart.

3. Use a press to remove the 6 differential pins (2) and 6 differential spur gears (3) from the differential housings (1).

Inspecting the Differential Assembly

1. Clean all the differential assembly components.

2. Inspect all the differential spur gears (3) carefully looking for chipped teeth, wear or other damage. Because gear tooth damage is rarely isolated to 1 gear, replace the gears as complete set if there is a internal damage.

3. Inspect the differential pins (2) for the scoring or wear.

4. Replace all the differential assembly components that are worn or damaged.
Assembling the Differential Assembly

1. Place the differential housings (1) on the work bench.
2. Insert the 3 differential pins (2) in each differential housing.

3. The differential pins (2) must be inserted in alternate holes of the differential housing (1) and ensure that the differential pins (2) are flush to the surface of the differential housing; refer to Figure 29.

4. Apply a coat of grease to the differential spur gears (3) and the differential pins (2).

5. Insert the differential spur gears (3) to the differential pins (2) by pointing the gears shoulder up.

6. Fill the differential housing assembly (1) with 0.08 lb (1.25 oz) of grease.

7. Attach the 2 differential housings (1) to each other.

8. Slide and install the differential housing assembly (1) into the differential gear (4) and secure with the 6 socket head screws (5).

9. In alternate pattern torque tighten the socket head screws (5) to 10 to 12.4 N·m (90 to 110 in-lb).

Installing the Differential Assembly

Install the differential assembly into the transmission gear box; refer to Assembling the Transmission Gear Box Assembly (page 4–28).
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General Information

The Greensmaster e1021 and e1026 machines use a 48 VDC electrical system that is an isolated circuit. The machine frame is not used for any ground connections.

After performing any repair on the machine electrical components, ensure that the wiring is routed and secured so as to prevent abrasion or contact with moving machine parts.

Operator's Manual

The Traction Unit Operator’s Manual and Lithium Battery Pack Charger Operator’s Manual provide information regarding the operation, general maintenance, and maintenance intervals for your Greensmaster machine and charger. Refer to these Operator’s Manuals for additional information when servicing the machine.

Electrical Schematics and Diagrams

Refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1).
Connecting the Lithium Battery Pack

⚠️ **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 battery, 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.
- Do not place anything in the battery connector other than the wire harness connector that came with the product.
- Only use the charger designed for the battery.

⚠️ **CAUTION** ⚠️

Always disconnect the batteries at the battery disconnect provided when servicing products with lithium-ion batteries. Failure to do so may result in personal injury and property damage.

---

To prevent unexpected machine operation during service, disconnect the machine from the battery pack as the first step in any repair (Figure 30). Once the battery pack has been disconnected, the electrical system on the machine can be safely worked on. During repairs, ensure that you do not allow tools or machine components to complete the battery circuit that was opened with the cable removal.

Connect the machine wire harness to the battery pack as the last step in any repair.

---

Figure 30

1. Machine connector
2. Battery pack
3. Battery connector

---

Greensmaster® e1021/e1026
20246SL Rev A

Page 5–3
Electrical System: General Information
Electrical System Operation

The Greensmaster machines use a 48 VDC lithium-ion battery pack to supply electrical power to the Toro electronic controller (TEC), an electric motor, and a main contactor. Circuit protection for this 48 VDC system includes 3 fuses that reside in the wire harness fuse block.

The battery pack provides a 48 VDC supply and includes a battery management system. The battery management system uses CAN communication with the TEC and battery charger.

A Toro Electronic Controller (TEC) is used on the e1021/e1026 machines to manage the machine electrical functions. The controller is microprocessor controlled that senses the condition of various switches (inputs) and directs electrical power to control appropriate machine functions (outputs) based on the inputs.

The electric motor used on the machine is a 48 VDC, brushless, permanent magnet DC motor. The motor has its own integral controller. The machine TEC provides motor direction with communication via the CAN-bus system. The motor provides power for the traction drum and cutting unit when engaged by the operator.

The main contactor exists in the electrical system to connect the battery pack to the electric motor. The TEC determines when the main contactor should be engaged.

Control for the components in the electrical system is handled by integral controllers in the battery pack and electric motor along with direction from the machine TEC via the CAN-bus system.

The InfoCenter display provides information to the operator during the operation of the machine, provides electrical system diagnostic assistance for the technicians, and allows inputs for the adjustable machine settings. The status of TEC inputs and outputs can be monitored with the InfoCenter display.

The 48 VDC system is an isolated system so that the machine frame is not used for any ground connections on the e1021/e1026 machine. A set of connectors are included on the machine, which can be used to disconnect the machine wire harness from the battery pack to prevent unexpected machine operation when performing service.

**Note:** Information about individual electrical components in the electrical system is included in Testing the Electrical Components (page 5–21).

Battery Charging

The lithium ion battery pack requires regular charging that is provided by the lithium battery pack charger. The output voltage and current of the charger are controlled with CAN communication with the battery management system. Ensure that the charger is connected to the battery pack whenever the machine is not in use.

Refer to the 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.
Start Process

When the key switch is turned to the ON position, the machine electrical system goes through a wake-up process. The contactor in the battery pack should click as it is energized followed by the main contactor being energized (audible click). Both the TEC and electric motor controller will be initialized. Once the InfoCenter display comes on-line and the machine will be ready for operation.

Run Process

The traction bail lever controls the traction speed potentiometer. This traction speed potentiometer is used as an input by the TEC which communicates to the electric motor to engage. The motor rotation speed and traction speed is determined by the throttle potentiometer setting that is adjusted by the operator. Actual motor speed is monitored by the TEC and motor controller so that as traction load changes (e.g., moving up or down an incline) the motor can compensate as necessary.
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 CAN bus system reduces the number of electrical components and connections used on the machine and allows the number of wires in the wire harness to be significantly reduced.

The InfoCenter, lithium-ion battery controller (BMS - Battery Management System), electric motor controller and TEC are on the CAN bus. Additional controllers may be added to the CAN bus in the future through the expansion port connector and/or the telematics connector.

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

Two specially designed, twisted wires form the CAN bus. These wires provide the data pathways between the components on the network. The engineering term for these cables are CAN High and CAN Low. The CAN bus wires are red/white (CAN-High) and black/white (CAN-Low). At end of the CAN bus is a 120 ohm termination resistor; refer to CAN-bus Terminator Resistor (page 5–38).

The Toro DIAG electronic control diagnostics service system is available to Authorized Toro Distributors to support machine fault diagnosis and maintenance services of the machine electrical control devices. The Toro DIAG connector is located inside the upper cover assembly; refer to Figure 31.
The Greensmaster machine uses a Toro Electronic Controller (TEC) to manage the machine electrical functions. The controller is a microprocessor controlled device that senses the condition of various switches (inputs) and directs electrical power to control the appropriate machine functions (outputs) based on the inputs. The status of inputs to the controller as well as outputs from the controller can be monitored with the InfoCenter display on the console. If a problem exists that could prevent normal operation, the InfoCenter display will display an operator advisory or fault code to assist in identifying the problem.

The TEC is attached to the battery mount inside the battery cover; refer to Figure 32.

**IMPORTANT**

Before performing any welding on the machine, do the following to prevent damaging the electrical system of the machine:

- Disconnect the machine connector from the lithium battery pack.
- Disconnect the wire harness connectors from the Toro Electronic Controller.

**Note:** If the TEC is replaced for any reason, the machine software must be updated; contact an Authorized Toro Distributor for assistance.
The machine uses a Lithium-ion battery controller or Battery Management System (BMS) to manage the lithium-ion batteries. The lithium-ion battery communicate with the BMS through a sub-net via the battery interface harness. The battery interface harness includes a 4-pin connector at the battery and a 9-pin connector at the BMS. The BMS uses the sub-net to verify the presence and condition of the battery 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 attached to the battery mount inside the battery cover.

The Lithium-ion battery controller (BMS):

1. Monitors the battery via a sub-net (battery interface harness).
   
   **Note:** The battery interface harness connections must be corrosion free and securely connected before machine operation can occur.

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

3. Operates an internal contactor to connect and disconnect the battery from the machine and the battery charger.
   
   **Note:** When the key switch is set to the Off position, the BMS delays disconnecting the battery from the machine for approximately 3 seconds to allow time for all of the other machine controllers to shut down.

4. Communicates battery information to the machine during operation via the CAN bus.

5. Communicates battery information to the battery charger via the CAN bus.

6. 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 Testing the Lithium-Ion Battery Controller (page 5–28) for more information.
Lithium-Ion Battery Controller (BMS) (continued)

**IMPORTANT**

Do not open the lithium-ion battery controller. There are no serviceable parts on or in the lithium-ion battery controller case. If you open the controller case, you will void the warranty. The controller case is protected by tamper-alerting devices. Opening the controller case may result in personal injury and property damage.

**Note:** If the Lithium-Ion Battery Controller is replaced for any reason, the machine software must be updated; contact an Authorized Toro Distributor for assistance.
The InfoCenter display used on your Greensmaster e1021/e1026 is a LCD device that is located on the handle console (Figure 34). The InfoCenter provides information to the operator during the operation of the machine, provides electrical system diagnostic assistance for the technicians, and allows inputs for the adjustable machine settings.

Power for the InfoCenter is available when energized by the TEC (the key switch is in the ON position). A CAN-bus system involving the TEC, electric motor controller, and lithium-ion battery pack provides necessary machine communication for the InfoCenter operation.

**Note:** Icons that are used on the InfoCenter display are identified in the *Traction Unit Operator’s Manual*.

**Note:** If the InfoCenter display is replaced for any reason, the machine software must be updated; contact an Authorized Toro Distributor for assistance.
KEY SWITCHED
ON

SPASH SCREEN

AFTER 5 SECONDS

MAIN INFORMATION SCREEN

MAIN MENU SCREEN

Faults
Service
Diagnostics
Settings
About

FAULTS SCREEN

Cleared @ Hours Ago
Code # Hours Ago
Clear System Faults

SERVICE SCREEN

Service
Hours:
Power Use:
Watts
Battery Charge:
%
Battery Current:
Amps
Battery Volts:
Volts
Total Usage:
A-H
Capacity:
A-H
Charge Cycles:
No.
Battery Hours:
No.
Backlap

DIAGNOSTICS SCREEN

Diagnostics
Key On:
ON
Key Start:
ON
Traction:
OFF
Throttle:
Volts
Target RPM:
RPM
Motor RPM:
RPM
12V:
Volts
+5V:
Volts
CAN:
Normal
Traction:
Volts

SETTINGS SCREEN

Settings
Language:
Language
Units:
Eng/Metric
Backlight:
%
Contrast:
%

ABOUT SCREEN

About
Model:
XXXXX
Serial No:
XXXXXXXXXX
SW Rev:
XX

Software Version 139-9704 Rev G shown

Figure 35
When the key switch is initially turned to the ON position, the fault indicator illuminates for a few seconds to verify indicator operation and the InfoCenter splash screen appears (Figure 36). The splash screen provides the hour meter information.

After the splash screen has been displayed for 5 seconds, the main information screen will appear on the InfoCenter screen.
Main Information Screen (continued)

The InfoCenter main information screen (Figure 37) is displayed after the initial splash screen has been displayed for 5 seconds. The main information screen is the default screen as it will be displayed during normal machine operation. The main information screen provides the following information to the operator:

- Battery charge indicator
- Speed control setting

If an electrical machine fault occurs, the InfoCenter fault indicator will blink to notify the operator and a descriptive message will be displayed. Also, the fault log indicator on the InfoCenter screen will be displayed to notify the operator that recent machine faults have occurred. Accessing the fault log is described below in the Faults Screen (page 5–15).

![Figure 38](image)

Figure 38

1. Main menu  
2. Left/right button  
3. Down button  
4. Menu/back button  
5. Menu items

The main menu and additional information screens can be accessed from the InfoCenter main information screen by pressing and releasing the menu/back button (as indicated by the symbol at the bottom of the screen) on the display. Once to the main menu screen (Figure 38), navigation to the menu items can occur. For information on the main menu and menu item screens; refer to Main Menu Screen (page 5–14).
Operator advisories are automatically displayed by the InfoCenter when a machine function requires additional action (Figure 39). An advisory will not be logged into the fault log. (Refer to Operator Advisories (page 3–3)).

Main Menu Screen

The main menu screen can be accessed from the InfoCenter main information screen by pressing and releasing the menu/back button (as indicated by at the bottom of the screen) on the display. Once to the main menu screen (Figure 40), navigation to the 5 different menu items can occur.

The main menu screen provides access to the following menu screens:

- Faults
- Service
- Diagnostics
Main Menu Screen (continued)

- Settings
- About

Press the down button (as indicated by the $\downarrow$ at the bottom of the screen) to highlight the desired menu screen, then press the left/right button (as indicated by the $\rightarrow$ at the bottom of the screen) to enter the highlighted menu screen.

To return to the main information screen from the main menu screen, press the menu/back button (as indicated by the $\square$ at the bottom of the screen).

Faults Screen

![Image of Faults Screen]

Figure 41

1. Left/right button
2. Down button
3. Menu/back button
4. Fault items
5. Fault menu

The faults screen (Figure 41) will list all the machine electrical faults that have occurred since the faults were last cleared from the InfoCenter. The faults will be identified by a number and when the fault occurred. The faults that might occur on the e1021/e1026 machine are listed in the Machine Faults (page 3–5).

The InfoCenter fault log can be cleared by selecting the clear system faults menu item. The cleared faults will be removed from the InfoCenter but will be retained in the TEC memory.

If a fault occurs during machine use, there may be a change in machine functionality due to the fault. Should there be machine operation issues due to a fault, a first step to remedy the issue would be to move the traction lever to the NEUTRAL position, turn the key switch to the OFF position, and allow all the machine functions to stop. Then, attempt to restart the machine to see if operation has returned to normal. Some faults will be reset during the restart and will then allow normal function. If a fault continues to occur, further system evaluation and possible component repair or replacement will be necessary.

To return to the main menu screen from the faults screen, press the menu/back button (as indicated by the $\square$ at the bottom of the screen).
The service screen (Figure 42) contains the following machine information:

- **Hours** (hours that the key switch has been in the ON position)
- **Power use** (power delivery by battery in watts)
- **Battery charge** (percent of battery capacity)
- **Battery current** (amps delivered by battery)
- **Battery volts** (battery potential in volts)
- **Total usage** (total usage of the battery over its entire life in Amp-hours)
- **Capacity** (total capacity of the battery in Amp-hours)
- **Charge cycles** (Total number of charge cycles)
- **Battery hours** (Total number of hours of battery usage)
- **Backlap** (Enable/disable the backlap)

Values listed for service menu items cannot be changed.

To return to the main menu screen from the service screen, press the menu/back button (as indicated by the \[\text{Edit}\] at the bottom of the screen).
The diagnostics screen (Figure 43) lists the various states of the machine electrical components. The diagnostics screen should be used to check the operation of the machine switches and controls.

**IMPORTANT**

When using the diagnostics screen, ensure to have the machine on kickstand to prevent unexpected machine movement as switches and controls are moved.

**Note:** Some of the component states may have description available when using the diagnostics screen. If an arrow icon is shown on the screen, pressing the left/right button (as indicated by the ➔ at the bottom of the screen) will display the description if available.

The diagnostics screen includes the following:

- **Key On** identifies that the key switch is in the RUN position.
- **Key Start** indicates that the key switch is in the START position or not.
  
  **Note:** The key start position can be verified in the diagnostics screen by rotating the switch to the START position. The motor will re-initialize.
- **Traction** identifies that the traction lever is engaged or not engaged.
- **Throttle** identifies the throttle control setting (in volts) that is used by the TEC to determine the electric motor speed. Movement of the throttle lever should change the setting. Voltage for throttle settings should range from 0.35 to 4.80 VDC depending on the throttle lever location.
- **Target RPM** lists the desired electric motor RPM based on the speed control setting. Rotating the speed wheel should change the setting.
- **Motor RPM** identifies the actual electric motor RPM. The motor RPM should be very close to the Target RPM.
- **12V Supply** indicates the supplied voltage available for the 12 VDC circuits. The 12V Supply should typically be slightly higher than 12.0 VDC.
Diagnostics Screen (continued)

- **5V Supply** indicates the supplied voltage available for the 5 VDC circuit. The 5V Supply should typically be slightly higher than 5.0 VDC.
- **CAN** identifies whether the machine communication bus status is normal or not.
- **Traction** identifies the traction bail lever setting (in volts) that is used by the TEC to determine the electric motor speed. Movement of the traction bail lever should change the setting. Voltage for traction bail lever settings should range from 0.35 to 4.80 VDC depending on the traction bail lever location.

To return to the main menu screen from the diagnostics screen, press the menu/back button (as indicated by the \[ \] at the bottom of the screen).

**Settings Screen**

![Figure 44](image)

1. Left/right button
2. Down button
3. Menu/back button
4. Settings items
5. Settings menu

The settings screen (Figure 44) identifies the InfoCenter language and units (English or Metric). The settings screen also allows the operator to customize the backlight (brightness) and contrast settings for the InfoCenter display.

**Units:** Use the left/right button (as indicated by the \[ \] at the bottom of the screen) to select between metric or English units of measure. Allow the desired selection to remain in view for 5 seconds.

**Language:** Use the left/right button (as indicated by the \[ \] at the bottom of the screen) to select from numerous language options. Allow the desired selection to remain in view for 5 seconds.

**Backlight:** Press the left/right button (as indicated by the \[ \] at the bottom of the screen) then use the down button to decrease or the left/right button to increase the InfoCenter display brightness (as indicated by the – and the + at the bottom of the screen).

**Contrast:** Press the left/right button (as indicated by the \[ \] at the bottom of the screen) then use the down button to decrease or the left/right button to increase the InfoCenter display contrast (as indicated by the – and the + at the bottom of the screen).

To return to the main menu screen from the settings screen, press the menu/back button (as indicated by the \[ \] at the bottom of the screen).
About Screen

Figure 45

1. Left/right button  
2. Down button  
3. Menu/back button  
4. About items  
5. About menu

The about screen (Figure 45) identifies the machine model number, serial number, and TEC software revision.

To return to the main menu screen from the about screen, press the menu/back button (as indicated by the button at the bottom of the screen).
Adjustments

Traction Bail Proximity Sensor

1. Park the machine on a level surface. Ensure that the key switch is in OFF position and the traction control is in NEUTRAL.
2. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
3. Remove the bolts and washers that secures the control cover to the handle assembly. Remove the control cover from the machine.
4. Get access to the proximity sensor. Pull up and release the traction bail.
5. When the bail is open, adjust the proximity sensor gap to **2.3 to 3.8 mm (0.09 to 0.15 in)**.
6. If the clearance is incorrect, loosen the proximity sensor jam nuts and adjust the clearance.
7. After achieving the required clearance, torque tighten the proximity sensor jam nuts to **18.3 to 22.3 N·m (13.5 to 16.5 ft-lb)**.
8. Install the control cover to the handle assembly and secure with bolts and washers.
9. Connect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
Testing the Electrical Components

Whenever possible, check the component circuit operation with the InfoCenter display on the console. With the key switch in the ON position, use the InfoCenter diagnostics menu to ensure that the component state changes as the component is toggled. This quick check identifies that the component and circuit wiring are working as designed. If the InfoCenter operation suggests that a component circuit is not functioning correctly, proceed to the appropriate component testing procedure found in this section. If the test procedure identifies no problem with the component, carefully inspect the wire harness and connectors for problems.

The Greensmaster uses a 48 VDC electrical system that is an isolated circuit. The machine frame is not used for any ground connections.

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 on switch). Individual components should be electrically isolated (e.g., disconnect all the leads or remove the leads from the circuit) from the circuit when tested.

⚠️ CAUTION ⚠️

When testing a machine electrical component for continuity with a multimeter (ohms setting), ensure that the component is disconnected from the machine wire harness to prevent current flow through the component.

⚠️ CAUTION ⚠️

Remove all the jewelry, especially rings and watches, before doing any electrical troubleshooting or testing. Disconnect the lithium battery pack to open the battery circuit before working on the electrical system.
Fuses

A group of fuses are used to protect the 12 VDC and 48 VDC systems and are located under the battery cover.

Accessing the Fuse

1. Park the machine on a level surface and make sure that the clutch bail in the NEUTRAL position. Turn the key switch to the OFF position and remove the key from the key switch.
2. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
3. Remove the 4 bolts that secures the battery cover to the battery mount; refer to Figure 47. Remove the battery cover from the battery mount.

Fuse Identification and Function

Refer to Figure 48 to identify each individual fuse and its correct amperage. The fuses for the Greensmaster e1021/e1026 machines have the following functions:

Fuse F1-1 (30 A): Protects main power supply circuits.
Fuse F1-2 (3 A): Protects logic power supply circuits.
Fuse F1-3 (3 A): Protects optional LED work light circuit.
Fuse F1-4: This fuse block position is open.
Testing the Fuse

1. Access the fuse block as described above.
2. Carefully remove the fuse from the fuse block for testing.
3. The fuse should have continuity between the fuse terminals.

---

**IMPORTANT**

The e1021/e1026 machine uses special fuses that are rated for 80 V. If the fuse replacement is necessary, ensure to use the fuses as identified in your e1021/e1026 Parts Catalog. Do not use regular automotive fuses in your e1021/e1026 machine.

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4. Carefully install the functional fuse into the fuse holder.
5. After you complete the fuse service, secure the battery cover to the machine with the 4 bolts.
6. Connect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
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 CAN bus system reduces the number of electrical components and connections used on the machine and allows the number of wires in the wire harness to be significantly reduced.

The InfoCenter, lithium-ion battery controller (BMS - Battery Management System) and TEC are on the CAN bus. Additional controllers may be added to the CAN bus in the future through the expansion port connector and/or the telematics connector.

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

Two specially designed, twisted wires form the CAN bus. These wires provide the data pathways between the components on the network. The ering term for these cables are CAN High and CAN Low. The CAN bus wires are red/white (CAN High) and black/white (CAN Low). At each end of the CAN bus is a 120 ohm termination resistor; refer to CAN-bus Terminator Resistor (page 5–38).

Testing the CAN bus

1. Park the machine on a level surface and make sure that the clutch bail in the NEUTRAL position. Turn the key switch to the OFF position and remove the key from the key switch.
2. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
3. The Toro DIAG connector is located inside the upper cover assembly; refer to Figure 49.
Testing the CAN bus (continued)

<table>
<thead>
<tr>
<th>Harness</th>
<th>Connector</th>
<th>Pin</th>
<th>Wire Color</th>
<th>Expected Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main</td>
<td>P14</td>
<td>A</td>
<td>Yellow</td>
<td></td>
</tr>
<tr>
<td>Main</td>
<td>P14</td>
<td>B</td>
<td>Green</td>
<td>54 to 66 ohms</td>
</tr>
</tbody>
</table>

**Note:** A reading of 120 ohms indicates the CAN bus terminator resistor is not connected or damaged.

4. Refer to CAN-bus Terminator Resistor (page 5–38) and/or see electrical schematic and wire harness drawing in Appendix A (page A–1). If necessary, contact an Authorized Toro Distributor for assistance.
The Greensmaster machine uses a Toro Electronic Controller (TEC) to manage the machine electrical functions. The controller is a microprocessor-controlled device that senses the condition of various switches (inputs) and directs electrical power to control the appropriate machine functions (outputs) based on the inputs. The status of inputs to the controller as well as outputs from the controller can be monitored with the InfoCenter display on the console. If a problem exists that could prevent normal operation, the InfoCenter display will display an operator advisory or fault code to assist in identifying the problem.

The TEC is attached to the battery mount inside the battery cover; refer to Figure 51.

**IMPORTANT**

**Before performing any welding on the machine, do the following to prevent damaging the electrical system of the machine:**

- Disconnect the machine connector from the lithium battery pack.
- Disconnect the wire harness connectors from the Toro Electronic Controller.

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

The inputs from the key switch, traction switch, throttle potentiometer, and clutch bail potentiometer are all monitored by the TEC.

The TEC current output to the electric motor precharge circuit, main contactor, 12 VDC outputs (InfoCenter display and optional hour meter), and 5 VDC output (throttle potentiometer and clutch bail potentiometer) are controlled based on the inputs received by the controller.
The diagram in Figure 52 depicts the connection terminal functions of the TEC. Two wire harness connectors attach to the controller with each of the connectors including 12 pins. The connector pins are listed in the diagram.

The InfoCenter display should be used for checking inputs and outputs of the controller used on your Greensmaster (refer to InfoCenter Display (page 5–10)). The InfoCenter display can also be used to identify faults and operator advisories that indicate operation issues with the machine.

Because of the solid state circuitry built into the controller, there is no method to test it directly. The controller may be damaged if an attempt is made to test it with an electrical test device (e.g., digital multimeter).
Lithium-Ion Battery Controller (BMS)

1. Lithium-ion battery controller

The machine uses a Lithium-ion battery controller or Battery Management System (BMS) to manage the lithium-ion battery. The lithium-ion battery communicate with the BMS through a sub-net via the battery interface harness. The battery interface harness includes a 4-pin connector at the battery and a 9-pin connector at the BMS. The BMS uses the sub-net to verify the presence and condition of the battery 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 attached to the battery mount inside the battery cover.

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

Testing the Lithium-Ion Battery Controller
Testing the Lithium-Ion Battery Controller (continued)

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 54.

1. With the battery connected to the BMS, the battery pack voltage can be tested across the BMS B+ and B- terminals.

2. With the battery connected to the BMS, signal voltage from the BMS to the key switch can be tested at the controller wire harness connector pin 6 and the BMS B- terminal.

3. 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.

4. Once the BMS internal contactor has closed, battery pack voltage can be tested across the BMS positive (+) and negative (–) terminals.

5. 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 pins 3 and 4, the normal resistance must be 50k to 55k ohms.
Electric Motor

The electric motor is a 48 VDC, brushless, permanent magnet motor. The electric motor has its own on-board controller (T5). If a problem exists with the electric motor, a fault may have occurred that would be indicated by a fault code on the InfoCenter Display. Before considering that electric motor service work is necessary, check for any existing fault codes that indicate problems with the electric motor; refer to Machine Faults (page 3–5). If the electric motor is faulty, there will likely be numerous fault codes that are listed by the InfoCenter display.

To operate, the electric 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 electric motor controller is not serviceable. Refer to Appendix A (page A–1) for circuit wiring information.

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

**Testing the Electric Motor**

1. Park the machine on a level surface and make sure that the clutch bail in the NEUTRAL position. Turn the key switch to the OFF position and remove the key from the key switch.

2. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).

3. Locate and disconnect the electric 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.

4. Use a multimeter (ohms setting) measure the resistance between the ground terminal (black wire) and the pin two in four pin connector. Resistance should be approximately 18.8 K-ohms.

![Figure 56](image)

**Figure 56**

- 1. Electric motor connector – 2 pin
- 2. Ground terminal
- 3. Electric motor connector – 4 pin
- 4. Pin 2

5. If electric motor removal, installation, disassembly or assembly is required; refer to Electric Motor (page 5–41).

6. 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).

7. After testing is complete, secure the electric motor wire harness connectors.

8. Connect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
Key Switch

Figure 57

1. Screw (4 each) 4. InfoCenter mount
2. InfoCenter display 5. Key switch
3. Key 6. Handle

The key switch allows the machine operation to be turned on and off. The key switch has 3 positions: OFF and ON. This switch is 1 of the several inputs for the TEC and is located on the InfoCenter mount (Figure 57).

Check the key switch operation with the InfoCenter on the console. With the key switch in the ON position, the InfoCenter should allow the information screen to be displayed. If the InfoCenter operation suggests a damaged key switch, proceed to the key switch testing below.

**Note:** If the e1021/e1026 machine is sitting idle for 5 minutes with the key switch in the ON position, the machine will shut off.

**Note:** A damaged key switch may cause a #12 fault to be generated and displayed on the InfoCenter. Refer to the Faults Screen (page 5–15) for information on faults.

**Testing the Key Switch**

1. Park the machine on a level surface and make sure that the clutch bail in the NEUTRAL position. Turn the key switch to the OFF position and remove the key from the key switch.

2. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).

3. Remove the InfoCenter mount from the handle to access the key switch; refer to Figure 57.

4. Disconnect the wire harness electrical connector from the key switch.
5. With the use of a multimeter (ohms setting), test the switch functions to determine if continuity exists between the various terminals for each switch position. The switch terminals are marked as shown in Figure 58. The circuitry of the key switch is shown in the Circuit Logic Table (page 5–32). Check the continuity between the switch terminals.

Circuit Logic Table

<table>
<thead>
<tr>
<th>Switch Position</th>
<th>Circuits</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>None</td>
</tr>
<tr>
<td>ON</td>
<td>B+C+F, D+E</td>
</tr>
<tr>
<td>START</td>
<td>A+B+C</td>
</tr>
</tbody>
</table>

6. Replace the key switch if necessary.

7. After you complete the testing, connect the wire harness electrical connector to the key switch.

8. Install the InfoCenter mount to the handle; refer to Figure 57.

9. Connect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
The throttle and clutch bail potentiometers controls the electric motor speed which determines the traction speed. The TEC uses the potentiometers setting as an input to determine the necessary signal output for the motor controller for correct electric motor speed. The throttle potentiometer is attached to the bottom handle cover and clutch bail potentiometer is attached to the upper receiver weldment; refer to (Figure 59).
Checking the Operation of Throttle and Clutch Bail Potentiometers

Check the operation of throttle and clutch bail potentiometers with the InfoCenter. With the key switch in the ON position and the InfoCenter in the diagnostics menu, choose the Throttle and ensure that the displayed voltage changes as the speed wheel is rotated. Further potentiometer testing is necessary only if the displayed voltage does not change when using the InfoCenter.

Testing the Throttle and Clutch Bail Potentiometers

1. Park the machine on a level surface and make sure that the clutch bail in the NEUTRAL position. Turn the key switch to the OFF position and remove the key from the key switch.

2. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).

3. Remove the handle cover from the handle to get access to the throttle and clutch bail potentiometers.

4. Disconnect the machine wire harness connector from the potentiometer to be tested, and remove the potentiometer from the machine (Figure 59).

   **Note:** Before taking the small resistance readings with a digital multimeter, short the multimeter test leads together. The meter displays a small resistance value (usually 0.5 ohms or less). This resistance is because of the internal resistance of the multimeter and test leads. Subtract this value from the measured value of the component that you are testing.

   ![Figure 60](image)

   **Figure 60**

   1. Terminal A
   2. Terminal B
   3. Terminal C

5. Use a multimeter, measure the resistances between the potentiometer terminals as follows (Figure 60).

   A. Check that the resistance between the terminals B and C is approximately 5,000 ohms. Record the measured resistance.

   B. Measure the resistance between the terminals A and C and then measure the resistance between the terminals A and B. Record these resistances. The total of the 2 measured resistances should be approximately 5,000 ohms.

   C. Rotate the reel speed potentiometer to other settings and repeat the step B. The total of the 2 resistances should consistently be approximately 5,000 ohms.

   D. If measured resistances are incorrect, replace the speed control potentiometer.
Testing the Throttle and Clutch Bail Potentiometers (continued)

6. After you complete the testing, secure the potentiometers to the machine (Figure 59). Secure the wire harness connector to the potentiometer. Secure the handle cover to the handle.

**Note:** When re-installing the potentiometers, a minimum voltage reading of 0.5V for proper function is required. This can be read in the InfoCenter. The adjustment is completed by rotating the potentiometers in the mounting slots until the minimum voltage at the neutral position is achieved.

7. Connect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
Main Contactor

The Greensmaster e1021/e1026 machines use the main contactor to connect the lithium battery pack and the electric motor. The contactor is energized by the TEC.

The contactor is attached to the battery mount under the battery cover; refer to Figure 61.

**Note:** When the key switch is turned to the ON position, the contactor inside the battery pack will be energized followed shortly by the main contactor being energized. There should be an audible click as each of these contactors are energized.

**Note:** A damaged main contactor may cause a #16 fault to be generated and displayed on the InfoCenter. Refer to the Faults Screen (page 5–15) for information on faults.

**Testing the Main Contactor**

1. Park the machine on a level surface and make sure that the clutch bail in the NEUTRAL position. Turn the key switch to the OFF position and remove the key from the key switch.

2. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).

3. Remove the four bolts that secures the battery cover to the battery mount. Remove the battery cover from the machine.
Testing the Main Contactor (continued)

1. Main contact post
2. Coil post

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.

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

6. With the contactor coil not energized, resistance across the contactor main terminals should be infinite ohms.

7. If testing determines that the main contactor is damaged, ensure that the battery pack is disconnected and then replace the main contactor.

8. After you complete the main contactor testing, install the battery cover onto the battery mount. Secure the battery cover with four bolts.

9. Connect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
The system communication between the electrical components on the Greensmaster e1021/e1026 machines are accomplished on a CAN-bus communication system. The 2 specially designed, twisted cables form the bus for the networks used on the e1021/e1026. These wires provide the data pathways between the machine components. At the ends of the twisted pair of bus cables are 120 ohm terminator resistors.

The resistors plug into the wire harness in the following areas:

1. On the main wire harness under the key switch, inside the handle cover.
2. On the main wire harness near the TEC controller.

**Note:** Refer to the Electrical Schematic and Wire Harness Drawings in Appendix A (page A–1) for additional information on the terminator resistor locations and wire connections.

**IMPORTANT**

The terminator resistors at the ends of the bus cables are required for proper electrical system operation.

**Testing the CAN-bus Terminator Resistor**

1. The CAN-bus terminator resistor (Figure 63) can be tested using a digital multimeter (ohms setting). Locate the CAN-bus terminator resistor and remove the cable tie that secures the resistor to the wire harness. Unplug the resistor from the wire harness for testing.
2. Check the resistor and resistor holder for damage or corrosion and clean or repair if necessary.
3. Use a digital multimeter (ohms setting) to measure the resistance value for the CAN-bus terminator resistor. There should be 120 ohms resistance between the terminals 1 and 2.
4. If the testing determines that the CAN-bus terminator resistor is damaged, replace the CAN-bus terminator resistor.
5. After you complete the testing, ensure that the CAN-bus terminator resistor is fully installed into the wire harness connector and secured to the wire harness with cable tie.
6. If the resistor test correctly and a circuit problem still exists, check the CAN-bus; refer to Testing the CAN bus (page 5–24), wire harness drawings in Appendix A (page A–1) for additional information, or contact an Authorized Toro Distributor for assistance.
The relay used on the e1021/e1026 machine is 4 terminal 48 V relay and located inside the battery cover and next to TEC controller; refer to Figure 64.

Testing the Relay

1. Park the machine on a level surface and make sure that the clutch bail in the NEUTRAL position. Turn the key switch to the OFF position and remove the key from the key switch.
2. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
3. Remove the four bolts that secures the battery cover to the battery mount. Remove the battery cover from the machine.
4. Disconnect the machine wire harness connector from the relay. Remove the relay from the machine for ease of testing.

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

5. Using a multimeter (ohms setting), measure the coil resistance between terminals 85 and 86. The resistance should be from 990 to 1210 ohms.

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 +48 VDC to terminal 85 of the relay. The 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. Install the battery cover onto the battery mount. Secure the battery cover with four bolts.

12. Connect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
Service and Repairs

Electric Motor

Figure 66

1. Frame assembly
2. Transmission gear box assembly
3. Socket head screw (4 each)
4. Motor adaptor
5. Socket head screw (3 each)
6. Closed cell foam seal
7. Key
8. Electric motor

Note: A damaged electric motor assembly may cause a #6, #7, #8, #9, or #10 fault to be generated and displayed on the InfoCenter display. Refer to the Faults Screen (page 5–15) for information on faults.

Removing the Electric Motor

1. Park the machine on a level surface and make sure that the clutch bail in the NEUTRAL position. Turn the key switch to the OFF position and remove the key from the key switch.
2. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
3. Disconnect the electric motor connections from the machine wire harness.
4. Support the electric motor to prevent it from falling.
Removing the Electric Motor (continued)

5. Remove the 4 socket-head screws (item 3 in Figure 66) that secure the electric motor to the motor adaptor (4).

6. Carefully slide the electric motor from the transmission, and remove the motor from the machine.

7. Remove the key (7) from the motor shaft.

8. Remove and discard the closed cell foam seal (item 6 in Figure 66) from the motor shaft.

Installing the Electric Motor

1. Install the closed cell foam seal (6) onto the electric motor shaft.

2. Apply a coat of anti-seize to the key (7) and install the key onto the motor shaft.

3. Position the electric motor to the transmission, align the key of the motor shaft to the transmission coupler, and insert the motor shaft into the coupler. Slide the motor fully to the motor adaptor (4).

4. Secure the electric motor to the motor adaptor (4) with the 4 socket-head screws (3).

5. Connect the electric motor connections to the machine wire harness.

6. Connect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
Servicing the Electric Motor

Figure 67

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, controller, or cable damage occurs, the electric motor replacement is necessary. These components are not available separately.

**Note:** If problems with electric motor exist, an advisory or fault may be identified on the InfoCenter display. Refer to the InfoCenter Display (page 5–10) for information on advisories and faults.

Use of the motor rotor tool part number TOR6028 is recommended for this procedure: refer to Special Tools (page 2–13).

**Note:** When servicing the electric 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.

Disassembling the Electric Motor

Refer to Figure 67 for this procedure.

1. Inspect the electric motor cable for wear or damage. Replace cable components or complete electric 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.
Disassembling the Electric Motor (continued)

![Image of electric motor components]

**Figure 68**

1. Electric motor housing  
2. Motor rotor tool base plate  
3. Motor rotor tool shaft  
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.  
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 electric motor components for wear or damage. Replace components or complete electric motor assembly if necessary.

Assembling the Electric Motor

Refer to Figure 67 for 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 Electric 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.

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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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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.
Removing and Installing Lithium-Ion Battery Controller (BMS)

**CAUTION**

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

Do not open the lithium-ion battery controller. There are no serviceable parts on or in the lithium-ion battery controller case. If you open the controller case, you will void the warranty. The controller case is protected by tamper-alerting devices. Opening the controller case may result in personal injury and property damage.

1. Park the machine on a level surface and make sure that the clutch bail in the NEUTRAL position. Turn the key switch to the OFF position and remove the key from the key switch.

2. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).

3. Remove the four bolts that secures the battery cover to the battery mount. Remove the battery cover from the machine.

4. Label and disconnect the negative (−) battery cable, positive (+) battery cable from the lithium-ion battery controller B- and +B terminals.

5. Label and disconnect the battery interface harness and the machine wire harness connector from the lithium-ion battery controller M-S and COM terminals.

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

7. Remove the four nuts, bolts and washers that secures the BMS to battery mount.

8. Carefully remove the BMS from the machine.
Removing and Installing Lithium-Ion Battery Controller (BMS) (continued)

**CAUTION**

Pay close attention to the lithium-ion battery controller orientation during installation. Ensure that the lithium-ion battery controller is installed in the proper orientation prior to connecting any cables. Failure to do so may result in personal injury and property damage.

9. Install the lithium-ion battery controller in reverse order. Install the controller with the positive (+) terminals upward; refer to Figure 69 and Figure 71.

10. Tighten the power supply and battery cable fasteners from 9 to 10 N·m (80 to 90 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.
Lithium-Ion Battery Pack

The Greensmaster e1021/e1026 is powered by a maintenance free lithium-ion battery. The battery consists of numerous cells. The battery is located inside the battery mount. The battery is managed by the lithium-ion battery controller (BMS); refer to Lithium-Ion Battery Controller (BMS) (page 5–8).

**WARNING**

Immediately discontinue use of the battery if the battery emits an unusual smell, feels hot, changes color or shape, or appears abnormal in any other way. Move the product or battery to a safe outdoor area away from any building, vehicle, or combustible material. Observe the battery for at least 1 hour to ensure that any reaction has stopped. If the reaction continues, or if any smoke is observed, call your local emergency services immediately. Failure to do so may result in personal injury and property damage.

Use only Toro-specified lithium-ion battery packs designed for your machine. Do not mix batteries of any brand or type in Toro products. Failure to do so may result in personal injury and property damage.

**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 Battery

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 battery.

If problems with the battery exist, an advisory or fault may be identified on the IntoCenter; refer to InfoCenter Display (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 battery when you are finished mowing for the day to ensure that the batteries are fully charged for the next mowing. Lithium-ion battery 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.

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 Battery

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.

- Storage of 1 to 6 months: Charge or discharge the battery to 50 - 100%. 50% is ideal due to 100% will degrade the battery faster.
- Storage of 6 to 12 months: Charge the battery to 100%.
- Storage of more than 12 months: Check the state of charge. If it is under 50% charging is required.

After charging, disconnect the charger from battery to prevent minimal drain on the battery. If charger is left connected to the battery for an extended period, it will shut off after the battery is fully charged and will NOT turn back on unless the charger is disconnected and reconnected.

Shipping and Transporting the Lithium-ion Battery

The US Department of Transportation and international transportation authorities require that lithium-ion battery 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 battery in the USA. If the original packaging is damaged or not available, use a Battery Shipping Kit; refer to Special Tools (page 2–13). Contact the appropriate government body in your country for detailed regulations on shipping the lithium-ion battery.

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 battery 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

**WARNING**

When charging lithium-ion battery:

- Use only the Toro-specified lithium-ion charger designed to charge your machine. Do not attempt to use any other battery charger.
- Do not over-charge or over-discharge lithium-ion battery.

Failure to follow these recommendations may result in personal injury and property damage.

The e1021/e1026 lithium ion battery pack requires regular charging that is provided by the lithium battery pack charger (included with the machine). The output voltage and current of the charger are controlled with CAN communication with the battery management system. Ensure that the charger is connected to the battery pack whenever the machine is not in use.

Refer to the 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.

Removing the Lithium-Ion Battery

**WARNING**

When removing or installing the battery:

- Always disconnect the battery at the battery disconnect provided when servicing products with lithium-ion battery.
- Always service lithium-ion battery with the machine parked near a service door large enough to move the product or battery outside in case of an emergency and keep a fire blanket nearby. Do not use a fire extinguisher on lithium-ion battery.

Failure to follow these recommendations may result in personal injury and property damage.
Removing the Lithium-Ion Battery (continued)

**WARNING**

When removing or installing the battery:

- 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 battery.

Failure to follow these recommendations may result in personal injury and property damage.

**CAUTION**

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 cables. Failure to do so may result in personal injury and property damage; refer to Figure 72.

**Figure 72**

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

**CAUTION**

Do not open the lithium-ion battery. There are no serviceable parts on or in the lithium-ion battery case. If you open the battery case, you will void the warranty. The battery case is protected by tamper-alerting devices. Opening the battery case may result in personal injury and property damage.
Removing the Lithium-Ion Battery (continued)

Figure 73

1. Negative (-) terminal
2. Lithium-ion battery
3. Positive (+) terminal
4. Washer
5. Lock washer
6. Nut

1. Park the machine on a level surface and make sure that the clutch bail in the NEUTRAL position. Turn the key switch to the OFF position and remove the key from the key switch.

2. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).

3. Remove the four bolts that secures the battery cover to the battery mount. Remove the battery cover from the machine.

4. Label and disconnect the negative (-) battery cable, positive (+) battery cable, and battery interface harness from the lithium-ion battery; refer to Figure 73.

Figure 74

1. Bolt (4 each)
2. Washer (4 each)
3. Lithium-ion battery
4. Battery mount
5. Nut (4 each)

5. Remove the four nuts (item 5 in Figure 74), bolts (1) and washers (2) that secures the battery to the battery mount.
Removing the Lithium-Ion Battery (continued)

**CAUTION**

The battery weighs approximately 11 kg (24 lbs). Support the battery to prevent it from falling and causing personal injury or damage to the battery.

6. Carefully slide and remove the battery from the battery mount.

Installing the Lithium-Ion Battery

**CAUTION**

Pay close attention to the battery orientation during installation. Ensure that each battery is installed in the proper orientation prior to connecting any cables. Failure to do so may result in personal injury and property damage.

1. Make sure the battery mount is clean and repaint if necessary. Make sure that the wires, cables and their terminals are clean (no corrosion) and in good condition.

**IMPORTANT**

Make sure that battery is installed with the positive terminal towards the front side and the negative terminal towards rear side of the machine.

2. After installing the battery into the battery mount, secure the battery with four bolts, washers and nuts.

3. Torque tighten the bolts (1) from 2.8 to 3.9 N·m (25 to 35 in-lb).

4. Using the labels that attached during the removal, connect the battery interface cable, positive (+) battery cable and negative (-) battery cable onto the battery pack.

5. Tighten the battery cable fasteners (item 6 in Figure 73) from 8.4 to 9.6 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.

6. Install the battery cover onto the battery mount. Secure the battery cover with four bolts.

7. Connect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
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General Information

Operator’s Manual

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

Adjusting the Reel Cable

1. Park the machine on a level surface. Ensure that the key switch is in OFF position and the traction control is in NEUTRAL and parking brake is released.

2. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).

3. To remove slack from the reel cable, perform the following steps:
   A. Move the reel selector knob to the high-reel-speed position; refer to Figure 75.
   B. Loosen the rear jam nut and tighten the front jam nut; refer to Figure 76.

4. Connect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
Removing the Brake Cable

**Note:** Refer to Figure 77 during this procedure.

1. Park the machine on a level surface. Ensure that the key switch is in OFF position and the traction control is in NEUTRAL and parking brake is released.

2. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
Removing the Brake Cable (continued)

3. Remove the brake cable (item 5 in Figure 78) from the brake lever shaft on the transmission gear box assembly as follows:
   A. Loosen the front cable jam nut (4) that secures the brake cable to the casting slot on the transmission gear box assembly. Remove the brake cable from the slot.
   B. Remove the retaining ring (1) that secures the cable eyelet (2) to the brake lever (3) on the transmission gear box assembly.
   C. Remove the brake cable eyelet (2) from the brake lever (3).
4. Remove the control cover and lower cover from the handle assembly to allow access to upper end of the brake cable.
5. Remove the brake cable (item 9 in Figure 77) from the brake lever assembly as follows:
   A. Loosen the lower brake cable jam nut (8) that secures the brake cable (9) to the upper receiver weldment (4). Slide the brake cable from the upper receiver weldment.
   B. Remove the brake cable spring (7) from the spring anchor on the brake lever assembly (3). Note the orientation of the brake cable spring hook on the brake lever assembly for assembly purpose.
6. Remove the brake cable (9) from the machine.

Installing the Brake Cable

1. Secure the brake cable (9) to the brake lever assembly as follows:
   A. Install the cable spring (7) to the spring anchor on the brake lever assembly (3).
   B. Slide the brake cable into the shift mount bracket slot. Ensure that the jam nut (8), flat washer and lock washer are both sides of the bracket. Adjust the jam nuts so that equal amount of cable threads are visible above and below jam nuts. Leave jam nuts snug until final cable adjustment.
2. Route the brake cable (9) to the transmission gear box assembly and install the brake cable to the transmission gear box assembly as follows:
   A. Install the brake cable eyelet (2) onto the brake lever (3) on transmission gear box assembly and secure with a snap ring (1).
   B. Position the brake cable (5) to the casting slot of the transmission gear box assembly with a jam nut (4), flat washer and lock washer on each
Installing the Brake Cable (continued)

side of the slot. Adjust and tighten the jam nuts so that equal amount of cable threads are visible above and below jam nuts.

3. Make final adjustment of the brake cable at the brake cable lever assembly. Adjust the cable jam nuts to remove the slack in the brake cable.

4. Check the brake cable adjustment; refer to Operator’s Manual.

5. Install the lower cover and control cover to the handle assembly.

6. Connect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
Replacing the Reel Cable

Figure 79

5. Reel lever handle rod 10. Clevis connector

Removing the Reel Cable

Note: Refer to Figure 79 during this procedure.

1. Park the machine on a level surface. Ensure that the key switch is in OFF position and the traction control is in NEUTRAL.

2. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).

Figure 80

1. Retaining ring 3. Jam nut
2. Reel selector assembly 4. Reel cable
Removing the Reel Cable (continued)

3. Remove the reel cable (item 4 in Figure 80) from the reel selector assembly (2) as follows:
   A. Loosen the front cable jam nut (3) and lift the reel cable (4) from the casting slot of the base.
   B. Remove the retaining ring (1) that secures the reel cable eyelet to the reel selector assembly (2) and slide the reel cable eyelet from the selector assembly.

4. Remove the control cover and lower cover from the handle assembly to allow access to upper end of the reel cable.

5. Remove the reel cable (item 1 in Figure 79) from the traction lever assembly as follows:
   A. Loosen the lower cable jam nut (2) that secures the reel cable (1) to the upper receiver weldment (12). Slide the cable from the upper receiver weldment.
   B. Remove the cable spring (3) from the clevis connector (10) on the reel lever assembly (5). Note the orientation of cable spring hook on the shaft assembly for assembly purposes.

6. Remove the reel cable (1) from the machine.

Installing the Reel Cable

1. Secure the reel cable (item 1 in Figure 79) to the traction lever assembly as follows:
   A. Install the cable spring (3) to the clevis connector (10) on the reel lever assembly (7). Orientate the cable spring hook end toward front of the machine.
   B. Slide the cable (1) into the upper receiver weldment (12). Ensure that the jam nut (2), flat washer and lock washer are on both sides of the bracket. Adjust jam nuts so that equal amount of cable threads are visible above the jam nuts. Leave the jam nuts snug until final cable adjustment.

2. Route the reel cable to the reel selector assembly (item 2 in Figure 80) and install the reel cable (4) as follows:
   A. Slide the cable eyelet to the reel selector assembly (2) and secure with a retaining ring (1).
   B. Position the reel cable (4) to the casting slot of the base with a jam nut (3), flat washer and a lock washer on each side of the slot.

3. Make final adjustment of the reel cable at the reel cable lever assembly. Adjust the cable jam nuts to remove the slack in the clutch cable.

4. Check the reel cable adjustment; refer to Adjusting the Reel Cable (page 6–3).

5. Install the lower cover and control cover to the handle assembly.

6. Connect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
Cutting Unit Drive Lever Assembly

Figure 81

2. Reel lever handle rod 11. Reel cable 20. Clevis pin (4 each)
5. Control shaft clamp (2 each) 14. Link assembly 23. Reel lock lever assembly
6. Socket head screw (4 each) 15. Main control shaft 24. Bail latch spacer
7. Extension spring (2 each) 16. Split bushing 25. Upper receiver weldment
9. Bolt and washer assembly (8 each) 18. Cotter pin clip 27. Reel lever assembly

Disassembling the Cutting Unit Drive Lever Assembly

Note: Refer to Figure 81 during this procedure.

1. Park the machine on a level surface. Ensure that the key switch is in OFF position and the traction control is in NEUTRAL.

2. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
Disassembling the Cutting Unit Drive Lever Assembly (continued)

3. Remove the bolts and washers (9) that secures the controls covers (item 8 and 10) to the upper receiver weldment (25) and handle assembly.
4. Remove the reel lever handle rod (2) from the reel lever assembly (27).
5. If necessary, remove the reel lever knob (3) from the reel lever handle (2).
6. Remove the cotter pin (18) and clevis pin (20) that secures the link assembly (14) to the main control shaft (15).
7. Remove the cotter pin (18) and clevis pin (20) that secures the clevis connector (19) to the reel lever assembly (27).
8. Remove the extension spring (21) from the reel lock lever (23).
9. Remove the flange nut (26) and shoulder screw (22) that secures the reel lock lever (23) to the upper receiver weldment (25). Remove the reel lock lever (23) and bail latch spacer (24).
10. Remove the retaining ring (4) and V-ring seal (1) that secures the reel lever assembly (27) to the main control shaft (15). Slide and remove the reel lever assembly.
11. Remove the socket head screws (6) and control shaft clamps (5) that secures the main control shaft (15) to the upper receiver weldment (23).
12. Remove the main control shaft (15). If necessary, remove the split bushing (16 and 12) from the main control shaft.

Assembling the Cutting Unit Drive Lever Assembly

1. If removed, apply a coat of grease in inner diameter of split bushings (item 16 and 12 in Figure 81) and install the split bushing onto the main control shaft (15).
2. Position the main control shaft (15) on the upper receiver weldment (25) and secure the main control shaft (15) with control shaft clamps (5) and the bolts (6).
3. Slide the reel lever assembly (27) and V-ring seal (1) onto the main control shaft (15) and secure reel lever assembly with the retaining ring (4).
4. Install the reel lock lever (23) and bail latch spacer (24) to the upper receiver weldment (25) and secure with the shoulder screw (22) and flange nut (26).
5. Install the link assembly (14) to the main control shaft (15) with clevis pin (20). Secure the clevis pin with the cotter pin clip (13).
6. Install the clevis connector (19) to the reel lever assembly (27) with clevis pin (20) and secure the clevis pin with the cotter pin clip (18).
7. Install the reel lever handle rod (2) to the reel lever assembly (27).
8. If removed, install the reel lever knob (3) to reel lever handle rod (2).
9. Install the control covers (8 and 10) to the handle assembly with bolts and washers (9).
10. Connect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
Disassembling the Brake Latch Shaft

**Note:** Refer to Figure 82 during this procedure.

1. Park the machine on a level surface. Ensure that the key switch is in OFF position and the traction control is in NEUTRAL.
2. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
3. Remove the bolts and washers that secures the controls covers to the upper receiver weldment.
4. Using the drift pin, remove the roll pin (5) from the brake lock lever (4).
5. Slide and remove the brake lock lever (4) from the brake latch shaft (9).
6. Slide and remove the brake latch shaft (9) from the upper receiver weldment (12).
7. Slide and remove the torsion spring (10) from the brake latch shaft (9).
Assembling the Brake Latch Shaft

1. Slide and position the torsion spring (10) onto the brake latch shaft (9).
2. Slide and position the brake latch shaft (9) into the upper receiver weldment (12).
3. Slide and position the brake lock lever (4) onto the brake latch shaft (9). Secure the brake lock lever with the roll pin (5).
4. Install the control covers to the handle assembly with bolts and washers.
5. Connect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
## Handle Assembly

![Diagram of handle assembly](image)

**Figure 83**

<table>
<thead>
<tr>
<th>Number</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Throttle arm</td>
</tr>
<tr>
<td>2</td>
<td>Washer</td>
</tr>
<tr>
<td>3</td>
<td>Handle</td>
</tr>
<tr>
<td>4</td>
<td>Shoulder screw</td>
</tr>
<tr>
<td>5</td>
<td>Flange bushing (2 each)</td>
</tr>
<tr>
<td>6</td>
<td>Lever</td>
</tr>
<tr>
<td>7</td>
<td>Flange nut (4 each)</td>
</tr>
<tr>
<td>8</td>
<td>Upper receiver weldment</td>
</tr>
<tr>
<td>9</td>
<td>Nut</td>
</tr>
<tr>
<td>10</td>
<td>Bolt</td>
</tr>
<tr>
<td>11</td>
<td>Bolt</td>
</tr>
<tr>
<td>12</td>
<td>Bolt</td>
</tr>
<tr>
<td>13</td>
<td>Flange nut</td>
</tr>
<tr>
<td>14</td>
<td>Clevis pin</td>
</tr>
<tr>
<td>15</td>
<td>Bearing spacer</td>
</tr>
<tr>
<td>16</td>
<td>Bolt</td>
</tr>
<tr>
<td>17</td>
<td>Brake cable</td>
</tr>
<tr>
<td>18</td>
<td>Cotter pin</td>
</tr>
<tr>
<td>19</td>
<td>Lower handle assembly</td>
</tr>
<tr>
<td>20</td>
<td>Flange nut</td>
</tr>
<tr>
<td>21</td>
<td>Bolt</td>
</tr>
<tr>
<td>22</td>
<td>Handle adjuster assembly</td>
</tr>
<tr>
<td>23</td>
<td>Handle torsion spring</td>
</tr>
<tr>
<td>24</td>
<td>Spring spacer</td>
</tr>
<tr>
<td>25</td>
<td>Screw and washer assembly (2 each)</td>
</tr>
<tr>
<td>26</td>
<td>Bottom control cover</td>
</tr>
<tr>
<td>27</td>
<td>Lift assist handle</td>
</tr>
<tr>
<td>28</td>
<td>Jam nut</td>
</tr>
<tr>
<td>29</td>
<td>Bolt</td>
</tr>
<tr>
<td>30</td>
<td>Bolt</td>
</tr>
<tr>
<td>31</td>
<td>Bolt (2 each)</td>
</tr>
<tr>
<td>32</td>
<td>Bolt</td>
</tr>
<tr>
<td>33</td>
<td>Bolt (2 each)</td>
</tr>
<tr>
<td>34</td>
<td>Throttle lever</td>
</tr>
</tbody>
</table>

2.2 to 3.4 N·m (20 to 30 in-lb)
Figure 84

1. Screw (4 each)  
2. InfoCenter display  
3. Key  
4. InfoCenter mount  
5. Key switch  
6. Bail catch fork  
7. Clip pin (2 each)  
8. Link shaft  
9. Washer  
10. Clevis pin  
11. Spacer (2 each)  
12. Control bail lever  
13. Clevis pin  
14. Lock nut  
15. Lock  
16. Potentiometer sensor  
17. Mount  
18. Proximity sensor  
19. Screw (2 each)  
20. Screw (2 each)  
21. Extension spring  
22. Spring tab  
23. Spacer (2 each)  
24. Screw (2 each)  
25. Potentiometer sensor  
26. Control bail lever  
27. Throttle cable  
28. Lock  
29. Lock nut (2 each)
Disassembling the Handle Assembly

**Note:** Refer to Figure 83 and Figure 84 during this procedure.

1. Park the machine on a level surface. Ensure that the key switch is in OFF position and the traction control is in NEUTRAL.
2. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
3. Remove the 4 bolts that secure the controls cover to the handle assembly. Remove the controls cover from the handle assembly.
4. Remove the 4 bolts that secure the lower handle cover to the handle assembly. Remove the lower handle cover.
5. Remove the wire harness from bottom control cover.
6. Remove the 2 nuts (7) and bolts (33) that secure the bottom control cover (26) to the upper receiver weldment (8).
7. Remove the 2 screw and washer assembly (33) that secures the bottom control cover (26) to the upper receiver weldment (8). Remove the bottom control cover from the upper receiver weldment.
8. Remove the throttle cable (27 in Figure 84).
9. Remove the brake cable; refer to Removing the Brake Cable (page 6–4).
10. Remove the reel cable; refer to Removing the Reel Cable (page 6–7).
11. Remove the cutting unit drive lever assembly; refer to Disassembling the Cutting Unit Drive Lever Assembly (page 6–9).
12. Remove the brake latch shaft; refer to Disassembling the Brake Latch Shaft (page 6–11).
13. Remove the flange nut (7) and bolt (21) from the upper receiver weldment (8) which acts as a throttle arm stop bolt.
14. Remove the nut (20), washer (2) and bolt (30) that secures the throttle arm (1) to the handle assembly (3). Remove the throttle arm from the handle assembly.
15. If necessary, remove the screw (32) that secures the throttle lever (34) to the throttle arm (1). Slide and remove the throttle lever from the throttle arm.
16. If necessary, remove the flange bushings (31) from the throttle arm (1).
17. Remove the 4 screws (item 1 in Figure 84) that secures the InfoCenter mount (4) to the handle assembly.
18. Disconnect the main wire harness from the InfoCenter (2) and key switch (5).
19. Remove the flange nut (Item 7 in Figure 83) and shoulder screw (4) that secures the brake lever (6) to the upper receiver weldment (8). Remove the brake lever from the upper receiver weldment.
20. If necessary, remove the flange bushings (5), flange nut (13) and bolt (12) from the brake lever (6).
21. Remove the 2 bolts (11 and 16) that secures the lift assist handle (27) to the upper receiver weldment (8).
22. Remove the nut (9) and bolt (29) that secures the upper receiver weldment (8) to the lower handle (19).
23. Disconnect the wire harness from the potentiometer sensor (item 16 in Figure 84) and proximity sensor (18). Slide and remove the upper receiver weldment from the lower handle assembly.
24. If necessary, remove the cotter pin (item 18 in Figure 83) and bearing spacer (15) and clevis pin (14) that secures the handle adjuster assembly (22) to the upper receiver weldment (8).
Disassembling the Handle Assembly (continued)

25. Remove the handle adjuster assembly from the upper receiver weldment and separate handle torsion spring (23) and spring spacer (24) from the handle adjuster assembly (22).

26. Remove the 2 nuts (item 8 in Figure 85) and 2 bolts (17) that secures the handle (16) to handle mount (7). Remove the handle from the clutch bail assembly and the handle mount.

27. If necessary, remove the 2 screws (14) that secures the LH and RH bail brackets (1 and 15) to the handle (16).

28. Remove the flange nut (8), and bolt (2) that secure the clutch bail link (5) to the handle mount (7). Remove the 2 flange bushings (3) and spacer tube (13) from the handle mount.
Disassembling the Handle Assembly (continued)

29. Remove the flange nut (8) and bolt (2) that secure the clutch bail assembly (4) to the handle mount (7). Remove the clutch bail assembly from the handle mount. Remove the compression spring (6), 2 flange bushings (3) and spacer tube (13) from the handle mount.

30. Remove the 2 nuts (9) and 2 bolts (11) that secures the handle mount (7) to the upper receiver weldment (15). Remove the handle mount from the upper receiver weldment.

![Figure 86](image)

**Figure 86**

1. Lower handle assembly  
2. Bolt  
3. Washer (2 each)  
4. Nut  
5. Frame assembly

31. If necessary, remove the nut (item 4 in Figure 86), washers (3) and bolt (2) that secures the lower handle assembly (1) to the frame assembly (5).

Assembling the Handle Assembly

1. If removed, install the lower handle assembly (item 1 in Figure 86) onto the frame assembly (5) and secure with the bolt (2), washers (3) and nut (4).

2. Lift the lower handle assembly to maximum top position and torque tighten the bolt (2) to **5.6 to 6.2 N·m (50 to 55 ft-lb)**.

3. Install the handle mount (item 7 in Figure 85) to the upper receiver weldment (10) and secure with 2 bolts (11) and 2 nuts (9).

4. Position the clutch bail link (5) in the handle mount (7). Install the spacer tube (13) and 2 flange bushings (3) to the handle mount. Secure the clutch bail link to the handle mount with the bolt (2) and flange nut (8).
Assembling the Handle Assembly (continued)

5. Position the compression spring (6), spacer tube (13) and 2 bushings (3) into the handle mount (7). Install the clutch bail assembly (4) to the handle mount (7) and secure with the bolt (2) and flange nut (8).

6. If removed, install the LH and RH bail brackets (1 and 15) to the handle (16) with the 2 screws (14).

7. Install the clutch bail assembly (4) to the handle (16). Secure the handle to the handle mount (7) with the 2 bolts (17) and 2 nuts (8).

8. Position the spring spacer (Item 24 in Figure 83) and handle torsion spring (23) into the handle adjuster assembly (22). Install the handle adjuster assembly to the upper receiver weldment (8) with the clevis pin (14), bearing washer (15) and cotter pin (18).

9. If removed, install the lift assist handle (27) to the upper receiver weldment (8) and secure with the bolts (16 and 11).

10. Slide the upper receiver weldment (8) in to the lower handle assembly (19) and secure with the bolt (29) and flange nut (9).

   Note: Do not tighten bolt and nut. Install the nut to engage locking feature. The upper receiver weldment (8) must be free to slide.

11. Reposition the wire harness.

12. If removed, install the flange bushings (5), bolt (12) and flange nut (13) into the brake lever (6).

13. Position the brake lever (6) to the upper receiver weldment (8) and secure with the shoulder screw (4) and flange nut (7).

14. Install the InfoCenter mount (item 4 in Figure 84) onto the handle and secure with the 4 screws (1).

15. Install the wire harness.

16. If removed, install the flange bushings (item 31 in Figure 83) inside the throttle arm (1).

17. If removed, slide the throttle lever (34) onto the throttle arm (1) and secure with bolt (32).

18. Torque tighten the bolt from 2.2 to 3.4 N·m (20 to 30 in-lb).

19. Install the throttle arm (1) to the handle assembly (3) and secure with bolt (30), washer (2) and nut (20).

20. Install the bolt (21) and 2 flange nuts (7) to the upper receiver weldment (8). Ensure that the head of the bolt is resting the on throttle arm (1).

21. Install the brake latch shaft; refer to Assembling the Brake Latch Shaft (page 6–12).

22. Install the clutch and reel drive lever assembly; refer to Assembling the Cutting Unit Drive Lever Assembly (page 6–10).

23. Install the reel cable; refer to Installing the Reel Cable (page 6–8).

24. Install the brake cable; refer to Installing the Brake Cable (page 6–5).

25. Install the throttle cable (27).

26. Adjust the traction bail proximity sensor; refer to Adjusting the Traction Bail Proximity Sensor (page 5–20).

27. Install the bottom control cover and re-position the wire harness to the upper receiver weldment and secure with the 2 screw and washer assemblies, 2 bolts and 2 nuts.
Assembling the Handle Assembly (continued)

28. Install the lower handle cover to the handle assembly and secure with the 4 bolts.
29. Install the controls cover to the handle assembly and secure with the 4 bolts.
30. Connect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
Removing the Kickstand

CAUTION

Be careful when removing or applying tension from or to the torsion spring of the kickstand.

The spring is under heavy load and may cause personal injury.
Removing the Kickstand (continued)

1. Park the machine on a level surface. Ensure that the key switch is in OFF position and the traction control is in NEUTRAL.
2. Disconnect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
3. Pivot the kickstand up and hold against the frame stops.
4. Remove the bolt (item 11 in Figure 87) that secures the spring mount pin (3) and torsion spring (2) to the kickstand (16).
5. Remove the spring mount pin (3) and torsion spring (2) from the kickstand (16).
6. Remove the bolt (11), spacer (10) and nut (5) that secures the kickstand (16) to the frame (9).
7. Remove the kickstand (16) from the frame (1).
8. If necessary, remove the spring retainer (14) by removing the nut (15), washer (13) and bolt (12).
9. If necessary, remove the spacers (10) from the kickstand (16).

Installing the Kickstand

![Figure 88](Image)

- Kickstand (raised)
- Torsion spring
- Kickstand (lowered)

1. If removed, install the spacers (10) to the kickstand (16).
2. If removed, secure the spring retainer (14) to kickstand with the bolt (12), washer (13) and nut (15).
3. Secure the kickstand (16) to the frame (9) with the torsion spring (2), spring mount pin (3) and bolt (11).
4. Secure the kickstand (16) to the frame (9) with spacer (10), bolt (11) and nut (5).
5. Connect the battery pack; refer to Connecting the Lithium Battery Pack (page 5–3).
Transport Wheels (Optional)

**Figure 89**

1. Bolt (3 each)  
2. Flange nut (4 each)  
3. Shallow rim  
4. Tire  
5. Inner tube  
6. Deep rim  
7. Hub  
8. Torsion spring  
9. Wheel retaining lever  
10. Shoulder screw (2 each)  
11. Hub bushing  
12. Bolt (4 each)  
13. Lock washer (3 each)

**Removing the Transport Wheel**

1. Park the machine on a level surface. Ensure that the key switch is in OFF position and the traction control is in NEUTRAL.
2. Support the machine onto the machine onto the kickstand.
Removing the Transport Wheel (continued)

Figure 90

1. Wheel retaining lever

3. Pivot the wheel retaining lever away from the center of the wheel. Slide the transport wheel off the wheel hex shaft.

Disassembling the Transport Wheel

Figure 91

1. Wheel hex shaft

1. Ensure that the tire is fully deflated before disassembly of the wheel.

2. Remove the 3 bolts and 3 lock washers from the shallow rim and hub. Remove the hub from the deep rim.

3. Inspect the hub bushing. Replace the bushing, if worn or damaged.

4. Remove the 4 bolts and 4 flange nuts from the deep rim and shallow rim. Remove the shallow rim from the deep rim.

5. Separate the tire, tube and deep rim.

6. If necessary, remove the shoulder screws, torsion spring, and retaining lever from the hub.
Assembling the Transport Wheel

1. If the shoulder screws were removed from the hub, apply Loctite #242 (or equivalent) to the threads of the shoulder screws. Secure the torsion spring and retaining lever to the hub with the shoulder screws.

2. Assemble the tire, tube, and deep rim.

3. Install the shallow rim into the tire. Align and secure the shallow rim to the deep rim with 4 bolts and 4 flange nuts. Tighten the fasteners.

4. Install the hub into the deep rim. Secure the hub to the deep rim with the 3 bolts and 3 lock washers. Tighten the fasteners.

5. Inflate the tire to **83 to 103 kPa (12 to 15 psi)**.

Installing the Transport Wheel

1. Ensure that the machine is parked on a level surface.

2. Support the machine onto the kickstand.

3. Slide the transport wheel completely onto the wheel hex shaft until the wheel retaining lever is secured into the groove onto the wheel hex shaft.
Rail Kit Wheels (Optional)

Removing the Rail Kit Wheel
1. Park the machine on a level surface. Ensure that the key switch is in OFF position and the traction control is in NEUTRAL.
2. Support the machine onto the kickstand.
3. Remove the wheel clip, and remove the rail kit wheel from the wheel hex shaft on each side.
4. If necessary, install the transport wheels; refer to Installing the Transport Wheel (page 6–24).

Installing the Rail Kit Wheel
1. Ensure that the machine is parked on a level surface.
2. Support the machine onto the kickstand.
3. If installed, remove the transport wheels; refer to Removing the Transport Wheel (page 6–22).
4. Slide the rail kit wheel onto the wheel hex shaft and secure the wheel with a wheel clip.
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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), 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.

Grass Basket Installation

![Diagram of grass basket installation]

Figure 93

1. Grass basket  
2. Mounting rod

Grasp the grass basket by top rear lip and slide on or off the basket mounting rods.
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

⚠️ CAUTION ⚠️

Never install or work on or near a cutting unit or cutting unit suspension with the engine running. Always stop the engine and remove the key before working on or near a cutting unit.

Note: When adjusting reel to bedknife or grinding/backlapping, cutting unit assembly must be attached to traction unit or frame fixture.

The dual point adjust (DPA) 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.

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.
2. Adjust the bedknife after grinding, backlapping or disassembly; 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 top shield; refer to the Cutting Unit Operator’s Manual.
Grass Shield Height Adjustment

Figure 95

1. Grass shield
2. Bolt (2 each)
3. Side plate
4. Support rod

Adjust the grass shield to assure proper grass clipping discharge into the basket.

1. Park the machine on a level surface. Ensure that the engine is OFF and the traction control is in NEUTRAL.

2. Remove the spark plug wire from the engine spark plug.

3. Place 1.5 mm (0.06 inch) shim between the reel assembly and grass shield.

   Note: The shield can be lowered for drier conditions (clippings fly over top of the basket) or raised to allow for heavy wet grass conditions (clippings build up on rear of the basket).

4. Loosen the bolts that secures each end of the shield to the side plates. Adjust the shield to the correct height and tighten the fasteners.
Service and Repairs

Bedbar Assembly

Figure 96

1. Side plate
2. Keyed flanged bushing (4 each)
3. Bedbar adjuster shaft (2 each)
4. Rubber bushing assembly (2 each)
5. Nylon bushing (2 each)
6. Plastic washer (2 each)
7. Flat washer (2 each)
8. Bedbar bolt (2 each)
9. Lock nut (2 each)
10. Wave washer (2 each)
11. Retaining ring (2 each)
12. Bedbar adjuster screw (2 each)
13. Detent (2 each)
14. Bolt (2 each)
15. Plastic washer (2 each)
16. Bedbar assembly
17. Washer (2 each)
18. Compression spring
19. Nut (2 each)
Removing the Bedbar

**Note:** Refer to Figure 96 during this procedure.

1. Park the machine on a level surface. Ensure that the engine is OFF and the traction control is in NEUTRAL.
2. Remove the spark plug wire from the engine spark plug.
3. Loosen the nuts (19) on the end of each bedbar adjuster assembly (3) until the washer (17) is loose.
4. Loosen the locknuts (9) on each bedbar bolt (8).
5. Remove the 2 bedbar bolts (8), 2 flat washers (7) and 4 plastic washers (6 and 15) from the cutting unit side plates (1).

⚠️ 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 (6) from the cutting unit.
7. Inspect the nylon bushings (5) and rubber bushings (4) in the side plates for wear or damage. Replace the bushings if necessary.
Installing the Bedbar

1. Side plate
2. Rubber bushing
3. Nylon bushing
4. Plastic washer (2 each)
5. Metal washer
6. Bedbar
7. Bedbar pivot bolt
8. Lock nut

1. If rubber bushing (item 4 in Figure 97) was removed from either side plate, apply grease to outside surface of new bushing and install into side plate (1). The bushing (4) should be installed flush with the inside surface of the side plate; refer to Figure 97.

2. If removed, install the nylon bushings (5) with flange facing outward.

3. Apply anti-seize lubricant to the threads and shank of each bedbar bolt (8); refer to Figure 97.

**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 assembly (16) into the cutting unit. Make sure that the top of each bedbar arm is between the washer (17) and adjuster screw flange (12).

**IMPORTANT**

When installing the washers, make sure that the plastic washers (6 and 15) are positioned against the side plate.

5. Position one plastic washer (6 and 15) between the bedbar (16) and each side plate (1).

6. Slide a metal washer (7) onto the bedbar bolt (8).
Installing the Bedbar (continued)

7. Install the bedbar bolt assemblies (8). Make sure that the washers are not caught on the threads of the pivot bolts. Torque tighten each bedbar bolt (8) 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 (9) until outside metal washers do not have any end play and can still be rotated.

9. Tighten the nut (19) on each bedbar adjuster assembly (16) until the adjuster spring (18) is fully compressed, then loosen the nut (19) to 1/2 turn.

10. Adjust the bedknife to reel contact; refer to the *Cutting Unit Operator's Manual*. 
Servicing the Bedbar Adjuster

Removing the Bedbar Adjuster

Note: Refer to Figure 98 during this procedure.

1. Remove the bedbar; refer to Removing the Bedbar (page 7–7).

   Note: The bedbar adjuster shaft (1) has left-hand threads.

2. Remove the lock nut (11), compression spring (10) and washer (9) from the bedbar adjuster screw (7).

3. Unscrew the bedbar adjuster shaft (1) from the bedbar adjuster screw (7).

4. Remove the retaining ring (6) and wave washer (5) from the adjuster shaft (7) and remove the adjuster shaft.

5. Inspect the flange bushings (2) in the cutting unit side plate (12) and replace them if necessary.

6. Inspect the detent (3) and replace it if necessary.
Installing the Bedbar Adjuster

1. If previously removed, secure the detent (3) to the side plate (12) with the bolt (4).

2. If previously removed, align the key on the flange bushings (2) to the slots in the cutting unit side plate (12) and install.

3. Slide adjuster shaft (1) into flange bushings (2) and secure with a wave washer (5) and a retaining ring (6).

   **Note:** The bedbar adjuster shaft (1) has left-hand threads.

4. Apply anti-seize lubricant to the threads of the bedbar adjuster screw (7) that fit into adjuster shaft (1) (the left hand threads) and thread the bedbar adjuster screw into the adjuster shaft.

5. Install the washer (9), compression spring (10) and lock nut (11) onto the adjuster screw (7).

6. Install the bedbar (8); refer to Installing the Bedbar (page 7–8).
Bedknife

Removing the Bedknife

1. Bedknife screw (13 used)
2. Bedknife
3. Bedbar

1. Remove the bedbar from the cutting unit; refer to Removing the Bedbar (page 7–7).
2. Remove screws from bedbar using a socket wrench and bedknife screw tool; refer to Bedknife Screw Tool (page 2–15). Discard the screws. Remove bedknife from the bedbar.
3. Refer to Grinding the Bedknife (page 7–13) 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 (5/16-18UNC-2A) are clean.
Installing the Bedknife (continued)

**IMPORTANT**

Do not use an impact wrench to tighten screws into the bedbar.

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.

5. Using a torque wrench and bedknife screw tool, tighten the 2 outer screws to 1 N·m (10 in-lb).

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**

| Standard Bedknife Relief Angle | 3° minimum |
| Fairway Bedknife Relief Angle  | 3° minimum |
| Extended Bedknife Relief Angle | 7° minimum |
| Front Angle Range              | 13° to 17° |

**Figure 101**

1. Top angle
2. Top surface
3. Remove burr
4. Front surface
5. Front angle

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 7–13). Grind only enough so the top surface of the bedknife is true; refer to Figure 101.
Grinding the Bedknife (continued)

Figure 102

1. Service limit (reel contacts back of bedknife scallop during operation)
2. Service limit (bottom of bedknife scallop reached when grinding)

IMPORTANT

Do not grind the bedknife below its service limit; refer to Figure 102. 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. 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.

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 2–15).

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 7–8).

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.
Removing the Cutting Unit Assembly

**Note:** Refer to Figure 103 during this procedure.

1. Park the machine on a level surface on the traction drum. Ensure that the engine is OFF and the traction control is in NEUTRAL.
2. Remove the spark plug wire from the engine spark plug.
3. Slide the telescopic coupler on the reel drive assembly (2) from the transmission drive shaft.
   **Note:** If necessary, remove the reel drive assembly (2) from the cutting unit assembly (1); refer to Removing the Reel Drive Assembly (page 4–7).
4. Remove the 4 socket head screws (3) that secures the cutting unit assembly (1) to the frame assembly (5).
   **Note:** Support the traction unit and lock the kick stand.
5. Slide and remove the cutting unit assembly (1) from the frame assembly (5).
6. If necessary, remove the dowel pins (4) from the frame assembly (5).
Installing the Cutting Unit Assembly

1. If removed, install the dowel pins (4) into the frame assembly (5).

2. If removed, install the reel drive assembly (2) onto the cutting unit assembly (item 1); refer to Installing the Reel Drive Assembly (page 4–10).

3. Install the cutting unit assembly (1) onto the frame assembly (5).

4. Secure the cutting unit assembly (1) with 4 socket head screws (3).

5. Align the reel drive assembly shaft to transmission gear box driveshaft. Slide the telescopic coupler on the reel drive assembly (2) to the transmission gear shaft.
This section provides the procedure for removing and installing the reel assembly (reel, reel bearing, bearing lock screw, reel nut and seals) from the cutting unit.

Removing the Reel Assembly

*Note:* Refer to Figure 104 during this procedure.

1. Park the machine on a level surface. Ensure that the engine is OFF and the traction control is in NEUTRAL.
2. Remove the spark plug wire from the engine spark plug.
3. If the cutting unit is equipped with an optional groomer, remove the drive components for those options from cutting unit. Refer to Removing the Gear Box Assembly (page 8–4) for universal groomer, and Universal Groomer (page 2–4) for additional information.
4. Remove the cutting unit assembly from the frame assembly; refer to Removing the Cutting Unit Assembly (page 7–15).
5. Remove the reel drive assembly; refer to Removing the Reel Drive Assembly (page 4–7).
Important

If the reel bearings or seals are being replaced, the bearing lock screw and the reel drive shaft must be removed. Use the following procedure to restrain the reel and loosen the components before removing the rollers.

6. Loosen the reel drive nut (11) and bearing lock nut (2).
   A. Tip up the cutting unit to access the bottom of the reel.
   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; refer to Figure 105.

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 bearing lock screw.

Important

The reel drive shaft on the left end of the cutting reel has left hand threads. The bearing lock screw on the right end of the cutting reel has right-hand threads.

D. Rest the handle of the pry bar against the front roller and loosen the bearing lock screw.
Removing the Reel Assembly (continued)

**IMPORTANT**

Do not use 1/2” extension on end of reel drive shaft when loosening or tightening drive shaft. The 1/2” hex is intended for back lapping only.

---

E. Position the pry bar in the same manner on the opposite end of the reel and use the appropriate wrench or socket on the 1” hex portion of the shaft to loosen the reel drive shaft.

F. Tip the cutting unit back onto its rollers.

7. Remove the bedbar; refer to Removing the Bedbar (page 7–7).

8. Remove the front roller; refer to Removing the Front Roller (page 7–25).

**CAUTION**

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when removing the cutting reel.

---

**Note:** If the reel bearings or seals are being replaced, the reel nuts must be removed. Use a block of wood between the cutting reel blades to prevent the reel from rotating and loosen the reel nuts before removing the reel from the cutting unit. 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.

9. Support the cutting reel to prevent it from shifting or falling and remove the 2 socket head screws (3 and 17) that secure the LH side plate (4) to the reel assembly (8).

10. Remove the bolt (16) and washer (15) that secures the grass shield assembly (18) to the LH side plate (4).

11. Remove the LH side plate (4) from the reel assembly (8).

12. Remove the 2 socket head screws (3 and 17) that secure the RH side plate (10) to the reel assembly (8).

13. Remove the bolt (16) and washer (15) that secures the grass shield assembly (18) to the RH side plate (10).

14. Remove the RH side plate (10), grass shield assembly (18) and 2 frame support rods (9 and 14) from the reel assembly (8).

15. 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.

16. Thoroughly clean any grease and corrosion from the reel bearing bores in the side plates.

17. Inspect the remaining cutting unit components for corrosion, wear, or damage and replace the components as necessary.
Inspecting the Reel Assembly

Figure 106

1. Cutting reel
2. Flocked seal (2 each)
3. Bearing (2 each)
4. Reel nut (right hand thread)
5. Reel nut (black – left hand thread)
6. Groove indication left hand threads
7. Left-most reel spider
8. Bearing shoulder

1. Remove the reel nuts from the cutting reel.
2. Slide the bearings and 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 as follows:
   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.
   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 7–23).
4. Replace the reel if damage is evident.

**IMPORTANT**

The seal must be installed with the flocked side (red) of the seal toward the bearing.

5. Slide the new flocked seals and the bearings onto the reel shaft until they contact the shoulder of the reel shaft.
Inspecting the Reel Assembly (continued)

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. Tighten the reel nuts to the specified torque once the cutting reel is installed in the cutting unit.

6. Install the reel nuts finger tight.

Installing the Reel Assembly

1. Position the cutting unit on a flat work area.

**CAUTION**

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when installing the cutting reel.

2. 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 RH side plate, and that the reel nut on the left (exposed) end of the cutting reel has a black finish.

3. Place the grass shield assembly (18), frame support rods (9 and 14) onto the RH side plate (10).

4. Place the flat wire spring into bearing bore of LH side plate and carefully slide the left side plate onto the cutting reel assembly as far as possible.

5. Install the 4 socket head screws (3 and 17) that secure the RH and LH side plates (4 and 10) to the frame support rods (9 and 14). Tighten the socket head screws from **24 to 27 N·m (18 to 20 ft-lb)**.

6. If loosened during cutting reel service, tighten the bearing lock screw and the reel drive nut.

---

**Figure 107**

1. Bearing lock screw
2. Reel shaft
3. Support plate, weld side
4. Pry bar

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; refer to **Figure 107**.
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.

B. Move the pry bar against the weld side of the reel support plate closest to the bearing lock screw.

**IMPORTANT**

The reel drive shaft on the left end of the cutting reel has left hand threads. The bearing lock screw on the right end of the cutting reel has right-hand threads.

C. Rest the handle of the pry bar against the front roller and tighten the bearing lock screw from 123 to 149 N·m (90 to 110 ft-lb).

**IMPORTANT**

Do not use 1/2” extension on end of reel drive shaft when loosening or tightening drive shaft. The 1/2” hex is intended for back lapping only.

D. Position the pry bar in the same manner on the opposite end of the reel and use the appropriate wrench or socket on the 1” hex portion of the shaft to tighten the reel drive shaft from 123 to 149 N·m (90 to 110 ft-lb).

7. Secure the grass shield assembly (18) to the RH and LH side plates (4 and 10) with the 2 washers (15) and 2 bolts (16).

8. If the reel nuts were loosened during cutting reel service, put a block of wood between the cutting reel blades to prevent the reel from rotating and tighten the reel nuts from 123 to 149 N·m (90 to 110 ft-lb).

9. Install the reel drive assembly; refer to Installing the Reel Drive Assembly (page 4–10). Grease the splines with high temp Mobil XHP−222 grease or equivalent.

10. Install the bedbar assembly; refer to Installing the Bedbar (page 7–8).

11. Install the front roller; refer to Installing the Front Roller (page 7–27).

12. Install the cutting unit assembly to the frame assembly; refer to Installing the Cutting Unit Assembly (page 7–16).

13. If the cutting unit is equipped with an optional groomer, install the components for those options. Refer to Removing the Gear Box Assembly (page 8–4) for universal groomer, and Universal Groomer (page 2–4) for additional information.
Preparing the Reel for Grinding

Reel Grinding Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</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 7–23). 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 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.
Preparing the Reel for Grinding (continued)

**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.
Note: Refer to Figure 109 during this procedure.

1. Loosen the pinch bolts (8) that secure the front roller shaft (3) to the front height-of-cut arms (5).

2. Remove the lock nut (6), height-of-cut washer (7) and plow bolt (1) that secures one of the height-of-cut arms (5) to the cutting unit side plate (10) and remove the height-of-cut arm.

3. Slide the front roller assembly (3) from the remaining height-of-cut arm (5).

4. Remove the remaining height-of-cut arm (5) from the cutting unit (10) if necessary.
Disassembling the Roller

1. To hold the roller shaft (5) stationary while removing the bearing lock nut (1), install a 3/8-24 UNF 2B screw with a jam nut into the threaded end of the roller shaft (5) and tighten the jam nut against the roller shaft. Remove the bearing lock nuts (1).

2. Carefully inspect the seating surface and threads of the bearing lock nuts (1) and replace them if damaged.

3. Loosely secure the roller assembly (4) in a bench vise and lightly tap on the roller shaft (5) to remove the sealing washers (2) and bearings (3). Discard the sealing washers (2).

4. Clean and carefully remove any corrosion from the bearing cavities of the roller.

Figure 110

1. Bearing lock nut (2 each) 3. Ball bearing (2 each) 5. Roller shaft
2. Sealing washer (2 each) 4. Wiehle roller
Assembling the Roller

1. Roller
2. Ball bearing
3. Seal
4. Bearing lock nut
5. Roller shaft

1. Press the bearing into the roller (support both inner and outer raceways).
2. Place the roller shaft into the roller.
3. Press the 2nd bearing into the roller (support both).
4. Install the sealing washer and bearing lock nut onto each end of the roller shaft. Tighten the lock nuts to **34 to 41 N-m (25 to 30 ft-lb)**.

Installing the Front Roller

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 (9) and replace them if necessary. Apply anti-seize lubricant to the threads of a new height-of-cut screw (9).

**Note:** When installing the height-of-cut arms (5), make sure that the tab of the side plate fits between the head and the washer of the height-of-cut screw (9).
3. Secure one of the height-of-cut arms (5) to the side plate with a plow bolt (1), height-of-cut washer (7) and lock nut (6). 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 (3) into the height-of-cut arm (5) attached to the cutting unit (10).
5. Slide the remaining height-of-cut arm (5) onto the other end of roller shaft. Secure the remaining height-of-cut arm to the side plate with a plow bolt (2), height-of-cut washer and lock nut.

6. Center the front roller (3) in the cutting unit and tighten the pinch bolts (8) that secure the front roller shaft to the height-of-cut arms.

7. Install the cutting unit assembly to the frame assembly; refer to Installing the Cutting Unit Assembly (page 7–16), (If necessary).

8. Adjust the cutting unit height-of-cut; refer to the Cutting Unit Operator's Manual.
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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.

Grooming Performance

There are a number of factors that can affect the performance of grooming. These factors vary for different golf courses and from fairway to fairway. 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.
Service and Repairs

Figure 113

1. Gear box assembly
2. Idler assembly
3. Groomer reel
4. Height adjuster assembly (2 each)

**CAUTION**

Never work on the groomer with the engine running. Always stop the engine and wait for all machine movement to stop before working on the groomer.
The Gear Box Assembly

1. Gear box assembly
2. Drive shield
3. Cotter pin
4. Clevis pin
5. Input shaft
6. Shim
7. Adapter

The groomer gear box assembly is located on the opposite side of the cutting unit from the reel drive.

Removing the Gear Box Assembly

1. Remove the groomer reel assembly; refer to Removing the Groomer Reel (page 8–14).
2. Safely prevent the reel from rotating by blocking the cutting reel with a piece of wood near one of the reel spiders.

IMPORTANT

The groomer gear box for this machine is installed on the left side of the cutting unit. Groomer gear boxes installed on the left side of the cutting unit use a left hand thread. Turn the input shaft clockwise to remove the gear box.
Removing the Gear Box Assembly (continued)

3. Remove the drive shield.

![Diagram]

Figure 115

1. 5/16–18 X 5/8 inch square head set screw
2. Input shaft assembly
3. Groomer gear box assembly
4. Reel shaft
5. Weld side of reel support plate
6. Pry bar

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 115.

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.

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.

Figure 116

1. Socket head screw (4 each)  8. Sun gear
2. Gear box cover assembly  9. Planet gear (3 each)
3. Cover gasket  10. Flange bushing (3 each)
4. Driven gear  11. Retaining ring
5. Thrust washer  12. Gear box housing assembly
6. Ring gear  13. Damaged drive shaft
7. Flange bushing

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.
   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.

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 Special Tools (page 2–13).

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 Special Tools (page 2–13).
Servicing the Gear Box

Figure 118

1. Drive adapter  15. Thrust washer  29. Ring gear
3. O-ring (3 each)  17. O-ring  31. Sun gear
4. V-ring  18. Dowel pin (2 each)  32. Bearing
5. Oil seal  19. Drain/fill plug (4 each)  33. Planet gear (3 each)
6. Groomer housing  20. Straight bushing (2 each)  34. Flange bushing (3 each)
7. Ball bearing (2 each)  21. Detent ball  35. Locknut
8. Retaining ring  22. Detent spring  36. Driver gear
9. Driven gear  23. Oil seal  37. Bearing (2 each)
10. Actuator shaft  24. Socket-head screw (4 each)  38. Oil seal
13. Knob  27. Thrust washer
Servicing the Gear Box (continued)

**Note:** Refer to Figure 97 during this procedure.

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.

---

**CAUTION**

Use the 1–3/8 inch flats on the input shaft to prevent the input shaft from rotating during drive adapter removal and installation. DO NOT use the 1/2 inch hex on the input shaft for drive adapter removal or installation as input shaft damage may occur.

---

5. If the drive adapter requires replacement, apply high strength thread locker (Loctite 243 or equivalent) to the 5/8 inch threads of the drive adapter and tighten the adapter from 150 to 163 N·m (110 to 120 ft-lb).

6. Carefully clean all the gasket material from the gear box housing and cover.

7. Inspect the V-ring, seals, bearings, gears, and bushings in the gear box assembly. Replace the damaged or worn components as necessary.

8. 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.

9. If the flange bushings are replaced, ensure that the flange bushing is fully seated against the part.

10. Assembly the gearbox.
   - 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.

11. Clean the gasket surface on the gear box housing and cover with the solvent and install new gasket.

12. 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).

13. 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).

14. Operate the groomer gear box by hand to check for proper operation prior to installation.
Installing the Gear Box Assembly

1. Safely prevent the reel from rotating by blocking the cutting reel with a piece of wood near one of the reel spiders.

**IMPORTANT**

The groomer gear box for this machine is installed on the left side of the cutting unit. Groomer gear boxes installed on the left side of the cutting unit use a left hand thread. Turn the input shaft counter-clockwise to install the gear box.

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.
Installing the Gear Box Assembly (continued)

9. Install the groomer reel assembly; refer to Installing the Groomer Reel (page 8–16).
The Idler Assembly

The groomer idler assembly is located on the opposite side of the groomer gear box.

Removing the Idler Assembly

**Note:** Refer to Figure 120 during this procedure.

1. Remove the reel drive from the cutting unit; refer to Removing the Reel Drive Assembly (page 4–7).
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 flange nut that secures the idler arm to the stub shaft. Remove the idler assembly.
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.
   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).

2. Install the clevis pin and a new cotter pin to secure the height adjustment rod to the front of the idler arm.

3. Install the reel drive; refer to Installing the Reel Drive Assembly (page 4–10).
The 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

**CAUTION**

Contact with the reel or other cutting unit parts can result in personal injury.

Use heavy gloves when handling the groomer reel.

1. Carefully remove the 4 jam nuts, 4 bolts, and 4 shaft clamps that secure the groomer reel to the output and stub shafts.
2. Lift the groomer reel from the cutting unit.
3. Inspect the shields, stub shaft, driven shaft and shaft bearings for wear or damage and replace components as necessary; refer to Figure 122 and The Idler Assembly (page 8–12).
Inspect the groomer reel blades frequently for any damage and wear. Straighten the bent blades. Either replace the worn blades or reverse the individual blades to put the sharpest blade edge forward: refer to Figure 122.

1. Remove the groomer reel from the cutting unit; refer to Removing the Groomer Reel (page 8–14).
2. Remove the lock nut from either end of the groomer reel shaft.
3. Remove the blades from the groomer shaft. If necessary, remove second lock nut from the shaft.
4. Inspect and replace worn or damaged components.
5. 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.
Servicing the Groomer Reel (continued)

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 (375 to 425 in-lb)**. After tightening the lock nut, spacers should not be free to rotate and the groomer blades should be centered on the shaft.

6. 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 groomer reel between the groomer driven and stub shafts.

2. 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)**.

3. Check the groomer reel height and mower height-of-cut settings and adjust as necessary.
The Height Adjuster Assembly

Figure 123

1. Cotter pin
2. Clevis pin
3. Height adjustment rod
4. Flange nut
5. Washer (2 each)
6. Compression spring
7. Compression spring
8. Bumper
9. Lock nut
10. Pinch bolt
11. Height-of-cut bracket
12. Quick up lever
13. Quick up cover
14. Detent spring
15. Button-head screw
16. Height adjuster knob
17. Height adjustment bolt
18. Plow 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; refer to Figure 124.

Disassembling the Height Adjuster

Note: Refer to Figure 123 during this procedure.

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.
Disassembling the Height Adjuster (continued)

4. Remove the hex nuts 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.

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 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 19 mm (0.75 inch).
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 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 2.3 to 2.8 N·m (20 to 25 in-lb).
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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>
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<th>COLOR</th>
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<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>
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<td>GN</td>
<td>GREEN</td>
</tr>
<tr>
<td>GY</td>
<td>GRAY</td>
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<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>
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</tbody>
</table>

Numerous harness wires used on the Toro machines include a line with an alternate color. These wires are identified with the wire color and line color with either a / or _ separating the color abbreviations listed above (e.g., R/BK is a red wire with a black line, OR_BK is an orange wire with a black line).

Wire Size

The individual wires of the electrical harness diagrams in this chapter identify both the wire color and the wire size.

Examples:
- 16 BK = 16 AWG (American Wire Gauge) wire that has a black insulator
- 050 R = 0.5 mm metric wire that has a red insulator (AWG equivalents for metric wire appear in the following table)

<table>
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