## Revision History

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<th>Date</th>
<th>Description</th>
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<td>2016</td>
<td>Initial Issue.</td>
</tr>
<tr>
<td>A</td>
<td>02/2018</td>
<td>Added revision history.</td>
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Reader Comments

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or Mail to:

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Preface

The purpose of this publication is to provide the service technician with information for troubleshooting, testing and repair of major systems and components on the Workman GTX Electric vehicle.


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

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

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

This safety symbol means DANGER, WARNING or CAUTION, PERSONAL SAFETY INSTRUCTION. When you see this symbol, carefully read the instructions that follow. Failure to obey the instructions may result in personal injury.
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# Chapter 1
## Safety

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<td>SAFETY AND INSTRUCTION DECALS</td>
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</table>
## Safety Instructions

The Workman GTX Electric is designed and tested to offer safe service when operated and maintained properly. Although hazard control and accident prevention are partially dependent upon the design and configuration of the machine, these factors are also dependent upon the awareness, concern and proper training of the personnel involved in the operation, transport, maintenance and storage of the machine. Improper use or maintenance of the machine can result in injury or death. To reduce the potential for injury or death, comply with the following safety instructions.


### Supervisor’s Responsibilities

1. Make sure operators are thoroughly trained and familiar with the Operator’s Manual and all labels on the vehicle.

2. Be sure to establish your own special procedures and work rules for unusual operating conditions (e.g. slopes too steep for vehicle operation).

### Before Operating


2. Keep all shields, safety devices and decals in place. If a shield, safety device or decal is defective, illegible or damaged, repair or replace it before operating the vehicle. Also, tighten any loose nuts, bolts or screws to ensure vehicle is in safe operating condition.
While Operating

1. Sit on the operator seat when starting and operating the vehicle.

2. Before starting the vehicle:
   A. Make sure that the AC power supply cord (extension cord) is disconnected from the vehicle onboard charger receptacle.
   B. Engage the parking brake.
   C. Make sure accelerator pedal is not depressed.
   D. Check position of direction selector switch and supervision speed limit switch.

3. Before getting off the operator seat:
   A. Stop vehicle, turn key switch to OFF and remove key from the key switch.
   B. Apply the parking brake.

4. If vehicle is parked on incline, chock or block the wheels after getting off the vehicle.

Maintenance and Service

1. Before servicing or making adjustments to the vehicle, stop vehicle, turn key switch to OFF, engage parking brake and remove key from the key switch.

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

3. Do not use open pans of flammable cleaning fluids for cleaning vehicle parts.

4. Keep battery area free of excessive grease, grass, leaves and dirt.

5. As the first step in any electrical system repair, open the battery circuit by disconnecting the conductors between the battery pack and vehicle components (see Opening Battery Circuit in the General Information section of Chapter 3 – Electrical System). Take care during repairs, however, to not allow tools or vehicle components to complete the battery circuit that was opened. Connect the conductors between the battery pack and vehicle components as the last step in the repair.

6. When using metal, uninsulated tools around batteries, do not allow tools to contact both positive and negative battery terminals simultaneously.

7. Remove jewelry and watches before servicing electrical components of the vehicle.

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

9. Battery gases can explode. Keep cigarettes, sparks and flames away from the batteries. Always service, store and charge the vehicle batteries in a well ventilated area.

10. When connecting the AC power supply cord (extension cord) to the vehicle onboard battery charger, connect the power supply cord to the vehicle charger receptacle before plugging the supply cord into an AC outlet (electrical supply for charger). After charging the vehicle batteries, unplug the supply cord from the outlet before disconnecting the supply cord from the vehicle charger receptacle.

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

12. To assure optimum performance and continued safety of the machine, use genuine Toro replacement parts and accessories. Replacement parts and accessories made by other manufacturers may result in non-conformance with safety standards and the warranty may be voided.

13. When raising the machine to change tires or to perform other service, use correct blocks, hoists and jacks. Make sure machine is parked on a solid level surface such as a concrete floor. Prior to raising the machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels that remain on the ground for vehicle stability. Use jack stands to support the raised machine. If the machine is not properly supported by jack stands, the machine may move or fall, which may result in personal injury (see Jacking Instructions in the Operator’s Manual and in this Chapter).

14. Make sure to dispose potentially harmful waste (e.g. batteries, oil) in an environmentally safe manner. Follow all local codes and regulations when recycling or disposing of waste.
Jacking and Other Instructions

Jacking Vehicle

DANGER

POTENTIAL HAZARD
• A vehicle that is not properly supported may become unstable.
WHAT CAN HAPPEN
• The vehicle may move or fall. Personal injury or damage to the machine may result.
HOW TO AVOID THE HAZARD
• Make sure vehicle is parked on a solid level surface, such as a concrete floor.
• Make sure key switch is OFF and key is removed from the switch before getting off the vehicle.
• Before raising the vehicle, remove any attachments that may interfere with the safe and proper raising of the vehicle.
• Always chock or block wheels to prevent the vehicle from rolling.
• Make sure proper hoists and jack stands are used to raise and support the vehicle.

Jacking Locations

1. Jack front of the vehicle on the front of the frame behind the towing tongue (Fig. 1).

2. Jack rear of the vehicle under each rear axle tube. Do not jack vehicle below the transaxle case (Fig. 2).

Towing Vehicle

IMPORTANT: Frequent or long distance towing of the Workman GTX Electric is not recommended.

In case of emergency, the vehicle can be towed for a short distance. See Operator’s Manual for towing information.

Transporting Vehicle

When moving the vehicle long distances, use a trailer or flatbed truck. Make sure vehicle is secured to the trailer properly. Also, make sure to secure seats to vehicle during transport. See Operator’s Manual for transport information.
Safety and Instruction Decals

There are several safety and instruction decals attached to your Workman vehicle. If any decal becomes illegible or damaged, install a new decal. Part numbers are listed in the Parts Catalog. Order replacement decals from your Authorized Toro Distributor.
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Product Records

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

Maintenance

Maintenance procedures and recommended service intervals for the Workman GTX Electric are covered in the Operator’s Manual. Refer to that publication when performing regular vehicle maintenance.
### Equivalents and Conversions

#### Decimal and Millimeter Equivalents

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

#### U.S. to Metric Conversions

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Torque Specifications

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

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

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

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

Fastener Identification

![Fastener Identification Table](image1)

Inch Series Bolts and Screws

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<th>Grade 8</th>
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Metric Bolts and Screws

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<th>Class 10.9</th>
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</thead>
</table>

Using a Torque Wrench with an Offset Wrench

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

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

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

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

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

![Using a Torque Wrench with an Offset Wrench Diagram](image2)
### Standard Torque for Dry, Zinc Plated and Steel Fasteners (Inch Series)

<table>
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<th>Thread Size</th>
<th>Grade 1, 5 &amp; 8 with Thin Height Nuts</th>
<th>SAE Grade 1 Bolts, Screws, Studs &amp; Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)</th>
<th>SAE Grade 5 Bolts, Screws, Studs &amp; Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)</th>
<th>SAE Grade 8 Bolts, Screws, Studs &amp; Sems with Regular Height Nuts (SAE J995 Grade 5 or Stronger Nuts)</th>
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<td>10 ± 2</td>
<td>13 ± 2</td>
<td>147 ± 23</td>
<td>15 ± 2</td>
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<td># 6 − 40 UNF</td>
<td>13 ± 2</td>
<td>25 ± 5</td>
<td>282 ± 30</td>
<td>29 ± 3</td>
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<td># 8 − 32 UNC</td>
<td>18 ± 2</td>
<td>30 ± 5</td>
<td>339 ± 56</td>
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<td># 10 − 24 UNC</td>
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<td>68 ± 7</td>
<td>768 ± 77</td>
</tr>
<tr>
<td>1/4 − 20 UNC</td>
<td>48 ± 7</td>
<td>53 ± 7</td>
<td>599 ± 79</td>
<td>100 ± 10</td>
</tr>
<tr>
<td>1/4 − 28 UNF</td>
<td>53 ± 7</td>
<td>65 ± 10</td>
<td>734 ± 113</td>
<td>115 ± 12</td>
</tr>
<tr>
<td>5/16 − 18 UNC</td>
<td>115 ± 15</td>
<td>105 ± 15</td>
<td>1186 ± 169</td>
<td>200 ± 25</td>
</tr>
<tr>
<td>5/16 − 24 UNF</td>
<td>138 ± 17</td>
<td>128 ± 17</td>
<td>1446 ± 192</td>
<td>225 ± 25</td>
</tr>
<tr>
<td>3/8 − 16 UNC</td>
<td>16 ± 2</td>
<td>16 ± 2</td>
<td>22 ± 3</td>
<td>30 ± 3</td>
</tr>
<tr>
<td>3/8 − 24 UNF</td>
<td>17 ± 2</td>
<td>18 ± 2</td>
<td>24 ± 3</td>
<td>35 ± 4</td>
</tr>
<tr>
<td>7/16 − 14 UNC</td>
<td>27 ± 3</td>
<td>27 ± 3</td>
<td>37 ± 4</td>
<td>50 ± 5</td>
</tr>
<tr>
<td>7/16 − 20 UNF</td>
<td>29 ± 3</td>
<td>29 ± 3</td>
<td>39 ± 4</td>
<td>55 ± 6</td>
</tr>
<tr>
<td>1/2 − 13 UNC</td>
<td>30 ± 3</td>
<td>48 ± 7</td>
<td>65 ± 9</td>
<td>75 ± 8</td>
</tr>
<tr>
<td>1/2 − 20 UNF</td>
<td>32 ± 4</td>
<td>53 ± 7</td>
<td>72 ± 9</td>
<td>85 ± 9</td>
</tr>
<tr>
<td>5/8 − 11 UNC</td>
<td>65 ± 10</td>
<td>88 ± 12</td>
<td>119 ± 16</td>
<td>150 ± 15</td>
</tr>
<tr>
<td>5/8 − 18 UNC</td>
<td>75 ± 10</td>
<td>95 ± 15</td>
<td>129 ± 20</td>
<td>170 ± 18</td>
</tr>
<tr>
<td>3/4 − 10 UNC</td>
<td>93 ± 12</td>
<td>140 ± 20</td>
<td>190 ± 27</td>
<td>265 ± 27</td>
</tr>
<tr>
<td>3/4 − 16 UNF</td>
<td>115 ± 15</td>
<td>165 ± 25</td>
<td>224 ± 34</td>
<td>300 ± 30</td>
</tr>
<tr>
<td>7/8 − 9 UNC</td>
<td>140 ± 20</td>
<td>225 ± 25</td>
<td>305 ± 34</td>
<td>430 ± 45</td>
</tr>
<tr>
<td>7/8 − 14 UNC</td>
<td>155 ± 25</td>
<td>260 ± 30</td>
<td>353 ± 41</td>
<td>475 ± 48</td>
</tr>
</tbody>
</table>

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

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

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

<table>
<thead>
<tr>
<th>Thread Size</th>
<th>Class 8.8 Bolts, Screws and Studs with Regular Height Nuts (Class 8 or Stronger Nuts)</th>
<th>Class 10.9 Bolts, Screws and Studs with Regular Height Nuts (Class 10 or Stronger Nuts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M5 X 0.8</td>
<td>$57 \pm 6 \text{ in} \cdot \text{lb}$</td>
<td>$644 \pm 68 \text{ N} \cdot \text{cm}$</td>
</tr>
<tr>
<td>M6 X 1.0</td>
<td>$96 \pm 10 \text{ in} \cdot \text{lb}$</td>
<td>$1085 \pm 113 \text{ N} \cdot \text{cm}$</td>
</tr>
<tr>
<td>M8 X 1.25</td>
<td>$19 \pm 2 \text{ ft} \cdot \text{lb}$</td>
<td>$26 \pm 3 \text{ N} \cdot \text{m}$</td>
</tr>
<tr>
<td>M10 X 1.5</td>
<td>$38 \pm 4 \text{ ft} \cdot \text{lb}$</td>
<td>$52 \pm 5 \text{ N} \cdot \text{m}$</td>
</tr>
<tr>
<td>M12 X 1.75</td>
<td>$66 \pm 7 \text{ ft} \cdot \text{lb}$</td>
<td>$90 \pm 10 \text{ N} \cdot \text{m}$</td>
</tr>
<tr>
<td>M16 X 2.0</td>
<td>$166 \pm 17 \text{ ft} \cdot \text{lb}$</td>
<td>$225 \pm 23 \text{ N} \cdot \text{m}$</td>
</tr>
<tr>
<td>M20 X 2.5</td>
<td>$325 \pm 33 \text{ ft} \cdot \text{lb}$</td>
<td>$440 \pm 45 \text{ N} \cdot \text{m}$</td>
</tr>
</tbody>
</table>

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

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

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

**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, 88 ± 14 N−m</td>
</tr>
<tr>
<td>1/2 − 20 UNF Grade 5</td>
<td>80 ± 10 ft−lb, 108 ± 14 N−m</td>
</tr>
<tr>
<td>M12 X 1.25 Class 8.8</td>
<td>80 ± 10 ft−lb, 108 ± 14 N−m</td>
</tr>
<tr>
<td>M12 X 1.5 Class 8.8</td>
<td>80 ± 10 ft−lb, 108 ± 14 N−m</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Thread Size</th>
<th>Baseline Torque*</th>
</tr>
</thead>
<tbody>
<tr>
<td>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>

**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>

**Conversion Factors**

\[
in−lb \times 11.2985 = N−cm \quad N−cm \times 0.08851 = in−lb
\]

\[
ft−lb \times 1.3558 = N−m \quad N−m \times 0.7376 = ft−lb
\]
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Electrical System
General Information

The Workman GTX Electric uses a 48 VDC electrical system that is an isolated circuit. The vehicle frame is not used for any ground connections.

The vehicle controller monitors operator and vehicle inputs to determine voltage to the traction motor. If a problem exists that will prevent normal vehicle operation, an LED on the controller and the status indicator light on the dash panel will flash a fault code to assist in identifying the problem.

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

Operator's Manual

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

Electrical Drawings

The electrical schematic and other electrical drawings for the Workman GTX Electric are located in Chapter 6 – Electrical Drawings.

Rear Frame Panel Cover

A panel cover is secured to the top of the rear frame behind the seats to prevent debris entry to the front of the swing arm area. The cover can easily be removed by releasing the latches and lifting the cover from the rear frame.
Opening Battery Circuit

To prevent allowing a current path through tools used during vehicle electrical circuit repairs, disconnect the conductors between the battery pack and vehicle components as the first step in any electrical system repair.

Battery pack cable routing is shown in Figure 2.

Before working on the vehicle electrical system, remove battery conductors as follows (Fig. 2):

1. Park vehicle on a level surface, turn key switch to OFF, engage the parking brake and remove key from the key switch. Make sure that the vehicle battery charger is not connected to an electrical outlet.

2. Raise and support cargo bed to allow access to battery pack.

3. Remove hex nut from negative terminal on the left, rear battery that secures the negative cable from the vehicle controller, the wire harness ground conductor and the negative (black and white) conductors from the battery charger. Remove all of the conductors from the negative battery terminal.

4. Remove hex nut from the positive terminal on the right, rear battery that secures the positive cable to the vehicle main contactor and the positive (red) conductor from the battery charger. Remove the conductors from the positive battery terminal.

5. Make sure that disconnected conductors are positioned away from the battery terminals.

6. Service electrical system on the vehicle as required. Take care during repairs, however, to not allow tools or vehicle components to complete the battery circuit that was opened with the cable removal.

After working on the vehicle electrical system, attach battery conductors as follows (Fig. 2):

1. Make sure that key is removed from the key switch.

2. Install the positive cable from the vehicle main contactor and the positive conductor (red charger wire) from the battery charger onto the positive terminal on the right, rear battery. Secure conductors to battery with hex nut and torque nut from 95 to 105 in−lb (10.8 to 11.8 N−m).

3. Install the negative cable from the vehicle controller, the wire harness ground conductor and the negative conductors (black and white charger wires) from the battery charger onto the negative terminal on the left, rear battery. Secure conductors to battery with hex nut and torque nut from 95 to 105 in−lb (10.8 to 11.8 N−m).

4. Apply battery terminal protector (see Special Tools in this chapter) to the connections after the conductors have been secured to the battery terminals. Also, make sure that boot is positioned over positive terminal of the right, rear battery.

5. Lower and secure cargo bed.
Vehicle Operation

The Workman GTX Electric electrical system uses a 48 volt battery pack, an electric traction motor, a vehicle controller and numerous other electrical components to allow vehicle operation.

Eight, 6 volt, advanced deep cycle batteries that are connected in series provide current for a 48V, brushless, high torque, AC inductive traction motor, the vehicle controller and vehicle accessories. The batteries are discharged as the vehicle is used so charging the batteries after using the vehicle is necessary. A battery discharge indicator on the dash provides the operator with information on battery charge level. Demands on the vehicle during use (speed, payload, incline use), battery condition (age, charge level), ambient temperature and vehicle condition will all put constraints on how long a vehicle can be used before the batteries are in need of recharging.

**IMPORTANT:** When connecting the battery pack in the 48 VDC system, make sure that battery polarity is carefully checked. System damage can occur if batteries are not connected correctly.

The Workman GTX electrical system is an isolated system so the vehicle frame is not used for any ground connections. Before performing any electrical service, it is recommended to open the vehicle battery circuit by disconnecting the conductors between the battery pack and vehicle components (see Opening Battery Circuit in the General Information section of this chapter). This will prevent unexpected component operation when performing service on the vehicle.

The electric traction motor directly drives a double reduction, high torque transaxle with integral differential. Operator inputs for forward/reverse, supervision speed limit switch position and accelerator pedal position are used by the controller to determine needed electrical power for the traction motor.

The traction motor is protected from overheating by a thermistor (thermally sensitive resistor) that resides in the motor housing. If unsafe motor temperature is sensed by the thermistor, the controller will limit vehicle speed and torque until the motor temperature reduces to a normal level.

The vehicle controller is a sealed electronic logic device that uses inputs from several vehicle components to control motor speed and direction. These inputs include several switches (key, direction selector, supervision speed limit, parking brake), the traction motor thermistor (temperature), the traction motor encoder (speed sensor), the accelerator pedal and the vehicle main contactor (solenoid). The controller also provides regenerative braking to assist in slowing the vehicle whenever the accelerator pedal is released. The controller has fault detection capabilities to help identify system problems. Battery current is available to the controller whenever the key switch is ON which energizes the main contactor. A high current fuse mounted to the controller protects the 48 VDC circuits.

The Workman controller also limits roll away speed in instances when the vehicle begins to move (roll away) after being stopped. On an incline and with the key switch in the ON position, if the vehicle starts moving, regenerative braking will limit vehicle speed.

Vehicle accessories (headlights, USB charge port, optional reverse alarm and optional lights) are operated by a 12 VDC system that is powered by a 48 VDC to 12 VDC converter mounted under the dash panel. These vehicle accessories receive current for operation when the key switch is ON. The 10 amp fuse in the fuse block provides circuit protection for the components in this 12 VDC system. Ground wires used for 12 VDC circuits have black insulation.

An on-board, fully automatic, high efficiency 1kW smart charger with 85 – 265 VAC global input is attached to the vehicle for charging the battery pack. The vehicle controller prevents the vehicle from operating while charging the batteries. Charger activity can be monitored at the indicator LED near the battery charge receptacle on the left side of the vehicle.

Testing and service information about components used in the Workman GTX electrical system is included in the Component Testing and Service and Repairs sections of this chapter.
Special Tools

Order special tools from your Toro Distributor. Some tools may also be available from a local supplier.

**Multimeter**

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

**NOTE:** Toro recommends the use of a DIGITAL Volt–Ohm–Amp multimeter when testing electrical circuits. The high impedance (internal resistance) of a digital meter in the voltage mode will make sure that excess current is not allowed through the meter. This excess current can cause damage to circuits not designed to carry it.

**NOTE:** Workman GTX Electric vehicles use a 48 volt, DC electrical system. If multimeter is not of the auto-range type, make sure to properly set multimeter range before performing any voltage test.

---

**Battery Terminal Protector**

Aerosol spray that should be used on battery terminals, ring terminals and fork terminals to reduce corrosion problems. Apply terminal protector to the connection after the battery cable, ring terminal or fork terminal has been secured.

Toro Part Number: 107–0392

---

**Dielectric Gel**

Dielectric gel should be used to prevent corrosion of unsealed connection terminals. To ensure complete coating of terminals, liberally apply gel to both component and wire harness connector, plug connector to component, unplug connector, reapply gel to both surfaces and reconnect harness connector to component. Connectors should be thoroughly packed with gel for effective results.

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

Toro Part Number: 107–0342
Hand Pump Hose Assembly

Use the hand pump hose assembly when adding distilled water to vehicle batteries through the single port fill system. The hand pump hose coupler attaches to the fill port coupler on the Workman vehicle.

Toro Part Number: 131−8522

Battery Lift Strap

Use the battery lift strap to remove and install batteries from the vehicle. Lift strap allows use of case loops on battery tops as safe battery lifting points. Obtain battery lift strap locally.

Battery Hydrometer

Use the battery hydrometer when measuring specific gravity of battery electrolyte. Obtain hydrometer locally.
36/48 Volt Battery Discharge Unit

The 36/48 Volt Battery Discharge Unit is recommended for quick and accurate load testing for the batteries on a Workman GTX Electric vehicle. This tool is used to determine the capacity of the Workman battery pack and also for finding a faulty battery (or batteries) in the battery pack.

Toro Part Number: TOR4106

Figure 9
For effective troubleshooting and repairs, there must be a good understanding of the electrical circuits and components used on this vehicle (see Electrical Schematic and wire harness drawings in Chapter 6 – Electrical Drawings).

If the vehicle has any switches bypassed, they must be reconnected for proper vehicle operation, troubleshooting and safety.

### General Run Problems

**NOTE:** Check status indicator light on dash panel or controller LED for possible faults whenever diagnosing vehicle electrical circuit problems (see Controller in the Component Testing section of this chapter).

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Causes</th>
</tr>
</thead>
</table>
| Main contactor clicks, but vehicle will not operate. | Battery charge is low (check battery discharge indicator on dash).  
Battery cables are loose, corroded or damaged.  
Cable connection(s) at main contactor is/are loose or corroded.  
Cable connection(s) at controller is/are loose or corroded.  
Cable connection(s) at traction motor is/are loose or corroded.  
Traction motor is faulty (check status indicator light on dash or LED on controller for possible fault).  
Controller is faulty (check status indicator light on dash or LED on controller for possible fault). |
## General Run Problems (Continued)

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nothing happens when key switch is turned to ON.</td>
<td>Battery charge is extremely low (check battery discharge indicator on dash).</td>
</tr>
<tr>
<td></td>
<td>Battery cables are loose, corroded or damaged.</td>
</tr>
<tr>
<td></td>
<td>Cable connection(s) at main contactor is/are loose or corroded.</td>
</tr>
<tr>
<td></td>
<td>10 ampere fuse to the key switch is loose or faulty.</td>
</tr>
<tr>
<td></td>
<td>Cable connection(s) at controller is/are loose or corroded.</td>
</tr>
<tr>
<td></td>
<td>425 ampere fuse on controller is loose or faulty.</td>
</tr>
<tr>
<td></td>
<td>Main contactor or circuit wiring is faulty (check status indicator light on dash or LED on controller for possible fault).</td>
</tr>
<tr>
<td></td>
<td>The key switch or circuit wiring is faulty.</td>
</tr>
<tr>
<td></td>
<td>Controller is faulty (check status indicator light on dash or LED on controller for possible fault).</td>
</tr>
<tr>
<td>Traction motor stops during operation.</td>
<td>Battery charge is extremely low (check battery discharge indicator on dash).</td>
</tr>
<tr>
<td></td>
<td>Wiring to the traction motor components (e.g. main contactor, controller, traction motor) is loose, corroded or damaged (refer to Electrical Schematic in Chapter 6 – Electrical Diagrams).</td>
</tr>
<tr>
<td></td>
<td>Battery cables are loose, corroded or damaged.</td>
</tr>
<tr>
<td></td>
<td>Traction motor is overheated (check status indicator light on dash or LED on controller for possible fault).</td>
</tr>
<tr>
<td></td>
<td>Controller is overheated (check status indicator light on dash or LED on controller for possible fault).</td>
</tr>
<tr>
<td></td>
<td>Traction motor is faulty (check status indicator light on dash or LED on controller for possible fault).</td>
</tr>
<tr>
<td></td>
<td>Brake problem exists (see Brakes in the Troubleshooting section of Chapter 5 – Chassis).</td>
</tr>
<tr>
<td></td>
<td>Transaxle problem exists (see Chapter 4 – Transaxle).</td>
</tr>
</tbody>
</table>
## General Run Problems (Continued)

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Causes</th>
</tr>
</thead>
</table>
| Vehicle runs slowly. | The supervision speed limit switch is in the slow position.  
Tire pressure is low (see Check Tire Pressure in the Service and Repairs section of Chapter 5 – Chassis).  
The parking brake is improperly adjusted (see Adjust Parking Brake in the Adjustments section of Chapter 5 – Chassis).  
Brakes are worn or faulty (see Brakes in the Troubleshooting section of Chapter 5 – Chassis).  
Battery charge is extremely low (check battery discharge indicator on dash).  
Controller is overheated (check status indicator light on dash or LED on controller for possible fault).  
Traction motor is overheated (check status indicator light on dash or LED on controller for possible fault). |
| Vehicle movement is erratic or jerky. | Accelerator pedal movement is dirty preventing smooth pedal operation.  
Accelerator pedal is worn or faulty (check status indicator light on dash or LED on controller for possible fault).  
A brake system problem exists (see Brakes in the Troubleshooting section of Chapter 5 – Chassis).  
A transaxle problem exists (see Chapter 4 – Transaxle). |

## Battery Charger Operation

<table>
<thead>
<tr>
<th>Light Status</th>
<th>Indicates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green light on battery charger is illuminated (not flashing).</td>
<td>Batteries is fully charged. Vehicle ready to operate.</td>
</tr>
</tbody>
</table>
| Green light on battery charger is flashing. | Slow flash (once per second): Batteries being charged (batteries less than 80% charged). Continue charging.  
Rapid flash (four times per second): Batteries being charged (batteries more than 80% charged). Continue charging. |
| Red light on battery charger is flashing. | Rapid flash: Charger timer shutoff has occurred after 20 hours of charging.  
Slow flash: No current to charger. Check AC outlet (electrical supply for charger) and AC power supply cord (extension cord). |
## Battery Charger Problems

**NOTE:** Check battery charger diagnostic LED for possible faults whenever diagnosing on-board battery charger problems (see On-board Battery Charger in the Component Testing section of this chapter).

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Causes</th>
</tr>
</thead>
</table>
| Battery charger does not turn on. | AC outlet (electrical supply for charger) circuit breaker or fuse is tripped or blown.  
AC outlet (electrical supply for charger) is faulty.  
AC power supply cord (extension cord) is faulty.  
Vehicle wiring is loose or damaged (see electrical schematic in Chapter 6 – Electrical Diagrams).  
Vehicle charger receptacle or circuit wiring is damaged.  
On-board battery charger is faulty (check charger diagnostic LED on charger for possible fault). |
| Battery charger does not turn off. | NOTE: Charging new batteries or charging batteries in cold temperatures may require extended charge time to achieve full charge.  
On-board battery charger is faulty (check charger diagnostic LED on charger for possible fault). |
| The AC outlet (electrical supply for charger) circuit breaker or fuse is tripped or blown when using the battery charger. | Overloaded AC circuit (electrical supply for charger).  
On-board battery charger is faulty (check charger diagnostic LED on charger for possible fault). |
Component Testing

For accurate resistance and/or continuity checks, electrically disconnect the component being tested from the circuit (e.g. disconnect the harness wire connectors from the vehicle key switch before doing a continuity check on the key switch).

**CAUTION**
When testing electrical components for continuity with a multimeter (ohms setting), make sure that power to the circuit has been disconnected.

Key Switch

The Workman GTX Electric key switch has two (2) positions (OFF and ON) and three (3) switch terminals on the back of the switch. The key switch is located on the dash panel.

NOTE: Only key switch terminals B1 and 3 are used on the Workman GTX Electric vehicle.

NOTE: The Workman GTX Electric key switch circuit is a 48 VDC circuit.

Testing

**CAUTION**
When testing the key switch for continuity with a multimeter (ohms setting), make sure that power to the circuit has been disconnected.

A. When the key switch is in the OFF position, no continuity (infinite ohms) should exist between switch terminals B1 and 3.

B. In the ON position, continuity (zero ohms) should exist between switch terminals B1 and 3.

1. Park vehicle on a level surface, turn key switch to OFF, engage the parking brake and remove key from the key switch.

2. Make sure that vehicle battery charger IS NOT connected to electrical outlet. Open the battery circuit by disconnecting the conductors between the battery pack and vehicle components (see Opening Battery Circuit in the General Information section of this chapter).

3. Raise hood to allow access to wire harness connections for switches mounted in dash.

4. Label and disconnect wire harness connectors from the key switch.

5. With the use of a multimeter (ohms setting), the key switch functions may be tested to determine whether continuity exists between the B1 and 3 terminals for each switch position. The key switch terminals are marked as shown in Figure 10.

6. Replace key switch if testing determines that the switch is faulty.

7. If key switch tests correctly and circuit problem still exists, check wire harness for possible problems (see electrical schematic and wire harness drawing in Chapter 6 – Electrical Drawings).

8. After key switch testing is complete, connect wire harness connectors to the switch.

9. Connect the conductors between the battery pack and vehicle components (see Opening Battery Circuit in the General Information section of this chapter). Make sure to torque hex nuts on battery terminals from 95 to 105 in−lb (10.8 to 11.8 N−m).

10. Lower and secure front hood.
Fuses

The Workman fuse block is located under the seat assembly (Fig. 11). All fuse block fuses are rated at 80 VDC.

The fuse location in the fuse block is shown in Figure 12. The fuses protect circuits as follows:

The front 10 amp (80 VDC) fuse protects the power supply to the key switch and all switched circuits. The battery charge indicator is also protected by the front fuse.

The second fuse position is used to protect the optional cargo bed lift circuit. When equipped with the bed lift kit, a 15 amp fuse (80 VDC) will be in the fuse block.

The third fuse position is used to protect the optional horn circuit. When equipped with the horn kit, a 30 amp (80 VDC) fuse will be in the fuse block.

The fourth fuse position is used for other optional kits, if equipped.

An additional fuse is attached to the controller (Fig. 13). This fuse is rated at 425 amperes continuous and protects the 48VDC vehicle power supply circuit. If this fuse has failed, vehicle operation will not occur.

IMPORTANT: If fuse replacement is necessary on your Workman GTX Electric vehicle, make sure that new fuses have the correct specifications (voltage and amperage).

Fuse Testing

![Diagram of fuse block]

**CAUTION**

When testing fuses for continuity with a multimeter (ohms setting), make sure that fuse is removed from circuit.

**IMPORTANT:** Before removing fuse from controller (425 Amp) for testing, open the battery circuit by removing one of the battery cables (see Opening Battery Circuit in the General Information section of this chapter).

Make sure key switch is turned OFF. Remove fuse to check continuity. The test meter should read **less than 1 ohm** if a fuse is functional. Replace the fuse if faulty.

If fuse was removed from controller, torque the nuts that secure the fuse from **89 to 106 in–lb (10 to 12 N–m).**
Battery Discharge Indicator

The battery discharge indicator identifies the battery pack state of charge and is located on the dash panel (Fig. 14).

The discharge indicator reads full (10 indicator bars) after the battery pack has been fully charged (approximately 51 volts). As battery pack voltage decreases with vehicle use, fewer battery indicator bars are shown on the indicator.

When the discharge indicator reaches two (2) indicator bars due to diminished battery pack charge, the remaining two (2) bars will blink to identify that the battery charge level is extremely low. At this point or before, the batteries should be charged for best battery durability.

If the vehicle continues to be used after the battery discharge indicator reaches two (2) bars, the remaining two (2) bars will alternatively flash. At this point, the batteries should be charged to prevent serious battery damage.

IMPORTANT: To obtain maximum battery life, always charge the batteries when there are two (2) or more bars remaining on the battery discharge indicator. Regularly depleting the batteries to lower than two (2) bars will reduce the life of the batteries in your Workman GTX Electric vehicle. Also, when only two (2) bars remain on the indicator, the vehicle may enter a reduced speed mode. This reduced speed helps to protect the batteries and acts as a notice that the batteries should be charged.

NOTE: It should be noted that very high or very low ambient temperatures may affect the operation of the battery discharge indicator.

The back of the discharge indicator is shown in Figure 16. A wire harness connector plugs into the indicator. Refer to Chapter 6 – Electrical Diagrams for electrical schematic and wire harness information.

If the battery discharge indicator proves to be inaccurate, the meter should be replaced.
Light Switch

The light switch allows the headlights to be turned ON and OFF. This rocker switch is located on the dash panel (Fig. 17).

**NOTE:** The Workman GTX Electric headlight circuit is a 12 VDC circuit.

**Testing**

1. Park vehicle on a level surface, turn key switch to OFF, engage the parking brake and remove key from the key switch.

2. Raise hood to allow access to wire harness connections for switches mounted in dash.

3. Disconnect wire harness connector from the light switch.

4. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each light switch position. The light switch terminals are marked as shown in Figure 18. The circuitry of this switch is shown in the chart below. Verify continuity between switch terminals.

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

5. Replace light switch if testing determines that the switch is faulty.

6. If light switch tests correctly and circuit problem still exists, check fuse, headlights and wire harness for possible problems (see electrical schematic and wire harness drawing in Chapter 6 – Electrical Drawings).

7. After light switch testing is complete, connect wire harness connector to the light switch. Lower and secure front hood.
**Direction Selector Switch**

The direction selector switch allows the direction (forward/neutral/reverse) of the vehicle to be changed by the operator and is one of several inputs for the vehicle controller. The direction selector switch is located on the dash panel (Fig. 19).

**NOTE:** Direction selector switch terminals 1, 2 and 3 are used on all Workman GTX Electric vehicles to change the direction of the vehicle. On vehicles with a reverse alarm (12 VDC circuit), switch terminals 4 and 5 are also used to activate the alarm when the selector switch is in the reverse direction.

**NOTE:** The Workman GTX Electric direction selector circuit is a 48 VDC circuit.

**Testing**

1. Park vehicle on a level surface, turn key switch to OFF, engage the parking brake and remove key from the key switch.

2. Raise hood to allow access to wire harness connections to the direction selector switch.

3. Disconnect wire harness connector from the direction selector switch.

4. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each direction switch position. The direction switch terminals are marked as shown in Figure 20. The circuitry of this switch is shown in the chart below. Verify continuity between switch terminals.

<table>
<thead>
<tr>
<th>SWITCH POSITION</th>
<th>NORMAL CIRCUITS</th>
<th>OTHER CIRCUITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>FORWARD</td>
<td>2 + 3</td>
<td>5 + 6</td>
</tr>
<tr>
<td>NEUTRAL</td>
<td>NONE</td>
<td>NONE</td>
</tr>
<tr>
<td>REVERSE</td>
<td>2 + 1</td>
<td>5 + 4</td>
</tr>
</tbody>
</table>

5. Replace direction selector switch if testing determines that the switch is faulty.

6. If direction selector switch tests correctly and circuit problem still exists, check wire harness for possible problems (see electrical schematic and wire harness drawing in Chapter 6 – Electrical Drawings).

7. After direction selector switch testing is complete, connect wire harness connector to the selector switch. Lower and secure front hood.
Status Indicator Light

The status indicator light is located on the control panel next to the parking brake lever (Fig. 21). During normal operation, the status indicator light should be continuously illuminated. A vehicle electrical problem will be identified by a flashing status indicator light.

The status indicator and LED on the vehicle controller should have the same condition (off, illuminated or flashing). If the status indicator does not illuminate when the key switch is turned ON, check the LED on the vehicle controller to make sure it is illuminated. If the controller LED is illuminated and the status indicator light is not illuminated, check the status indicator light and circuit wiring.

See Controller (in this section) and your Operator’s Manual for information on a flashing status indicator light.

Testing

1. Park vehicle on a level surface, turn key switch to OFF, engage the parking brake and remove key from the key switch.

2. Raise hood to allow access to wire harness connections to the status indicator light.

3. Disconnect wire harness connectors from status indicator light.

IMPORTANT: The status indicator light is a 48 VDC component. To test the light, use jumper wires from the vehicle battery pack (48 VDC).

4. The two (2) terminals for the light are shown in Figure 22. Use appropriate jumper wires to connect a 48 VDC source to the status indicator light terminals.

5. Status indicator light should illuminate as long as the jumper leads are connected to the light.

6. Remove voltage source from the light. Replace light if testing determines that it is faulty.

7. When status indicator light testing is completed, connect wire harness connectors to light.

8. Lower and secure hood.
Supervision Speed Limit Switch

The supervision speed limit switch allows the maximum speed of the vehicle to be set to either performance (16 mph/26 kph) or economy (12 mph/19 kph). The speed limit switch is one of several inputs for the vehicle controller and is located under the seat assembly (Fig. 23).

The supervision speed limit switch is open in the performance position (key vertical) and closed in the economy position (key rotated clockwise).

NOTE: Only speed limit switch terminals A and D are used on the Workman GTX Electric vehicle.

NOTE: The Workman GTX Electric supervision speed limit circuit is a 48 VDC circuit.

Testing

1. Park vehicle on a level surface, turn key switch to OFF, engage the parking brake and remove key from the key switch.

2. Remove seat assembly to allow access to supervision speed limit switch.

3. Disconnect wire harness connector from the supervision speed limit switch.

4. With the use of a multimeter (ohms setting), the speed limit switch functions may be tested to determine whether continuity exists between the A and D terminals for each switch position. The speed limit switch terminals are identified as shown in Figure 24.

   A. When the speed limit switch is in the performance position (vertical), no continuity (infinite ohms) should exist between switch terminals A and D.

   B. In the economy position (key rotated clockwise), continuity (zero ohms) should exist between switch terminals A and D.

5. Replace the speed limit switch if testing determines that the switch is faulty.

6. If the speed limit switch tests correctly and circuit problem still exists, check wire harness for possible problems (see electrical schematic and wire harness drawing in Chapter 6 – Electrical Drawings).

7. After speed limit switch testing is complete, plug wire harness connector to the switch. Install seat assembly.
Parking Brake Switch

The parking brake switch is used as an input for the vehicle controller to identify when the parking brake is applied. The parking brake switch is attached to the parking brake mount behind the dash (Fig. 25).

A normally closed contact in the switch is opened when the parking brake is released. When the parking brake is applied, the switch is in its normally closed state. Only two (2) of the switch terminals are used in the parking brake switch circuit.

If the direction selector switch is in either the forward or reverse direction and the parking brake is applied, the status indicator light on the dash should blink two (2) times.

Testing

1. Park vehicle on a level surface, turn key switch to OFF, engage the parking brake and remove key from the key switch.

2. To access the parking brake switch, remove dash (see Dash in the Service and Repairs section of Chapter 5 – Chassis).

3. Disconnect wire harness electrical connector from the brake switch (Fig. 25).

4. Connect a multimeter (ohms setting) across the common and normally closed (NC) terminals of the brake switch (Fig. 26).

5. With the parking brake released (not applied), the washer on the parking brake lever should be depressing the lever on the brake switch. In this switch position, there should not be continuity (infinite ohms) between the common and normally closed (NC) switch terminals.

6. With the parking brake applied, the washer on the parking brake lever should not be depressing the lever on the brake switch. In this switch position, there should be continuity (zero ohms) between the common and NC switch terminals.

NOTE: The normally open (NO) switch terminal is not used in the parking brake circuit.

7. If testing determines that the brake switch is faulty, replace switch.

8. If the brake switch tests correctly and a circuit problem still exists, check wire harness for problems (see electrical schematic and wire harness drawing in Chapter 6 – Electrical Drawings).

9. After brake switch testing is completed, connect wire harness electrical connector to the switch.

10. Carefully position and secure dash to vehicle (see Dash in the Service and Repairs section of Chapter 5 – Chassis).

![Figure 25](image-url)

1. Parking brake lever  
2. Parking brake switch  
3. Wire harness connector

![Figure 26](image-url)

1. Common terminal  
2. NO terminal  
3. NC terminal  
4. Switch lever
USB Charge Port

The USB charge port can be used to charge or power electrical devices that use a USB port. The charge port has a 5 VDC output and is mounted to the dash (Fig. 27).

If the vehicle wire harness is to be disconnected from the charge port, note the wire harness connections at the charge port for assembly purposes. The white wire harness lead should be connected to the positive (+) terminal on the charge port and the black wire harness lead should be connected to the negative (−) terminal on the charge port (Fig. 28).

Figure 27
1. Dash panel 2. USB charge port

Figure 28
1. Positive (+) terminal 2. Negative (−) terminal
Main Contactor (48 VDC)

The main contactor provides current to the 48 VDC system circuits (e.g. controller, traction motor) and is energized by the controller when the key switch is ON. The main contactor is mounted to the controller bracket beneath the cargo bed (Fig. 29).

**NOTE:** If main contactor is faulty, a fault may be displayed at the status indicator light on dash and LED on controller (see Controller in this section).

**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) that is due to the internal resistance of the meter and test leads. Subtract this value from the measured value of the component you are testing.

1. Park vehicle on a level surface, turn key switch to OFF, engage the parking brake and remove key from the key switch. Raise and support cargo bed to access the main contactor.

2. Make sure that vehicle battery charger IS NOT connected to electrical outlet. Open the battery circuit by disconnecting the conductors between the battery pack and vehicle components (see Opening Battery Circuit in the General Information section of this chapter).

3. Locate main contactor. Disconnect all vehicle wire harness connectors from contactor. Note wire connector locations on contactor for assembly purposes.

4. Using jumper wires, apply 48 VDC directly across the contactor coil posts (Fig. 30). The contactor should click as voltage is applied. With the contactor coil energized, resistance across the main contact posts should be less than 1 ohm.

5. Remove voltage from contactor coil posts. The contactor should click as voltage is removed. With the contactor coil not energized, resistance across the main contact posts should be infinite ohms.

6. With voltage removed from contactor coil posts, measure resistance across the coil posts (Fig. 30). The resistance should be approximately 126 ohms.

7. Replace main contactor if testing determines that it is faulty.

8. When contactor testing is completed, connect wire harness connectors to contactor.

9. Connect the conductors between the battery pack and vehicle components (see Opening Battery Circuit in the General Information section of this chapter). Make sure to torque hex nuts on battery terminals from 95 to 105 in−lb (10.8 to 11.8 N−m).

10. Lower and secure cargo bed.

![Figure 29](image1)

![Figure 30](image2)
Accelerator Pedal

The accelerator pedal is attached to the foot board under the dash (Fig. 31). This pedal is used as one of the inputs for the vehicle controller to determine vehicle speed. The electronic control incorporated in the accelerator pedal is a non-contact, rotary hall effect sensor that varies output voltage based on the pedal position. When the operator presses or releases the accelerator pedal, the voltage from the pedal sensor changes. Output voltage from the pedal is used by the controller to determine appropriate current flow to the traction motor.

If the accelerator pedal is thought to be faulty, consider the following before replacing the pedal:

1. Make sure that the accelerator pedal moves smoothly through its entire range of motion.

2. Check the vehicle controller for any existing faults that indicate a problem with the accelerator pedal (see Controller in this section of this chapter).

3. The wire harness connector and accelerator pedal connector should be inspected for corrosion or connector pin damage.

NOTE: No internal parts are available for the acceleration pedal.
Traction Motor

The traction motor stator winding, thermistor (temperature) and encoder (speed sensor) can be tested with the motor attached to the transaxle. Test connection points for the traction motor are shown in Fig. 33.

If a traction motor component is faulty, there should likely be a fault code displayed on the controller LED and the status indicator light. Before disconnecting electrical connections on the motor, check for existing fault codes that suggest a problem with the motor. See Controller in this section for additional information regarding faults.

Before disconnecting any electrical connections from the traction motor, open the vehicle battery circuit by disconnecting the conductors between the battery pack and vehicle components (see Opening Battery Circuit in the General Information section of this chapter). When installing cables to motor terminals, torque jam nuts at terminals from 49 to 61 in−lb (5.5 to 7.0 N−m) (Fig. 37). Apply Toro battery terminal protector (see Special Tools) to motor connections after tightening nuts.

Refer to Traction Motor and Traction Motor Service in the Service and Repairs section of this chapter for traction motor removal, installation, disassembly and assembly information.

Stator Winding Testing

Use a multimeter to measure resistance (ohms) between motor terminals (U, V and W). There should be very low (not zero) resistance between pairs of terminals (U and V, V and W and U and W). Also, measure resistance between each terminal and the motor drive end bracket. There should be infinite resistance between each terminal and the drive end bracket.

If resistance between terminals is either very high or zero, the stator is damaged. The stator is also faulty if resistance between any terminal and the drive end bracket is not infinite. If stator is damaged, replacement of the traction motor is necessary.

Thermistor (Thermally Sensitive Resistor) Testing

Use a multimeter to measure resistance (ohms) between the pins in the thermistor connector. The measured resistance at 77°F (25°C) (motor temperature) should be approximately 600 ohms. If resistance testing determines a short circuit (low resistance) or an open circuit (infinite resistance), the thermistor or thermistor wiring is damaged and the motor must be replaced. The thermistor is an integral component of the traction motor stator.

Encoder (Speed Sensor) Testing

If encoder problems exist, the vehicle controller should determine that a problem exists and a fault code should be displayed on the controller LED and the status indicator light. See Controller in this section for additional information regarding encoder faults.

NOTE: If a traction motor armature problem exists in the motor (e.g. worn bearing in rear end bracket, missing retaining ring on rear of armature shaft, loose or damaged tone ring on armature), an encoder fault could be generated due to the armature issue.
On−board Battery Charger

The Workman GTX Electric on−board battery charger is attached to the left side of the vehicle under the operator seat.

Power input to the charger is provided at the charging receptacle by an AC power supply cord. A four (4) wire output cable with three (3) connectors is used to connect the charger to the vehicle electrical system. The connectors include battery positive (red wire), battery negative (black and white wires) and charging lock out (green wire). The output cable connector for the battery negative (black and white wires) includes a thermistor (thermally sensitive resistor) used by the charger to identify battery temperature. Because of the solid state circuitry built into the charger, there is no method to test the charger directly (e.g. using a multimeter).

The battery pack charging operation is fully automated. While connected to an AC power supply, charger activity can be monitored at the charger diagnostic LED located near the battery charger charge port on the left side of the vehicle. Use the table below to identify charger activity based on the LED color and flash rate. The vehicle controller prevents the vehicle from operating while charging the batteries.

**IMPORTANT:** To obtain maximum battery life, always charge the batteries when there are 2 or more bars visible on the dash mounted battery charge indicator. Regularly depleting the batteries to lower than 2 bars will reduce the life of the batteries.

**NOTE:** In high−ambient temperature environments, remove the seat assembly for optimal charging time. If the battery charger is too hot, it may not charge properly. In cold temperatures, it may take a longer for the batteries to charge.

After charging the vehicle battery pack, make sure that the water level in all batteries is checked and adjusted as necessary.

**NOTE:** Refer to On−board Battery Charger in the Service and Repairs section of this chapter for battery charger removal and installation information.

<table>
<thead>
<tr>
<th>LED Pattern</th>
<th>Cause</th>
<th>Necessary Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green LED is always on (not flashing)</td>
<td>Battery pack is fully charged.</td>
<td>None required. Vehicle is ready for operation.</td>
</tr>
<tr>
<td>Green LED has short flash (0.1 second ON and 0.9 second OFF)</td>
<td>Batteries are less than 80% charged.</td>
<td>Continue charging batteries.</td>
</tr>
<tr>
<td>Green LED has long flash (0.5 second ON and 0.5 second OFF)</td>
<td>Batteries are more than 80% charged.</td>
<td>Continue charging batteries.</td>
</tr>
<tr>
<td>LED Pattern</td>
<td>Cause</td>
<td>Necessary Action</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>--------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Amber LED is flashing</td>
<td>Reduced–power mode: Low AC voltage or high internal charger temperature.</td>
<td>Make sure that electrical outlet is providing adequate voltage for charger. Remove operator seat assembly to allow additional cooling air to on–board battery charger. Also, make sure that charger cooling fins are clean. Make sure that extension cord that is being used has suitable gauge size and length if not using the cord that was provided with your Workman.</td>
</tr>
<tr>
<td>Red LED is flashing</td>
<td>Internal charger error (fault) or battery pack problem.</td>
<td>Reset charger by unplugging extension cord from vehicle charging receptacle, waiting for 15 seconds and then plugging extension cord back into the receptacle. If charger does not reset and red LED is still flashing, count the number of flashes between pauses and use information below to identify problem.</td>
</tr>
<tr>
<td>1 red LED flash between pauses</td>
<td>Battery voltage is excessive.</td>
<td>Check battery size and condition. Fault should clear when battery voltage is corrected.</td>
</tr>
<tr>
<td>2 red LED flashes between pauses</td>
<td>Battery voltage is low.</td>
<td>Check battery size and condition. Fault should clear when battery voltage is corrected.</td>
</tr>
<tr>
<td>3 red LED flashes between pauses</td>
<td>Charge timeout was caused by battery pack not reaching required voltage. Charger output was reduced due to high temperatures</td>
<td>Check battery connections. Operate charger at a lower ambient temperature. In elevated ambient temperatures, remove operator seat assembly to allow additional cooling air to on–board battery charger. Also, make sure that charger cooling fins are clean. Reset charger by unplugging extension cord from vehicle charging receptacle, waiting for 15 seconds and then plugging extension cord back into the receptacle.</td>
</tr>
<tr>
<td>4 red LED flashes between pauses</td>
<td>Battery charging could not be fully completed.</td>
<td>Reset charger by unplugging extension cord from vehicle charging receptacle, waiting for 15 seconds and then plugging extension cord back into the receptacle. If same red LED flash pattern exists after reset, check battery pack. Check for damaged cells in one of more of the batteries.</td>
</tr>
<tr>
<td>5 red LED flashes between pauses</td>
<td>Charger shut down due to high internal temperature.</td>
<td>Ensure that cooling air flow in charger area is sufficient. Remove operator seat assembly to allow additional cooling air to on–board battery charger. Also, make sure that charger cooling fins are clean. Reset charger by unplugging extension cord from vehicle charging receptacle, waiting for 15 seconds and then plugging extension cord back into the receptacle. If same red LED flash pattern exists after reset, allow charger to cool before continuing with charging process.</td>
</tr>
<tr>
<td>6 red LED flashes between pauses</td>
<td>Internal charger fault.</td>
<td>Reset charger by unplugging extension cord from vehicle charging receptacle, waiting for 15 seconds and then plugging extension cord back into the receptacle. If same red LED flash pattern exists after reset, charger replacement may be necessary.</td>
</tr>
</tbody>
</table>
The Workman controller is secured to the rear frame beneath the cargo box (Fig. 36). The controller uses inputs from several vehicle components to accurately control vehicle speed, direction (forward and reverse) and regenerative braking. Controller inputs include key switch, direction selector switch (forward/reverse), accelerator pedal, supervision speed limit switch, traction motor thermistor (temperature), traction motor encoder (speed sensor) and battery charger lockout. A single wire harness connection and five (5) cables are used to connect the controller to the vehicle electrical system.

A fuse that is rated at 425 amperes continuous is attached to the controller and protects the 48VDC vehicle power supply circuit. If this fuse has failed, vehicle operation will not occur.

Cable connections for the controller are as follows:
- Terminal B−: Negative (−) battery cable from the left, rear battery
- Terminal B+: Positive (+) cable from the main contactor post
- Terminal M1: Cable to traction motor terminal W
- Terminal M2: Cable to traction motor terminal V
- Terminal M3: Cable to traction motor terminal U

Because of the solid state circuitry built into the controller, there is no method to test it directly (e.g. using a multimeter). A LED exists on the controller to identify normal operation or faults that will prevent the vehicle from operating correctly. The status indicator light on the dash panel should display the same information as the LED on the controller. See chart below for light pattern fault codes identified by the controller LED and status indicator light.

**NOTE:** If the controller LED and status indicator light are flashing, attempt to reset the controller by turning the key switch to OFF, waiting several seconds and then turning the switch to ON. If the controller LED and status indicator light continue flashing after the reset attempt, proceed with fault code identification and necessary action.

Before removing any electrical connections from the controller, open the vehicle battery circuit by disconnecting the conductors between the battery pack and vehicle components (see Opening Battery Circuit in the General Information section of this chapter). When installing cables to controller, torque screws at all controller terminals from 89 to 106 in−lb (10 to 12 N−m) (Fig. 37). Apply Toro battery terminal protector (see Special Tools) to controller connections after tightening terminal screws. Refer to Controller in the Service and Repairs section of this chapter for controller removal and installation information.
<table>
<thead>
<tr>
<th>Light Pattern</th>
<th>Cause</th>
<th>Necessary Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Always on (not flashing)</td>
<td>System functioning normally.</td>
<td>None required.</td>
</tr>
</tbody>
</table>
| Always off | System inoperable.  
No electrical power to the controller.  
Status indicator light on dash is faulty.  
The controller has failed. | Check for low battery voltage, faulty fuse(s), loose battery cable connections, damaged battery cables and/or faulty main contactor.  
If batteries, cables and other electrical components are in good condition, controller replacement may be needed.  
If necessary, contact your Authorized Toro Distributor for assistance. |
| 1 Flash | System inoperable.  
There is a controller configuration fault | Turn key switch OFF, wait several seconds and turn key switch ON. If controller does not reset correctly, controller replacement may be required.  
If necessary, contact your Authorized Toro Distributor for assistance. |
| 2 Flashes | The parking brake is engaged while in the FORWARD or REVERSE position.  
This fault could also be caused by a problem with accelerator pedal operation. | Release the parking brake if it is applied. If controller does not reset correctly, parking brake switch or circuit wiring may be faulty.  
Turn key switch OFF, wait several seconds and turn key switch ON. If controller does not reset correctly, check accelerator pedal operation (see Accelerator Pedal in this section).  
Also, if necessary, inspect the circuit wires between the accelerator pedal and the controller (see Electrical Schematic and Wire Harness Drawings in Chapter 6 – Electrical Drawings). |
| 3 Flashes | System inoperable.  
The motor current exceeded the controller rated maximum.  
There is an internal controller power component fault. | Turn key switch OFF, wait several seconds and turn key switch ON. If controller does not reset correctly, check battery pack voltage and all battery cable connections.  
Check all batteries and high current controller connections.  
Controller replacement may be required.  
If the condition continues, contact your Authorized Toro Distributor for assistance. |
| 4 Flashes | Main contactor malfunction. | Turn key switch OFF, wait several seconds and turn key switch ON. If controller does not reset correctly, inspect main contactor (see Main Contactor in this section).  
Check main contactor wire and cable connections. |
| 5 Flashes | Exceeded the maximum motor speed. | Turn key switch OFF, wait several seconds and turn key switch ON. If controller does not reset correctly, inspect traction motor encoder (speed sensor) (see Traction Motor in this section).  
Inspect the circuit wires between the traction motor encoder and the controller (see Electrical Schematic and Wire Harness Drawings in Chapter 6 – Electrical Drawings). |
<table>
<thead>
<tr>
<th>Light Pattern</th>
<th>Cause</th>
<th>Necessary Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 Flashes</td>
<td>The accelerator pedal is pressed while starting the machine.</td>
<td>Release the accelerator pedal, turn the key switch to the OFF position, wait several seconds, turn the key switch to the ON position and check for normal vehicle operation. If controller does not reset correctly, check accelerator pedal operation (see Accelerator Pedal in this section). Also, if necessary, inspect the circuit wires between the accelerator pedal and the controller (see Electrical Schematic and Wire Harness Drawings in Chapter 6 – Electrical Drawings).</td>
</tr>
<tr>
<td></td>
<td>Accelerator pedal operation is abnormal.</td>
<td></td>
</tr>
<tr>
<td>7 Flashes</td>
<td>The remaining charge on the batteries is low (vehicle speed has been limited by controller). The batteries are fully discharged (vehicle does not operate). The internal capacitor has a pre-charge of less than 5V.</td>
<td>Charge the batteries fully and then check for normal operation. If this fault occurs regularly, consider that battery charging has not been regular or that batteries may need replacement.</td>
</tr>
<tr>
<td>8 Flashes</td>
<td>The controller or traction motor is overheated or too cold.</td>
<td>The vehicle may continue to operate but at reduced power until the component temperature reaches normal levels. Determine if the motor or controller is very hot or very cold, then allow the machine to return to normal temperatures before resuming operation. Make sure that motor and controller are cleaned of all dirt and debris that could lead to component overheating.</td>
</tr>
<tr>
<td>10 Flashes</td>
<td>A controller configuration fault occurred.</td>
<td>Turn the key switch to the OFF position, wait several seconds, turn the key switch to the ON position, and check for normal vehicle operation. If this fault continues to occur, contact your Authorized Toro Distributor for assistance.</td>
</tr>
<tr>
<td>11 Flashes</td>
<td>A motor encoder (speed sensor) fault occurred.</td>
<td>Turn the key switch to the OFF position, wait several seconds, turn the key switch to the ON position, and check for normal vehicle operation. If this fault continues to occur, inspect traction motor encoder (speed sensor) (see Traction Motor in this section). Also, inspect the circuit wires between the traction motor encoder and the controller (see Electrical Schematic and Wire Harness Drawings in Chapter 6 – Electrical Drawings). If a traction motor armature problem exists in the motor (e.g. worn bearing in rear end bracket, missing retaining ring on rear of armature shaft, loose or damaged tone ring on armature), an encoder fault could be generated due to the armature issue.</td>
</tr>
<tr>
<td>Light Pattern</td>
<td>Cause</td>
<td>Necessary Action</td>
</tr>
<tr>
<td>--------------</td>
<td>-------</td>
<td>-----------------</td>
</tr>
</tbody>
</table>
| 12 Flashes   | A controller configuration fault occurred.  | Turn the key switch to the OFF position, wait several seconds, turn the key switch to the ON position, and check for normal vehicle operation.  
If this fault continues to occur, contact your Authorized Toro Distributor for assistance. |
| 13 Flashes   | An internal controller software fault occurred | Turn the key switch to the OFF position, wait several seconds, turn the key switch to the ON position, and check for normal vehicle operation.  
If this fault continues to occur, contact your Authorized Toro Distributor for assistance. |
| 14 Flashes   | A controller communication fault occurred | Turn the key switch to the OFF position, wait several seconds, turn the key switch to the ON position, and check for normal vehicle operation.  
If this fault continues to occur, contact your Authorized Toro Distributor for assistance. |
**Diode Assembly**

A diode assembly is included in the Workman GTX Electric wire harness. This diode is used for circuit logic to allow key switch current to the controller. The diode plugs into the wire harness near the controller and main contactor.

The diode assembly can be identified by a black color and a diode symbol on the end of the diode assembly body (Fig. 38). Refer to the wire harness drawings in Chapter 6 – Electrical Drawings for additional information on diode assembly location.

**NOTE:** If a vehicle is equipped with the optional brake and turn signal kit that includes flashers, four (4) additional diode assemblies are used for hazard light and turn signal circuit logic. These diodes plug into the brake and turn signal kit wire harness and can be accessed by raising the hood.

**Testing**

1. Park vehicle on a level surface, turn key switch to OFF, engage the parking brake and remove key from the key switch.

2. Locate diode assembly that is to be tested.

3. Remove cable tie that secures diode to wire harness. Unplug the diode from the wire harness for testing.

4. Test diode assembly using a digital multimeter (diode test or ohms setting) and the table in the right column.

5. If testing determines that a diode assembly is faulty, replace diode assembly.

6. After diode testing is complete, make sure that diode assembly is fully installed into wire harness connector and secured to harness with cable tie.
Reverse Audio Alarm (If Equipped)

The reverse alarm sounds when the direction switch (forward/reverse) is placed in the reverse position. The alarm is located under the seat assembly attached to the rear frame panel near the fuse block (Fig. 39).

Testing

**IMPORTANT:** Make sure to observe polarity on the alarm terminals when testing. Damage to the alarm may result from an improper connection.

**IMPORTANT:** The audio alarm is a 12 volt DC component. Do not test the alarm using jumper wires from the vehicle battery pack (48 VDC).

1. Park vehicle on a level surface, turn key switch to OFF, engage the parking brake and remove key from the key switch.

2. Remove seat assembly from vehicle to access reverse alarm. Locate alarm on rear frame panel.

3. Disconnect wire harness connectors from alarm (Fig. 39).

4. Using jumper wires, correctly connect 12VDC source to the alarm terminals noting polarity shown in Figure 40.

5. Alarm should sound as long as voltage is applied to alarm terminals. Remove voltage source from the alarm.

6. Replace alarm if testing determines that it is faulty.

7. Connect wire harness connectors to alarm. Install seat assembly on vehicle.
Battery Service

The batteries are the heart of the Workman electrical system. With regular and proper service, battery life can be extended. Additionally, battery and electrical component failure can be prevented.

Battery Specifications:
Trojan model T-125 Battery (6 Volt Deep Cycle)
Capacity: 195 AH
Weight: 66 lbs (30 kg)
Battery Removal (Fig. 41)

**WARNING**

**POTENTIAL HAZARD:**
The battery terminals, metal tools and metal vehicle parts could short together.

**WHAT CAN HAPPEN:**
Sparks can cause battery gasses to explode.
Damaged cables could short against metal vehicle parts and cause sparks.

**HOW TO AVOID THE HAZARD:**
When removing or installing the batteries, do not allow the battery terminals to short against metal parts of the vehicle.
Do not allow metal tools or metal vehicle parts to short between the battery terminals or battery cables.
Always keep the battery hold downs in place to protect and secure the batteries.

1. Park vehicle on a level surface, turn key switch to OFF, engage the parking brake and remove key from the key switch.

2. Raise cargo bed and support with prop rod. Remove seat base assembly.

3. Remove rear frame panel cover to allow access to all vehicle batteries (see Rear Frame Panel Cover in the General Information section of this chapter).

4. Make sure that vehicle battery charger IS NOT connected to electrical outlet. Open the battery circuit by disconnecting the conductors between the battery pack and vehicle components (see Opening Battery Circuit in the General Information section of this chapter).

5. Once battery circuit has been opened, disconnect and remove battery cables from batteries that are to be removed from vehicle.

6. Carefully, disconnect watering hose connectors from all batteries that are to be removed from vehicle.

7. Remove flange nuts (item 6) and battery hold downs (item 7) used to secure batteries to vehicle.

8. Make sure that all battery filler caps are on tightly.

**IMPORTANT:** For assembly purposes, note that batteries are installed with the positive terminals toward the outside of the vehicle and the negative terminals toward the center of the vehicle (Fig. 42).

9. Use battery lift strap (see Special Tools in this chapter) to remove batteries from vehicle.

**CAUTION**

To prevent battery damage and personal injury, make sure that batteries are well supported as they are removed from vehicle. Each battery weighs approximately 66 pounds (30 kg).

Battery Installation (Fig. 41)

1. Make sure vehicle key switch and all accessories are OFF.

2. Raise cargo bed and support with prop rod. Remove seat base assembly and rear frame panel cover.

3. Make sure the battery trays are clean and repainted if necessary. Make sure conductors (wires and cables), conductor terminals, battery hold down rods and hold down retainers are clean (no corrosion) and in good condition.
CAUTION

To prevent battery damage and personal injury, make sure that batteries are well supported as they are installed into vehicle. Each battery weighs approximately 66 pounds (30 kg).

IMPORTANT: Make sure that batteries are installed with the positive terminals toward the outside of the vehicle and the negative terminals toward the center of the vehicle (Fig. 42).

4. Use battery lift strap (see Special Tools in this chapter) to set batteries on the battery supports with battery posts properly orientated (Fig. 42). Make sure that battery hold down rods (item 8) are positioned to allow installation of battery hold downs.

5. Install two (2) battery hold downs and flange nuts to secure batteries to vehicle.

6. Install all of the battery cables used to connect the battery pack (Figure 42). Make sure that cables are connected to correct battery terminal noting battery polarity. Install hex nut on each battery terminal to secure cable to battery and torque nuts from 95 to 105 in−lb (10.8 to 11.8 N·m).

7. Carefully connect watering hose connectors to all batteries.

8. Connect the conductors between the battery pack and vehicle components (see Opening Battery Circuit in the General Information section of this chapter). Make sure to torque hex nuts on battery terminals from 95 to 105 in−lb (10.8 to 11.8 N·m).

9. After connections are made, apply Toro battery terminal protector (see Special Tools) to all battery posts and cable connectors to prevent corrosion. Make sure that cable terminal boots are positioned over all connections.

10. Secure rear frame panel cover to vehicle. Lower and secure cargo box. Install seat base assembly.

11. Before returning vehicle to operation, fully charge the batteries by connecting the on−board battery charger to an appropriate electrical outlet.

Battery Inspection and Maintenance

WARNING

POTENTIAL HAZARD: Battery electrolyte contains sulfuric acid which is a deadly poison and it causes severe burns.

WHAT CAN HAPPEN: If you carelessly drink electrolyte you could die or if it gets onto your skin you will be burned.

HOW TO AVOID THE HAZARD: Do not drink electrolyte and avoid contact with skin, eyes or clothing. Wear safety glasses to shield your eyes and rubber gloves to protect your hands.

Fill the battery where clean water is always available for flushing the skin.

Follow all instructions and comply with all safety messages on the electrolyte container.

1. Check for cracks in battery case caused by overly tight or loose hold−down retainer. Replace any battery that is cracked and/or leaking.

2. Check battery terminal posts for corrosion. Use a terminal brush to clean corrosion from the battery terminal posts.

IMPORTANT: Before cleaning the battery, make sure the filler caps are on tightly.

3. Check for signs of wetness or leakage on the top of the battery which might indicate a loose or missing filler cap, overcharging, loose terminal post or overfilling.

4. Check the battery case for dirt and oil. Clean the battery with a solution of baking soda and water, then rinse battery with clean water.

5. Check that the battery cover seal is not broken away. Replace the battery if the seal is broken or leaking.

IMPORTANT: Make sure the area around the battery filler caps is clean before opening the caps. Also, do not add acid to the battery. Use only distilled water to adjust the battery electrolyte level.

6. On a daily basis, check electrolyte level in the batteries using the water level indicators on the top of each battery. A white indicator identifies that a battery needs water and a black indicator identifies that a battery has enough water. If necessary, add distilled water to ensure proper battery performance and service life. To properly fill the batteries, use watering hose assembly attached to the batteries and the hand pump hose assembly (see Special Tools in this chapter).
Battery Testing

When testing batteries in the Workman GTX Electric, it is important to periodically test all batteries. Proper performance of the vehicle depends on all batteries being in good condition. Testing will determine if one (or more) of the batteries needs to be replaced.

1. The preferred testing procedure is to use the Lester Electrical 36/48 Volt Battery Discharge Unit (Model 17770). This instrument puts a known discharge load (56.25 Amps) on the battery pack until the battery pack reaches 42 volts. A timer incorporated into the discharge unit measures the time needed to reach that voltage level. Battery capacity and remaining life can be determined from the test results. Refer to Discharge Unit Operating Instructions for further information.

Other types of battery load testers can also be used to test the Workman batteries. Many locally available battery load testers do not, however, have any adjustment on the load that is put on the battery. Results received from using load testers should follow the recommendations of the load tester manufacturer.

2. If the Lester Battery Discharge Unit (or other load tester) is not available, an alternate battery test can be done using a multimeter to perform a voltage test of each battery. Use the following procedure:

A. For accurate voltage testing, allow batteries to remain idle (no charging, no discharging) for at least six (6) hours and preferably 24 hours.

B. Open the battery circuit by carefully disconnecting the conductors between the battery pack and vehicle components (see Opening Battery Circuit in the General Information section of this chapter). Then, disconnect both cables from battery to be tested.

C. Measure the battery voltage with the multimeter. Record battery voltage. The measured voltage will determine battery state of charge.

D. If voltage reading is below 70% charged (see Fig. 43), charge battery and take voltage measurements again. If voltage remains low after charging, consider battery replacement.

3. A third option for battery testing is to perform a specific gravity test of the battery electrolyte using a hydrometer. Use the following procedure:

A. Remove battery filler caps. Do not add water prior to testing specific gravity of battery electrolyte. If electrolyte level is low, add distilled water and charge battery before performing specific gravity test.

B. Measure the specific gravity of each battery cell with a hydrometer. Fill and drain the hydrometer two (2) to four (4) times before drawing a sample. At the same time, take the temperature of the cell.

C. Have enough electrolyte in the hydrometer to completely support the hydrometer float. Record the hydrometer reading and return the electrolyte to the battery cell.

D. Repeat test for remaining battery cells.

E. Temperature correct each cell reading. For each 10°F (5.5°C) above 80°F (26.7°C) add 0.004 to the specific gravity reading. For each 10°F (5.5°C) below 80°F (26.7°C) subtract 0.004 from the specific gravity reading.

Example:

<table>
<thead>
<tr>
<th>Cell Temperature</th>
<th>Cell Specific Gravity Reading</th>
<th>ADD (20°F above 80°F)</th>
<th>Correction to 80°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>100°F</td>
<td>1.245</td>
<td>0.008</td>
<td>1.253</td>
</tr>
</tbody>
</table>

F. The temperature corrected specific gravity of all battery cells should be 1.277 ± 0.007. If low cell readings exist (see Fig. 43), charge battery and take specific gravity readings again.

G. If specific gravity of any cells remain low after complete charging, battery should be replaced.

<table>
<thead>
<tr>
<th>Battery Charge Level</th>
<th>Specific Gravity</th>
<th>Open Circuit Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>1.277</td>
<td>6.37</td>
</tr>
<tr>
<td>90%</td>
<td>1.258</td>
<td>6.31</td>
</tr>
<tr>
<td>80%</td>
<td>1.238</td>
<td>6.25</td>
</tr>
<tr>
<td>70%</td>
<td>1.217</td>
<td>6.19</td>
</tr>
<tr>
<td>60%</td>
<td>1.195</td>
<td>6.12</td>
</tr>
<tr>
<td>50%</td>
<td>1.172</td>
<td>6.05</td>
</tr>
<tr>
<td>40%</td>
<td>1.148</td>
<td>5.98</td>
</tr>
<tr>
<td>30%</td>
<td>1.124</td>
<td>5.91</td>
</tr>
<tr>
<td>20%</td>
<td>1.098</td>
<td>5.83</td>
</tr>
<tr>
<td>10%</td>
<td>1.073</td>
<td>5.75</td>
</tr>
</tbody>
</table>

Figure 43

IMPORTANT: Make sure the area around the battery fill caps is clean before removing the caps.
Battery Charging

When the vehicle is not in use, it is recommended to keep the batteries charged by connecting the on-board battery charger to an appropriate electrical outlet. The Workman GTX charger is designed to automatically charge the batteries fully without overcharging. An indicator LED on the charger provides information during the charging operation.

Colder temperatures will increase the time needed to fully charge the batteries. NEVER attempt to charge frozen batteries. Also, if temperatures below freezing are expected, do not add water to battery after charging as added water could freeze and damage battery.

For additional battery charging information, see your Operator’s Manual and the Battery Charger Operating Instructions.

Battery Storage

If the vehicle will be stored for any period of time, use the on-board battery charger to fully charge batteries. After charging batteries, check battery electrolyte level and adjust level if needed. Allow charger to remain connected to vehicle during storage to prevent battery discharge and potential battery damage.

If the vehicle will be stored for more than thirty (30) days and the battery charger cannot be used for some reason, charge the batteries fully. Either store batteries on a shelf or in the vehicle. Store the batteries in a cool atmosphere to avoid quick deterioration of the charge in the batteries. To prevent batteries from freezing, make sure they are fully charged before storage. During the storage period, charge the batteries at least once every three (3) months to prevent battery damage. Before returning the vehicle to service, make sure to fully charge the batteries.
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Traction Motor

Figure 44

1. Swing arm
2. Transaxle assembly
3. Traction motor
4. Motor thermistor connector
5. Motor encoder connector
6. Cable (motor W to controller M1)
7. Cable (motor V to controller M2)
8. Cable (motor U to controller M3)
9. Flange head screw (6 used)
10. Cable bracket
11. Washer head screw
12. Isolator retainer
13. Isolator

90 to 110 in−lb
(10.2 to 12.4 N−m)

Antiseize
Lubricant
Removal (Fig. 44)

1. Park vehicle on a level surface, turn key switch to OFF, engage the parking brake and remove key from the key switch.

2. To allow easier access to traction motor, remove cargo bed from vehicle (see Cargo Bed in the Service and Repairs section of Chapter 5 – Chassis).

3. Make sure that vehicle battery charger IS NOT connected to electrical outlet. Open the battery circuit by disconnecting the conductors between the battery pack and vehicle components (see Opening Battery Circuit in the General Information section of this chapter).

NOTE: Label all traction motor electrical leads for assembly purposes.

IMPORTANT: When removing cables from motor terminals (U, V and W), use a wrench to retain lower nut while loosening upper nut (Fig. 45). If terminal studs are allowed to turn during upper nut removal, internal motor damage can occur.

4. Disconnect electrical connectors from traction motor and position them away from motor:

   A. While retaining lower nut to prevent it from loosening, remove upper nut, lock washer and cable connector from traction motor terminal studs U, V and W.

   B. Unplug wire harness connectors from traction motor encoder (speed sensor) and thermistor (temperature).

5. Position disconnected cables and wire harness leads away from traction motor.

CAUTION

To prevent motor damage and personal injury, make sure that traction motor is well supported as it is removed. Motor weighs approximately 66 pounds (30 kg).

6. Wrap suitable lifting strap around center of traction motor housing for support and as a lifting point for motor removal. Do not capture encoder (speed sensor) or thermistor wires under strap. Support motor with strap to prevent it from moving.

7. Remove two (2) flange head screws (item 9) that secure cable bracket (item 10) to transaxle and traction motor. Position cable bracket with attached cables away from motor and transaxle.

8. Remove remaining four (4) flange head screws (item 9) that secure motor to transaxle.

9. Pull motor away from transaxle until motor shaft is disengaged from transaxle input shaft. Then, carefully lift motor from vehicle taking care to not damage motor sensors or vehicle components while motor is being removed.

10. If necessary, remove washer head screw (item 11) that secures isolator retainer and isolator to isolator bracket. Separate isolator and motor cables from bracket.

---

Figure 45

- 1. Motor terminal stud
- 2. Lower nut
- 3. Cable
- 4. Lock washer
- 5. Upper nut

Figure 46

- 1. Traction motor
- 2. W terminal
- 3. V terminal
- 4. U terminal
- 5. Thermistor connector
- 6. Encoder connector
Installation (Fig. 44)

1. If isolator and wire cables were removed from cable bracket (item 10), insert cables into isolator. Secure isolator and cables to bracket with isolator bracket and washer head screw. Torque screw from 90 to 110 in−lb (10.2 to 12.4 N−m).

2. Apply antiseize lubricant to the splines of the transaxle and traction motor shafts.

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>To prevent motor damage and personal injury, make sure that traction motor is well supported as it is installed. Motor weighs approximately 66 pounds (30 kg).</td>
</tr>
</tbody>
</table>

3. Wrap suitable lifting strap around traction motor housing for support and as a lowering point for motor installation. Do not capture encoder (speed sensor) or thermistor wires under strap.

4. Carefully lower traction motor into vehicle. Align motor shaft with transaxle input shaft and slide motor to transaxle. Take care to not damage encoder (speed sensor) while installing motor.

5. Secure traction motor to transaxle:
   A. Align mounting holes of motor and transaxle.
   B. Install four (4) flange head screws (item 9) through transaxle holes and into traction motor leaving upper two (2) holes vacant for cable bracket installation.
   C. Position cable bracket with attached cables to motor and transaxle. Install final two (2) flange head screws.
   D. Torque all six (6) flange head screws from 90 to 110 in−lb (10.2 to 12.4 N−m) to secure motor to transaxle.
   E. Remove lifting strap from traction motor.

6. Make sure motor terminals and cables are clean (no corrosion) and in good condition.

**IMPORTANT:** When connecting cables to motor terminals (U, V and W), use a wrench to retain lower nut while tightening upper nut (Fig. 45). If terminal studs are allowed to turn during upper nut installation, internal motor damage can occur.

7. Using labels placed during motor removal, secure electrical connections to traction motor:
   A. Plug connectors from traction motor traction motor encoder (speed sensor) and thermistor (temperature) into vehicle wire harness.
   B. Make sure that lower nuts are installed on motor terminals and are torqued from 49 to 61 in−lb (5.5 to 7.0 N−m).
   C. Install correct cable, lock washer and nut to motor terminals U, V and W. While retaining lower nut, torque upper nut from 49 to 61 in−lb (5.5 to 7.0 N−m).

8. Connect the conductors between the battery pack and vehicle components (see Opening Battery Circuit in the General Information section of this chapter). Make sure to torque hex nuts on battery terminals from 95 to 105 in−lb (10.8 to 11.8 N−m).

9. After all cable connections are made, apply Toro battery terminal protector (see Special Tools) to all battery posts and traction motor cable connectors to prevent corrosion. Make sure that cable terminal boots are positioned over all connections.

10. Install cargo bed to the vehicle (see Cargo Bed Installation in Service and Repairs section of Chapter 5 – Chassis).

11. Before returning vehicle to operation, fully charge the batteries by connecting the on−board battery charger to an appropriate electrical outlet.
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NOTE: If traction motor stator or armature damage occurs, traction motor replacement is necessary. These components are not available separately.

Motor Disassembly (Fig. 47)

1. Remove torx head screw that secures encoder (speed sensor) to traction motor. Slide encoder from drive end bracket.

2. Remove the retaining ring and wave washer that secure the armature assembly in the rear end bracket bearing (Fig. 48).

3. Carefully separate armature assembly out of bearing in rear end bracket and then remove armature from stator.

4. Remove connection plate assembly (item 12) from stator:
   A. Remove three (3) lower jam nuts from stator terminal screws.
   B. Remove two (2) torx screws that secure connection plate assembly to stator.
   C. Remove connection plate assembly from stator.

5. For assembly purposes, note locations of drainage slots in drive and rear end brackets and the aligning position slots in the stator assembly (Fig. 49).
6. Remove four (4) socket head screws and lock washers that secure drive and rear end brackets to stator assembly. Remove end brackets from stator.

**NOTE:** After the traction motor has been disassembled, it is recommended that a new rear end bracket bearing be installed. Although the bearing may appear and feel in good condition, the bearing could be "brielled" (races or balls deformed). After assembly with a questionable bearing, the motor may exhibit noise and vibration problems or fail within a relatively short period of service.

7. Remove the retaining ring from the rear end bracket (Fig. 50). Press bearing from the rear end bracket and discard the removed bearing.

---

**CAUTION**

When using compressed air for cleaning motor components, follow all safety instructions, including wearing eye and respiratory protection.

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8. Carefully blow out any accumulated debris from the stator and the armature using clean, oil free, compressed air.

9. Inspect traction motor armature and transaxle input shaft splines for wear or damage. Replace motor and/or transaxle input shaft if spline damage is found.

10. Visually inspect the armature and stator components. If damage to either of these components is found, replace traction motor.

**Motor Assembly (Fig. 47)**

1. Make sure that all traction motor components are clean and in good condition before assembling the motor.

**IMPORTANT:** To prevent bearing damage when installing new bearing in the rear end bracket, support end bracket and press only against the bearing outer race.

2. Press a new bearing into the rear end bracket, pressing on the bearing outer race only. Secure bearing in bracket with retaining ring (Fig. 50). Make sure that retaining ring is fully seated in groove in bracket after assembly.

3. Position drive and rear end brackets to stator assembly using notes made during disassembly to properly align drainage slots in brackets and stator (Fig. 49).
4. Secure drive and rear end brackets to stator assembly with four (4) socket head screws and lock washers. Tighten screws in two (2) stages using the sequence shown in Figure 51. Final torque on screws should be from 71 to 97 in−lb (8 to 11 N−m).

5. Install connection plate assembly (item 12) to stator:
   A. Place connection plate assembly onto stator so that three (3) terminal screws fit through plate.
   B. Secure connection plate assembly to stator with two (2) torx screws. Torque screws from 25 to 33 in−lb (2.8 to 3.8 N−m).
   C. Install three (3) lower jam nuts onto stator terminal screws. Torque nuts from 49 to 61 in−lb (5.5 to 7.0 N−m).

6. Carefully install armature assembly into the stator. End of stator must extend completely through bearing in rear end bracket.

7. Install wave washer (item 5) and retaining ring (item 6) to secure the armature assembly in the rear end bracket bearing (Fig. 48). Make sure that retaining ring is fully seated into groove in armature shaft.

8. Slide encoder into drive end bracket and secure with torx head screw. Torque screw from 25 to 33 in−lb (2.8 to 3.8 N−m).
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Removal (Fig. 52)

1. Park vehicle on a level surface, turn key switch to OFF, engage the parking brake and remove key from the key switch.

2. Raise cargo bed and support with prop rod to allow access to controller.

3. Make sure that vehicle battery charger IS NOT connected to electrical outlet. Open the battery circuit by disconnecting the conductors between the battery pack and vehicle components (see Opening Battery Circuit in the General Information section of this chapter).

NOTE: Label all controller electrical leads for assembly purposes.

4. Disconnect electrical conductors from controller and position them away from controller:

   A. Remove cap screw, lock washer, flat washer and cable connector from controller terminals B+, B−, M1, M2 and M3 (Fig. 53).

   B. Carefully unplug wire harness connector from controller.

   C. Position cables and wire harness connector away from controller.
5. Support controller to prevent it from falling.

6. Remove four (4) washer head screws that secure controller to controller bracket. Carefully remove controller from vehicle.

7. If necessary, remove washer head screw (item 3) that secures isolator retainer, isolator and controller cables to controller bracket. Separate isolator and controller cables from bracket.

**Installation (Fig. 52)**

1. If isolator and controller cables were removed from controller bracket, insert cables into isolator. Secure isolator and cables to bracket with isolator bracket and washer head screw. Torque screw from **90 to 110 in−lb (10.2 to 12.4 N−m)**.

2. Position controller to controller bracket and secure with four (4) washer head screws.

3. Make sure controller terminals and cables are clean (no corrosion) and in good condition.

4. Connect electrical conductors to controller:
   A. Carefully plug wire harness connector into controller. Make sure that connector is fully plugged into controller socket.
   B. Secure controller cables to controller terminals B+, B−, M1, M2 and M3 with cap screw, lock washer and flat washer (Fig. 53). Torque cap screws from **89 to 106 in−lb (10 to 12 N−m)**.

5. Connect the conductors between the battery pack and vehicle components (see Opening Battery Circuit in the General Information section of this chapter). Make sure to torque hex nuts on battery terminals from **95 to 105 in−lb (10.8 to 11.8 N−m)**.

6. After all cable connections are made, apply Toro battery terminal protector (see Special Tools) to all battery posts and controller cable connectors to prevent corrosion. Make sure that cable terminal boots are positioned over all connections.

7. Lower and secure cargo bed.

8. Before returning vehicle to operation, fully charge the batteries by connecting the on−board battery charger to an appropriate electrical outlet.
On-board Battery Charger

IMPORTANT: No serviceable parts (including electrical conductors) are contained inside the battery charger. DO NOT attempt to open or disassemble the charger.

Removal (Fig. 55)

1. Park vehicle on a level surface, turn key switch to OFF, engage the parking brake and remove key from the key switch. Make sure that vehicle charger IS NOT connected to electrical outlet.

2. Raise cargo bed and support with prop rod. Remove seat base assembly.

3. Remove rear frame panel cover to allow access to battery charger electrical connections (see Rear Frame Panel Cover in the General Information section of this chapter).

4. Open the battery circuit by disconnecting the conductors between the battery pack and vehicle components (see Opening Battery Circuit in the General Information section of this chapter).

NOTE: Label all battery charger electrical leads for assembly purposes.

FRONT

RIGHT

1. On-board battery charger
2. Heat shrink tube
3. Cord set
4. Lock nut (2 used)
5. Screw (2 used)
6. AC power cord
7. LED holder
8. Charger function decal
9. LH seat base side
10. Screw (4 used)
11. Charger bracket
12. Flange head screw (4 used)
13. Flange nut (4 used)
14. Washer head screw (2 used)
15. Controller
16. Main contactor

Figure 55
5. Disconnect charger electrical conductors from vehicle connections:

A. Remove positive charger connection (red charger wire) from right, rear battery positive (+) terminal.

B. Remove negative charger connection (black and white charger wires) from left, rear battery negative (−) terminal.

C. Unplug charger lock out connection (green charger wire) from vehicle wire harness connector (yellow harness wire).

D. Remove two (2) screws and lock nuts that secure cord set receptacle to charger bracket. Separate receptacle from bracket.

E. Carefully slide remote charger LED indicator out of LED holder in charger bracket.

6. Separate charger cable from the clips in the rear frame. Route cable away from rear batteries and position near charger so it can be removed from vehicle along with charger.

7. Remove four (4) flange head screws and flange nuts that secure battery charger to charger bracket. Carefully remove charger with attached electrical conductors from vehicle.

8. Check that cooling fins on charger are free of accumulation of dirt and debris. Carefully clean charger fins if necessary.

Installation (Fig. 55)

1. Position battery charger to charger bracket. Secure charger to bracket with four (4) flange head screws and flange nuts.

2. Secure to charger electrical conductors to vehicle:

A. Carefully slide remote charger LED indicator into LED holder in charger bracket.

B. Secure cord set receptacle to charger bracket with two (2) screws and lock nuts.

C. Route charger cable to rear battery area and secure to the rear frame with clips.

D. Plug charger lock out connection (green charger wire) into vehicle wire harness connector (yellow harness wire).

E. Position negative charger connection (black and white charger wires) near left, rear battery negative (−) terminal.

F. Position positive charger connection (red charger wire) near right, rear battery positive (+) terminal.

3. Connect the conductors between the battery pack and vehicle components (see Opening Battery Circuit in the General Information section of this chapter). Make sure that wires from battery charger cable are connected to correct battery terminals and to torque hex nuts on battery terminals from 95 to 105 in−lb (10.8 to 11.8 N−m).

4. After connections are made, apply Toro battery terminal protector (see Special Tools) to all battery posts to prevent corrosion. Make sure that cable terminal boots are positioned over all connections.

5. Secure rear frame panel cover to vehicle. Lower and secure cargo bed. Install seat base assembly.

6. Before returning vehicle to operation, fully charge the batteries by connecting the on−board battery charger to an appropriate electrical outlet.
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## Table of Contents

- GENERAL INFORMATION .................. 2
  - Operator’s Manual ...................... 2
- SPECIFICATIONS .......................... 3
- SERVICE AND REPAIRS .................... 4
  - Transaxle Assembly ..................... 4
  - Transaxle Assembly Service ............. 8
General Information

Operator’s Manual

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

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transaxle</td>
<td></td>
</tr>
<tr>
<td>Transaxle Fluid Capacity</td>
<td>1.5 quarts (1.4 liters)</td>
</tr>
<tr>
<td>Transaxle Fluid</td>
<td>10W-30 Motor Oil</td>
</tr>
</tbody>
</table>
Service and Repairs

Transaxle Assembly

1. Transaxle assembly
2. Traction motor
3. Cable (motor W to controller M1)
4. Cable (motor V to controller M2)
5. Cable (motor U to controller M3)
6. Motor speed sensor connector
7. Motor thermistor connector
8. Cable bracket
9. Isolator
10. Isolator retainer
11. Washer head screw
12. Flange head screw (6 used)
13. Flange head screw (4 used)
14. Lock nut (4 used)
15. Sway bar link bracket
16. Stabilizer bar bracket
17. Swing arm

Figure 1

90 to 110 in-lb
(10.2 to 12.4 N-m)

77 to 95 ft-lb
(105 to 128 N-m)

Antiseize Lubricant

FRONT
RIGHT
Workman GTX Electric

Transaxle Removal (Fig. 1)

1. Park vehicle on a level surface, turn key switch to OFF, engage the parking brake and remove key from the key switch.

2. To allow easier access to transaxle assembly, remove cargo bed from the frame (see Cargo Bed in the Service and Repairs section of Chapter 5 − Chassis).

3. Open the battery circuit by disconnecting the conductors between the battery pack and vehicle components (see Opening Battery Circuit in the General Information section of Chapter 3 − Electrical System).

NOTE: Label all traction motor electrical leads for assembly purposes (Fig. 2).

4. Remove traction motor from transaxle (see Traction Motor in the Service and Repairs section of Chapter 3 − Electrical System).

WARNING

Before jacking up the vehicle, review and follow Jacking Instructions in Chapter 1 − Safety.

5. Raise and support rear of vehicle to allow rear wheels and transaxle to be removed.

   A. Chock the front and rear of both front tires to prevent the vehicle from moving.

   B. Jack up both sides of the frame enough to remove both rear wheels.

   C. Support both sides of the frame with appropriate jack stands positioned just in front of the transaxle shafts. This will allow the transaxle to be removed toward the rear of the vehicle.

6. Remove both rear wheels and wheel hub assemblies from the transaxle (see Rear Wheels and Hubs in the Service and Repairs section of Chapter 5 − Chassis). Make sure that brake calipers, brake lines and parking brake cables are positioned and supported so that transaxle assembly can be lowered from vehicle.

7. Support transaxle from below to prevent it from moving.

8. Remove four (4) flange head screws (item 13) and lock nuts (item 14) that secure the transaxle to the swing arm.

   IMPORTANT: Take care to not damage any vehicle components while lowering the transaxle assembly from the swing arm and vehicle.

9. Carefully lower and remove transaxle assembly toward the rear of the vehicle.

Transaxle Installation (Fig. 1)

   IMPORTANT: Take care to not damage any vehicle components while installing the transaxle assembly to the vehicle.

1. Carefully raise transaxle assembly and align it with swing arm mounting points. Make sure that transaxle input shaft is orientated to left side of vehicle.

2. Secure the transaxle to the swing arm with four (4) flange head screws and lock nuts. Torque screws from 77 to 95 ft-lb (105 to 128 N-m).
3. Install both rear wheel hubs and wheels to the vehicle (see Rear Wheel and Hubs in the Service and Repairs section of Chapter 5 – Chassis). Make sure that fasteners for wheel hubs, brake calipers and wheels are properly torqued during assembly.

4. Lower vehicle to ground.

5. Apply antiseize lubricant to the splines of the transaxle and motor shafts.

6. Install traction motor to transaxle (see Traction Motor in the Service and Repairs section of Chapter 3 – Electrical System).

7. Make sure that transaxle is filled with 1.5 quarts (1.4 liters) of new SAE 10W–30 motor oil.

8. Install cargo bed to the frame (see Cargo Bed in the Service and Repairs section of Chapter 5 – Chassis).

9. Connect the conductors between the battery pack and vehicle components (see Opening Battery Circuit in the General Information section of Chapter 3 – Electrical System). Make sure to torque hex nuts on battery terminals from 95 to 105 in–lb (10.8 to 11.8 N–m).

10. After connections are made, apply Toro battery terminal protector (see Special Tools) to all battery posts and cable connectors on traction motor to prevent corrosion. Make sure that cable terminal boots are positioned over all connections.

11. Check brakes for proper operation.
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Transaxle Assembly Service

1. Transaxle housing assembly (includes bearing caps)
2. Bearing cap (2 used)
3. Bearing cap bolt (4 used)
4. Input shaft
5. Retaining ring (3 used)
6. O-ring (3 used)
7. Ball bearing
8. Ball bearing
9. Oil seal
10. End cap plug (2 used)
11. Ball bearing (2 used)
12. Intermediate gear assembly
13. O-ring (2 used)
14. Final drive gear
15. Ball bearing (2 used)
16. Differential assembly
17. Flange head bolt (4 used)
18. Lock nut (4 used)
19. Vent elbow
20. Cover plate
21. Plug
22. Screw (10 used)
23. LH axle shaft
24. RH axle shaft
25. Oil seal (2 used)
26. Retaining ring (4 used)
27. Ball bearing (2 used)
28. Hose clamp
29. Breather bellows

Figure 3

- Apply Silicone Sealant
- Apply Rapid-Curing Anaerobic Adhesive

- 55 to 63 ft-lb (75 to 85 N-m)
- 35 to 45 ft-lb (47 to 61 N-m)
- 35 to 45 ft-lb (47 to 61 N-m)
- 16 to 24 ft-lb (22 to 33 N-m)
- 15 to 20 ft-lb (20 to 27 N-m)

35 to 45 ft-lb (47 to 61 N-m)
Disassembly (Fig. 3)

CAUTION

The transaxle assembly is a precision assembly, and any repair or replacement of parts must be done with great care in a clean environment. Handle all components (especially gears) with extreme care.

1. Remove the drain plug (item 21) and drain the oil from the transaxle assembly.

2. Remove the axle shaft and bearing assembly.
   A. Remove the outer retaining ring (item 26).
   B. Using a slide hammer attached to the threads on the end of the axle shaft, remove the axle shaft and bearing assembly from the axle housing.
   C. Remove the inner retaining ring. Use caution to not damage the bearing surface.
   D. Using an oil seal puller attached to a slide hammer, remove the oil seal from the axle housing and discard (item 25).
   E. Remove the bearing (item 27) from the axle shaft by supporting the inner race of the bearing in an arbor press, and apply pressure to the wheel hub end of the axle shaft.
   F. Repeat procedure for opposite side.

3. Remove the differential case and final drive gear.
   A. Remove the ten cover plate screws (item 22).
   B. Using a putty knife, separate the cover plate (item 20) from the transaxle housing. Be careful not to damage the housing sealing surface or deform the cover plate.
   C. Remove the four (4) bearing cap screws (item 3) Remove bearing caps and lift differential case from axle housing.
   D. Using a bearing puller, remove bearings (item 15) from each end of the differential case.

4. Remove the intermediate shaft and gear assembly.
   A. Punch or drill a small hole in the center of each end cap plug (item 10). Insert a suitable sheet metal screw into the hole until the the cap plug is driven from the housing bore.
   B. Remove retaining rings (item 5) from intermediate shaft bores.
   C. From the motor flange side of the housing, use a brass drift and drive the intermediate shaft in enough to allow engagement of an I.D. bearing puller.
   D. Using an I.D. bearing puller attached to a slide hammer, remove the bearing from the motor flange side of the housing.
   E. Repeat steps C. and D. for remaining bearing.
   F. Tilt small end of intermediate shaft assembly toward opening in bottom of housing and remove.
   G. Remove and discard O−rings (item 6) from intermediate bearing bores.
   H. Remove and discard O−rings (item 13) from intermediate shaft bearing shoulders.

5. Remove input shaft assembly.
   A. Remove oil seal (item 9) from input shaft bore.
   B. Remove retaining ring (item 5) from input shaft bore.
   C. Pull input shaft assembly from housing. The input shaft assembly should slide out of the housing easily. Use a slide hammer attached to the input shaft if necessary for removal.
   D. Using a bearing puller, remove inner and outer bearings (item 7 and 8) from the input shaft.
   E. Remove and discard O−ring (item 6) from input bearing bore.

6. Clean any residual sealant from transaxle housing at intermediate shaft bearing bores and cover plate sealing surface, and from cover plate.

7. Inspect all parts for signs of wear or damage. Bearing and seal surfaces should be free of pitting, wear, or signs of overheating. Gears should be free of pitting, wear or scoring. Inspect axle shafts for worn splines, bends or cracks. Replace worn or damaged parts as necessary.
Assembly (Fig. 3)

1. Assemble and install the input shaft.
   
   A. Press the inner and outer bearings (items 7 and 8) onto input shaft until seated against bearing shoulders.
   
   B. Apply a light coat of oil to a new O−ring (item 6) and install into input bearing bore of housing.
   
   C. Install input shaft assembly in housing. Bearings should slide easily into housing. Use a soft mallet to tap the input shaft assembly into position if necessary.
   
   D. Install retaining ring (item 5).
   
   E. Apply a light coat of oil to a new oil seal (item 9). Protect oil seal lip from damage by input shaft splines and install oil seal into input bearing bore of housing.
   
2. Install the intermediate shaft and gear assembly.
   
   A. Apply a light coat of oil to a new O−rings (item 6) and install into intermediate bearing bores of housing.
   
   B. Apply a light coat of oil to a new O−rings (item 13) and install onto bearing shoulders of intermediate shaft.
   
   C. Tilt small end of intermediate shaft assembly toward opening in bottom of housing and position intermediate shaft and gear assembly in housing.
   
   D. Install the motor flange side bearing first. While supporting the intermediate shaft and gear assembly in position, fit the bearing (item 11) in housing bore.
   
   E. Use a soft mallet to drive the bearing past the O−ring and retaining ring groove.
   
   F. Install retaining ring (item 5).
   
   G. Repeat steps D. thru F. for opposite bearing.
   
   H. Apply a rapid−curing anaerobic adhesive (Loctite 609 or equivalent) to the intermediate shaft bores. Using a properly sized driver, install new end cap plugs (item 10) with stamping outward until seated against the retaining rings.
   
3. Assemble and install the differential case and final drive gear.
   
   A. Press bearings (items 15) onto differential case until seated against bearing shoulders.
   
   B. Position final drive gear over differential case and install four (4) flange head bolts and lock nuts (items 17 and 18). Bolts should be installed from the differential flange side. Tighten lock nuts from 55 to 63 ft−lb (75 to 85 N−m).
   
   NOTE: Bearing caps are marked for identification. Letters or numbers are stamped in a horizontal or vertical position. Make sure the bearing caps are installed in their original locations during assembly.
   
   C. Position differential case assembly into transaxle housing and install bearing caps (item 2). Tighten bearing cap bolts from 35 to 45 ft−lb (47 to 61 N−m).
   
   D. Apply a small bead of silicone sealant around the entire cover plate sealing surface. Sealant should be applied to the inside of the cover plate mounting holes.
   
   E. Install the cover plate and cover plate screws. Tighten cover plate screws from 16 to 24 ft−lb (22 to 33 N−m).

4. Install the axle shaft and bearing assembly (Fig. 4).

   A. Using a seal driver, install the oil seal into the axle housing. Drive the oil seal to a depth of 1.125 in. (28.6 mm).
   
   B. Install the inner retaining ring.
   
   C. Install the bearing to the axle shaft by supporting the inner race of the bearing in an arbor press, and apply pressure to the differential end of the axle shaft. Make sure the bearing seats against the shoulder of the axle shaft.
D. Apply light oil or grease to the inner lip of the oil seal and insert the shaft and bearing assembly into the axle housing. Align the axle shaft splines with those in the differential assembly and drive the axle shaft and bearing assembly into the axle housing. Use a bearing driver against the outer race of the bearing and continue until the bearing seats against the inner retaining ring.

E. Install the outer snap ring.

F. Repeat procedure for opposite side.

5. Fill the transaxle with 1.5 quarts (1.4 liters) of new SAE 10W-30 motor oil.
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Tools for Frame Extension Kit

Use this tool kit (shown in Fig. 4) when installing or servicing the vehicle frame extension kit.

When the front and rear frame components are separated to install or service the frame extension kit, the rear frame of the machine can be supported with the legs included in this tool kit. The legs attach to the rear frame with two (2) flange head screws and nuts for each leg (Fig. 5).

Toro Part Number: TOR6040
## Troubleshooting

### Suspension and Steering

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
</tr>
</thead>
</table>
| Front end is noisy.      | Front wheel lug nuts are loose.  
                           | Front suspension struts are loose or worn.  
                           | Front wheel bearings are loose or worn.  
                           | Front end components (e.g. tie-rod, spindle, A-arm) are loose or worn.  
                           | Steering rack assembly is damaged or worn. |
| Rear end is noisy.       | Rear wheel lug nuts are loose.  
                           | Rear suspension shocks are loose or worn.  
                           | Rear wheel bearings are loose or worn.  
                           | Rear end components (e.g. rubber bushing, stabilizer, anti-sway bar, A-arm) are loose or worn.  
                           | Transaxle problem (see Chapter 4 – Transaxle). |
| Excessive steering play. | Front wheel lug nuts are loose.  
                           | Front wheel bearings are loose or worn.  
                           | Steering shaft joints are loose or worn.  
                           | Tie rod ends are loose or worn.  
                           | Bushings in spindle or A-arm are loose or worn.  
                           | Steering rack assembly is damaged or worn. |
| Vehicle is unstable or wanders. | Tire pressure is low or uneven between tires.  
                                 | Wheel lug nuts are loose.  
                                 | Front wheel bearings are loose or worn.  
                                 | Steering shaft bushings are worn.  
                                 | Front wheel alignment (toe-in) is incorrect.  
                                 | Bushings in spindle or A-arm are loose or worn.  
                                 | Rubber shock insert in front suspension strut is loose or worn.  
                                 | Steering rack assembly is damaged or worn. |
## Suspension and Steering (continued)

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front end shimmies.</td>
<td>Front wheel lug nuts are loose.</td>
</tr>
<tr>
<td></td>
<td>Front wheel alignment (toe–in) is incorrect.</td>
</tr>
<tr>
<td></td>
<td>Front wheel bearings are loose or worn.</td>
</tr>
<tr>
<td></td>
<td>Tie rod ends are loose or worn.</td>
</tr>
<tr>
<td></td>
<td>Steering shaft bearings or joints are loose or worn.</td>
</tr>
<tr>
<td></td>
<td>Bushings in spindle or A–arm are loose or worn.</td>
</tr>
<tr>
<td>Steering is hard.</td>
<td>Tire pressure is low or uneven between tires.</td>
</tr>
<tr>
<td></td>
<td>Steering components are binding or damaged.</td>
</tr>
<tr>
<td></td>
<td>Front wheel alignment (toe–in) is incorrect.</td>
</tr>
<tr>
<td></td>
<td>Steering rack assembly is damaged or worn.</td>
</tr>
<tr>
<td>Vehicle pulls to one side when not</td>
<td>Tire pressure is low or uneven between tires.</td>
</tr>
<tr>
<td>braking.</td>
<td>Front wheel alignment (toe–in) is incorrect.</td>
</tr>
<tr>
<td></td>
<td>Steering or suspension component may be damaged.</td>
</tr>
</tbody>
</table>

## Brakes

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brake pedal goes to the floor.</td>
<td>Brake fluid level in master cylinder is low.</td>
</tr>
<tr>
<td></td>
<td>Brake fluid leak exists at master cylinder, brake hose or brake caliper.</td>
</tr>
<tr>
<td></td>
<td>Brake pads are excessively worn.</td>
</tr>
<tr>
<td></td>
<td>Brake master cylinder is faulty.</td>
</tr>
<tr>
<td>Brake pedal is spongy.</td>
<td>Air is trapped in brake lines.</td>
</tr>
<tr>
<td></td>
<td>Transaxle bearings are loose or damaged.</td>
</tr>
<tr>
<td></td>
<td>Brake master cylinder is faulty.</td>
</tr>
<tr>
<td>Problem</td>
<td>Possible Cause</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Brakes pull to either side.</td>
<td>Tire pressure is incorrect or uneven between tires.</td>
</tr>
<tr>
<td></td>
<td>Brake pads are worn or contaminated.</td>
</tr>
<tr>
<td></td>
<td>Front wheel alignment (toe–in) is incorrect.</td>
</tr>
<tr>
<td></td>
<td>Brake rotors are bent or damaged.</td>
</tr>
<tr>
<td></td>
<td>Tires on same axle are unmatched.</td>
</tr>
<tr>
<td>Brakes squeal.</td>
<td>Brake pads are worn or contaminated.</td>
</tr>
<tr>
<td></td>
<td>Brake components are dirty.</td>
</tr>
<tr>
<td></td>
<td>Brake rotors are scored or bent.</td>
</tr>
<tr>
<td>Brakes drag.</td>
<td>Parking brake is applied or incorrectly adjusted.</td>
</tr>
<tr>
<td></td>
<td>Brake pedal is binding.</td>
</tr>
<tr>
<td></td>
<td>Parking brake cable is binding.</td>
</tr>
<tr>
<td></td>
<td>Brake pads are saturated.</td>
</tr>
<tr>
<td></td>
<td>Floating calipers are binding due to dirt or corrosion.</td>
</tr>
<tr>
<td></td>
<td>Brake rotors are bent.</td>
</tr>
<tr>
<td>Brake pedal is hard to push.</td>
<td>Incorrect brake pad material.</td>
</tr>
<tr>
<td></td>
<td>Brake pedal is binding.</td>
</tr>
<tr>
<td></td>
<td>Calipers are binding due to dirt or corrosion in the float pins or brake piston.</td>
</tr>
<tr>
<td></td>
<td>New brake pads and/or rotors are not burnished.</td>
</tr>
<tr>
<td>Wheels lock–up when braking.</td>
<td>Brake pads are worn or contaminated.</td>
</tr>
<tr>
<td></td>
<td>Wheel or transaxle bearings are damaged.</td>
</tr>
<tr>
<td></td>
<td>Brake rotors are worn.</td>
</tr>
<tr>
<td>Brakes fade.</td>
<td>Brake rotors are overheated.</td>
</tr>
<tr>
<td></td>
<td>Air is trapped in brake lines.</td>
</tr>
<tr>
<td></td>
<td>Excessive moisture in brake fluid.</td>
</tr>
<tr>
<td></td>
<td>Brake pads are saturated.</td>
</tr>
<tr>
<td>Vehicle surges at slow speeds and chatters at fast speeds.</td>
<td>Brake rotors are bent or damaged.</td>
</tr>
</tbody>
</table>
**Adjustments**

**Adjust Parking Brake**

**Checking Parking Brake (Fig. 6)**

1. Apply parking brake with brake lever on dash.

2. There should be tension felt when applying the parking brake within 4½” to 6½” (11.4 to 16.5 cm) measured from the ‘P’ symbol that is molded into the recessed dash area directly in front of the parking brake lever.

3. If parking brake lever movement is incorrect, parking brake adjustment is necessary.

**Parking Brake Adjustment (Fig. 7)**

1. Make sure that the vehicle is on a level surface and that the parking brake is NOT applied.

2. Chock front wheels to prevent vehicle movement. Lift rear wheels off the ground using a jack and support rear of vehicle with appropriate jack stands beneath the frame.

3. Starting on one of the rear wheels, locate the parking brake rod on the inside of the rear brake caliper.

4. Using two (2) wrenches, loosen lock nut on parking brake rod while holding brake rod to prevent it from rotating.

5. Making sure that lock nut stays loose on parking brake rod, adjust brake rod until rear wheel rotates with little evidence of brake drag on brake rotor.

6. Hold parking brake rod in place and secure adjustment by tightening lock nut. Torque lock nut from 80 to 120 in–lb (9.1 to 13.5 N–m).

7. After securing parking brake adjustment, make sure that rear wheel still rotates with little evidence of brake drag.

8. Adjust other rear wheel using steps 4 to 7 above.

9. Check parking brake adjustment as described in Checking Parking Brake on this page. Make additional parking brake adjustments if necessary.

10. Lower vehicle to ground after brake adjustment is complete.

**WARNING**

Before jacking up the vehicle, review and follow Jacking Instructions in Chapter 1 – Safety.

---

[Figures 6 and 7]
Adjust Front Wheel Toe-in

1. Adjust tire pressures from 24 to 30 PSI (165 to 207 kPa) before checking front wheel toe-in.

2. Either have an operator on the vehicle operator’s seat or add weight to the driver’s seat equal to the average operator who will run the vehicle. The operator or weight must remain on the seat for the duration of the front wheel toe-in adjustment procedure.

3. On a level surface, roll the vehicle straight back 6 to 10 feet (2 to 3 meters) and then straight forward to the original starting position. This will allow the vehicle suspension to settle into the normal operating position.

4. Make sure that the front wheels are facing straight ahead.

5. Measure the distance between the front tires at axle height at both the front and rear of the tires (Fig. 8). Front wheel toe-in should be $0 \pm 0.125$ inch ($0 \pm 3$ mm).

6. If the front wheel toe-in is incorrect, adjust as follows (Fig. 9):
   A. Loosen jam nuts at both ends of steering rack tie rods.
   B. Rotate both tie rods equally to move front of tires inward or outward.
   C. Tighten tie rod jam nuts when toe-in adjustment is correct. Tie rod jam nuts should be torqued from 45 to 55 ft-lb (62 to 74 N-m).

7. After toe-in adjustment has been completed, ensure that there is full steering travel in both directions. There should be no contact between any machine components as the wheels are moved from lock to lock. Adjust if necessary.
Service and Repairs

Check Tire Pressure

The tire pressure range for front and rear tires is **24 to 30 PSI (165 to 207 kPa)**.

Higher pressures should be used for heavier payloads at higher speeds. Do not exceed the maximum tire pressure.

The air pressure needed is determined by the payload carried. **Lower** air pressure will provide less compaction, a smoother ride and fewer tire marks. Lower pressure should not be used for heavy payloads at higher speeds.

Inspect Tires and Wheels

Operating accidents, such as hitting curbs, can damage a tire or rim and also disrupt wheel alignment. Inspect tire and rim condition after any accident.

Check wheels to ensure they are mounted securely. Torque wheel lug nuts in a crossing pattern from **75 to 95 ft-lb (102 to 128 N-m)**.
Front Wheels and Hubs

1. Front wheel assembly
2. Lug nut (4 per wheel)
3. Front brake caliper (LH shown)
4. Socket head screw (2 per caliper)
5. Front brake line
6. Banjo bolt and washers
7. Dust cap
8. Retainer
9. Cotter pin
10. Jam nut
11. Tab washer
12. Bearing (2 per hub)
13. Front wheel hub
14. Wheel stud (4 per hub)
15. Brake rotor
16. Socket head screw (4 per rotor)
17. Oil seal
18. Spindle (LH shown)

Removal (Fig. 10)

1. Park vehicle on a level surface, turn key switch OFF, apply parking brake and remove key from the key switch.

2. Chock wheels not being removed. Use a jack to raise front wheel that is to be removed off the ground. Support vehicle with appropriate jack stands beneath the frame.

3. Remove four (4) lug nuts and then remove front wheel assembly from the wheel hub.

4. Remove two (2) socket head screws that secure front brake caliper to the mounts on the spindle. Slide caliper assembly with attached brake line from brake rotor and support caliper away from the front wheel hub.

WARNING

Before jacking up the vehicle, review and follow Jacking Instructions in Chapter 1 – Safety.
5. Remove the dust cap from the wheel hub.

6. Remove the cotter pin, retainer, jam nut and tab washer. Slide the front wheel hub from the spindle shaft.

7. Pull the seal out of the wheel hub. Discard seal.

8. Remove the bearing cones from both sides of the wheel hub. Clean the bearings in solvent. Make sure the bearings are in good operating condition. Clean the inside of the wheel hub. Check the bearing cups for wear, pitting or other damage. Replace worn or damaged parts.

9. If necessary, separate brake rotor from wheel hub by removing four (4) socket head screws.

10. If necessary, press wheel studs from wheel hub (Fig. 11).

**Installation (Fig. 10)**

1. If brake rotor was removed from wheel hub, place rotor on hub and secure with four (4) socket head screws. Torque screws from 9 to 11 ft-lb (13 to 14 N·m).

2. If any wheel studs were removed from wheel hub, use a press to install new studs into hub (Fig. 11). Make sure that stud shoulder is fully pressed against housing surface.

3. If bearing cups were removed from the wheel hub, press new cups into the hub until they seat against the shoulder of the hub (Fig. 11).

**NOTE:** Use High Temperature Mobil XHP–222 grease (or equivalent) when greasing front wheel hub components.

**IMPORTANT:** The lip of the oil seal must be toward the bearing. The seal should be pressed in so it is flush with the end of the wheel hub.

4. Pack both bearings with grease. Install one bearing into the bearing cup on inboard side of the wheel hub. Lubricate the inside of a new oil seal and press it into the wheel hub with the seal lip toward the bearing.

5. Fill wheel hub cavity between bearings approximately 50% full of grease. Position remaining bearing into the outer bearing cup.

6. Slide the wheel hub assembly onto the spindle shaft and secure it in place with the tab washer and jam nut. DO NOT fully tighten the nut.

7. While rotating the wheel hub by hand, torque the jam nut to 130 in-lb (14.7 N·m) to set the bearings. Then, loosen the nut until the hub has endplay.

8. While rotating the wheel hub by hand, torque the jam nut from 15 to 20 in-lb (1.7 to 2.3 N·m). After tightening, make sure that the wheel hub does not have any free play.

9. Install retainer with slot aligned to cotter pin hole in spindle. Install cotter pin.

10. Fill dust cap approximately 50% full of grease. Install dust cap to wheel hub.

**IMPORTANT:** The socket head screws that secure the brake calipers have a patch lock feature. If screws are being re-installed on vehicle, apply medium strength thread locker to screw threads before installation.

11. Slide brake caliper onto brake rotor. Make sure that rotor is between the brake pads in the caliper. Secure caliper to the mounts on the spindle with socket head screws. Torque screws from 35 to 40 ft-lb (48 to 54 N·m).

12. Position wheel assembly to the vehicle with valve stem facing out and secure with four (4) lug nuts.

13. Lower vehicle to ground.

14. Torque lug nuts in a crossing pattern from 75 to 95 ft-lb (102 to 128 N·m).

**CAUTION**

After servicing brake system components, always check the brakes in a wide open, level area that is free of other persons and obstructions.

15. Check brake operation.
Rear Wheels and Hubs

1. Rear wheel assembly
2. Lug nut (4 per wheel)
3. Transaxle assembly
4. Rear swing arm
5. Socket head screw (2 per caliper)
6. Parking brake cable (2 used)
7. Rear brake line
8. LH brake caliper
9. RH brake caliper
10. Cotter pin
11. Slotted hex nut
12. Thrust washer
13. Wheel hub
14. Hardened spacer
15. Brake rotor
16. Socket head screw (4 per rotor)
17. Wheel stud (4 per hub)

Figure 12

35 to 40 ft–lb
(48 to 54 N–m)
Medium Strength Threadlocker

75 to 95 ft–lb
(102 to 128 N–m)

9 to 11 ft–lb
(13 to 14 N–m)

220 to 240 ft–lb
(299 to 325 N–m)

Antiseize Lubricant

113 to 14 N–m

258 to 342 N–m

75 to 95 ft–lb
(102 to 128 N–m)
Removal (Fig. 12)

1. Park vehicle on a level surface, turn key switch OFF and remove key from the key switch. Do not apply parking brake.

**WARNING**

**Before jacking up the vehicle, review and follow Jacking Instructions in Chapter 1 – Safety.**

2. Chock wheels not being removed. Use a jack to raise rear wheel that is to be removed off the ground. Support vehicle with appropriate jack stands beneath the frame.

3. Remove four (4) lug nuts and then remove rear wheel assembly from the wheel hub.

4. Remove two (2) socket head screws that secure rear brake caliper to the mounts on the transaxle tube. Slide caliper assembly with attached brake line and parking brake cable from brake rotor and support it away from the rear wheel hub.

5. Remove rear wheel hub from transaxle shaft:
   A. Remove cotter pin from the slotted hex nut and transaxle shaft.
   B. Remove nut, thrust washer, wheel hub and hardened spacer from the shaft. During removal, note differences between thrust washer and hardened spacer for installation purposes. The hardened spacer has a slightly larger OD and ID than the thrust washer.

6. If necessary, separate brake rotor from wheel hub by removing four (4) socket head screws.

7. If necessary, press wheel studs from wheel hub.

Installation (Fig. 12)

1. If brake rotor was removed from wheel hub, place rotor on hub and secure with four (4) socket head screws. Torque screws from 9 to 11 ft-lb (13 to 14 N-m).

2. If any wheel studs were removed from wheel hub, use a press to install new studs into hub. Make sure that stud shoulder is fully pressed against housing surface.

**IMPORTANT:** Do not get antiseize lubricant onto brake rotor or brake pads.

3. Apply a light coating of antiseize lubricant to both the transaxle shaft and splines in wheel hub bore.

4. Install the wheel hub to the transaxle shaft:
   A. Install hardened spacer, wheel hub and then thrust washer onto the transaxle shaft.
   B. Secure wheel hub assembly with slotted hex nut. Torque slotted hex nut from **220 to 240 ft-lb (299 to 325 N–m)**. Make sure that slot in nut aligns with hole in transaxle shaft to allow installation of cotter pin. If necessary, tighten slotted hex nut slightly to align holes for cotter pin installation. **DO NOT** loosen slotted hex nut to align holes.
   C. Secure slotted hex nut to transaxle shaft with cotter pin.

**IMPORTANT:** The socket head screws that secure the brake calipers have a patch lock feature. If screws are being re-installed on vehicle, apply medium strength thread locker to screw threads before installation.

5. Slide brake caliper onto brake rotor. Make sure that rotor is between the brake pads in the caliper. Secure caliper to the mounts on the transaxle tube with socket head screws. Torque screws from **35 to 40 ft-lb (48 to 54 N–m).**

6. Position rear wheel assembly to the vehicle with valve stem facing out and secure with four (4) lug nuts.

7. Lower vehicle to ground.

8. Torque lug nuts in a crossing pattern from **75 to 95 ft-lb (102 to 128 N–m).**

9. Check parking brake operation. Adjust parking brake if necessary (see Parking Brake Adjustment in the Adjustments section of this chapter).

**CAUTION**

**After disassembling any brake system components, always check the brakes in a wide open, level area that is free of other persons and obstructions.**

10. Check brake operation.
**Front Brake Calipers**

**Disassembly (Fig. 13)**

1. Park vehicle on a level surface, turn key switch OFF, apply parking brake and remove key from the key switch.

2. Chock wheels not being removed. Use a jack to raise front wheel that is to be removed off the ground. Support vehicle with appropriate jack stands beneath the frame.

3. Remove front wheel from machine (see Front Wheels and Hubs in this section).

4. Disconnect brake line from front caliper (Fig. 14):
   
   A. Clean hydraulic brake line area of brake caliper to prevent contamination of brake system.

   B. Remove banjo bolt that secures brake line fitting to caliper.

   C. Carefully separate brake line from caliper. Locate and retrieve two (2) banjo washers from sides of brake line fitting.

   D. Plug brake line and position it away from caliper.

5. Remove two (2) socket head screws that secure the brake caliper to the spindle.

6. Slide brake caliper from brake rotor and remove caliper from vehicle.
7. Inspect front brake rotor for wear or damage. Minimum brake rotor thickness is 0.154” (3.9 mm). If brake rotors need to be removed from vehicle, refer to Front Wheels and Hubs in this section.

Assembly (Fig. 13)

1. Make sure that brake rotor is properly secured to wheel hub (see Front Wheels and Hubs in this section).

2. Slide brake caliper onto brake rotor. Make sure that rotor is between brake pads.

IMPORTANT: The socket head screws that secure the brake calipers have a patch lock feature. If screws are being re-installed on vehicle, apply medium strength thread locker to screw threads before installation.

3. Align caliper mounting holes with spindle. Secure caliper with two (2) socket head screws. Torque screws from 35 to 40 ft-lb (48 to 54 N-m).

4. Connect brake line to front brake caliper (Fig. 14):
   A. Position brake line to caliper.
   B. Place banjo washer on each side of brake line fitting.
   C. Install banjo bolt through brake line fitting and banjo washers and then thread into caliper. Torque banjo bolt from 108 to 132 in-lb (12.3 to 14.9 N-m).

5. Install front wheel assembly (see Front Wheels and Hubs in this section).

6. Lower machine to ground.

7. Make sure that wheel lug nuts are torqued in a cross- ing pattern from 75 to 95 ft-lb (102 to 128 N-m).

8. Bleed brakes (see Bleed Brake System in this section).

9. Check brake operation.

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Burnish Brake Pads

After brake pad replacement, burnish (break-in) the brakes before use.

1. Bring the machine to full speed and apply the brakes to rapidly stop the machine without skidding or locking up the wheels.

2. Repeat this procedure 10 times. To avoid overheating the brakes, wait 1 minute between each stop.
Front Brake Caliper Service

27 to 33 ft-lb (37 to 44 N-m)

1. Bolt (2 used)
2. Caliper body
3. O-ring (4 used)
4. Caliper bracket
5. Square seal (2 used)
6. Dust seal (used)
7. Piston (2 used)
8. Brake pad (2 used)
9. Caliper anvil

Figure 15

White Lithium Grease

BAF-12 Assembly Lube
Disassembly (Fig. 15)

1. Remove two (2) bolts that secure brake caliper body to the caliper anvil.

2. Remove caliper anvil and then slide brake pads from pins on caliper bracket.

3. Slide caliper body assembly from caliper bracket.

4. If necessary, remove remaining components from caliper body:
   A. Carefully remove pistons from caliper body making sure that outer surface of pistons are not damaged during removal.
   B. Carefully remove and discard O-rings, square seals and dust seals from caliper body. Make sure that caliper body is not damaged during removal of O-rings and seals.

5. Clean caliper components with brake cleaner.

Inspection

1. Check brake pads for uneven wear that would indicate binding in the caliper assembly. Replace the brake pads if the friction material is worn to less than 1/16” (1.6 mm). Also, if pads are contaminated with grease or oil, they must be replaced.

2. Inspect brake pistons and piston bores in caliper body for damage or wear. Replace brake pistons or complete brake caliper assembly if necessary.

3. Check that pins on caliper bracket are not worn or damaged. Wear on the pins will prevent smooth brake operation.

Assembly (Fig. 15)

1. If caliper body was disassembled, install components in caliper body:
   A. Apply hydraulic brake cylinder assembly lube (BAF-12 or equivalent) to square seals, dust seals and piston before installation.
   B. Fit lubricated seals into grooves of caliper body. Make sure that seals are not twisted in groove after installation.
   C. Install lubricated pistons into caliper body bores. Pistons should slide into bores with light resistance.
   D. Lubricate O-rings with white lithium grease and install into grooves in caliper body.
   E. Slide caliper body assembly onto pins on caliper bracket.

NOTE: If brake pads are being replaced, it will be necessary to push caliper pistons back into the caliper bore before installing new pads.

2. Slide brake pads onto pins on caliper bracket. Make sure that friction material on pads is toward brake rotor position.

3. Fit caliper anvil to assembly and secure caliper components with two (2) bolts. Tighten bolts from 27 to 33 ft-lb (37 to 44 N-m).
Rear Brake Calipers

1. LH rear brake caliper assembly
2. RH rear brake caliper assembly
3. Transaxle assembly
4. Rear swing arm
5. Socket head screw (2 per caliper)
6. Parking brake cable (2 used)
7. Rear brake line
8. Banjo bolt
9. Banjo washer (2 per caliper)
10. Bleed screw
11. Rear brake rotor
12. Socket head screw (4 per rotor)
13. Cotter pin
14. Slotted hex nut
15. Thrust washer
16. Rear wheel hub
17. Hardened spacer

Figure 16

1. Park vehicle on a level surface, turn key switch OFF and remove key from the key switch. Do not apply parking brake.

WARNING

Before jacking up the vehicle, review and follow Jacking Instructions in Chapter 1 - Safety.

2. Chock wheels not being removed. Use a jack to raise rear wheel that is to be removed off the ground. Support vehicle with appropriate jack stands beneath the frame.

3. Remove rear wheel from machine (see Rear Wheels and Hubs in this section).

4. Disconnect parking brake cable from rear brake caliper (Fig. 17):
   A. Make sure that parking brake is released.
   B. Loosen parking brake adjustment by loosening lock nut and then loosen parking brake rod two (2) turns.
   C. Rotate brake lever on caliper toward front of vehicle and hold lever in place. Carefully pull parking brake cable to release cable conduit from caliper bracket and then rotate parking cable to allow removal of cable end from parking brake lever.
   D. Position disconnected parking brake cable away from brake caliper.
5. Disconnect brake line from rear brake caliper:
   A. Clean brake line area of brake caliper to prevent contamination of brake system.
   B. Remove banjo bolt that secures brake line fitting to caliper.
   C. Carefully separate brake line from caliper. Locate and retrieve two (2) banjo washers from sides of brake line fitting.
   D. Plug brake line and position it away from caliper.

6. Remove two (2) socket head screws that secure the brake caliper to the mounts on the transaxle tubes.

7. Slide brake caliper from brake rotor and remove caliper from vehicle.

8. Inspect rear brake rotor for wear or damage. Minimum brake rotor thickness is 0.154" (3.9 mm). If brake rotors need to be removed from vehicle, refer to Rear Wheels and Hubs in this section.

Installation (Fig. 16)

IMPORTANT: When installing rear brake calipers, make sure that parking brake levers extend toward the upper side of the calipers.

1. Make sure that brake rotor is properly secured to wheel hub (see Rear Wheels and Hubs in this section).

IMPORTANT: The socket head screws that secure the brake calipers have a patch lock feature. If screws are being re-installed on vehicle, apply medium strength thread locker to screw threads before installation.

2. Slide rear brake caliper onto brake rotor. Make sure that rotor is between the brake pads in the caliper. Secure caliper to the mounts on the transaxle tube with socket head screws. Torque screws to 35 to 40 ft-lb (48 to 54 N-m).

3. Connect brake line to rear brake caliper:
   A. Place banjo washer on each side of brake line fitting.
   B. Install banjo bolt through brake line fitting and banjo washers and then thread into caliper. Torque banjo bolt from 108 to 132 in-lb (12.3 to 14.9 N-m).

4. Connect parking brake cable to rear brake caliper (Fig. 17):
   A. Make sure that parking brake is not applied.
   B. Insert parking brake cable end into parking brake lever.
   C. Rotate brake lever on caliper toward front of vehicle and hold lever in place. Then, insert cable into caliper bracket and slowly release brake lever to align cable conduit with caliper bracket.

5. Install rear wheel assembly (see Rear Wheels and Hubs in this section).

6. Lower vehicle to ground.

7. Make sure that rear wheel lug nuts are torqued in a crossing pattern from 75 to 95 ft-lb (102 to 128 N-m).

8. Adjust parking brake (see Parking Brake Adjustment in the Adjustments section of this chapter).

9. Bleed brakes (see Bleed Brake System in this section).

10. Check brake operation.

CAUTION

After servicing brake system components, always check the brakes in a wide open, level area that is free of other persons and obstructions.

Burnish Brake Pads

After brake pad replacement, burnish (break-in) the brakes before use.

1. Bring the machine to full speed and apply the brakes to rapidly stop the machine without skidding or locking up the wheels.

2. Repeat this procedure 10 times. To avoid overheating the brakes, wait 1 minute between each stop.
Rear Brake Caliper Service

Figure 18

1. Brake caliper assembly (LH shown)  3. Anti–rattle spring (2 used)  5. Bleed screw
2. Caliper slide pin (2 used)  4. Brake pad assembly

NOTE: Replacement parts for the rear caliper assembly are limited to the brake pad assembly and bleed screw. If any other caliper components are damaged or worn, replace the caliper assembly.

30 to 35 ft–lb
(41 to 47 N–m)

108 to 132 in–lb
(12.3 to 14.9 N–m)
Disassembly (Fig. 18)

1. Remove two (2) caliper slide pins that secure brake pads to the caliper assembly.
2. Slide brake pads with attached anti-rattle springs from caliper.
3. Remove anti-rattle springs from brake pads.
4. Clean caliper components with brake cleaner.

Inspection

1. Check brake pads for uneven wear that might indicate binding in the caliper assembly. Replace the brake pads if the friction material is worn to less than 1/16" (1.6 mm). Also, if pads are contaminated with grease or oil, they must be replaced.
2. Check that slide pins are not worn or damaged. Wear on the pins will prevent smooth brake operation.
3. If caliper damage or wear exists, replace complete brake caliper assembly as caliper components are not available separately.

Assembly (Fig. 18)

1. If brake pads are being replaced, it will be necessary to push the caliper piston back into the caliper bore before installing new pads:
   A. Loosen lock nut on parking brake push rod and then unscrew the push rod that threads into the brake armature in the caliper (Fig. 19).
   B. While loosening push rod, make sure that lock nut remains loose on push rod. Also, periodically push caliper piston back into caliper until there is sufficient room in the caliper for the brake pads and brake rotor.
   C. Leave lock nut on push rod loose so that parking brake can be adjusted after caliper installation.
2. Place brake pads with friction material positioned toward brake rotor position. Then, install anti-rattle springs to holes in brake pads.
3. Slide brake pads with attached anti-rattle springs into caliper. Make sure that friction material on pads is toward brake rotor location.
4. Secure brake pads to the caliper assembly with two (2) caliper slide pins. Make sure that the slide pins are inserted through the center of the anti-rattle springs. Tighten pins from 30 to 35 ft-lb (41 to 47 N-m).
Parking Brake Cables and Lever Assembly

NOTE: The parking brake assembly includes the dash mounted parking brake lever, two (2) identical brake cables and parking brake actuators in the rear brake calipers.
Disassembly (Fig. 20)

1. Park vehicle on a level surface, turn key switch OFF and remove key from the key switch. Chock wheels to prevent the vehicle from moving.

2. Disconnect both parking brake cables from rear brake calipers (Fig. 21):
   A. Make sure that parking brake is released.
   B. Loosen parking brake adjustment by loosening lock nut and then loosen parking brake rod two (2) turns.
   C. Rotate brake lever on caliper toward front of vehicle and hold lever in place. Carefully pull parking brake cable to release cable conduit from caliper bracket and then rotate parking cable to allow removal of cable end from parking brake lever.
   D. Position disconnected parking brake cable away from brake caliper.

3. Carefully separate parking brake cables from four (4) clips on swing arm.

4. Remove dash and position it toward the front of the vehicle to allow access to parking brake cables and brake lever (see Dash in this section).

5. Loosen the jam nuts that secure parking brake cables to parking brake mount.

6. Remove clevis pin and hair pin that secure cable equalizer bracket (item 8) to parking brake link.

7. Remove parking brake cables from cable equalizer bracket. Once cables are removed from equalizer, remove ends of brake cables from jam nut and brake mount.

8. Note routing of brake cables for assembly purposes.

9. Carefully remove brake cables by pulling them through front frame toward front of vehicle.

10. If necessary, remove parking brake lever components using Figure 20 as a guide.

Assembly (Fig. 20)

1. Install removed parking brake lever components using Figure 20 as a guide.

2. Carefully route parking brake cables through the front frame and toward the rear wheels using cable routing noted during disassembly. Position the brake cables in the vehicle so that the cable ends are close to the rear brake calipers and the parking brake lever assembly.

3. Secure brake cables to parking brake lever assembly:
   A. Insert both brake cable ends through parking brake mount and then through jam nuts.
   B. Insert both cable ends into cable equalizer bracket.
   C. Secure cable equalizer bracket with attached cable ends to parking brake link with clevis pin and hair pin.
   D. Install and tighten the jam nuts to secure parking brake cables to parking brake mount.

4. Connect both parking brake cables to rear brake caliper (Fig. 21):
   A. Make sure that parking brake is not applied.
   B. Insert parking brake cable end into parking brake lever.
   C. Rotate brake lever on caliper toward front of vehicle and hold lever in place. Then, insert cable into caliper bracket and slowly release brake lever to align cable conduit with caliper bracket.
   D. Secure brake cables to swing arm with four (4) clips.

5. Adjust parking brake on both rear wheel calipers (see Parking Brake Adjustment in the Adjustments section of this chapter).

6. Check parking brake operation.

7. Carefully position and secure dash to vehicle (see Dash in this section).
Brake Master Cylinder

1. Master cylinder
2. Hair pin
3. Clevis pin
4. Brake pedal
5. Pedal mount
6. Flange nut (2 used)
7. Flange head screw (2 used)
8. Front brake line
9. Rear brake line

Figure 22

75 to 85 in-lb
(8.5 to 9.6 N-m)
Removal (Fig. 22)

1. Park vehicle on a level surface, turn key switch OFF, apply parking brake and remove key from the key switch.

2. Raise front hood to gain access to master cylinder.

3. Remove hair pin from the clevis pin that connects master cylinder to brake pedal.

**IMPORTANT:** To prevent contamination of the brake system, make sure to clean master cylinder components before disassembly.

4. Clean hydraulic brake line area of master cylinder to prevent contamination. Remove both brake lines from master cylinder. Cap ends of brake lines and carefully position them away from master cylinder.

5. Remove two (2) flange nuts and flange head screws that secure master cylinder to pedal mount.

6. Carefully remove master cylinder from vehicle.

Installation (Fig. 22)

1. Position master cylinder to pedal mount and secure with flange head screws and flange nuts.

2. Remove plugs from brake lines. Install brake lines to master cylinder. Torque brake lines from 75 to 85 in−lb (8.5 to 9.6 N−m).

3. Connect master cylinder to brake pedal with clevis pin and hair pin.

4. Bleed brakes (see Bleed Brake System in this section).

5. Lower and secure front hood.

**CAUTION**

After servicing brake system components, always check the brakes in a wide open, level area that is free of other persons and obstructions.

6. Check brake operation.
Brake Master Cylinder Service

Disassembly (Fig. 24)

1. Thoroughly clean outside of master cylinder before disassembly.
2. Remove reservoir and flange seal. Push in on the push rod so the stop pin can be removed.
3. Disconnect lower end of the dust cover from the housing.
4. Push in on the push rod and remove circlip, then remove push rod with dust cover and clevis. Remove retainer washer.
5. Remove primary piston assembly and secondary piston assembly from cylinder housing.

Inspection

CAUTION

Use eye protection such as goggles when using compressed air for master cylinder service.

1. Clean all metal parts with isopropyl alcohol, then clean out and dry grooves and passageways with compressed air. Make sure cylinder bore and component pieces are thoroughly clean.
2. Check cylinder bore, pistons and springs for damage or excessive wear. Replace brake cylinder assembly if signs of pitting, scoring or cracks are evident in cylinder bore.

Assembly (Fig. 24)

1. Apply a film of clean brake fluid to cylinder bore and piston assemblies.
2. Install secondary piston assembly and primary piston assembly into cylinder.
3. Install retainer washer.
4. Install push rod and secure in place with circlip. Install lower end of dust cover to housing.
5. Push in on push rod so stop pin can be installed to retain secondary piston assembly, then install flange seal and reservoir.
Bleed Brake System

IMPORTANT: To prevent contamination of the brake system, make sure to clean components before disassembly.

1. Park vehicle on a level surface, turn key switch OFF, apply parking brake and remove key from the key switch.

2. Connect a suitable transparent hose to bleeder valve on front or rear brake caliper. Submerge other end of hose in a glass container partially filled with clean brake fluid.

3. Have a second person pump brake pedal several times, then hold pedal down firmly.

4. With pedal firmly depressed, open bleeder valve of brake until pedal fades to floor. Close bleeder valve before releasing pedal.

5. Repeat procedure until a continuous flow of brake fluid, with no air bubbles, is released from bleeder valve. **Make sure fluid level is maintained in brake fluid reservoir at all times.**

6. Torque bleeder valve from 54 to 66 in−lb (6.1 to 7.4 N−m).

7. Repeat steps 1 to 5 for other brake calipers.

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**CAUTION**

After servicing the brakes, always check the brakes in a wide open, level area that is free of other persons and obstructions.

8. After bleeding of brakes is completed, test vehicle to make sure brakes are operating correctly and brake pedal is firm when applying brakes.
Steering Assembly

1. Steering rack assembly
2. Steering column
3. Bearing (2 used)
4. Steering shaft
5. Lock washer
6. Cap screw
7. Dust cover
8. Washer head screw (4 used)
9. Carriage bolt (4 used)
10. Flange nut (4 used)
11. Steering wheel
12. Flat washer
13. Lock nut
14. Steering wheel cap
15. Cotter pin (2 used)
16. Slotted hex nut (2 used)

Disassembly (Fig. 27)

1. Park vehicle on a level surface, turn key switch OFF, apply parking brake and remove key from the key switch.

2. Raise front hood to gain access to the steering components.

3. Carefully remove steering wheel cover from the steering wheel. Remove nut and flat washer securing the steering wheel to the steering shaft.

4. Use suitable puller to remove steering wheel from steering shaft.

5. Remove dash and position it toward the front of the vehicle to allow the steering column to be moved (see Dash in this section).

6. Remove cap screw and lock washer securing the lower steering shaft joint to the steering rack assembly input shaft.

7. Support steering column to prevent it from falling. Remove four (4) flange nuts and carriage bolts securing the steering column to the mounting plate on the frame.
8. Lift up on steering column assembly, slide lower steering shaft joint from the steering rack assembly input shaft and remove steering column from vehicle.

9. Remove dust cover from the steering shaft. Replace cover if damaged.

10. Slide steering shaft and bearings out of the steering column.
   
   A. Check steering shaft universal joints for roughness that would indicate bearing wear or damage. Replace steering shaft if universal joint bearing damage exists.
   
   B. Check bearings for evidence of wear or damage and replace bearings if necessary.

11. Disconnect both steering rack tie rods from the spindles at the front wheel hubs (see Front Suspension in this section).

12. Remove four (4) washer head screws that secure the steering rack assembly to the front frame. Remove rack assembly from the vehicle.

NOTE: Refer to Steering Rack Assembly Service in this chapter for information on repair of the steering rack assembly.

Assembly (Fig. 27)

1. Position steering rack assembly to the front frame with the input shaft toward the left side of the vehicle.

2. Secure rack assembly to the frame with four (4) washer head screws. Torque screws from 200 to 230 in−lb (23 to 25 N⋅m).

3. Insert steering shaft up through the steering column.

4. Position steering column assembly to vehicle frame and slide lower steering shaft joint onto the steering rack input shaft. Secure steering column to the mounting plate on the frame with four (4) carriage bolts and flange nuts.

5. Secure lower steering shaft joint to the steering rack input shaft with cap screw and lock washer. Torque screw from 200 to 230 in−lb (23 to 25 N⋅m).

6. Place dust cover onto the steering shaft.

7. Connect both steering rack tie rods to the spindles at the front wheel hubs (see Front Suspension in this section).

8. Make sure that front wheels are centered by the steering rack before securing the steering wheel.
   
   A. Install steering wheel onto steering shaft. Leave steering wheel loose on shaft.
   
   B. Rotate the steering wheel until the distance from the steering rack boot to the tie rod is equal on both sides of vehicle indicating that the front wheels are centered.
   
   C. Rotate the steering wheel from lock to lock and check that the front wheel spindles have equal clearances at end of steering rotation. If one spindle contacts a steering component and the other spindle still has clearance, a rotation of the steering shaft is needed to center the wheels.
   
   D. Once wheels are centered, position steering wheel onto steering shaft so that the steering wheel spokes are centered when the front wheels are centered.

9. Secure steering wheel to steering shaft with flat washer and lock nut. Torque nut from 13 to 22 ft−lb (18 to 29 N⋅m). Install steering wheel cover to steering wheel.

10. Carefully position and secure dash to vehicle (see Dash in this section).

11. Lower and secure front hood.

12. Check front wheel alignment and adjust as necessary (see Adjust Front Wheel Toe−in in the Adjustments section of this chapter).
NOTE: Check parts catalog to identify individual components that are available for the steering rack assembly on your Workman GTX vehicle. Depending on wear or damage that exists with the steering rack, replacement of the complete steering rack assembly might be necessary.
Disassembly (Fig. 28)

1. For assembly purposes, measure the distance from shoulder on the tie rod track to the location of the tie rod end (Fig. 29). This will help to adjust front wheel toe-in during assembly of steering rack.

2. Loosen jam nut that secures tie rod end to tie rod track. Remove tie rod end and jam nut from end of tie rod track.

3. Remove clamps that secure bellows to the tie rod track and steering rack housing. Remove bellows from steering rack assembly.

4. Secure steering rack assembly in a vise with soft jaws. Clamp on the mounting surfaces of the rack to prevent damage to internal components.

5. Loosen and remove tie rack track from shaft of steering rack.

6. If necessary, remove input shaft seal from steering rack input shaft (Fig. 30):
   A. Mark and drill two (2) holes in the outer face of the seal.
   B. Thread two (2) self-tapping screws into the drilled holes in the face of the seal.
   C. Use the screws in the face of the seal to pull the seal from the steering rack assembly. Discard seal.

7. Clean and inspect all removed steering rack components. Replace parts that are worn or damaged.

8. Check teeth on steering rack shaft by rotating input shaft to extend rack shaft in one direction, inspect exposed rack teeth and then repeat in opposite direction. If any gear teeth are damaged, steering rack assembly replacement is necessary.

Assembly (Fig. 28)

1. If input shaft seal was removed from steering rack, install new seal into rack. Seal should be pressed fully into bore of rack until it contacts retaining ring in bore (Fig. 30).

2. Lubricate steering rack shaft by rotating input shaft to extend rack shaft in one direction and apply general purpose grease to exposed teeth on rack. Rotate input shaft to extend rack shaft in opposite direction and apply general purpose grease to exposed teeth on rack.

3. Secure steering rack in a vise with soft jaws. Clamp on the mounting surfaces of the rack to prevent damage to internal components.

4. Apply medium strength thread locker to threads of tie rack track. Install tie rack track into shaft of steering rack. Torque tie rack track from 34 to 42 ft-lb (47 to 57 N·m).

5. Carefully install bellows onto steering rack assembly. Secure bellows to the tie rod track and steering rack housing with new clamps. To prevent damage to bellows, do not over-tighten clamps.

6. Install jam nut and then tie rod end to tie rod track. Use measured distance made during disassembly to position the tie rod end. Leave jam nut loose to allow easier toe-in adjustment after steering rack assembly installation on vehicle.
Front Suspension

Disassembly (Fig. 31)

1. Park vehicle on a level surface, turn key switch OFF, apply parking brake and remove key from the key switch.

2. Raise hood to allow access to suspension components from above.

WARNING
Before jacking up the vehicle, review and follow Jacking Instructions in Chapter 1 – Safety.
3. Chock wheels not being removed. Use a jack to raise front wheel that is to be removed off the ground. Support vehicle with appropriate jack stands beneath the frame.

4. Remove front wheel assembly and wheel hub from vehicle (see Front Wheels and Hubs in this section).

5. Remove spindle assembly from vehicle:
   A. Remove cotter pin and slotted hex nut securing steering rack tie rod ball joint stud to the spindle. Separate ball joint from the spindle.
   B. Remove flange nut and cap screw securing the spindle assembly to the suspension strut assembly. Separate spindle from strut and remove spindle from vehicle.

6. Remove flange head screw and flange nut that secure lower end of suspension strut assembly to A-arm. Pivot strut assembly away from A-arm.

7. If suspension strut assembly removal is necessary, remove flange head screw and lock nut that secure the top of the strut assembly to the front frame. Remove strut assembly from vehicle.

8. Support A-arm to prevent it from falling.

9. Remove cap screw and flange nut that secure A-arm to frame. Remove A-arm assembly from frame.

10. Inspect sleeves and bushings in spindle (Fig. 31) and A-arm (Fig. 32) for wear or damage. If necessary, replace sleeves and bushings from spindle or A-arm:
    A. Remove sleeves from flange bushings.
    B. Remove flange bushings from spindle or A-arm. Take care to not damage bore of component during bushing removal. Clean the inside of the bore to remove all dirt, grease and foreign material.
    C. Apply grease to the inside and outside of the new bushings. Use an arbor press to fully install the bushings into the spindle or A-arm.
    D. Install sleeves into spindle or A-arm.

NOTE: On Workman GTX electric vehicles, suspension strut assembly should be set to second lowest preload setting.

Assembly (Fig. 31)

1. Position A-arm to the frame. Secure A-arm to the frame with cap screw and flange nut. Torque screw from 27 to 33 ft-lb (37 to 44 N-m).

2. If suspension strut assembly was removed from vehicle, position the top of the strut assembly to the front frame and secure with flange head screw and lock nut. Torque screw from 80 to 90 ft-lb (109 to 122 N-m).

3. Position lower end of strut assembly to A-arm and secure with flange head screw and flange nut. Torque screw from 27 to 33 ft-lb (37 to 44 N-m).

4. Install spindle assembly to vehicle:
   A. Position spindle to suspension strut assembly and secure with cap screw and flange nut. Torque screw from 27 to 33 ft-lb (37 to 44 N-m).
   B. Clean tapers of steering rack tie rod ball joint stud and spindle bore.
   C. Insert tie rod ball joint stud into spindle and secure with slotted hex nut. Torque slotted hex nut from 35 to 40 ft-lb (48 to 55 N-m). If necessary, tighten nut further until slot in nut aligns with hole in tie rod ball joint stud. Install cotter pin.

5. Install front wheel hub and wheel assembly to vehicle (see Front Wheels and Hubs in this section).

6. Lower vehicle to ground. Make sure that wheel lug nuts are properly torqued in a crossing pattern from 75 to 95 ft-lb (102 to 128 N-m).

7. Lubricate spindle and A-arm grease fittings with High-Temp Mobil XHP-222 grease (or equivalent).

8. Lower and secure hood.

9. Check front wheel toe-in and adjust if necessary (see Adjust Front Wheel Toe-in in the Adjustments section of this chapter).

NOTE: On Workman GTX electric vehicles, suspension strut assembly should be set to second lowest preload setting.

Assembly (Fig. 31)

1. A-arm
2. Inner sleeve
3. Outer sleeve
4. Flange bushing (4 used)
5. Grease fitting (2 used)
Rear Suspension

Figure 33

1. Rear frame
2. Stabilizer bar bracket
3. Stabilizer bar bracket
4. Flange head screw (5 used)
5. Flange nut (9 used)
6. Flange head screw (6 used)
7. Lock nut (10 used)
8. Panhard rod assembly
9. Thrust washer (6 used)
10. Sway bar link bracket
11. Flange head screw (4 used)
12. Carriage bolt (4 used)
13. Sway bar bracket (2 used)
14. Sway bar clamp (2 used)
15. Rubber bushing (2 used)
16. Anti–sway bar
17. Sway bar link (2 used)
18. Swing arm

Disassembly (Fig. 31)

1. Park vehicle on a level surface, turn key switch OFF, apply parking brake and remove key from the key switch.

2. Raise and support cargo bed for access to rear suspension components from above.

WARNING

Before jacking up the vehicle, review and follow Jacking Instructions in Chapter 1 – Safety.
3. Chock front wheels. Use a jack to raise rear wheels off the ground. Support vehicle with appropriate jack stands beneath the rear frame.

4. Support transaxle from below to prevent the transaxle and swing arm from moving during rear suspension disassembly.

**CAUTION**

If stabilizer bar bracket (item 3) or sway bar link bracket need to be removed, make sure that transaxle is supported from below.

5. Remove rear suspension components as needed using Figure 31 as a guide.

   A. Check for wear in bushings in panhard rod assembly and replace bushings and or spacers if necessary (shown in Fig. 35).

6. Inspect suspension components for wear or damage and replace parts as needed.

7. If necessary, remove rear shock absorber(s) (Fig. 34):

   A. Remove flange head screws and lock nuts that secure shock absorber(s) to rear frame and swing arm.

   B. Remove shock absorber(s) from vehicle.

**NOTE:** On Workman GTX Electric vehicles, rear shocks should be set to third lowest pre-load setting.

**NOTE:** Use spanner wrench TOR6010 (see Special Tools in this chapter) if rear shock spring pre-load requires adjustment. If the spring is to be removed from the shock absorber, shock spring compressor tool TOR6015 (see Special Tools in this chapter) can be used.

**Assembly (Fig. 31)**

**IMPORTANT:** During assembly of rear suspension components, install all components before fully tightening fasteners.

1. Install all removed rear suspension components using Figure 31 as a guide. After all parts have been installed fully tighten fasteners to secure suspension to vehicle. Torque fasteners to specifications listed in Figure 31.

2. Install rear shock absorber(s) if it was removed (Fig. 34):

   A. Position shock absorber(s) to rear frame and swing arm brackets.

   B. Secure shock absorber(s) to vehicle with flange head screws and lock nuts. Torque screws from **77 to 95 ft-lb (105 to 128 N·m)**.

3. Lower vehicle to ground and lower cargo bed.
Swing Arm Mount Assembly

1. Front frame
2. Swing arm
3. Cap screw
4. Upper plate
5. Isolator (upper portion)
6. Isolator (lower portion)
7. Snubbing washer
8. Rear suspension mount
9. Cap screw (2 used)
10. Flange nut (2 used)

Figure 36

140 to 160 ft−lb
(190 to 216 N−m)

27 to 33 ft−lb
(37 to 44 N−m)
Removal (Fig. 36)

1. Park vehicle on a level surface, turn key switch OFF and remove key from the key switch. Make sure to apply parking brake.

2. Raise and support cargo bed with prop rod.

3. Chock the front and rear of both front tires to prevent the vehicle from moving.

**IMPORTANT:** Make sure to not damage the rear brake lines, electrical harness, parking brake cables or other parts while disassembling the swing arm mount.

4. Remove cap screw that secures swing arm to rear suspension mount.

5. Carefully, raise and support front of swing arm just enough to allow clearance for removal of isolator and snubbing washers.

6. Remove snubbing washers and isolator mount from bore in front of swing arm.

7. If necessary, remove two (2) cap screws, washers and flange nuts that secure the rear suspension mount to the front frame. Remove mount from front frame.

Installation (Fig. 36)

1. If rear suspension mount was removed, position mount to front frame and secure with two (2) cap screws, washers and flange nuts. Torque cap screws from **27 to 33 ft−lb (37 to 44 N−m)**.

**IMPORTANT:** Make sure to not damage the brake lines, electrical harness, parking brake cables or other parts while assembling the swing arm mount.

2. Insert upper portion of isolator mount down through the swing arm and into the lower portion of the mount.

3. Place snubbing washer between the bottom of the isolator mount and the top of the rear suspension mount.

4. Carefully lower front of swing arm so the holes in the isolator mount, snubbing washer and threaded hole in rear suspension mount are aligned.

5. Place second snubbing washer on the top of the isolator mount and then secure swing arm to rear suspension mount with cap screw. Torque screw from **140 to 160 ft−lb (190 to 216 N−m)**.

6. Lower and secure cargo bed.
Seat Base

1. RH seat base side
2. Seat base front panel
3. LH seat base side
4. Seat support angle
5. Rear seat support angle
6. Seat support channel (2 used)
7. Screw with washer (2 used)
8. Seat base assembly
9. Floor plate clamp (2 used)
10. Flat washer (2 used)
11. Flange head screw (2 used)
12. Flange nut (8 used)
13. LH side support bracket
14. RH side support bracket
15. Washer head screw (5 used)
16. Screw (12 used)
17. Flange head screw (6 used)
18. Washer head screw (6 used)
19. Flange nut (6 used)
20. RH hip restraint
21. LH hip restraint
22. Flange head screw (2 used)
23. Flange nut (2 used)

Figure 37

- 40 to 45 in-lb (4.6 to 5.0 N-m)
- 90 to 110 in-lb (10.2 to 12.4 N-m)
- 18 to 22 in-lb (2.1 to 2.4 N-m)
- 18 to 22 in-lb (2.1 to 2.4 N-m)
- 90 to 110 in-lb (10.2 to 12.4 N-m)

40 to 45 in-lb (4.6 to 5.0 N-m)

- 40 to 45 in-lb (4.6 to 5.0 N-m)
- 90 to 110 in-lb (10.2 to 12.4 N-m)

18 to 22 in-lb (2.1 to 2.4 N-m)

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18 to 22 in-lb (2.1 to 2.4 N-m)

- 18 to 22 in-lb (2.1 to 2.4 N-m)
- 90 to 110 in-lb (10.2 to 12.4 N-m)

90 to 110 in-lb (10.2 to 12.4 N-m)

- 90 to 110 in-lb (10.2 to 12.4 N-m)
- 40 to 45 in-lb (4.6 to 5.0 N-m)
Disassembly (Fig. 37)

1. Park vehicle on a level surface, turn key switch OFF, apply parking brake and remove key from the key switch.

2. Remove seat base assembly with attached seats from vehicle.

3. If left hand seat base side is to be removed from vehicle (Fig. 38):
   - A. Remove onboard battery charger from vehicle (see Onboard Battery Charger in the Service and Repairs section of Chapter 3 – Electrical System).
   - B. Remove four (4) screws that secure seat base side to charger bracket (Fig. 38).
   - C. Support left hand seat base side and remove four (4) screws that secure seat base side to supports illustrated in Figure 37.
   - D. Remove left hand seat base side from vehicle.

4. Remove remaining seat base panels and supports from vehicle as needed using Figure 37 as a guide.

5. If needed, remove seats from seat base (Fig. 39).

Assembly (Fig. 37)

1. Secure seats to seat base if they were removed (Fig. 39). Torque cap screws from 90 to 110 in–lb (10.2 to 12.4 N–m).

2. Install all removed seat base panels and supports to vehicle using Figures 37 and 38 as guides. When securing seat base supports to vehicle, use torque values identified in Figures 37 and 38.

3. If onboard battery charger was removed from vehicle, install charger (see Onboard Battery Charger in the Service and Repairs section of Chapter 3 – Electrical System).

4. Install seat base assembly with attached seats to vehicle.
Dash

Figure 40

1. Dash
2. Washer head screw (10 used)
3. Foot board
4. Screw (2 used)
5. Washer head screw (10 used)
6. Foot board cover
7. Flange nut (4 used)
8. Flat washer (2 used)
9. RH dash bracket
10. LH dash bracket
11. Dash angle bracket
12. Dash bracket
13. Washer head screw (8 used)
14. Washer head screw (4 used)
15. Side dash bracket (2 used)
16. Flange nut (2 used)

90 to 100 in-lb (10.2 to 11.3 N-m)
40 to 45 in-lb (4.6 to 5.0 N-m)
200 to 230 in-lb (23 to 25 N-m)
40 to 45 in-lb (4.6 to 5.0 N-m)

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14
15
16
Removal (Fig. 40)

1. Park vehicle on a level surface, turn key switch OFF, apply parking brake and remove key from the key switch.

2. Raise hood to allow access to wire harness connections to switches mounted in dash.

3. Disconnect wire harness connectors from all switches and power ports on dash.

4. Remove ten (10) washer head screws that secure dash to vehicle.

5. Carefully lift dash from vehicle supports and remove it from the vehicle.

Installation (Fig. 40)

NOTE: Do not fully tighten fasteners securing dash until all fasteners are in place.

1. Carefully position dash to vehicle by lowering it over parking brake lever.

2. Secure dash with removed washer head screws using fastener torque specifications that are identified in Figure 40.

IMPORTANT: Make sure that the USB power point is connected with the correct polarity. The white (positive) harness wire should be connected to the upper USB power point terminal.

3. Connect wire harness connectors to all switches and power ports on dash.

4. Lower and secure front hood.
Front Fenders, Hood and Bumper

1. Bumper
2. LH headlight bracket
3. RH headlight bracket
4. Washer head screw (8 used)
5. Headlight assembly (2 used)
6. Speed clip (6 used)
7. Hood
8. Clevis pin (2 used)
9. Spring pin (2 used)
10. Retainer pin (2 used)
11. Washer head screw (6 used)
12. LH front fender
13. RH front fender
14. Flange head screw (4 used)
15. Flat washer (4 used)
16. Flange nut (4 used)
17. Washer head screw (2 used)
18. Screw (2 used)
19. Hold down strap (2 used)
20. Lock nut (2 used)
21. Washer head screw (4 used)
22. LED bulb (2 used)
23. Angle bracket (2 used)
24. Flange nut (4 used)
25. Flat washer (2 used)

Figure 41

- 7 to 13 in–lb (0.8 to 1.4 N·m)
- 18 to 22 in–lb (2.1 to 2.4 N·m)
- 40 to 45 in–lb (4.6 to 5.0 N·m)
- 200 to 230 in–lb (23 to 25 N·m)
- 40 to 45 in–lb (4.6 to 5.0 N·m)
Removal (Fig. 41)

1. Park vehicle on a level surface, turn key switch OFF, apply parking brake and remove key from the key switch.

2. Remove front fenders, hood or front bumper using Figure 41 as a guide.

Installation (Fig. 41)

**NOTE:** Do not fully tighten fasteners securing body components until all fasteners are in place.

1. Install removed body components using Figure 41 as a guide. During assembly, use fastener torque specifications that are identified in Figure 41.
1. Cap screw (2 used)
2. Cargo bed assembly
3. Flange head screw
4. Bed latch striker (2 used)
5. Prop rod
6. RH cargo bed support
7. LH cargo bed support
8. Flange head screw (6 used)
9. Flange nut (6 used)
10. Lock nut (2 used)
11. Prop rod bracket
12. Prop rod U-bracket

Figure 42

133 to 147 in-lb
(15 to 16 N·m)

27 to 33 ft-lb
(37 to 44 N·m)

140 to 170 in-lb
(16 to 19 N·m)
Disassembly

1. Park vehicle on a level surface, turn key switch OFF, apply parking brake and remove key from the key switch.

2. Make sure that cargo bed is empty.

3. If necessary, remove cargo bed from vehicle (Fig. 42):
   
   A. Raise cargo bed and support bed so that prop rod assembly can be removed from bottom of bed.
   
   B. Remove three (3) flange head screws that secure prop rod U-bracket (item 12) to bed and remove bracket and prop rod (item 5).
   
   C. Lower cargo bed to vehicle frame.
   
   D. Remove two (2) cap screws (item 1) and lock nuts (item 10) that secure cargo bed assembly to frame.
   
   E. Lift cargo bed assembly from vehicle.

4. Disassemble cargo bed as necessary using Figures 42, 43 and 44 as guides.

Assembly

1. Assemble cargo bed using Figures 42, 43 and 44 as guides.

   A. Use torque specifications that are identified in the illustrations when assembling cargo bed.

2. If removed, secure cargo bed to vehicle (Fig. 42):

   A. Position cargo bed assembly to vehicle.

   B. Secure cargo bed assembly to frame with two (2) cap screws (item 1) and lock nuts. Torque cap screws from 140 to 170 in-lb (16 to 19 N-m).

   C. Raise cargo bed and support bed so that prop rod assembly can be secured to bottom of bed.

   D. Make sure that end of prop rod (item 5) is installed into slot in prop rod bracket (item 11) attached to frame.

   E. Secure prop rod U-bracket (item 12) and prop rod to bed with three (3) flange head screws. Torque screws from 133 to 147 in-lb (15 to 16 N-m).

   F. Lower cargo bed to vehicle frame.

3. Adjust bed latch strikers (item 4 in Fig. 42) so that cargo bed closes completely and is latched at both sides. Strikers can be raised or lowered to latch bed.
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### Electrical Drawing Designations

The following abbreviations are used for wire harness colors on the electrical schematics and wire harness drawings in this chapter.

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Color</th>
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<tbody>
<tr>
<td>BK</td>
<td>BLACK</td>
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<tr>
<td>BN</td>
<td>BROWN</td>
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<tr>
<td>BU</td>
<td>BLUE</td>
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<tr>
<td>VIO</td>
<td>VIOLET</td>
</tr>
<tr>
<td>W or WH</td>
<td>WHITE</td>
</tr>
<tr>
<td>Y or YE</td>
<td>YELLOW</td>
</tr>
</tbody>
</table>

Numerous harness wires used on Workman GTX Electric vehicles include a line with an alternate color. These wires are identified with the wire color and line color with a / separating the color abbreviations listed above (e.g. BK/W is a black wire with a white line).

**NOTE:** The wire harness diagram in this chapter identifies both the wire color and the wire gauge. For example, 16 BK on a harness diagram identifies a 16 gauge wire that has a black insulator.

**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).
Run Circuits

Power Current

Control Current

Indication Current

Workman GTX Electric

KEY SWITCH

MOTOR

TRACTION CONTROLLER

LIMIT SWITCH

INDICATOR

BATTERY DISCHARGE SWITCH

DIRECTION SELECTOR

LIGHT SUPERVISION SPEED STATUS INDICATOR

SWITCH

BED LIFT ACTUATOR

BED LIFT PEDAL

ACCELERATOR (NOT APPLIED)

D C

B A

654 321

122-0525 REV. B

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Battery Charging Circuit

Power Current

Control Current

Indication Current

Workman GTX Electric

KEY SWITCH

MOTOR

TRACTION CONTROLLER

LIMIT SWITCH

INDICATOR

BATTERY DISCHARGE SWITCH

DIRECTION SELECTOR

LIGHT SUPERVISION SPEED STATUS INDICATOR

SWITCH

BED LIFT ACTUATOR

PEDAL

ACCELERATOR
Workman GTX
Wire Harness Drawing and Diagram – Cab Model 07142