



Count on it.

Form No. 20248SL Rev B

Service Manual

Greensmaster® eFlex 1021 (Model 04861)

Revision History

[illegible]

Reader Comments

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

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NOTES

Preface

The purpose of this publication is to provide the service technician with the information for troubleshooting, testing, and repair of the major systems and components on the Greensmaster eFlex 1021 (Model 04861).

Refer to the *Operator's Manuals* and *Installation Instructions* for installing, operating, maintenance, and adjustment instructions. Keep a copy of the *Operator's Manuals*, *Installation Instructions* and *Parts Catalogs* for your machine and its accessories with this *Service Manual* for reference. Additional copies of the *Operator's Manuals*, *Installation Instructions* and *Parts Catalogs* are available at www.toro.com.

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



DANGER



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



WARNING



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



CAUTION

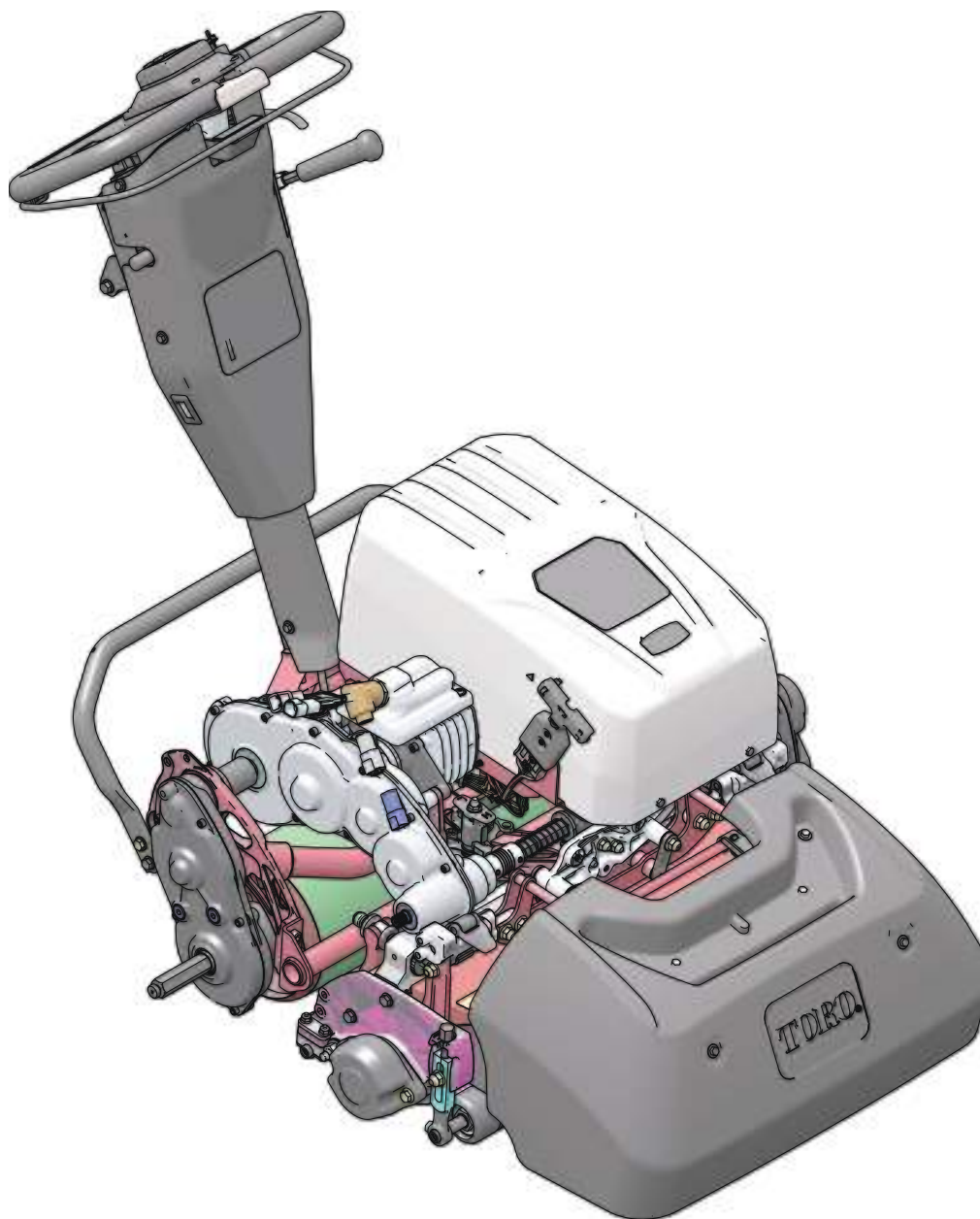


This safety symbol means caution. When you see this symbol, carefully read the instructions that follow. Failure to obey the instructions can result in minor to moderate injury.

IMPORTANT

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

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



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Figure 1

Service Procedure Icons

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



Critical Process

This icon is used to highlight:

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



Critical Torque

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



Fluid Specifications

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

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

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Safety Instructions

The Greensmaster eFlex 1021 machine is tested and certified by Toro for compliance with existing safety standards and specifications. Although hazard control and accident prevention are partially dependent upon the design and configuration of the machine, these factors are also dependent on the awareness, concern, and proper training of the personnel involved in the operation, transport, maintenance, and storage of the machine. The improper use or maintenance of the machine can result in injury or death.



WARNING



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

- **Avoid unexpected starting of the machine...**

Always turn off the machine, remove the key and unplug the 48V battery disconnect before cleaning, adjusting, or repair.

- **Avoid lacerations and amputations...**

Stay clear of all moving parts whenever the engine is running. Treat all normally moving parts as if they were moving whenever the engine is running or has the potential to start.

- **Avoid burns...**

Do not touch the engine, muffler, or other components, which may be hot during operation, while the unit is running or shortly after it has been running. Allow the engine, muffler, and other components to cool before working near them.

- **Avoid fires and explosions...**

Use extreme care in handling fuel. Fuel is flammable and its vapors are explosive.

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

- **Avoid asphyxiation...**

Do not operate an engine in a confined area without proper ventilation.

- **Avoid injury from lithium-ion battery...**

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

- Use only Toro-specified lithium-ion battery packs designed for your machine. Do not mix battery of any brand or type in Toro products.
- Use only the Toro-specified lithium-ion charger designed to charge your machine. Do not attempt to use any other battery charger.
- Do not over-charge or over-discharge lithium-ion battery.
- Do not heat, puncture, or open the battery case.
- Always disconnect the battery at the battery disconnect provided when servicing products with lithium-ion batteries.
- Always service lithium-ion battery with the machine parked near a service door large enough to move the product or battery outside in case of an emergency and keep a fire blanket nearby. Do not use a fire extinguisher on lithium-ion batteries.
- **Avoid injury due to inferior parts...**
 - Use only original equipment parts to ensure that important safety criteria are met.
- **Avoid injury to bystanders...**
 - Always clear the area of bystanders before starting or testing powered equipment.
- **Avoid injury due to projectiles...**
 - Always clear the area of any debris that could be picked up and thrown by the powered equipment.
- **Avoid modifications...**
 - Do not alter or modify any part unless it is a factory approved procedure.
- **Avoid unsafe machine operation...**
 - Always test the safety interlock system after making adjustments or repairs on the machine. Refer to the [Chapter 5: Electrical System \(page 5–1\)](#) in this manual for more information.
- **Avoid electrical shock...**
 - Never touch electrical wires or components while the engine is running. They can be sources of shock.
 - De-energize the system if you are having to do repairs.
 - If testing electrical components ensure you are working in a dry environment.
 - Do not wear metal jewelry when working on or near electrical components or wiring.
- **Use personal protective equipment...**
 - Tie back long hair, and do not wear loose clothing or jewelry.
 - Use appropriate personal protective equipment (PPE) for protecting yourself from potential hazards in the environment in which you will work.
 - Each process outlined in this manual may need different PPE to protect the service person. Use the proper PPE for the task at hand.
- **Using tools...**
 - All tools should be in proper working order. Do not use tools that are broken or in disrepair.
 - Use the proper tool for the proper application.
- **Using lifts, hoists, and jacks...**
 - All lifts, hoists, and jacks should be used in accordance with the manufacturer information.
 - Inspect lifts, hoists, and jacks prior to use.
 - Do not over load lifts, hoists, and jacks.

- Do not work under a suspended load.
- Ensure chock blocks are used on equipment that can move.
- Use lifts or jacks and jack stands that are rated to support the total weight of the machine and any attachments.
- Do not rely on jacks to support the machine.
- If you are unfamiliar with any lifts, hoists or jacks, do not use them until you know how to operate them correctly.
- **Using fire extinguishers...**
 - Use the proper class of fire extinguisher in case of fire.
 - Ensure fire extinguishers are serviced regularly, and replace any fire extinguishers that are discharged or in use beyond their expiration dates.



WARNING



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

-
- **Class A** fire extinguishers are for ordinary combustible materials such as paper, wood, cardboard, and most plastics. The numerical rating on these types of extinguishers indicates the amount of water it holds and the amount of fire it can extinguish. Geometric symbol (green triangle).
 - **Class B** fire extinguishers are for fires that involve flammable or combustible liquids such as gasoline, kerosene, grease and oil. The numerical rating for class B extinguishers indicates the approximate number of square feet of fire it can extinguish. Geometric symbol (red square).
 - **Class C** fire extinguishers are for fires that involve electrical equipment such as appliances, wiring, circuit breakers and outlets. Never use water to extinguish class C fires - the risk of electrical shock is far too great! Class C extinguishers do not have a numerical rating. The C classification means the extinguishing agent is non-conductive. Geometric symbol (blue circle).
 - **Class ABC** fire extinguishers are a dry chemical type used for multiple purposes. See above descriptions for additional information.

Safety and Instructional Decals

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



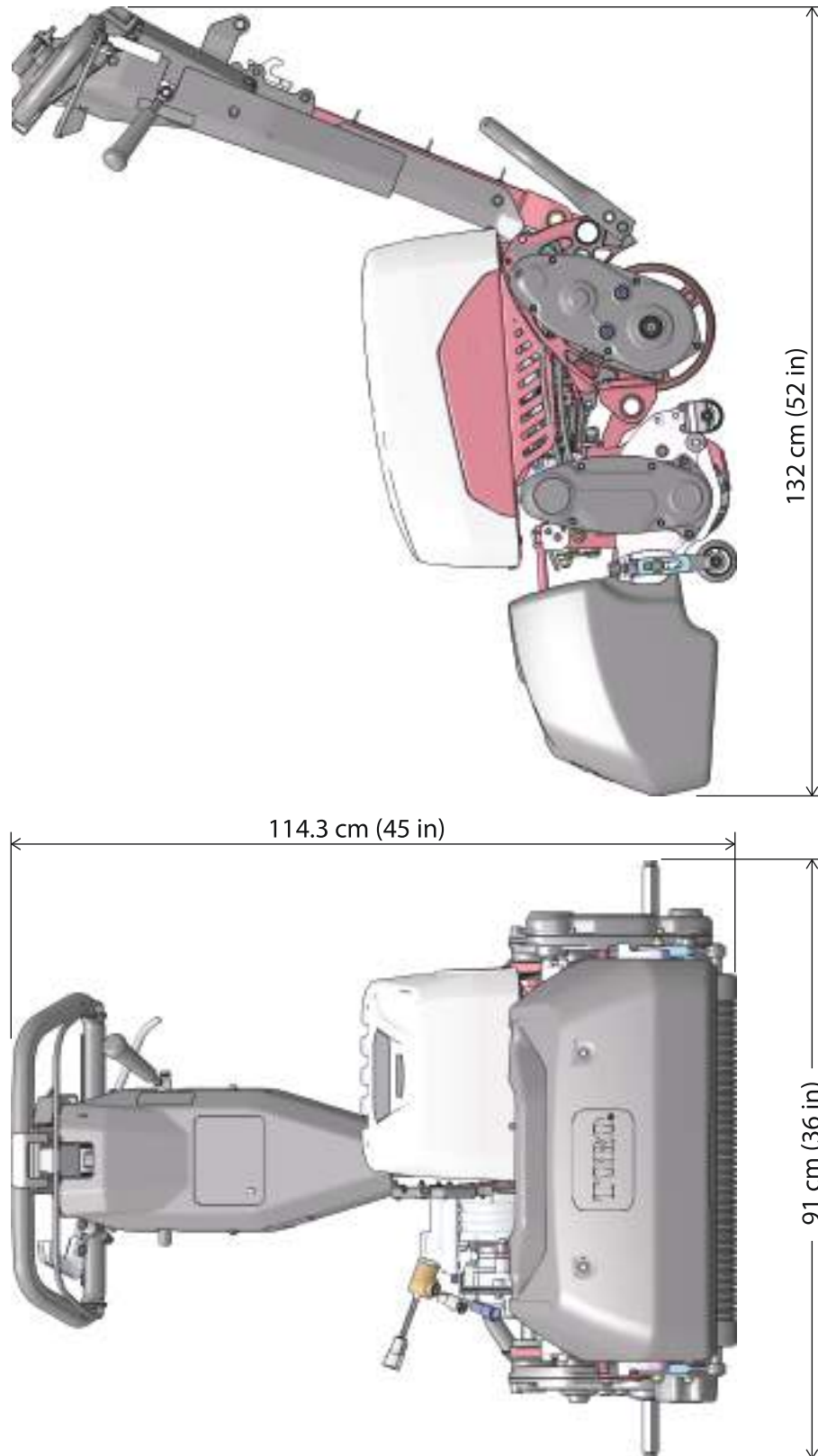
Specifications and Maintenance

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Specifications

Overall Dimensions



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Figure 2

Traction and Reel Drive Systems

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

Controls, Wheels and Accessories

Item	Description
Transport Wheel (Optional) Tire Pressure	83 to 103 kPa (12 to 15 PSI)

DPA Cutting Units

Frame construction:	Precision machined die cast aluminum crossmember with 2 bolt-on die-cast aluminum side plates.
Reel construction:	12.7 cm (5 inches) diameter, 11 or 14 carbon steel blades welded to 5 stamped steel spiders. High strength low alloy steel blades are through hardened.
Height-of-cut:	Cutting height is adjusted on the front roller by two vertical screws. Standard bench height of cut range is 1.6 to 12.7 mm (0.062 to 0.500 inch) depending on type of bedknife installed. Effective HOC may vary depending on turf conditions, type of bedknife, rollers, attachments installed and rear drum position.
Bedknife and bedbar:	Replaceable single edged Edgemax™ bedknife (solid tool steel construction) is standard. Bedknife is fastened to the bedbar with thirteen bedknife screws. A variety of optional bedknives are available.
Bedknife adjustment	Dual adjustment (one on each side of the bedbar) with 0.018 mm (0.0007 inch) bedknife movement for each detent.
Rollers:	The rear roller is a 5.1 cm (2 inches) diameter aluminum full roller. The front roller is a 6.3 cm (2.5 inches) diameter roller that is chosen from a variety of configurations.
Grass shield:	Non-adjustable shield with adjustable cut-off bar to improve grass discharge from reel in wet conditions.
Counterbalance weight:	A cast iron weight mounted on right end of the cutting unit balances the cutting unit.

Cutting unit weight (approximate):

	18 inch	21 inch
11 blade	33.5 kg (74 lbs)	35 kg (77 lbs)
14 blade	35 kg (77 lbs)	36.3 kg (80 lbs)

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

Universal Groomer

Item	Description
Grooming reel diameter	6 cm (2.375 inch)
Groomer mounting	The drive assembly for the grooming reel is located on the opposite side of the cutting unit from the belt drive.
Groomer height setting	Mowing: 0.8 to 15.7 mm (0.030 to 0.620 inch). HOC range: 1.5 to 19.1 mm (0.060 to 0.750 inch).
Width-of-groomer	54.6 cm (21.5 inch).
Height adjustment knob	Allows a 0.08 mm (0.003 inch) increment of height adjustment for each click of the adjuster.
Quick-up feature	Allows grooming reel to be raised above the height/depth adjustment for no grooming reel action while mowing.

Torque Specifications

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

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

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

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

Calculating the Torque Values When Using a Drive-Adapter Wrench

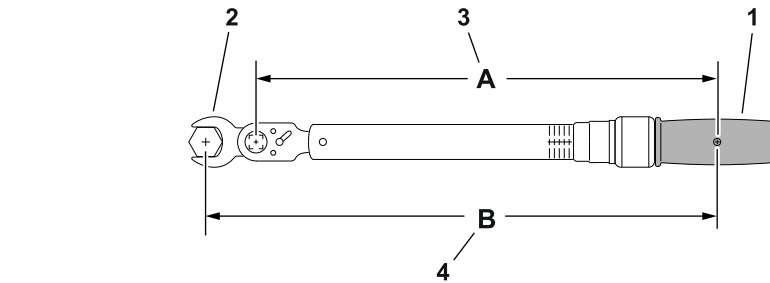


Figure 3

Torque Conversion Factor = A / B

- | | |
|-------------------------------------|---|
| 1. Torque wrench | 3. A (effective length of torque wrench) |
| 2. Drive-adapter wrench (crowsfoot) | 4. B (effective length of torque wrench and drive-adapter wrench) |

Using a drive-adapter wrench (e.g., crowfoot wrench) in any position other than 90° and 270° to the frame of the torque wrench will affect the torque value measured by the torque wrench because of the effective length (lever) of the torque wrench changes. When using a torque wrench with a drive-adapter wrench, multiply the listed torque recommendation by the calculated torque conversion factor (Figure 3) to determine proper tightening torque. When using a torque wrench with a drive-adapter wrench, the calculated torque will be lower than the listed torque recommendation.

Example: The measured effective length of the torque wrench (distance from the center of the handle to the center of the square drive) is 457 mm (18 inches).

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

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

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

Identifying the Fastener

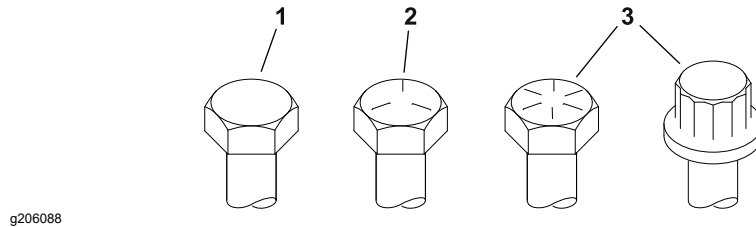


Figure 4

Inch Series Bolts and Screws

- | | | |
|------------|------------|------------|
| 1. Grade 1 | 2. Grade 5 | 3. Grade 8 |
|------------|------------|------------|

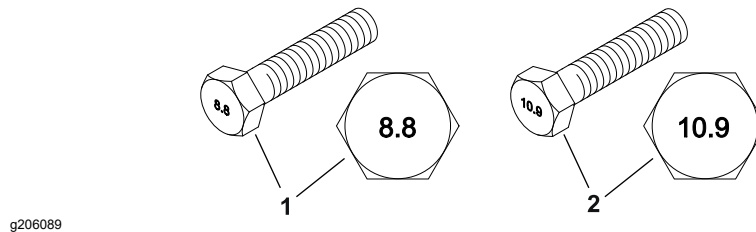


Figure 5

Metric Bolts and Screws

- | | |
|--------------|---------------|
| 1. Class 8.8 | 2. Class 10.9 |
|--------------|---------------|

Fasteners with a Locking Feature

IMPORTANT

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

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

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

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

Thread Size	Grade 1, 5 and 8 with Thin Height Nuts	SAE Grade 1 Bolts, Screws, Studs, and Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 5 Bolts, Screws, Studs, and Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 8 Bolts, Screws, Studs, and Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)	
	in-lb	in-lb	N·cm	in-lb	N·cm	in-lb	N·cm
# 6 - 32 UNC	10 ± 2	13 ± 2	147 ± 23	15 ± 2	169 ± 23	23 ± 3	262 ± 34
# 6 - 40 UNF				17 ± 2	192 ± 23	25 ± 3	282 ± 34
# 8 - 32 UNC	13 ± 2	25 ± 5	282 ± 56	29 ± 3	328 ± 34	41 ± 5	463 ± 56
# 8 - 36 UNF				31 ± 4	350 ± 45	43 ± 5	486 ± 56
# 10 - 24 UNC	18 ± 2	30 ± 5	339 ± 56	42 ± 5	475 ± 56	60 ± 6	678 ± 68
# 10 - 32 UNF				48 ± 5	542 ± 56	68 ± 7	768 ± 79
1/4 - 20 UNC	48 ± 7	53 ± 7	599 ± 79	100 ± 10	1130 ± 113	140 ± 15	1582 ± 169
1/4 - 28 UNF	53 ± 7	65 ± 10	734 ± 113	115 ± 12	1299 ± 136	160 ± 17	1808 ± 192
5/16 - 18 UNC	115 ± 15	105 ± 15	1186 ± 169	200 ± 25	2260 ± 282	300 ± 30	3390 ± 339
5/16 - 24 UNF	138 ± 17	128 ± 17	1146 ± 192	225 ± 25	2542 ± 282	325 ± 33	3672 ± 373
	ft-lb	ft-lb	N·m	ft-lb	N·m	ft-lb	N·m
3/8 - 16 UNC	16 ± 2	16 ± 2	22 ± 3	30 ± 3	41 ± 4	43 ± 5	58 ± 7
3/8 - 24 UNF	17 ± 2	18 ± 2	24 ± 3	35 ± 4	47 ± 5	50 ± 6	68 ± 8
7/16 - 14 UNC	27 ± 3	27 ± 3	37 ± 4	50 ± 5	68 ± 7	70 ± 7	95 ± 9
7/16 - 20 UNF	29 ± 3	29 ± 3	39 ± 4	55 ± 6	75 ± 8	77 ± 8	104 ± 11
1/2 - 13 UNC	30 ± 3	48 ± 7	65 ± 9	75 ± 8	102 ± 11	105 ± 11	142 ± 15
1/2 - 20 UNF	32 ± 4	53 ± 7	72 ± 9	85 ± 9	115 ± 12	120 ± 12	163 ± 16
5/8 - 11 UNC	65 ± 10	88 ± 12	119 ± 16	150 ± 15	203 ± 20	210 ± 21	285 ± 28
5/8 - 18 UNF	75 ± 10	95 ± 15	129 ± 20	170 ± 18	230 ± 24	240 ± 24	325 ± 33
3/4 - 10 UNC	93 ± 12	140 ± 20	190 ± 27	265 ± 27	359 ± 37	375 ± 38	508 ± 52
3/4 - 16 UNF	115 ± 15	165 ± 25	224 ± 34	300 ± 30	407 ± 41	420 ± 43	569 ± 58
7/8 - 9 UNC	140 ± 20	225 ± 25	305 ± 34	430 ± 45	583 ± 61	600 ± 60	813 ± 81
7/8 - 14 UNF	155 ± 25	260 ± 30	353 ± 41	475 ± 48	644 ± 65	667 ± 66	904 ± 89

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

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

Note: The nominal torque values listed above for Grade 5 and 8 fasteners are based on 75% of the minimum proof load specified in SAE J429. The tolerance is approximately ± 10% of the nominal torque value. The thin height nuts include jam nuts.

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

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

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

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

Note: The nominal torque values listed above are based on 75% of the minimum proof load specified in SAE J1199. The tolerance is approximately ± 10% of the nominal torque value.

Other Torque Specifications

SAE Grade 8 Steel Set Screws

Thread Size	Recommended Torque	
	Square Head	Hex Socket
1/4 - 20 UNC	140 ± 20 in-lb	73 ± 12 in-lb
5/16 - 18 UNC	215 ± 35 in-lb	145 ± 20 in-lb
3/8 - 16 UNC	35 ± 10 ft-lb	18 ± 3 ft-lb
1/2 - 13 UNC	75 ± 15 ft-lb	50 ± 10 ft-lb

Thread Cutting Screws (Zinc Plated Steel)

Type 1, Type 23 or Type F	
Thread Size	Baseline Torque**
No. 6 - 32 UNC	20 ± 5 in-lb
No. 8 - 32 UNC	30 ± 5 in-lb
No. 10 - 24 UNC	38 ± 7 in-lb
1/4 - 20 UNC	85 ± 15 in-lb
5/16 - 18 UNC	110 ± 20 in-lb
3/8 - 16 UNC	200 ± 100 in-lb

Wheel Bolts and Lug Nuts

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

*For steel wheels and non-lubricated fasteners

Thread Cutting Screws (Zinc Plated Steel)

Thread Size	Threads per Inch		Baseline Torque**
	Type A	Type B	
No. 6	18	20	20 ± 5 in-lb
No. 8	15	18	30 ± 5 in-lb
No. 10	12	16	38 ± 7 in-lb
No. 12	11	14	85 ± 15 in-lb

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

Conversion Factors

$$\text{in-lb} \times 11.2985 = \text{N·cm}$$

$$\text{ft-lb} \times 1.3558 = \text{N·m}$$

$$\text{N·cm} \times 0.08851 = \text{in-lb}$$

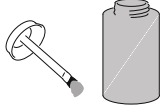

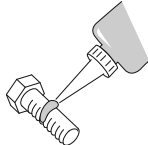


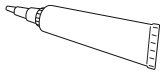
$$\text{N·m} \times 0.7376 = \text{ft-lb}$$

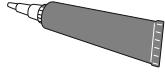

Shop Supplies

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

IMPORTANT

Always follow manufacturers instructions when using or storing shop supplies.

<p>ANTI-SEIZE LUBRICANT</p> <p>Used to prevent corrosion, galling and seizure between metal parts. Most often applied to shafts and bores during assembly. Unless otherwise specified, high viscosity regular grade lithium-graphite based anti-seize lubricant should be used.</p>	
<p>GREASE</p> <p>Can be used to pre-fill (pack) bearings, boots and seals prior to assembly, ease installation of components during assembly, or fill cavities between moving parts through grease fittings after assembly. Unless otherwise noted, refer to the machine <i>Operator's Manual</i> or <i>Installation Instructions</i> for grease specifications.</p>	
<p>THREAD LOCKING COMPOUND (Thread Locker)</p> <p>Used to lock threaded fasteners in position. Available in low, medium and high strength for various size fasteners and applications. Most thread locking compounds are applied immediately prior to fastener installation. Some thread locking compounds use a "Wicking" feature, and can be applied after fastener installation. Most thread locking compounds allow the fastener to be removed with standard tools once cured. High strength thread locking compounds may require applying heat to the fastener and the surrounding area to allow fastener removal.</p> <p>Note: Some fasteners have a dry thread locking compound pre-applied (Patch-Loc) so no additional thread locking compound is necessary when installing a "new" fastener. These fasteners are designed to be removed and re-installed only once before applying additional thread locking compound is necessary.</p>	
<p>RETAINING COMPOUND (bearings and sleeves)</p> <p>An adhesive used to secure bearings, bushings and cylindrical parts into housings or onto shafts. When cured, bearing and sleeve retaining compound fills the gap between mating parts with a hard resin that increases load distribution and protects against corrosion.</p>	
<p>ADHESIVE</p> <p>Used to secure a variety of components immediately prior to assembly. May be recommended for installing new components or when reusing a component that had a pre-applied adhesive such as hood seals, mouldings and weather-stripping.</p>	
<p>THREAD SEALANT</p> <p>Used to seal threaded fittings and sensors from air, fuel and oil pressure leaks and prevent galling and seizure between threaded parts. A thread sealant in paste form is preferred over sealant tape. The sealant should remain semi-pliable to allow for component removal with standard tools. Some thread sealants may require the use of a cleaner or primer prior to use.</p>	

<p>GASKET COMPOUND</p> <p>Used to create a seal between mating parts. Gasket compounds may be used with or without the presence of a pre-formed gasket. Gasket compounds may be solvent or silicone based, and cure when exposed to air or designed to cure in an air-less environment (anaerobic). Most gasket compounds are designed to be applied to clean surfaces free of oil, chemical residue and previously used gaskets or gasket compounds.</p>	
<p>SILICONE SEALANT</p> <p>Designed for a broad variety of sealing and bonding requirements, silicone sealants are usually room temperature vulcanizing (RTV) which form a flexible silicone rubber that bonds to a wide variety of smooth or porous materials when cured. Standard silicone sealants are designed to perform in temperatures from -51F to 232C (-60F to 400F), while high temperature variants can preform in temperatures up to 343C (650F).</p>	

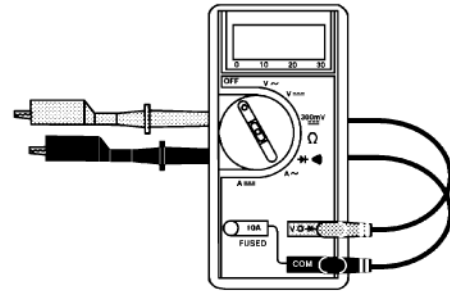
Special Tools

Multimeter

Obtain this tool locally

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

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



Dielectric Gel

Toro Part No. 107-0342

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

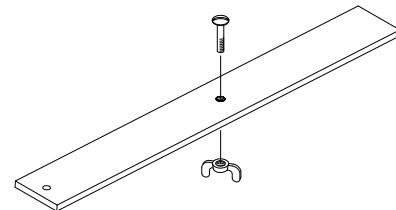
Note: Do not use the dielectric gel on the sealed connection terminals as the gel can unseat the connector seals during assembly.



Gauge Bar Assembly

K Line Part No. 94-9010

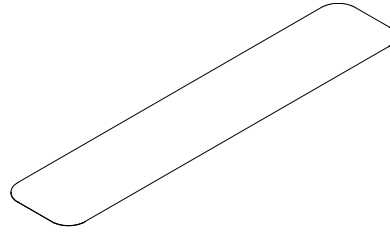
Use gauge bar to verify height-of-cut adjustment.



Cutting Reel Shim

Toro Part No. 125–5611

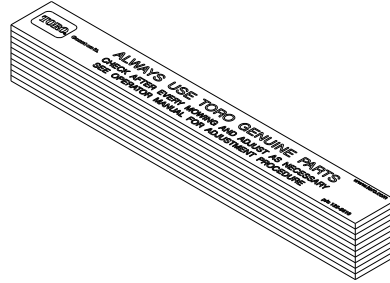
Use the 0.05 mm (0.002 in) shim like a feeler gauge to measure the gap between the reel and the bedknife during reel adjustment.



Cutting Performance Paper

Toro Part No. 125–5610 (300 strips)

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



Backlapping Brush Assembly

K Line Part No. 29–9100

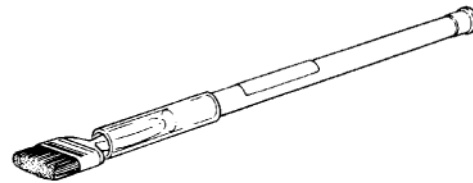
For applying lapping compound to cutting units while keeping hands a safe distance from the rotating reel.

Components for the brush assembly are also available individually.

Brush 36-4310

Handle 29-9080

Handle cap 2410-18



Spline Adapter Tool

Toro Part No. 120–3221 or 120–3222

Use either part number (current riding Greensmaster cutting unit reel nut) as a tool to remove and install the spline adapter on the cutting unit reel.



Reel Thread Repair Taps

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

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

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



Angle Indicator and Magnetic Mount

Angle Indicator: Toro Part No. 131-6828

Magnetic Mount: Toro Part No. 131-6829

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

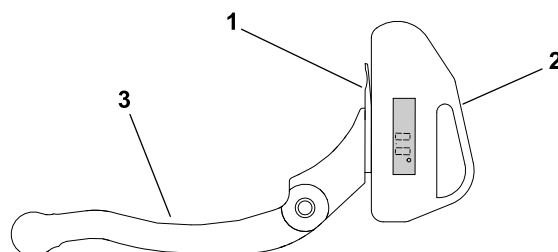
Since there can be variations in the mounting surface of the bedbar, it is necessary to grind the bedknife after installing it to the bedbar.

1. Place the angle indicator on the bottom side of the bedknife with the digital display facing you as shown.

2. Press the Alt Zero button on the angle indicator.

3. Remove the angle indicator and place the magnetic mount on the edge of the bedknife so the face of the magnet is flat against the top angle of the bedknife.

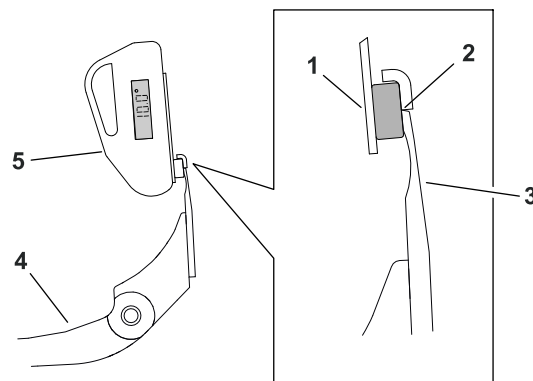
4. Place the angle indicator on the mount with the digital display facing you as shown. The angle displayed on the indicator is the current bedknife top angle.



g223327

Figure 6

- | | |
|--------------------|-----------|
| 1. Bedknife | 3. Bedbar |
| 2. Angle Indicator | |



g223326

Figure 7

- | | |
|----------------------------|--------------------|
| 1. Angle indicator surface | 4. Bedbar |
| 2. Magnetic mount | 5. Angle indicator |
| 3. Bedknife | |

Bedknife Screw Tool

K-Line Part No. TOR510880A

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

IMPORTANT

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



Diameter/Circumference Measuring Tape

K Line Part No. TOR6023

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



Roller Rebuilding Tools

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

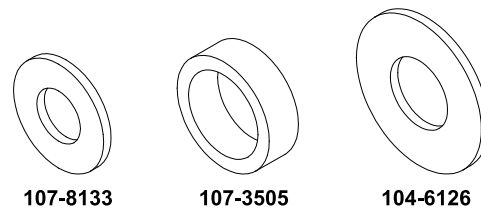
Bearing installation washer: 107-8133 (black)

Seal installation spacer: 107-3505

Seal installation washer: 104-6126 (yellow)

K-Line Part No. TOR4105

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



Turf Evaluator Tool

K Line Part No. 04399

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



Drive Shaft Removal Tool

Toro Part No. 137-0920

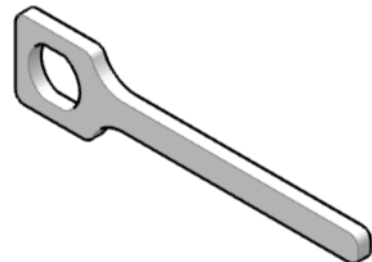
Use to remove the optional Universal Groomer drive shaft from the reel if the drive shaft hex is damaged.



Adapter Wrench

Toro Part No. 137-0921

Use to hold the optional Universal Groomer drive shaft securely when removing or installing the drive adapter.



Syringe – 50cc (2 ounce)

Toro Part No. 137-0872

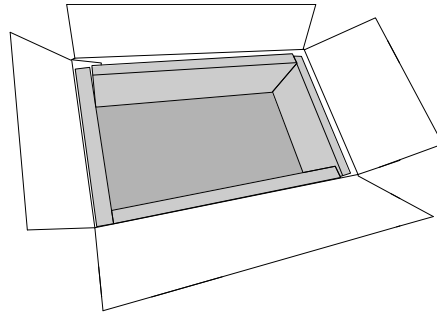
Aids in accurately filling the optional Universal Groomer gear box with oil.



Lithium-Ion Battery Shipping Kit

Toro Part No. 137-9650

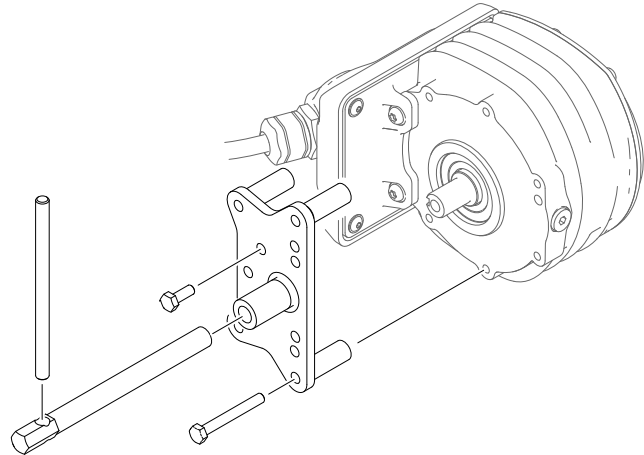
Use the original packaging or the battery shipping kit and a certified carrier to ship one of the lithium-ion batteries. The kit includes the appropriate carton, packing, labels, and instructions necessary to confirm to current lithium-ion battery shipping regulations in the USA.



Electric Motor Rotor Tool

Toro Part No. 139-8420

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

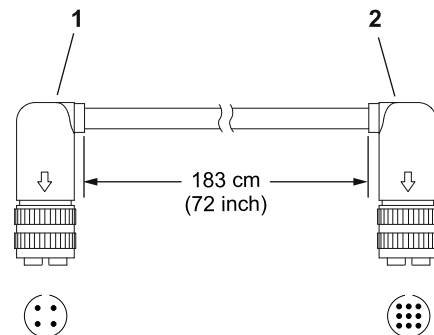


Lithium-Ion Battery Service Wire Harness

Toro Part No. 122-1947

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

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



g338615

Figure 8

1. 4-Pin battery connector
2. 9-Pin controller (BMS) connector



Troubleshooting

Table of Contents

GEARS – The Systematic Approach to Defining, Diagnosing and Solving Problems	3-2
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GEARS – The Systematic Approach to Defining, Diagnosing and Solving Problems

1. **Gather Information**

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

2. **Evaluate Potential Causes**

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

3. **Assess Performance**

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

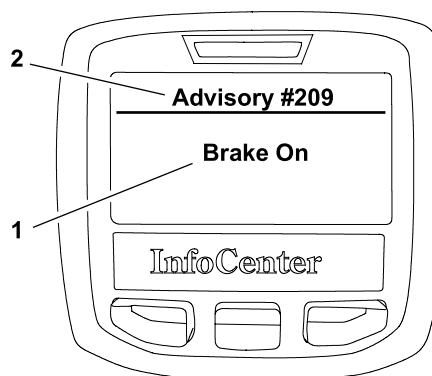
4. **Repair**

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

5. **Solution Confirmation**

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

Operator Advisories



g339631

Figure 9

1. Advisory name
2. Advisory identification

Operator advisories are automatically displayed by the InfoCenter when a machine function requires additional action (Figure 9). An advisory will not be logged into the fault log.

The InfoCenter advisories include the following:

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

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

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

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

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

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

#210 (High Power Consumption Run Time Reduced): The high power consumption identifies that electric motor draw is excessive and will reduce the run time of the machine. Excessive cutting unit bedknife contact or accessory use may generate this advisory.

#212 (Motor Disabled): The motor disabled advisory will identify that electric motor operation was stopped by the controller. A fault should have been generated that will provide additional information as to cause of the issue.

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

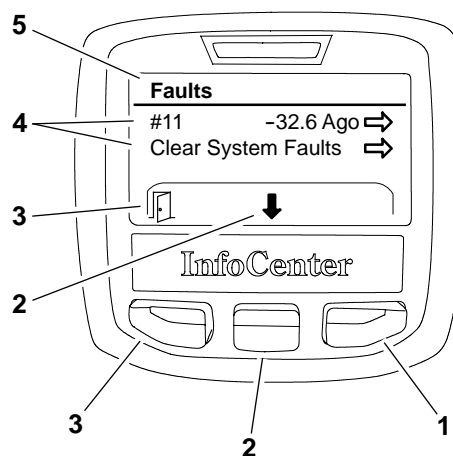
#214 (Battery Temperature Too Low): This advisory notifies that the battery operating temperature is too low and the controller was denied the motor operation.

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

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

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

Machine Faults



g339627


Figure 10

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

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

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

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

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

Fault Table

Fault Number	Fault Title	Controller Affected	Fault Condition/Circuit Description	Additional Notes	Service Actions
1	Internal TEC Fault	Primary	The 13.3 V regulator on the TEC is not able to maintain regulation at an acceptable voltage level.	This is an onboard power supply for the TEC.	<ol style="list-style-type: none"> 1. Reboot the machine. 2. Disconnect and reconnect the battery. 3. Look for short circuits in the harness. 4. Replace the TEC.
2	12Vdc Supply Fault	Primary	The 12 V regulator on the TEC cannot maintain regulation at an acceptable voltage level.		Most likely there is a short circuit on the 12 V supply line that powers the InfoCenter and the Slow-in-turn switch.

Fault Table (continued)

Fault Number	Fault Title	Controller Affected	Fault Condition/Circuit Description	Additional Notes	Service Actions
3	5V Supply Fault	Primary	The 5 V regulator on the TEC cannot maintain regulation at an acceptable voltage level.		Most likely there is a short circuit on the 5 V supply line that powers the throttle sensor.
4	Precharge Fault	Primary	The TEC checks and then monitors for proper voltage. The TEC confirms that the contactor voltage drops sufficiently during the discharge process and rises sufficiently during the pre-charge process. Failure of either process will trigger a fault.		<ol style="list-style-type: none"> 1. Verify the battery is charged. 2. Make sure the work lights are off, and check the wiring to the contactor for shorts. 3. Replace the contactor.
5	Communication Fault	Primary	The primary has not received a message from the motor for more than 2.5 seconds, or from the battery for more than 1 second.		Check the CAN bus for proper continuity and proper termination.
7	Motor Over Temperature	Motor	This fault is declared when the FET temperature or the motor temperature exceeds the design limit set point. When the overtemp region is entered, motor current is limited on a linear basis until the absolute overtemp value is reached.	A side effect of this fault is that the motor output torque will be limited. This will result in reduced reel speed and potential stall.	<ol style="list-style-type: none"> 1. Let machine cool. Note that this fault is not produced by a bad sensor. 2. Open the rear discharge of the cutting unit. 3. Reduce reel speed. 4. Reduce mow speed.
9	Internal Motor Fault	Motor	The motor detected an internal fault condition.		<ol style="list-style-type: none"> 1. Verify the battery is charged. 2. Test for proper supply voltage at the motor and its controller. 3. Test the main contactor coil. 4. Replace the motor. 5. Replace the TEC.
10	Motor Stalled	Motor	Motor at zero RPM for more than 3 seconds. Insufficient torque to rotate motor.	Can occur during heavy cutting conditions or cutting unit malfunction.	<ol style="list-style-type: none"> 1. Check cutting unit and motor mechanical resistance. 2. Check bedknife adjustment and condition of reel. 3. Motor will likely need replacing if the fault continues.
11	Software Incompatible		One of the devices in the system has software that is incompatible.		Use Toro DIAG to reprogram the machine.
12	Key Stuck On	Primary	The battery has detected the keyswitch in the START position for longer than allowed.		<ol style="list-style-type: none"> 1. Verify the battery is charged. 2. Test the key switch wiring. 3. Test the key switch.
13	Internal Battery Fault	Battery Management System	Internal BMS detected fault.		<ol style="list-style-type: none"> 1. Reboot the machine. 2. Disconnect and reconnect the battery. 3. Recharge the battery. 4. Replace the battery.

Fault Table (continued)

Fault Number	Fault Title	Controller Affected	Fault Condition/Circuit Description	Additional Notes	Service Actions
15	Software Error	Primary	The software has detected an issue with reading the throttle sensor.		<ol style="list-style-type: none">1. Try rebooting machine, disconnect and reconnect the battery, look for short circuits in the harness.2. Replace the TEC.
16	Contactor Fault	Primary	<p>The bus voltage was high enough at power up to require a discharge before precharge. The bus failed to discharge below threshold in the required amount of time.</p> <p>At shutdown, the contactor is opened and the bus discharged before shutting the machine down. This discharge failed to go below the threshold in the required amount of time.</p>		Most likely cause is a shorted contactor.
17	Throttle Sensor Fault	Primary	The sensor signals are outside the expected range.	Traction is disabled.	<ol style="list-style-type: none">1. Test the throttle sensor.2. Test the throttle sensor circuit wiring and connector P05.3. Replace throttle sensor.
18	Traction Bail Sensor Fault	Primary	The sensor signals are outside the expected range.	Traction is disabled.	<ol style="list-style-type: none">1. Test the traction bail sensor.2. Test the traction bail sensor circuit wiring and connector P26.3. Replace traction bail sensor.

Battery Charger Error and Fault Codes

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

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

Electrical System Problems



CAUTION



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

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

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

InfoCenter Does Not Start-Up

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

Traction Circuit is Inoperative

Possible Causes	Correction
The speed control potentiometer is damaged.	Use the InfoCenter Diagnostics screen to check the speed control potentiometer operation. Check and repair the speed control potentiometer and circuit wires if necessary.
The wire harness connections or wires are loose or damaged.	Check the electrical connections. Repair the wire harness as necessary.
A problem exists with the traction or reel drive system.	Refer to Chapter 4: Traction and Reel Drive Systems (page 4-1) .
The electric motor is damaged. Note: Fault should be displayed on the InfoCenter if the electric motor is damaged.	Use the InfoCenter Faults and Diagnostics screens to check the reel circuit operation. Check the electric motor and circuit wires. Repair as necessary.

Machine is Inoperative and InfoCenter Power Light Indicates That a Fault Has Occurred

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

Machine Operates But InfoCenter Display is Not Working

Possible Causes	Correction
The wire harness connections or wires to the InfoCenter display are loose or damaged.	Check the electrical connections. Repair the wiring as necessary.
The InfoCenter display is damaged.	Replace the InfoCenter display.

Aftercut Appearance

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

Refer to the *Cutting Unit Operator's Manual* detailed adjustment procedures. Refer to [Service and Repairs \(page 7–6\)](#) for cutting unit repair information.

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

Factors That Can Affect Quality of Cut

Factor	Possible Problem/Correction
Reel bearing condition	Check and replace the reel bearings if necessary; refer to Reel Assembly (page 7–16) .
Bedknife to reel adjustment	Check the bedknife to reel contact daily. The bedknife must have light contact across the entire reel. No contact will dull the cutting edges. Excessive contact accelerates wear of both edges. Quality of cut is adversely affected by both conditions.
Reel and bedknife sharpness	<p>A reel and/or bedknife that has rounded cutting edges or rifling (grooved or wavy appearance) cannot be corrected by tightening the bedknife to reel contact. Grind the reel to remove taper and/or rifling. Grind the bedknife to sharpen and/or remove rifling.</p> <p>A new bedknife must be ground or backlapped after installation to the bedbar. Refer to Grinding the Bedknife (page 7–14) for grinding information or the <i>Traction Unit Operator's Manual</i> for backlapping information.</p>
Height-of-cut	Effective or actual height-of-cut depends on the mower weight and turf conditions. Effective height-of-cut will be different than the bench set height-of-cut.
Proper bedknife for height-of-cut desired	If the bedknife is too thick for effective height-of-cut, poor quality of cut will result.
Stability of bedbar	Ensure that the bedbar pivot bolts are securely seated and washer free to rotate; refer to Bedbar Assembly (page 7–6) .
Number of reel blades	Use correct number of blades for clip frequency and optimum height-of-cut range.
Roller type and condition	<p>A variety of cutting unit rollers are available. Refer to the <i>Cutting Unit Parts Manual</i> for a listing of available accessories, or contact your local Authorized Toro Distributor for additional information.</p> <p>Ensure that the rollers rotate freely. Repair the roller bearings if necessary; refer to Roller Assemblies (page 7–26).</p>
Cutting unit accessories	A variety of cutting unit accessories are available that can be used to enhance aftercut appearance. Refer to the <i>Cutting Unit Parts Manual</i> for a listing of available accessories, or contact your local Authorized Toro Distributor for additional information.

Factors Affecting Grooming

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

IMPORTANT

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

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

Variables that Affect the Use and Performance of Grooming Reels:

1. The growing season and weather conditions.
2. General turf conditions.
3. The frequency of grooming/cutting-number of cuttings per week and how many passes per cutting.
4. The blade spacing on the grooming reel.
5. The height-of-cut.
6. The grooming depth.
7. The type of grass on the green.
8. The amount of time that a grooming reel has been in use on a particular turf area.
9. The amount of traffic on the turf.
10. The overall turf management program (e.g., irrigation, fertilizing, weed control, coring, over-seeding, disease control, sand dressing, and pest control).
11. Stress periods for turf (e.g., high temperatures, high humidity, and unusually high traffic).

Grooming Reel Mechanical Problems

Problem	Possible Causes	Correction
Groomer not engaged.	Groomer drive gears are worn or damaged.	Inspect groomer drive assembly and replace damaged drive components.
The turf is damaged or has uneven grooming.	The groomer is set too aggressively.	Refer to groomer Installation Instructions for groomer set-up information.
	The grooming reel blades are bent, damaged or missing.	Repair or replace blades if necessary.
	The grooming reel shaft is bent or damaged.	Replace grooming reel shaft.
	Grooming depth is not equal on both ends of grooming reel.	Adjust depth if necessary. Check and adjust cutting unit set up (level bed knife to reel, set height-of-cut, etc.).



Traction and Reel Drive Systems

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General Information

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

Disengaging The Drum Drive From Transmission

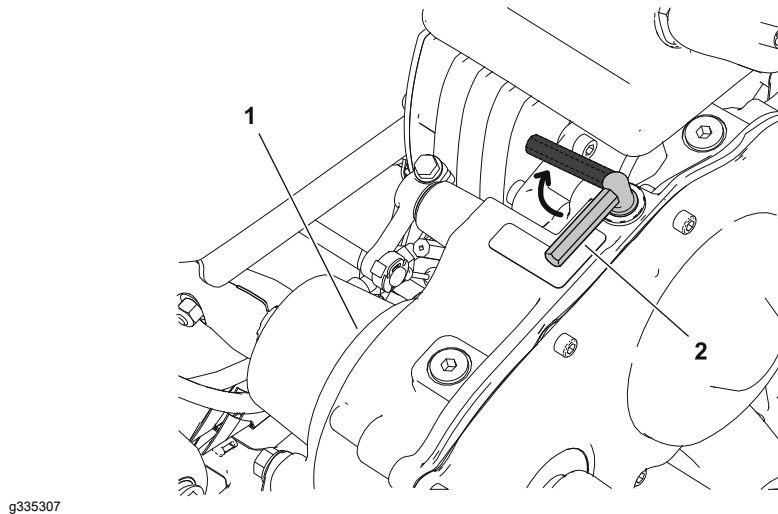


Figure 11

1. Transmission gear box assembly
2. Traction engage/disengage lever

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

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

Adjustments

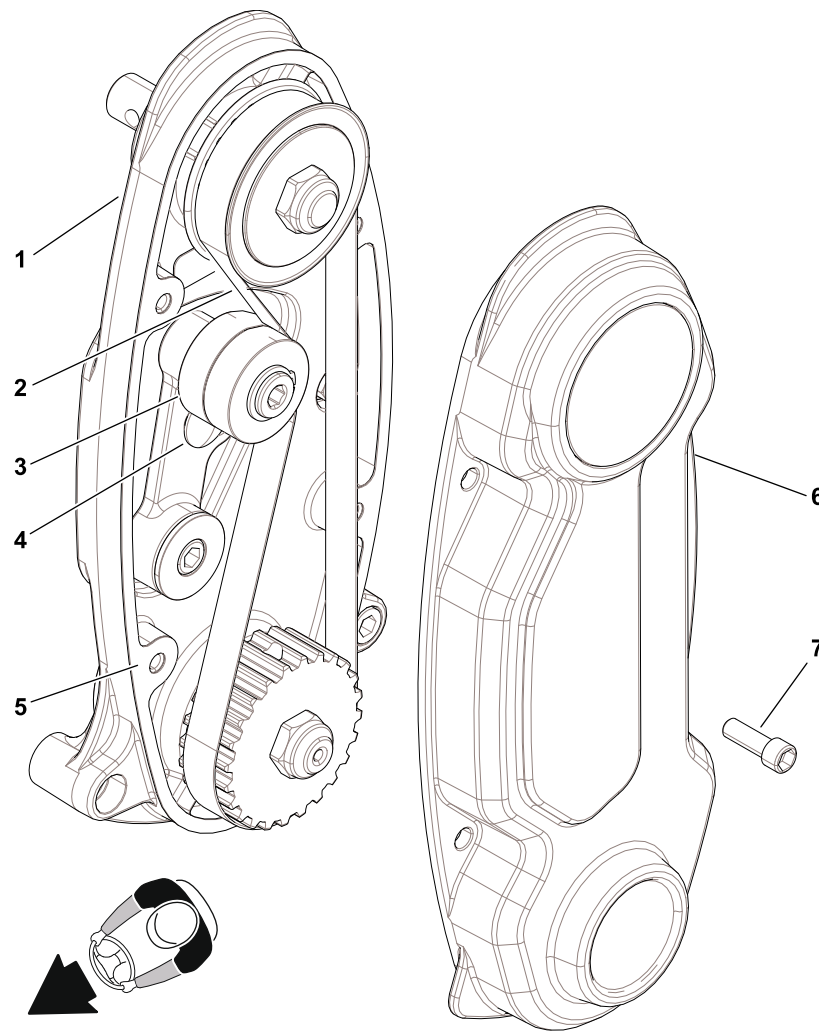


Figure 12

- | | | |
|----------------------------|---------------------|-------------------------------|
| 1. Reel drive box assembly | 4. Carriage bolt | 7. Socket head screw (4 each) |
| 2. Reel belt | 5. Bolt Gasket | |
| 3. Idler arm | 6. Reel drive cover | |

Adjusting the Reel Drive Belt

1. Park the machine on a level surface. Disconnect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).
2. Remove the 4 socket head screws (7) that secures the reel drive cover (6) to the reel drive assembly (1) and remove the reel drive cover to expose the reel drive belt (2).
3. Check the reel belt (item 2 in [Figure 12](#)) tension by depressing at mid span between pulleys with **18 to 22 N (4 to 5 lbs)** of force. The belt should deflect **6.35 mm (0.25 inch)**. If deflection is incorrect, proceed to next step. If deflection is correct, continue operation.

Adjusting the Reel Drive Belt (continued)

4. Adjust belt (2) tension as follows:

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



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

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

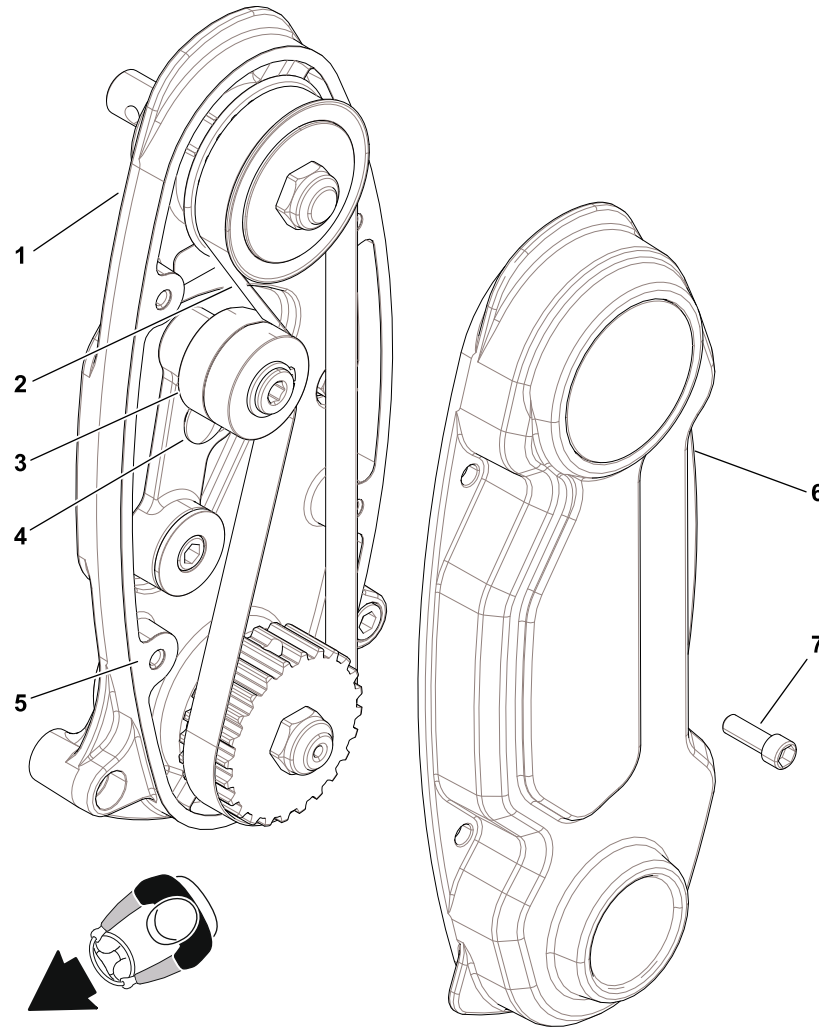


D. Torque tighten the socket head screws to **1.7 to 4.5 N·m (15 to 40 in-lb)**. Use an alternation pattern and torque tighten the socket head screws to **9.6 to 10.7 N·m (85 to 95 in-lb)**.

5. Connect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).

Service and Repairs

Reel Drive Belt



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Figure 13

- | | | |
|----------------------------|---------------------|-------------------------------|
| 1. Reel drive box assembly | 4. Carriage bolt | 7. Socket head screw (4 each) |
| 2. Reel belt | 5. Bolt Gasket | |
| 3. Idler arm | 6. Reel drive cover | |

The greensmaster machines use a positive drive belt on the right side of the machine to operate the cutting unit.

Removing the Reel Drive Belt

Note: Refer to [Figure 13](#) during this procedure.

1. Park the machine on a level surface. Disconnect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).
2. Remove the 4 socket head screws (7) that secures the reel drive cover (6) to reel drive assembly (1) and remove the reel drive cover to expose the reel drive belt (2).
3. Remove and inspect the reel drive gasket (5) from the reel drive assembly (1). Discard the reel drive gasket (5), if damaged.
4. Loosen the nut of carriage bolt (4) and rotate the idler arm (3) to release the tension on the reel drive belt (2).

Removing the Reel Drive Belt (continued)

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

Installing the Reel Drive Belt

1. Ensure that the carriage bolt (4) is loose enough to move the idler arm (3) freely.
2. Place the new drive belt (2) onto the pulleys.
3. Adjust the reel belt tension; refer to [Adjusting the Reel Drive Belt \(page 4–3\)](#).
4. Ensure that the reel drive gasket (5) is in position and install the reel drive cover (6) to the reel drive assembly (1) and secure with the 4 socket head screws (7).



5. Torque tighten the socket head screws to **1.7 to 4.5 N·m (15 to 40 in-lb)**. Use an alternation pattern and torque tighten the socket head screws to **9.6 to 10.7 N·m (85 to 95 in-lb)**.
6. Connect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).

Reel Drive Assembly

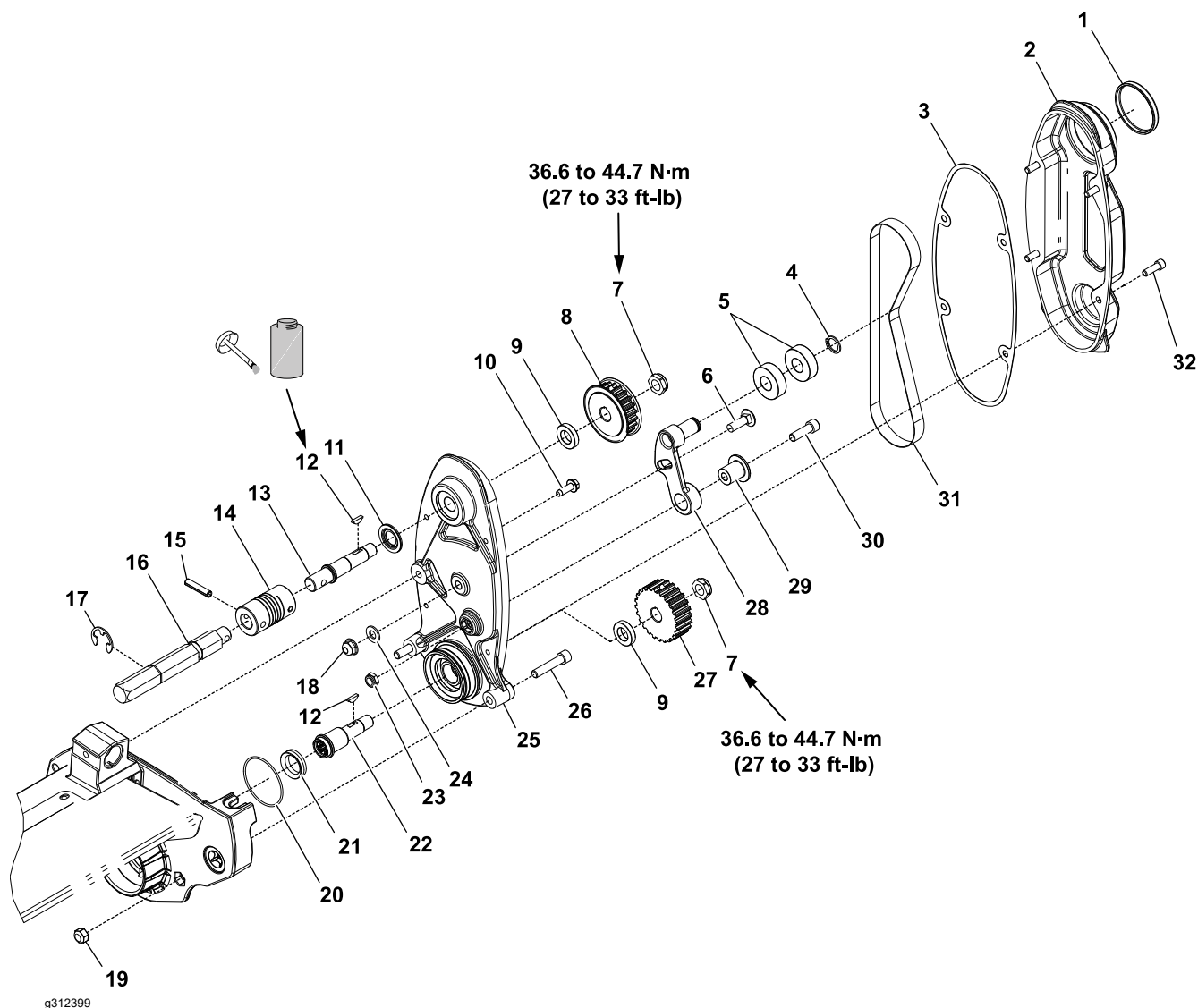


Figure 14

- | | | |
|--------------------------------|-------------------------|--------------------------------|
| 1. Expansion plug | 12. Hipro key | 23. Nut |
| 2. Reel drive cover | 13. Reel shaft-driver | 24. Washer |
| 3. Reel drive gasket | 14. Helical coupling | 25. Reel drive housing |
| 4. Retaining ring | 15. Spring pin (2 each) | 26. Socket head screw (2 each) |
| 5. Ball bearing (2 each) | 16. Coupler shaft | 27. Reel pulley - 24 tooth |
| 6. Carriage bolt | 17. Snap ring | 28. Idler arm |
| 7. Lock nut | 18. Nut | 29. Idler bushing |
| 8. Reel pulley - 22 tooth | 19. Nut | 30. Socket head screw |
| 9. Reel pulley spacer (2 each) | 20. O-ring | 31. Reel belt |
| 10. Bolt | 21. V-ring seal | 32. Socket head screw (4 each) |
| 11. Bearing shield | 22. Reel shaft-driven | |

Removing the Reel Drive Assembly

Note: Refer to [Figure 14](#) during this procedure.

1. Park the machine on a level surface. Disconnect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).
2. Remove the cutting unit from the machine; refer to *Operator's Manual*.

Removing the Reel Drive Assembly (continued)

3. Remove the reel drive belt; refer to [Removing the Reel Drive Belt \(page 4–5\)](#).
4. Remove and discard the reel drive gasket (3) from the housing (25).
5. If necessary remove the expansion plug (1) from the reel drive cover (2).
6. Remove the nuts (19), socket head screws (26) and bolt (10) that secures the reel drive housing (25) to the cutting unit.
7. Remove the reel drive housing assembly from the cutting unit.
8. Remove the V-ring seal (21) from the reel shaft driven (22).
9. Remove the nut (18) and washer (24) from the reel drive housing (25) and carriage bolt (6) from the idler arm (28).
10. Remove the socket head screw (30) that secures the idler arm (28) to the reel drive housing (25).
11. If necessary, remove the idler bushing (29) from the idler arm (28).
12. Remove the retaining ring (4) and use a press to remove the 2 ball bearings (5) from the idler arm (28). Discard the ball bearings after removal.
13. Remove the lock nut (7), reel pulley (27), hipro key (12) and spacer (9) from the reel shaft driven (22).
14. Slide and remove the reel shaft driven (22) from the reel drive housing (25).
15. Remove the locknut (7), reel pulley (8), hipro key (12) and spacer (9) from the reel shaft driver (13).
16. Slide and remove the reel shaft driver (13), helical coupling (14) and coupler shaft (16) from the reel drive housing (25).
17. Remove and discard the bearing shield (11) from the reel drive housing (25).
18. Remove and discard the O-ring (20) from the reel drive housing (25).

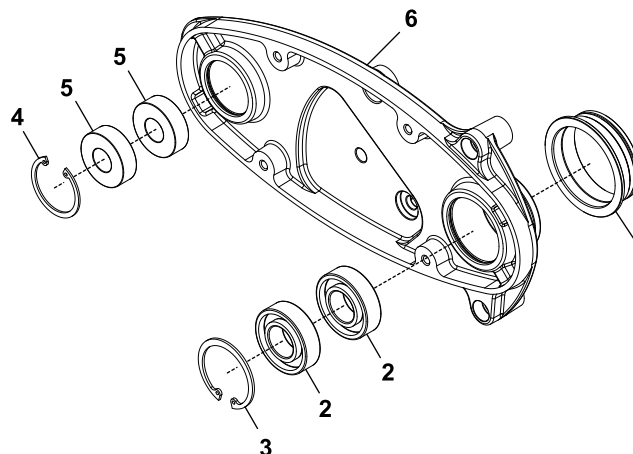


Figure 15

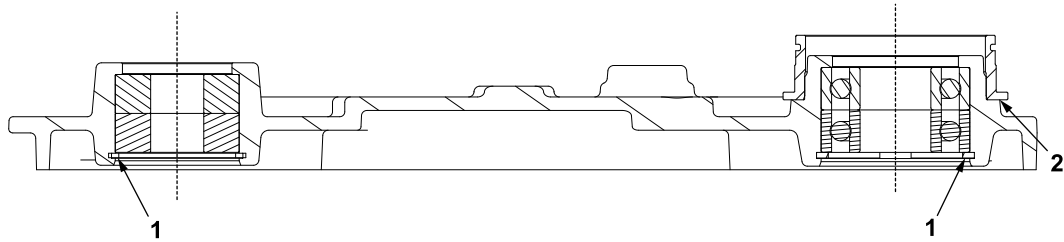
- | | |
|-------------------|-----------------------|
| 1. Pivot sleeve | 4. Retaining ring |
| 2. Ball bearing | 5. Ball bearing |
| 3. Retaining ring | 6. Reel drive housing |

19. If necessary, remove the retaining rings (3 and 4) from the reel drive housing (6).
20. Use a press to remove the 4 ball bearings (2 and 5) from the reel drive housing (6). Discard the ball bearings after removal.

Installing the Reel Drive Assembly

Note: Refer to [Figure 14](#) during the procedure.

1. Use a press to install the 4 ball bearings (items 2 and 5 in [Figure 15](#)) into the reel drive housing (6).
2. Secure the ball bearings with 2 retaining rings (item 3 and 4 in [Figure 15](#)) into the reel drive housing (6).



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Figure 16

1. Retaining ring must be fully seated

2. Press sleeve to shoulder

3. Install the bearing shield (11) into the reel drive housing (25).

Note: Make sure that the carpet side of the bearing shield (11) is facing towards the bearing.

4. Slide the reel shaft driver (13) into the reel drive housing (25).
5. Slide the spacer (9) into the reel drive housing (25).
6. Install the hipro key (12) onto the reel shaft driver (13). Apply anti-seize lubricant on top of the key.
7. Install the reel pulley (8) onto the reel shaft driver (13). Secure the reel pulley (8) with the lock nut (7).



8. Torque tighten the lock nut to **36.6 to 44.7 N·m (27 to 33 ft-lb)**.

9. If removed, apply a coat of grease to the new O-ring (20) and install onto the pivot sleeve.
10. Pack the internal splines of the reel shaft driven (22) with grease. Slide the reel shaft driven (22) into the reel drive housing (25).
11. Slide the spacer (9) into the reel drive housing (25).
12. Install the hipro key (12) onto the reel shaft driven (22). Apply anti-seize lubricant on top of the key.
13. Install the reel pulley (27) onto the reel shaft driven (22). Secure the reel pulley (27) with the lock nut (7).



14. Torque tighten the lock nut to **36.6 to 44.7 N·m (27 to 33 ft-lb)**.
15. If removed, install the bushing (29) into the idler arm (28).
16. If removed, use a press to install the 2 ball bearings (5) onto the idler arm (28) and secure the ball bearings with a retaining ring (4).
17. Install and secure the idler arm (28) into the reel drive housing (25) with socket head screw (30) and nut (23).
18. Install the carriage bolt (6), washer (24) and nut (18) to the idler arm (28) and reel drive housing (25). Do not tighten the nut (18).
19. Place the V-ring seal (21) into the reel drive housing (25).
20. Attach a new gasket (3) onto the reel drive housing (25).

Installing the Reel Drive Assembly (continued)

21. Install the reel drive housing (25) onto the cutting deck and secure with the bolt (10), 2 socket head screws (26) and nuts (19).
22. If removed, install the expansion plug (1) into the reel drive cover (2).
23. Install the reel drive belt; refer to [Installing the Reel Drive Belt \(page 4–6\)](#).
24. Adjust the reel drive belt; refer to [Adjusting the Reel Drive Belt \(page 4–3\)](#).
25. Install the cutting unit onto the machine; refer to the *Operator's Manual*.
26. Connect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).

Drum Drive Gear Box Assembly

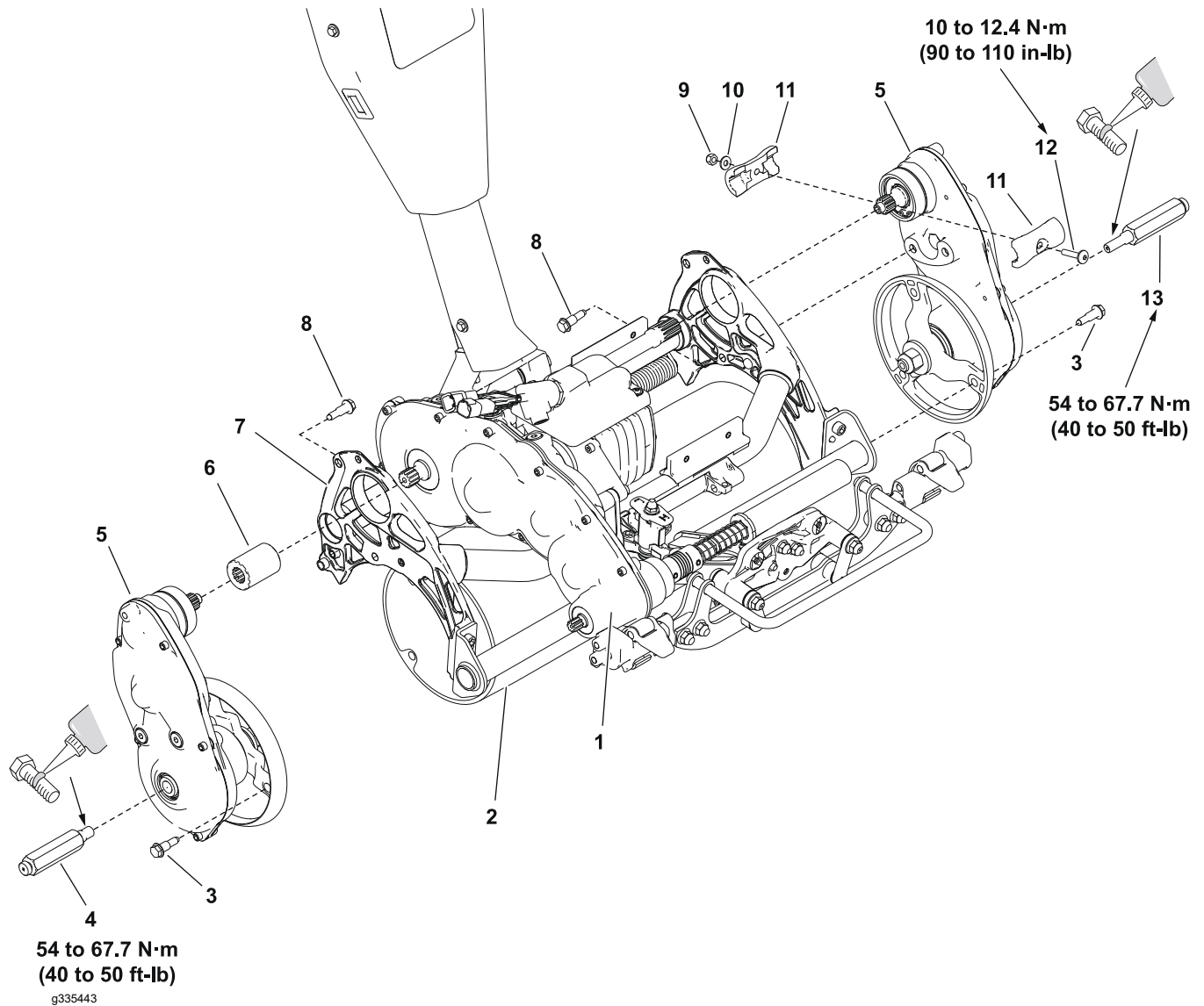


Figure 17

- | | | |
|-----------------------------------|-------------------|---------------------|
| 1. Transmission gear box assembly | 6. Drive tube | 11. Splined coupler |
| 2. Traction drum | 7. Frame assembly | 12. Truss screw |
| 3. Shoulder bolt (3 each) | 8. Shoulder bolt | 13. LH hex shaft |
| 4. RH hex shaft | 9. Nut | |
| 5. Drum drive gear box assembly | 10. Washer | |

Removing the Drum Drive Gear Box Assembly

Note: Refer to [Figure 17](#) during this procedure.

1. Park the machine on a level surface. Disconnect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).
2. Remove the transport wheel if attached; refer to [Removing the Transport Wheel \(page 6–22\)](#).

Note: Support the machine on kickstand during this operation.

3. Move the traction engage/disengage lever to the disengage position to remove torque from the drum drive gears.

Removing the Drum Drive Gear Box Assembly (continued)

4. Remove the shoulder bolt (8) that secures the RH drum drive gear box assembly (5) to the frame assembly (7).
5. Remove the 3 shoulder bolts (3) that secures the RH drum drive gear box assembly (5) to the traction drum (2). Remove the RH drum drive gear box assembly from the frame assembly. Support the drum assembly.
6. If necessary, slide and remove the drive tube (6) from the transmission gear box assembly (1).
7. If necessary, remove the RH hexagonal shaft (4) from the RH drum drive gear box assembly (5).
8. Remove the truss screw (12), nut (9) and washer (11) that secures the 2 splined couplers (11) to the transmission gear box assembly (1) and LH drum drive gear box assembly (5).
9. Remove the shoulder bolt (8) that secures the LH drum drive gear box assembly (5) to the frame assembly (7).
10. Remove the 3 shoulder bolts (3) that secures the LH drum drive gear box assembly (5) to the traction drum (2). Remove the LH drum drive gear box assembly from the frame assembly. Support the drum assembly.
11. If necessary, remove the LH hexagonal shaft (13) from the LH drum drive gear box assembly (5).

Disassembly of Drum Drive Gear Box Assembly

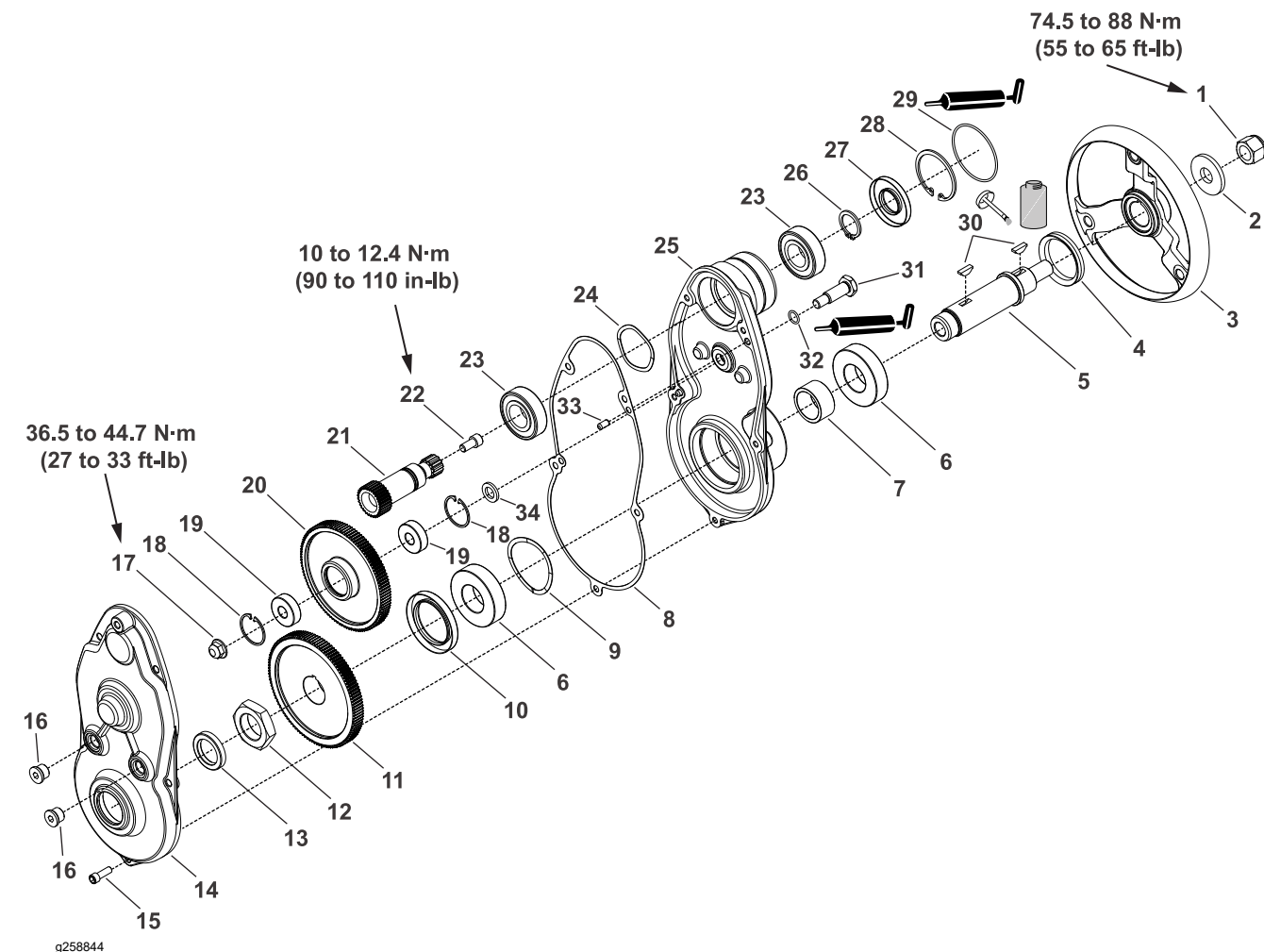


Figure 18

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

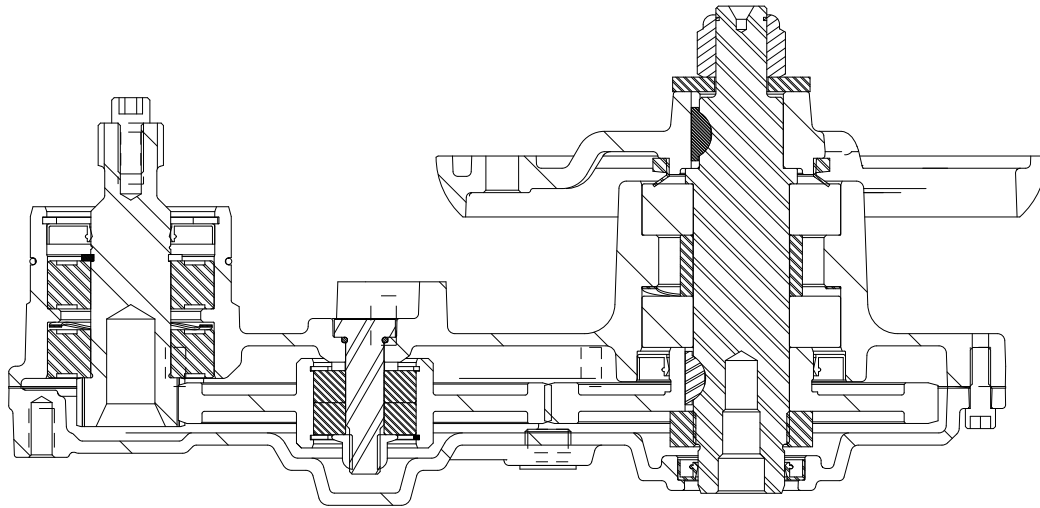
Note: Refer to [Figure 18](#) during this procedure.

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

Disassembly of Drum Drive Gear Box Assembly (continued)

5. Remove the nut (12) that secures the spur gear (11) to the drum drive shaft (5). Slide and remove the spur gear (11) from the drum drive shaft (5). Locate and retrieve the key (30) from the drum drive shaft (5).
6. Remove the nut (1) and washer (2) that secures the outer drum hub (3) to the drum drive shaft (5). Slide and remove the outer drum hub (3) and V-ring seal (4) from the drum drive shaft (5). Locate and retrieve the key (30) from the drum drive shaft (5).
7. If the ball bearings (6) are to be removed, use a press to remove the oil seal (10), ball bearings (6), bearing spacer (7), spring washer (9) and drum drive shaft (5) from the drum drive housing (25). Discard the ball bearings after removal.
8. Remove the nut (17) and bearing pin (31) that secures the spur gear (20) to the drum drive housing (25).
9. Remove the spur gear (20) and bearing spacer (34) from the drum drive housing (25).
10. Remove and discard the O-ring (32) from the bearing pin (31).
11. If the spur gear bearings (19) are to be removed, remove the retaining rings (18) and use a press to remove the ball bearings (19). Discard the bearings after removal.
12. Remove the retaining ring (28) and oil seal (27) from the drum drive housing (25). Discard the oil seal (27). Remove the retaining ring (26) from the spur gear (21).
13. Use a press to remove ball bearings (23), spur gear (21) and wave washer (24) from the drum drive housing (25). Discard the ball bearings after removal.
14. Remove and discard the O-ring (29) from the drum drive housing (25).

Assembly of Drum Drive Gear Box Assembly



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Figure 19

1. Install the ball bearings (23), wave washer (24) and spur gear (21) to the drum drive housing (25).
Note: The outer diameter and inner diameter of the ball bearings (23) must be slip fit.
2. Install the retaining ring (26) to the spur gear (21). Apply a light coat of oil to the oil seal (27). Install the oil seal (27) and retaining ring (28) to the drum driving housing (25).
3. Use a press to install the ball bearings (19) to the spur gear (20). Install the retaining rings (18) to spur gear (20).
Note: The inner diameter of the ball bearing (19) must be slip fit.
4. Apply a light coat of grease and install the O-ring (32) to the bearing pin (31). Install the bearing spacer (34), spur gear (20) onto the drum drive housing (25) and secure with the bearing pin (31) and nut (17).
5. Install the ball bearings (6), bearing spacer (7), spring washer (9) and drum drive shaft (5) to the drum drive housing (25).
Note: The outer diameter and inner diameter of the ball bearings (6) must be slip fit.
6. Install the V-ring seal (4) onto the drum outer hub (3). Install the key (30) to the drum drive shaft (5) and apply anti-seize lubricant at the top of the key. Slide the drum outer hub (3) to the drum drive shaft (5) and secure with the washer (2) and nut (1).
7. Install the oil seal (10) into the drum drive housing (25). Install the key (30) to the drum drive shaft (5) and apply anti-seize lubricant at the top of the key. Slide the spur gear (11) to the drum drive shaft (5) and secure with the nut (12).
8. Torque tighten the nut (17) from **36.5 to 44.7 N·m (27 to 33 ft-lb)**.
9. Hold the nut (12) and torque tighten the nut (1) from **74.5 to 88 N·m (55 to 65 ft-lb)**.
10. If removed, install the oil seal (13) to the drum drive cover (14).
11. Install the gasket (8) to the drum drive housing.



Assembly of Drum Drive Gear Box Assembly (continued)



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



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

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



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

Installing the Drum Drive Gear Box Assembly

1. If removed, apply a coat of loctite (blue) to threads of the hexagonal shaft (4 and 13). Install the hexagonal shaft (item 4 and 13 in [Figure 17](#)) to the LH and RH drum drive gear box assemblies (5). Torque tighten the hexagonal shaft to **54 to 67.7 N·m (40 to 50 ft-lb)**.
2. Apply a light coat of grease and install the O-ring (29) to the drum drive housing (25).
3. If removed, slide the drive tube (item 6 in [Figure 17](#)) onto the transmission gear box assembly (1).
4. Install the LH and RH drum drive gear box assemblies (Item 5 in [Figure 17](#)) to the frame assembly (7) and secure with the shoulder bolts (8).
5. Install the LH and RH drum drive gear box assemblies (5) to the traction drum (2) and secure with the 3 shoulder bolts (3).
6. Install the 2 splined couplers onto the transmission gear box assembly (1) and LH drum drive gear box assembly (5) and secure with the truss screw (12), washer (10) and nut (9).



7. Torque tighten the truss screw (12) to **10 to 12.4 N·m (90 to 110 in-lb)**.
8. If required, install the transport wheels; refer to [Installing the Transport Wheel \(page 6–24\)](#).
9. Connect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).

Drum Assembly

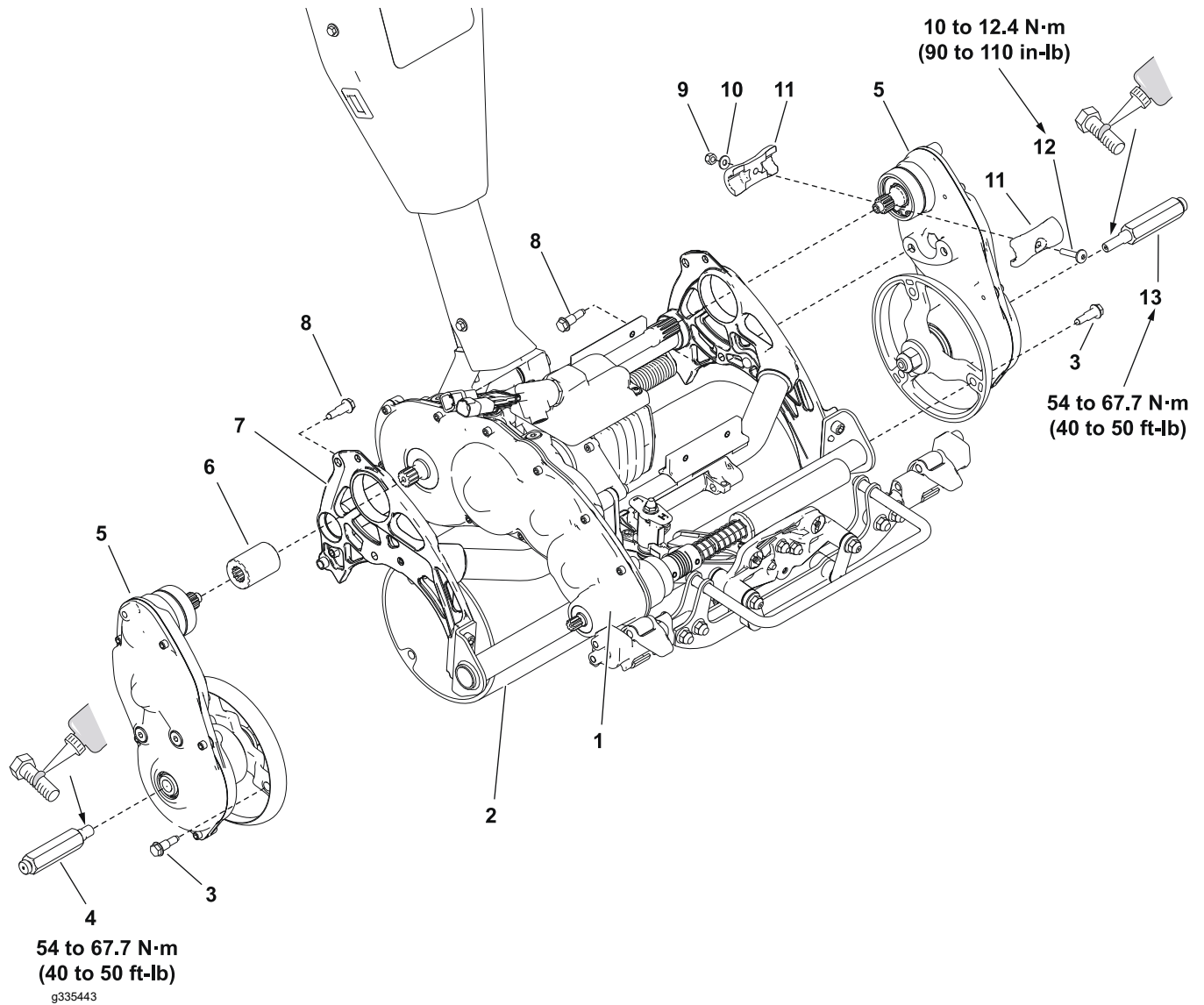


Figure 20

- | | | |
|-----------------------------------|-------------------|---------------------|
| 1. Transmission gear box assembly | 6. Drive tube | 11. Splined coupler |
| 2. Traction drum | 7. Frame assembly | 12. Truss screw |
| 3. Shoulder bolt (3 each) | 8. Shoulder bolt | 13. LH hex shaft |
| 4. RH hex shaft | 9. Nut | |
| 5. Drum drive gear box assembly | 10. Washer | |

Removing the Drum Assembly

Note: Refer to [Figure 20](#) during this procedure.

1. Park the machine on a level surface. Disconnect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).
2. Remove the LH and RH drum drive gear box assemblies (item 5 in [Figure 20](#)); refer to [Removing the Drum Drive Gear Box Assembly \(page 4–11\)](#).
3. Remove the traction drum (2) from the frame assembly (7).

Disassembly of Drum Drive Assembly

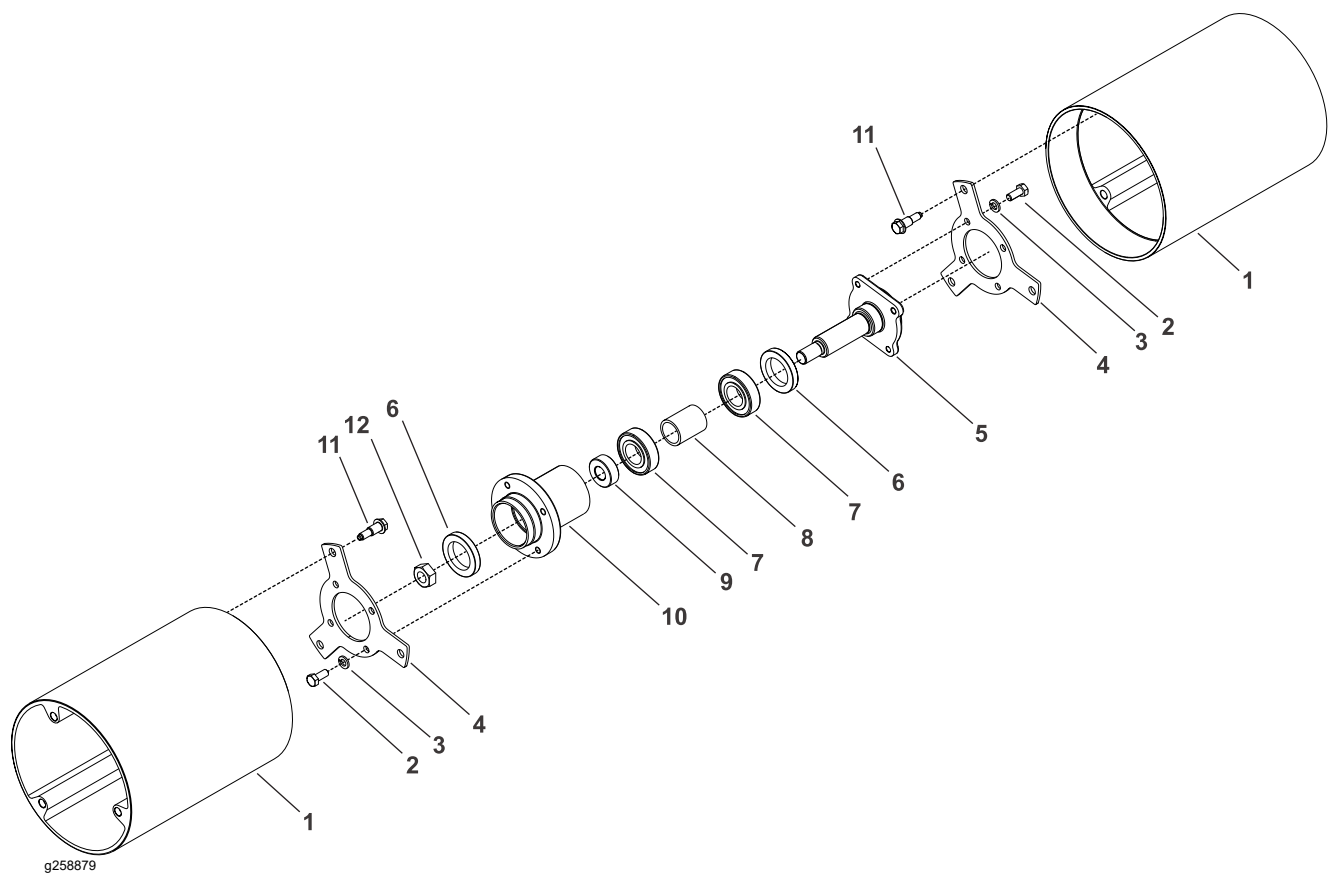


Figure 21

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

Note: Refer to [Figure 21](#) during this procedure.

1. Remove the 4 bolts (item 2 in [Figure 21](#)) and lock washers (3) that secures the drum hub plate (4) to the drum spindle (5).
2. Remove the 4 bolts (2) and lock washers (3) that secures the drum hub plate (4) to the drum hub (10).
3. Remove the shoulder bolts (11) that secures the drum hub plate (4) to the traction drum (1).
4. Remove the lock nut (12) that secures the drum spindle (5) and drum hub (10) together. Carefully slide and remove the drum spindle (5) out of the drum hub (10).
5. Remove the 2 seals (6) from the drum hub (10). Use a press to remove the 2 ball bearings (7) and a bearing spacer (8) from the drum hub (10). Discard the ball bearings.

Assembly of Drum Drive Assembly

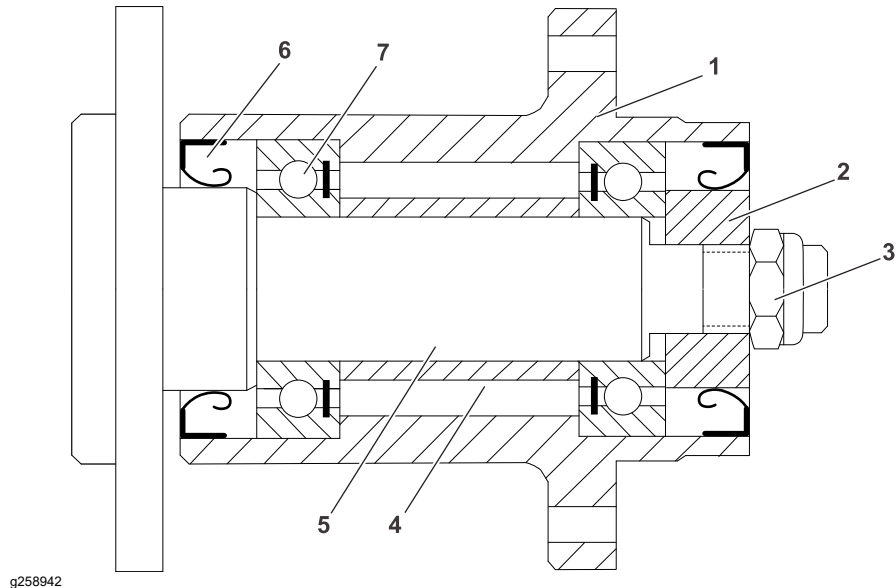


Figure 22

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

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

1. Use a press to install the bearings (7) and spacer (8) into the drum hub (10). Pack the bearings with grease. Fill outside space of the bearing with the grease.
2. Apply a coat of grease to the seals (6). Press the seals (6) into the drum hub (1) with its flat side facing outside; refer to [Figure 22](#).
3. Apply grease to the shaft of the drum spindle (5). Carefully slide the drum spindle into the drum hub bearings (7). Secure the drum spindle and drum hub (1) with a spacer (2) and lock nut (3). Make sure that the drum spindle (5) can move axially relative to the drum hub (1).

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

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

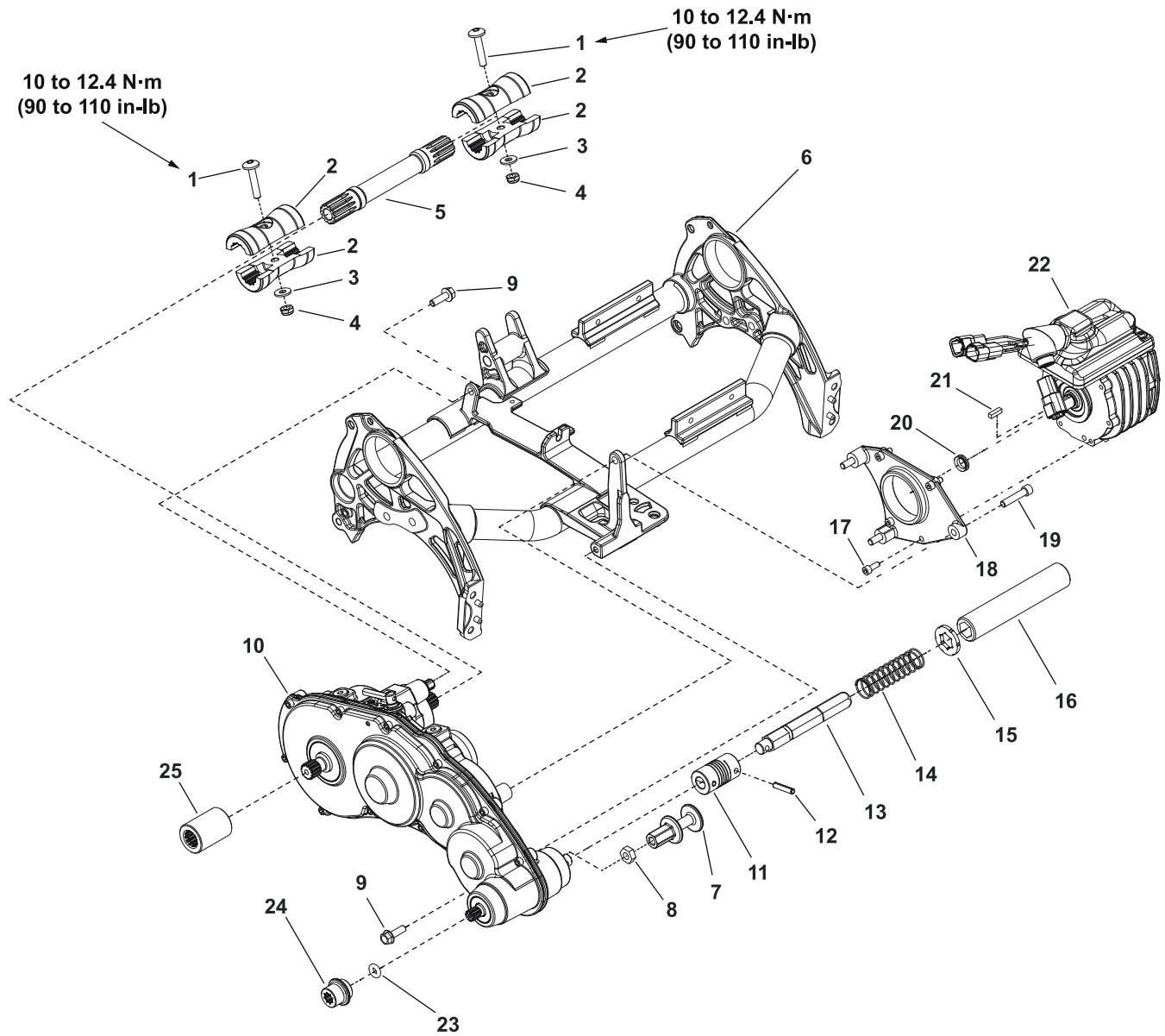
Note: The fit between the drum hub plate (item 4 in [Figure 21](#)) and drum (1) is a close tolerance and can be easily jammed. The hub can be rotated when seated properly in the bore of the drum.

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

Installing the Drum Drive Assembly

1. Park the machine on a level surface. Disconnect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).
2. Position the LH and RH drum drive gear box assembly (item 5 in [Figure 20](#)) and traction drum (2) onto the frame assembly (7).
3. Secure the LH and RH drum drive gear box assembly (5) to the traction drum (2); refer to [Installing the Drum Drive Gear Box Assembly \(page 4–16\)](#).
4. Connect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).

Transmission Gear Box Assembly



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Figure 23

- | | | |
|-----------------------------|------------------------------------|--------------------------------|
| 1. Truss screw (2 each) | 10. Transmission gear box assembly | 19. Socket head screw (3 each) |
| 2. Splined coupler (4 each) | 11. Helical coupling | 20. V-ring seal |
| 3. Washer (2 each) | 12. Spring pin (2 each) | 21. Key |
| 4. Lock nut (2 each) | 13. Coupler shaft | 22. Electric motor |
| 5. Drive shaft | 14. Compression Spring | 23. O-ring |
| 6. Frame assembly | 15. Collar lock | 24. Reel drive coupling |
| 7. Slide adaptor | 16. Hex tube | 25. Drive tube |
| 8. Jam nut | 17. Socket head screw (4 each) | |
| 9. Bolt (2 each) | 18. Motor adaptor | |

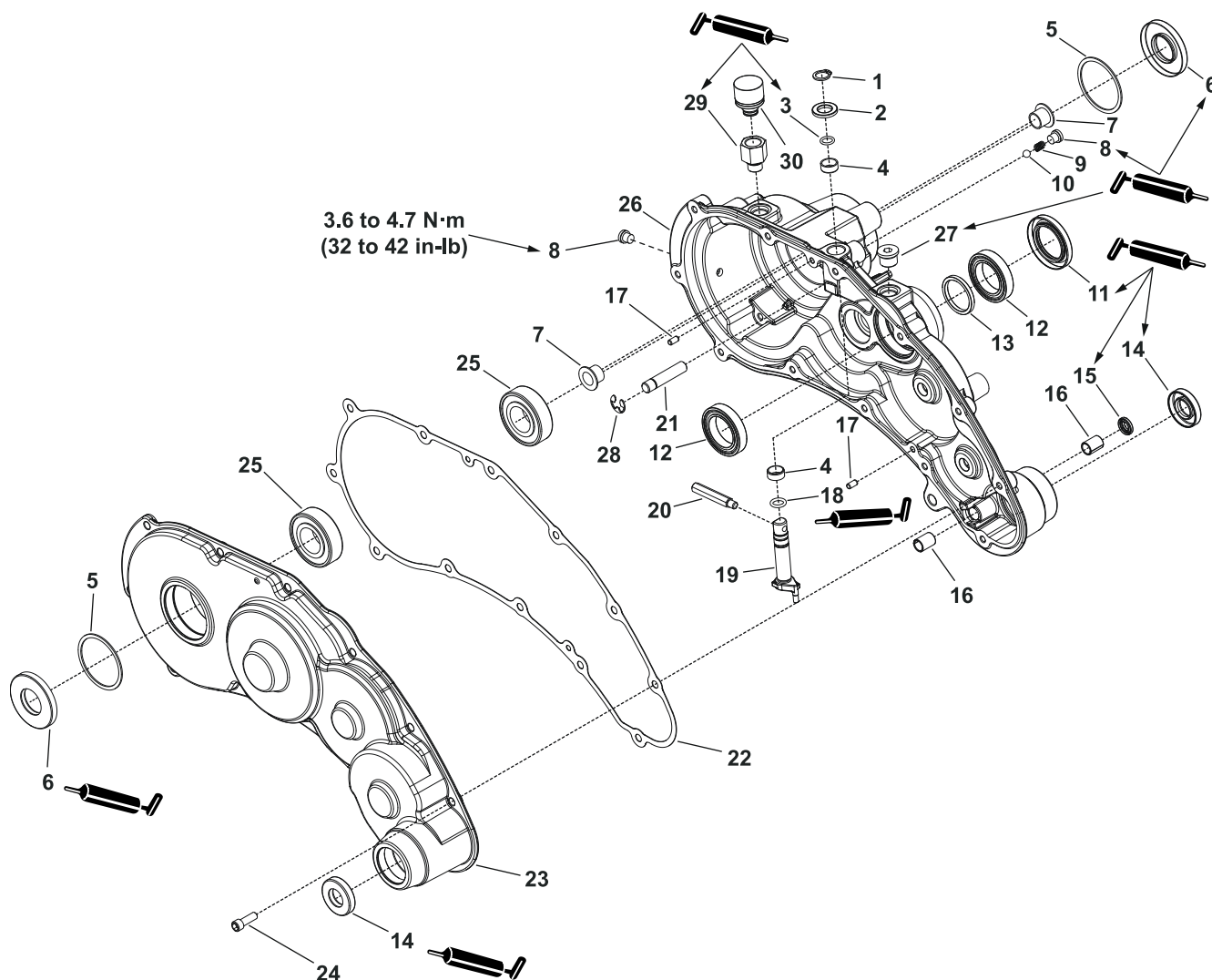
Removal of transmission gear box assembly is necessary in order to service the internal components.

Removing the Transmission Gear Box Assembly

Note: Refer to [Figure 23](#) during this procedure.

1. Park the machine on a level surface. Disconnect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).
2. Disconnect the brake cable; refer to [Removing the Brake Cable \(page 6–4\)](#).
3. Disconnect the reel cable; refer to [Removing the Reel Cable \(page 6–7\)](#).
4. Slide the collar lock (15) into the coupler shaft groove (13).
5. Slide the hex tube (16) to the coupler shaft (13) and disconnect the cutting unit from the transmission gear box assembly.
6. Remove the nuts (4), washers (3) and truss screws (1) that secures the splined couplers (2) to the drive shaft (5). Remove the splined couplers from the drive shaft.
7. Remove the socket head screw (19) that secures the motor adaptor (18) and transmission gear box assembly (10) to the frame assembly (6).
8. Remove the two flange head bolts (9) that secures the transmission gear box assembly (10) to the frame assembly (6). Remove the transmission gear box assembly with electric motor (22) from the frame assembly (6).
9. Remove the two socket head screws (19) that secures the motor adaptor (18) to the transmission gear box assembly (10). Remove the motor adaptor (18) and electric motor (22) from the transmission gear box assembly.

Disassembling the Transmission Gear Box Assembly



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Figure 24

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

Note: Refer to [Figure 24](#) during this procedure.

1. Remove the hollow hex plug (item 27 in [Figure 24](#)), breather-vent (30) and adapter-vent (29) from the transmission gear box assembly (26).
2. Remove the 12 socket head screws (24) that secures the transmission cover assembly (23) to the transmission housing assembly (26). Remove the transmission cover assembly and transmission gasket (22) from the transmission housing assembly. Discard the transmission gasket (22).

Disassembling the Transmission Gear Box Assembly (continued)

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

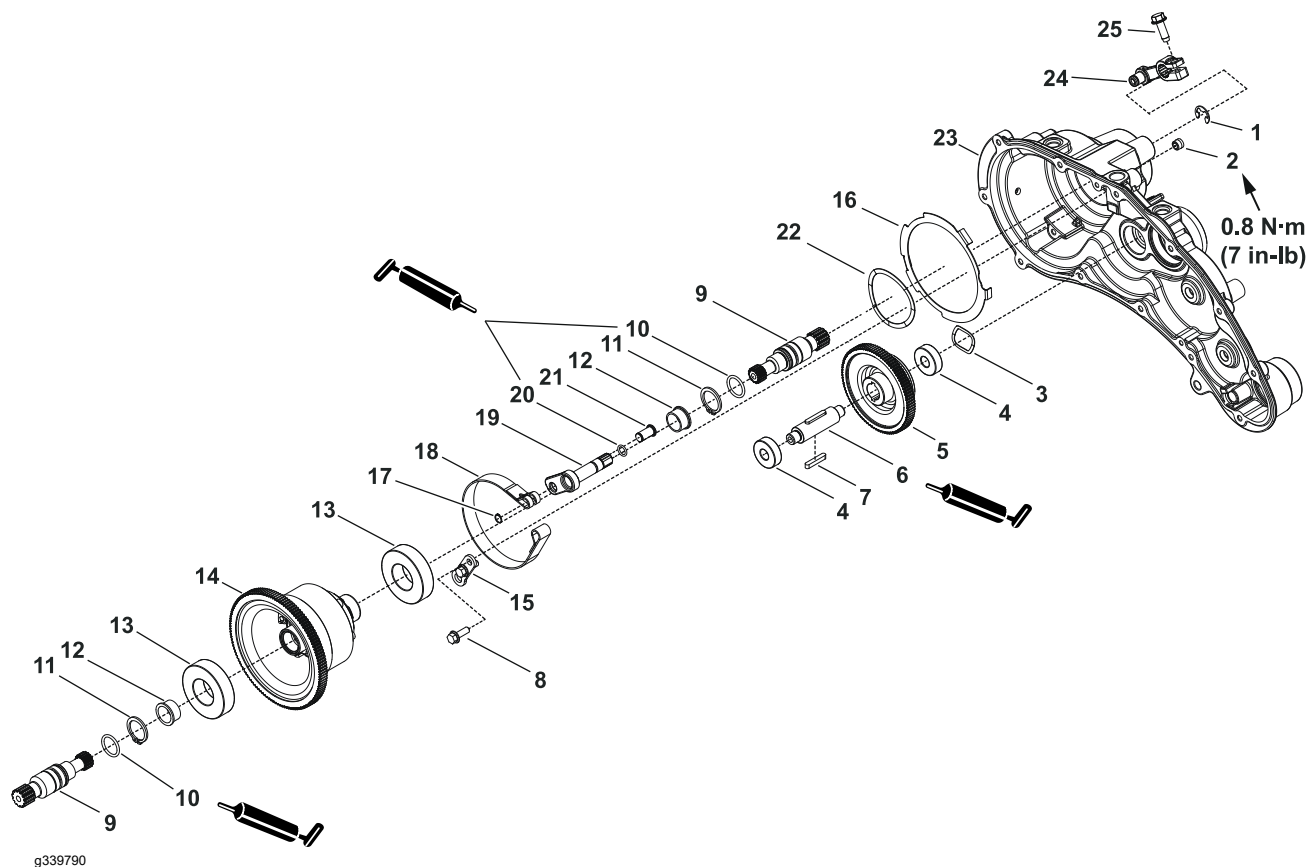


Figure 25

- | | | |
|--------------------------------|-----------------------------|-----------------------------------|
| 1. External retaining ring | 10. O-ring (2 each) | 19. Brake lever |
| 2. Pipe plug | 11. Retaining ring (2 each) | 20. O-ring |
| 3. Wave washer | 12. Flange bearing (2 each) | 21. Brake clevis pin |
| 4. Ball bearing (2 each) | 13. Ball bearing (2 each) | 22. Flat wire spring |
| 5. Neutral spur gear | 14. Differential assembly | 23. Transmission housing assembly |
| 6. Neutral slider shaft | 15. Retainer plate pin | 24. Cable brake lever |
| 7. Square key (2 each) | 16. Brake plate retainer | 25. Bolt |
| 8. Bolt (2 each) | 17. Retaining ring | |
| 9. Differential shaft (2 each) | 18. Brake band | |

4. Remove the neutral spur gear assembly (item 5 in [Figure 25](#)) and wave washer (3) from the transmission housing assembly (23).
5. Use a press to remove the ball bearings (4) from the neutral slider shaft (6). Remove the square keys (7) from the neutral slider shaft (6). Discard the ball bearings.
6. Remove the differential assembly (14) from the transmission housing assembly (23).
7. Remove the 2 differential shafts (9) from the differential housing (14). Remove the retaining rings (11) and O-rings (10) from the differential shafts (9). Discard the O-rings.
8. Use a press to remove the 2 ball bearings (13) and 2 flange bearings (12) from the differential assembly (14). Discard the ball bearings (13).

Disassembling the Transmission Gear Box Assembly (continued)

9. If necessary, disassemble the differential assembly (14); refer to [Disassembly of Differential Assembly \(page 4–33\)](#).
10. Remove the bolt (25) that secures the cable brake lever (24) onto the brake lever (19). Slide and remove the cable brake lever (24) and external retaining ring (1) from the brake lever (19).
11. Remove the 2 bolts (8) that secures the retainer plate pin (15) and brake plate retainer (16) to the transmission housing assembly (23). Remove the retainer plate (15) from the transmission housing assembly (23).
12. Slide and remove the brake lever assembly (19) from the transmission housing assembly (23). Remove the flat wire spring (22) from the transmission housing assembly (23).
13. Disassemble the brake lever assembly (19) as follows:
 - A. Remove the retaining ring (17) from the brake clevis pin (21).
 - B. Slide and remove the brake clevis pin (21) from the brake band (18) and brake lever (19).
 - C. Remove the brake lever (19) from the brake band (18).
 - D. Remove and discard the O-ring (20) from the brake lever (19).

Disassembling the Transmission Gear Box Assembly (continued)

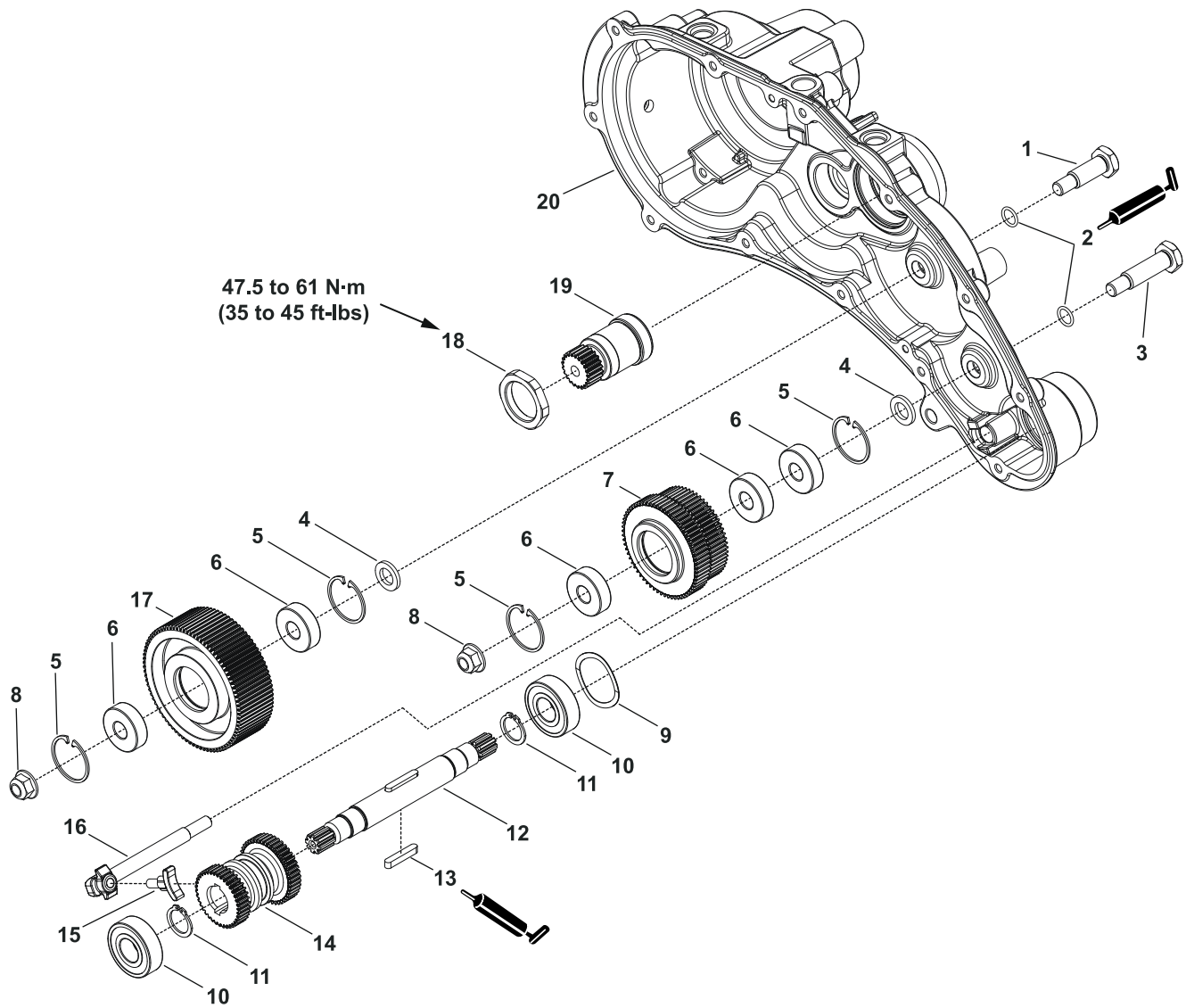


Figure 26

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

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

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

- A. Use a press to remove the ball bearings (10) from the reel drive shaft (12). Discard the bearings (10).
- B. Remove the retaining ring (11) from the reel drive shaft (12).

Disassembling the Transmission Gear Box Assembly (continued)

- C. Slide and remove the slider spur gear (14) from the reel drive shaft (12).
- D. Remove the two key squares (13) from the reel drive shaft (12).
- 16. Remove the nut (8) and long bearing pin (3) that secures the spur gear assembly (7) to the transmission housing assembly (20). Remove the spur gear (7) and bearing spacer (4) from the transmission housing assembly (20).
- 17. Remove and discard the O-ring (2) from the long bearing pin (3).
- 18. If necessary, disassemble the spur gear (7) as follows:
 - A. Remove the 2 retaining rings (5) from the spur gear (7).
 - B. Use a press and remove the 3 ball bearings (6) from the spur gear (7). Discard the ball bearings.
- 19. Remove the nut (8) and short bearing pin (1) that secures the spur gear assembly (17) to the transmission housing assembly (20). Remove the spur gear (17) and bearing spacer (4) from the transmission housing assembly (20).
- 20. Remove and discard the O-ring (2) from the short bearing pin (1).
- 21. If necessary, disassemble the spur gear (17) as follows:
 - A. Remove the 2 retaining rings (5) from the spur gear (17).
 - B. Use a press and remove the 2 ball bearings (6) from the spur gear (17). Discard the ball bearings (6).
- 22. Remove the thin lock nut (18) that secures the input shaft (19) to the transmission housing assembly (20). Slide and remove the input shaft.
- 23. Remove the ORB plug (item 8 in [Figure 24](#)), detent spring (9) and detent ball (10) from the transmission housing assembly (26).
- 24. Loosen and remove the groomer pin (item 20 in [Figure 24](#)) from the traction selector shaft (19).
- 25. Remove the retaining ring (item 1 in [Figure 24](#)), spacer bushing (2) and O-ring (3) from the traction selector shaft (19).
- 26. Slide and remove the traction selector shaft (item 19 in [Figure 24](#)) and O-ring (18) from the transmission housing assembly (26).
- 27. Remove oil seal (item 15 in [Figure 24](#)) and sleeve bushings (16) from the transmission housing (26). Discard the oil seal (15).
- 28. Remove the flange bushings (item 7 in [Figure 24](#)) from the transmission housing (26).
- 29. Remove the oil seals (item 6 in [Figure 24](#)), grease seals (11) and retaining ring (5) from the transmission housing (26). Discard the oil seals and grease seals.
- 30. Use a press and remove the ball bearings (items 12 and 25 in [Figure 24](#)) and spacer (13) from the transmission housing (26). Discard the ball bearings (12 and 25).

Assembling the Transmission Gear Box Assembly

1. Use a press to install the spacer (item 13 in [Figure 24](#)) and new ball bearings (12 and 25) into the transmission housing (26).
2. Install the retaining ring (item 5 in [Figure 24](#)) into the transmission housing (26).
3. Install the new grease seal (item 11 in [Figure 24](#)) into the transmission housing (26). Ensure that the seal lip is orientated toward the center of the transmission housing. Press the seal into the transmission housing bore so that the seal is flush to the edge of the transmission housing.
4. Install the new oil seal (item 6 in [Figure 24](#)) into the transmission housing. Ensure that the seal lip is orientated toward the center of the transmission housing. Press the seal into the transmission housing bore so that the seal is flush to the edge of the transmission housing.
5. Install the new oil seal (item 14 in [Figure 24](#)) into the transmission housing. Ensure that the seal lip is orientated toward the center of the transmission housing. Press the seal into the transmission housing bore so that the seal is flush to the edge of the transmission housing.
6. Press the flange bushings (item 7 in [Figure 24](#)) into the transmission housing (26).
7. Insert the sleeve bushing (Item 16 in [Figure 24](#)) into the transmission housing (26) until the sleeve bushing is flush with the transmission housing.
8. Press the oil seal (item 15 in [Figure 24](#)) into the transmission housing (26). Ensure that the oil seal lip is orientated toward the center of the transmission housing.
9. Apply a coat of grease to the O-ring seal (item 18 in [Figure 24](#)) and slide onto the groove of the traction selector shaft (19).
10. Insert the straight bushings (item 4 in [Figure 24](#)) into the transmission housing (26). Press the straight bushings into the transmission housing bore so that the bushings are recessed from the edge of the transmission housing.
11. Apply a coat of grease to the O-ring (item 18 in [Figure 24](#)) and slide onto the traction selector shaft (item 19 in [Figure 24](#)). Insert the traction selector shaft (item 19 in [Figure 24](#)) into the transmission housing (26).
12. Apply a coat of a grease to the O-ring (item 3 in [Figure 24](#)) and slide onto the groove of the traction selector shaft (19). Slide the spacer bushing (2) onto the traction selector shaft (19) and secure with a retaining ring (1).
13. Install the groomer pin (item 20 in [Figure 24](#)) onto the traction selector shaft (19).
14. Install the detent ball (item 10 in [Figure 24](#)), detent spring (9) and plug (8) into the transmission housing assembly (26).
15. Insert the input shaft (item 19 in [Figure 26](#)) into the transmission housing assembly (20) and secure with the thin lock nut (18). Torque tighten the thin lock nut to **47.5 to 61 N·m (35 to 45 ft-lbs)**.
16. Use a press to install the 2 new ball bearings (item 6 in [Figure 26](#)) into the spur gear (17) and secure with the 2 retaining rings (5).
17. Apply a coat of grease to the O-ring (item 2 in [Figure 26](#)) and slide the O-ring onto the short bearing pin (1). Install the spur gear assembly (17) and bearing spacer (4) onto the transmission housing assembly (20) and secure with the short bearing pin and nut (8).
18. Use a press to install the 3 new ball bearings (item 6 in [Figure 26](#)) into the spur gear (7) and secure with the 2 retaining rings (5).



Assembling the Transmission Gear Box Assembly (continued)

19. Apply a coat of grease to the O-ring (item 2 in [Figure 26](#)) and slide the O-ring onto the long bearing pin (3). Install the spur gear assembly (7) and bearing spacer (4) onto the transmission housing assembly (20) and secure with the long bearing pin (3) and nut (8).
20. Insert the square keys (item 13 in [Figure 26](#)) into the reel drive shaft (12) and apply a coat of grease to outside of the keys.
21. Slide the slider spur gear (item 14 in [Figure 26](#)) onto the reel drive shaft (12) and secure with the retaining rings (11). Press the new ball bearings (10) onto the reel drive shaft (12).
22. Install the wave spring (item 9 in [Figure 26](#)) and reel drive assembly (14) into the transmission housing assembly (20).
23. Insert the reel clutch shoe (item 15 in [Figure 26](#)) into the reel clutch actuator (16). Slide the reel clutch actuator (16) into the transmission housing assembly (20).
24. Assemble the brake lever assembly (item 19 in [Figure 25](#)) as follows:
 - A. Apply a coat of grease to the O-ring (item 20 in [Figure 25](#)) and slide the O-ring onto the brake lever.
 - B. Place the brake lever (item 19 in [Figure 25](#)) onto the brake band (18) and secure with the brake clevis pin (21) and retaining ring (17).
25. Slide and install the brake lever assembly (item 19 in [Figure 25](#)) into the transmission housing assembly (23).
26. If removed, insert the brake mount pin through brake band into the transmission housing assembly (item 23 in [Figure 25](#)), place the flat wire spring (22) and brake plate retainer (16) onto the transmission housing assembly.
27. Place the retainer plate pin (item 15 in [Figure 25](#)) onto the transmission housing assembly (23) and secure it with the 2 bolts (8).
28. Slide and install the external retaining ring (item 1 in [Figure 25](#)), cable brake lever (24) onto the brake lever (19) and secure it with the bolt (25).
29. If disassembled, assemble the differential assembly (item 14 in [Figure 25](#)); refer to [Assembly of Differential Assembly \(page 4–34\)](#).
30. Pack the differential assembly (item 14 in [Figure 25](#)) with grease and use a press to install the 2 ball bearing (13) and 2 flange bearings (12) into the differential assembly.
31. Apply a coat of grease to the 2 O-rings (item 10 in [Figure 25](#)) and slide the O-rings to the differential shafts (9). Install the retaining rings (11) onto the differential shaft (9).
32. Insert the 2 differential shafts (item 9 in [Figure 25](#)) into the differential housing (14).
33. Insert the differential housing assembly (item 14 in [Figure 25](#)) into the transmission housing assembly (23).
34. Insert the square keys (item 7 in [Figure 25](#)) into the neutral slider shaft (6). Apply a coat of grease to outer surface of the square keys (7).
35. Insert the neutral slider shaft (item 6 in [Figure 25](#)) into the neutral spur gear (5).
36. Use a press and insert the bearings (item 4 in [Figure 25](#)) onto the neutral slider shaft (6).

Assembling the Transmission Gear Box Assembly (continued)

37. Insert the wave washer (item 3 in [Figure 25](#)) and neutral spur gear assembly (5) into the transmission housing assembly (23). Make sure that the traction selector shaft (item 19 in [Figure 24](#)) is engaged in shift selection neutral spur gear (item 5 in [Figure 25](#)).
38. Apply a coat of grease to ORB plug (item 8 in [Figure 24](#)) and install the detent ball (10), detent spring (9) and ORB plug (8) into the transmission housing (26).



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

40. Use a press and insert the ball bearing (item 25 in [Figure 24](#)) into the transmission cover (23). Install the retaining ring (5) and oil seal (6) into the transmission cover (23).
41. Ensure that the oil seal lip is orientated toward the center of the transmission housing. Press the seal into the transmission housing bore so that the seal is flush to the edge of the transmission housing.
42. Install the oil seal (item 14 in [Figure 24](#)) into the transmission cover (23).
43. Ensure that the oil seal lip is orientated toward the center of the transmission housing. Press the seal into the transmission housing bore so that the seal is flush to the edge of the transmission housing.
44. If removed, insert the 2 dowel pins (item 17 in [Figure 24](#)) into the transmission housing assembly (26).



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

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



46. Fill the transmission gear box assembly (26) with **1 lb (16 oz)** of Mobil AFT D/M oil.
47. Apply a coat of grease to the O-rings and insert onto the hollow hex plugs. Install the hollow hex plug (item 27 in [Figure 24](#)) into the transmission gear box assembly (26).



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

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



50. Torque tighten the adapter-vent (29) from **12.4 to 14.7 N·m (110 to 130 in-lb)**.
51. Install the breather-vent (30) into the adapter-vent (29). Tighten the breather-vent (30) until the gasket contacts the adapter-vent and then tighten an additional 75° to 85° turn.

Installing the Transmission Gear Box Assembly

Note: Refer to [Figure 23](#) during this procedure.

1. Install the electric motor (22) and motor adaptor (18) onto the transmission gear box assembly (6) and secure with the two socket head screws (19).
2. Position the transmission gear box assembly (10) onto the frame assembly and secure with 2 bolts (9) and a socket head screw (19).
3. Install and adjust the slider adapter (7) until the neutral position is achieved and lock the position with jam nut (8) onto the transmission gear box assembly (10).



4. Install the splined couplers (2) to the drive shaft (5) and secure with truss screws (1), washers (3) and nuts (4). Torque tighten the truss screws to **10 to 12.4 N·m (90 to 110 in-lb)**.
5. Slide the hex tube (16) onto the reel drive box assembly and lock with collar lock (15).
6. If removed, install the reel cable; refer to [Installing the Reel Cable \(page 6–8\)](#).
7. Install the brake cable; refer to [Installing the Brake Cable \(page 6–5\)](#).
8. Connect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).

Differential Assembly

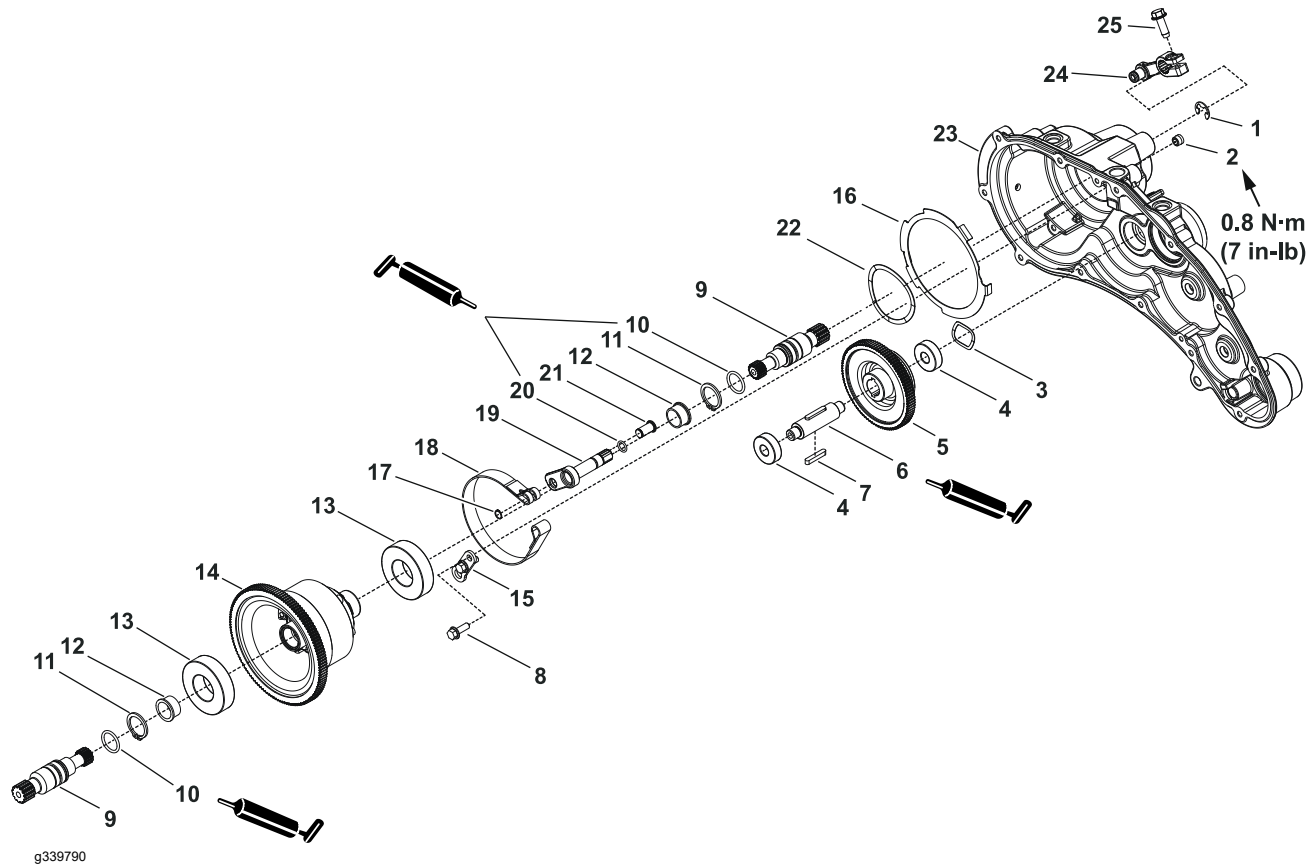


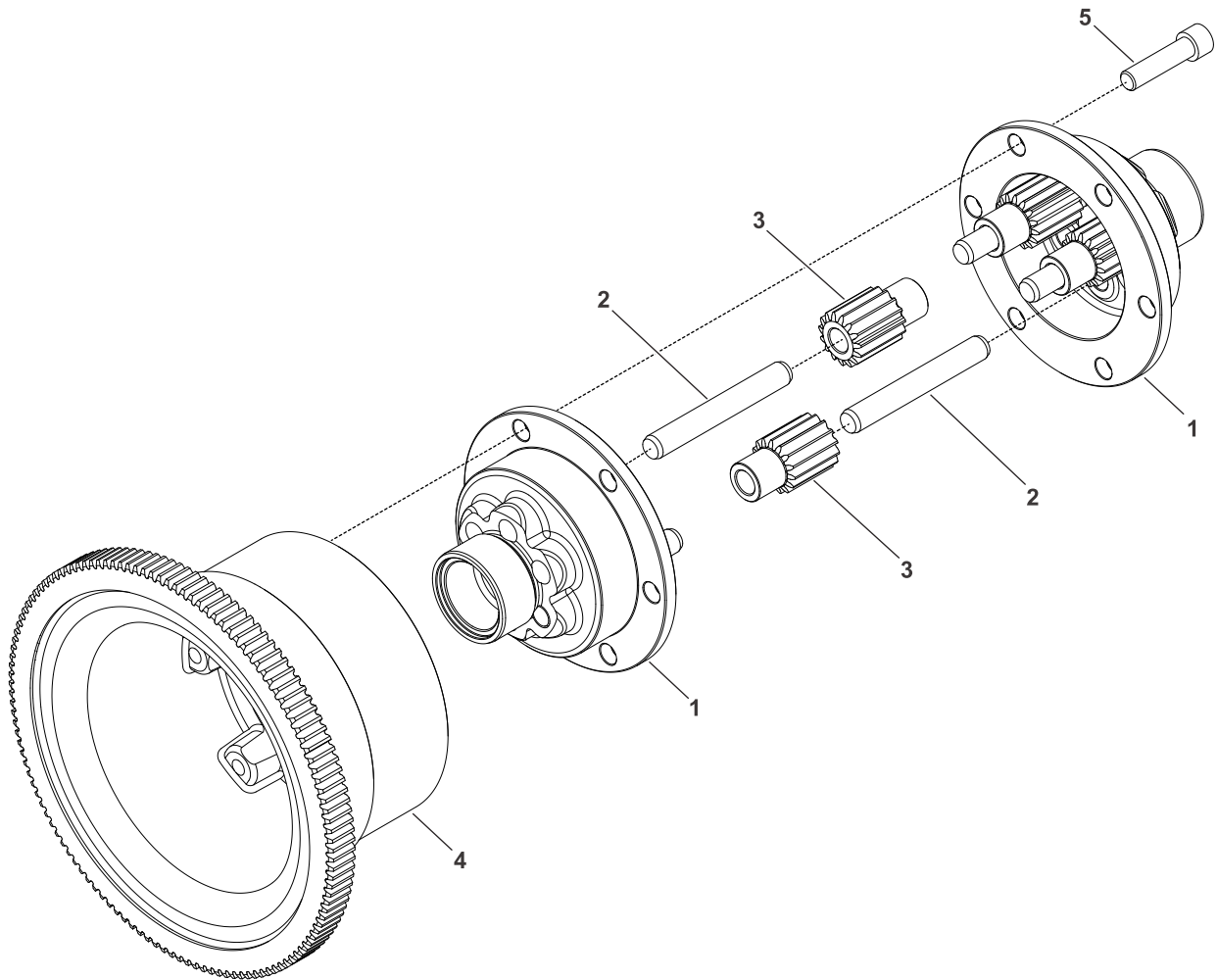
Figure 27

- | | | |
|--------------------------------|-----------------------------|-----------------------------------|
| 1. External retaining ring | 10. O-ring (2 each) | 19. Brake lever |
| 2. Pipe plug | 11. Retaining ring (2 each) | 20. O-ring |
| 3. Wave washer | 12. Flange bearing (2 each) | 21. Brake clevis pin |
| 4. Ball bearing (2 each) | 13. Ball bearing (2 each) | 22. Flat wire spring |
| 5. Neutral spur gear | 14. Differential assembly | 23. Transmission housing assembly |
| 6. Neutral slider shaft | 15. Retainer plate pin | 24. Cable brake lever |
| 7. Square key (2 each) | 16. Brake plate retainer | 25. Bolt |
| 8. Bolt (2 each) | 17. Retaining ring | |
| 9. Differential shaft (2 each) | 18. Brake band | |

Removing the Differential Assembly

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

Disassembly of Differential Assembly



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Figure 28

- | | | |
|----------------------------------|------------------------------------|-------------------------------|
| 1. Differential housing (2 each) | 3. Differential spur gear (6 each) | 5. Socket head screw (6 each) |
| 2. Differential pin (6 each) | 4. Differential gear | |

1. Remove the 6 socket head screws (item 5 in [Figure 28](#)) that secures the differential housing assembly (1) to the differential gear (4). Remove the differential gear from the differential housing assembly.
2. Place the differential housing assembly on workbench. Pull each differential housings (1) apart.
3. Use a press to remove the 6 differential pins (2) and 6 differential spur gears (3) from the differential housings (1).

Inspecting the Differential Assembly

1. Clean all the differential assembly components.
2. Inspect all the differential spur gears (3) carefully looking for chipped teeth, wear or other damage. Because gear tooth damage is rarely isolated to 1 gear, replace the gears as complete set if there is a internal damage.
3. Inspect the differential pins (2) for the scoring or wear.
4. Replace all the differential assembly components that are worn or damaged.

Assembly of Differential Assembly

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

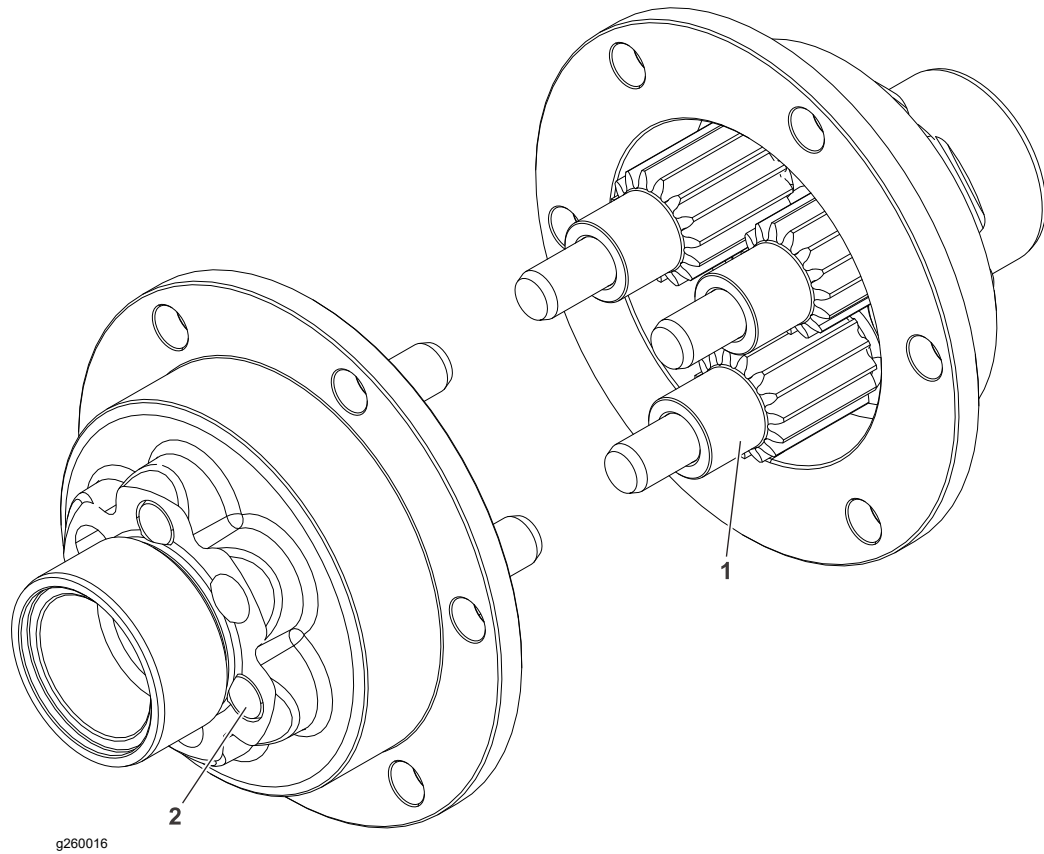


Figure 29

1. Differential spur gears with shoulder up
2. Press flush

3. The differential pins (2) must be inserted in alternate holes of the differential housing (1) and ensure that the differential pins (2) are flush to the surface of the differential housing; refer to [Figure 29](#).
4. Apply a coat of grease to the differential spur gears (3) and the differential pins (2).
5. Insert the differential spur gears (3) to the differential pins (2) by pointing the gears shoulder up.



6. Fill the differential housing assembly (1) with **0.08 lb (1.25 oz)** of grease.
7. Attach the 2 differential housings (1) to each other.

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



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

Installing the Differential Assembly

Install the differential assembly into the transmission gear box; refer to [Assembling the Transmission Gear Box Assembly \(page 4–28\)](#).



Electrical System

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General Information

The Greensmaster eFlex 1021 machine uses a 48 VDC electrical system that is an isolated circuit. The machine frame is not used for any ground connections.

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

Operator's Manual

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

Electrical Schematics and Diagrams

Refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in [Appendix A \(page A-1\)](#).

Connecting the Lithium Battery Pack



WARNING



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

- When removing or installing the battery, do not allow the battery terminals or battery cables to touch any metal parts of the machine.
- Do not allow metal tools to short between the battery terminals or battery cables and metal parts of the machine.
- Do not attach anything to the battery terminal other than the battery cable or wire harness connector that came with the product.
- Do not place anything in the battery connector other than the wire harness connector that came with the product.
- Only use the charger designed for the battery.



WARNING



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

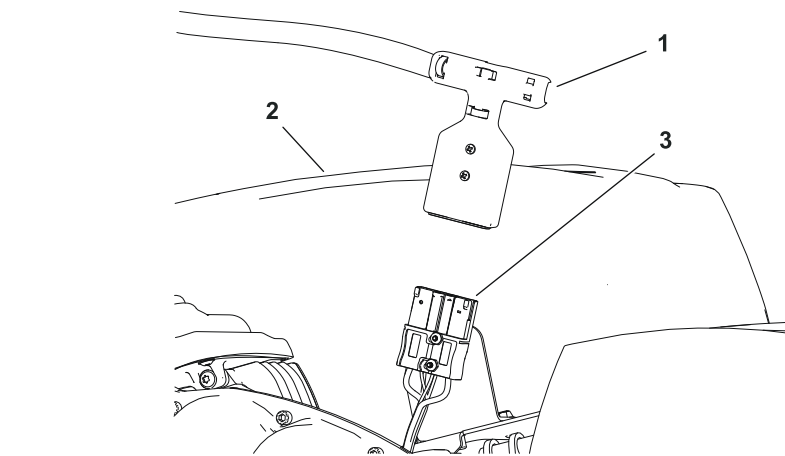


Figure 30

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

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

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

Electrical System Operation

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

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

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

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

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

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

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

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

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

Battery Charging

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

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

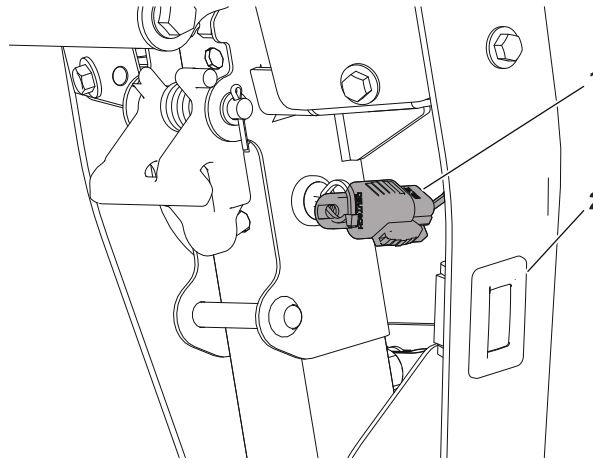
Start Process

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

Run Process

The traction bail lever controls the traction speed potentiometer. This traction speed potentiometer is used as an input by the TEC which communicates to the electric motor to engage. The motor rotation speed and traction speed is determined by the throttle potentiometer setting that is adjusted by the operator. Actual motor speed is monitored by the TEC and motor controller so that as traction load changes (e.g., moving up or down an incline) the motor can compensate as necessary.

CAN-bus Communications



g338222

Figure 31

1. Toro DIAG connector
2. Hour meter

The machine controllers communicate with each other on a Controller Area Network (CAN) bus system. Using this network allows full integration of all the different electrical components of the machine, allowing them to operate together as one. The CAN bus system reduces the number of electrical components and connections used on the machine and allows the number of wires in the wire harness to be significantly reduced.

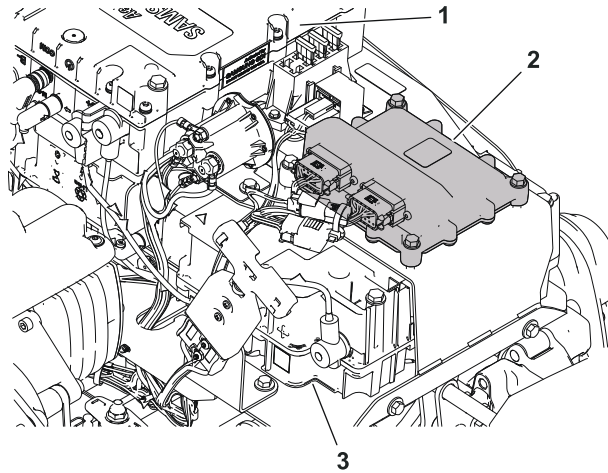
The InfoCenter, lithium-ion battery controller (BMS - Battery Management System), electric motor controller and TEC are on the CAN bus. Additional controllers may be added to the CAN bus in the future through the expansion port connector and/or the telematics connector.

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

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

The Toro DIAG electronic control diagnostics service system is available to Authorized Toro Distributors to support machine fault diagnosis and maintenance services of the machine electrical control devices. The Toro DIAG connector is located inside the upper cover assembly; refer to [Figure 31](#).

Toro Electronic Controller (TEC)



g338223

Figure 32

- | | |
|---------------------------|-------------------------|
| 1. Samsung SDI controller | 3. Lithium battery pack |
| 2. TEC | |

The Greensmaster machine use a Toro Electronic Controller (TEC) to manage the machine electrical functions. The controller is a microprocessor controlled device that senses the condition of various switches (inputs) and directs electrical power to control the appropriate machine functions (outputs) based on the inputs. The status of inputs to the controller as well as outputs from the controller can be monitored with the InfoCenter display on the console. If a problem exists that could prevent normal operation, the InfoCenter display will display an operator advisory or fault code to assist in identifying the problem.

The TEC is attached to the battery mount inside the battery cover; refer to [Figure 32](#).

IMPORTANT

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

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

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

Lithium-Ion Battery Controller (BMS)

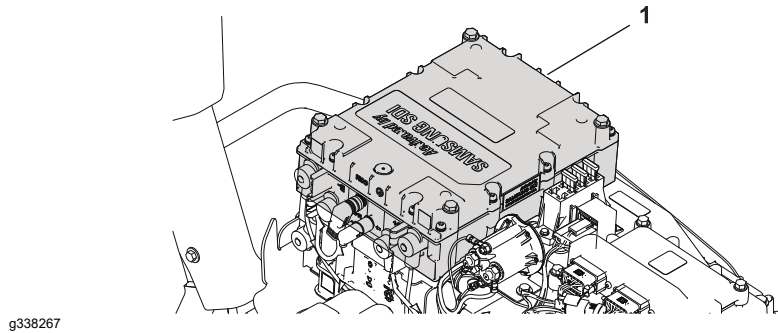


Figure 33

1. Lithium-ion battery controller

The machine uses a Lithium-ion battery controller or Battery Management System (BMS) to manage the lithium-ion battery. The lithium-ion battery communicate with the BMS through a sub-net via the battery interface harness. The battery interface harness includes a 4-pin connector at the battery and a 9-pin connector at the BMS. The BMS uses the sub-net to verify the presence and condition of the battery before allowing battery power to the machine. The BMS is also connected to the CAN bus which allows it to forward battery information to the rest of the machine. The BMS is attached to the battery mount inside the battery cover.

The Lithium-ion battery controller (BMS):

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

Note: The battery interface harness connections must be corrosion free and securely connected before machine operation can occur.

2. Protects the battery from operating (discharging and charging) outside their safe operating voltage, amperage, and temperature ranges.
3. Operates an internal contactor to connect and disconnect the battery from the machine and the battery charger.

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

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

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

Refer to [Testing the Lithium-Ion Battery Controller \(page 5–28\)](#) for more information.

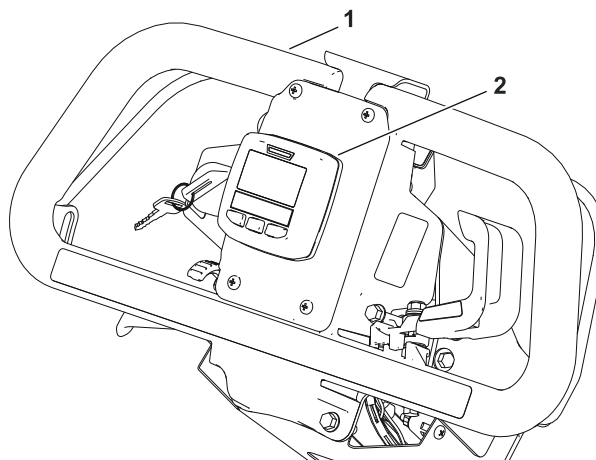
Lithium-Ion Battery Controller (BMS) (continued)

IMPORTANT

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

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

InfoCenter Display



g338445

Figure 34

1. Handle
2. InfoCenter display

The InfoCenter display used on your Greensmaster eFlex is a LCD device that is located on the handle console (Figure 34). The InfoCenter provides information to the operator during the operation of the machine, provides electrical system diagnostic assistance for the technicians, and allows inputs for the adjustable machine settings.

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

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

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

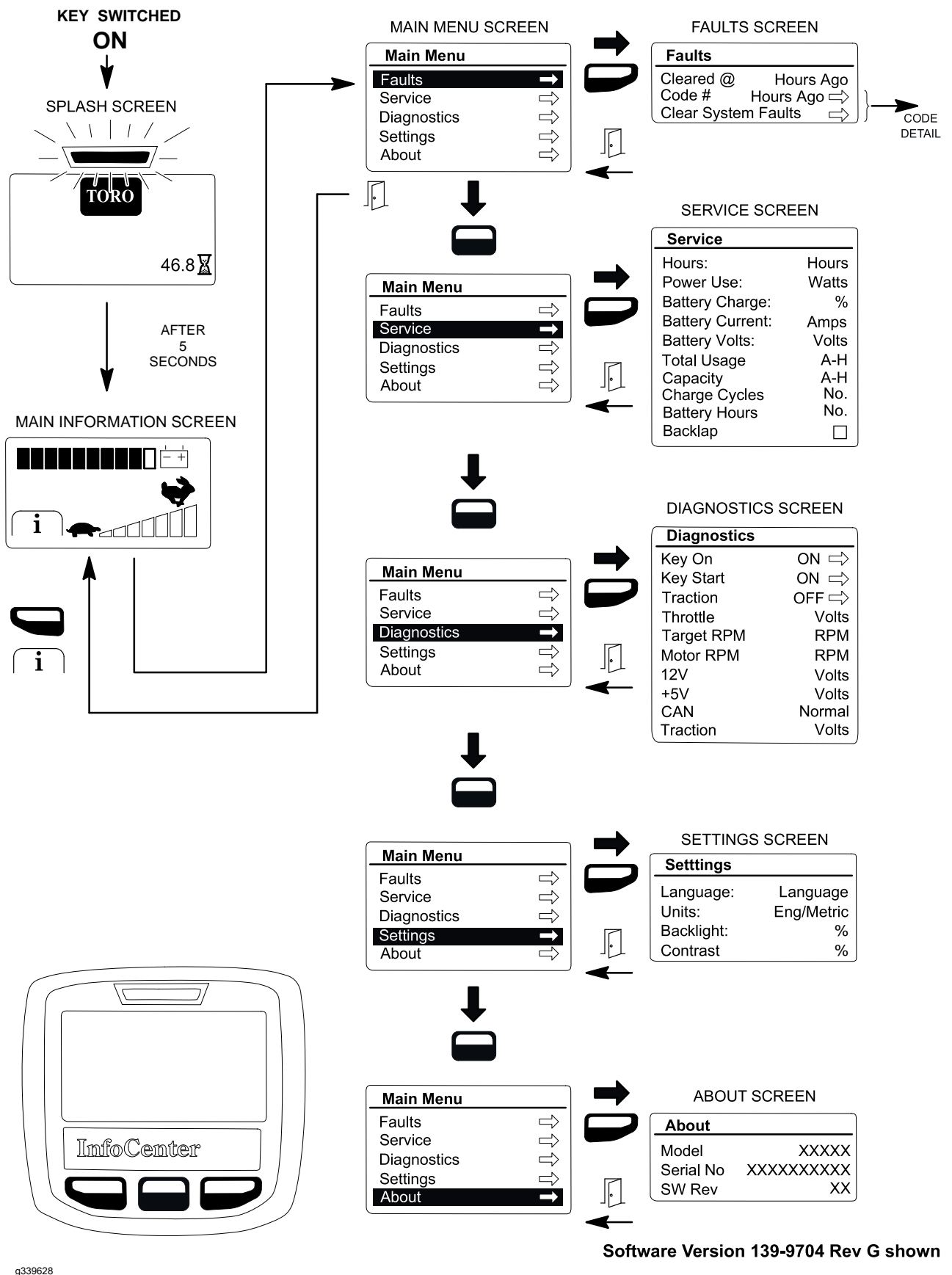
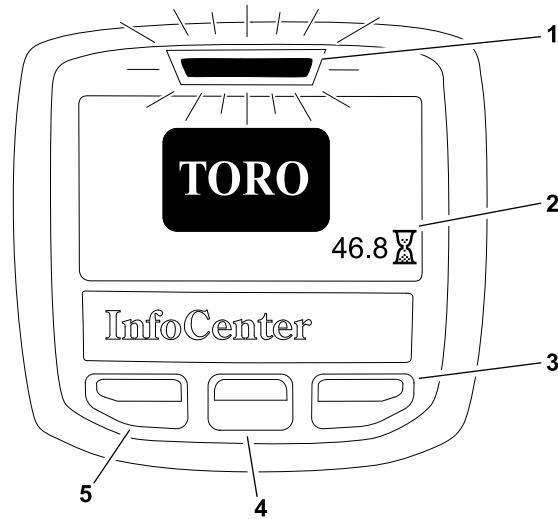


Figure 35

Splash Screen



g339634

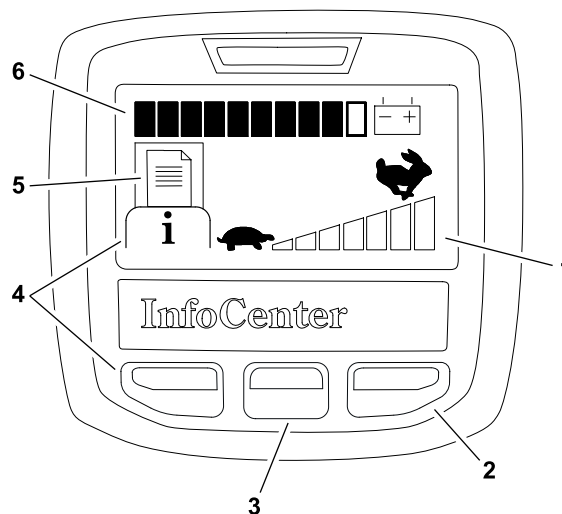
Figure 36

- | | |
|----------------------|---------------------|
| 1. Fault indicator | 4. Down button |
| 2. Hour meter | 5. Menu/back button |
| 3. Left/right button | |

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

After the splash screen has been displayed for 5 seconds, the main information screen will appear on the InfoCenter screen.

Main Information Screen



g339629

Figure 37

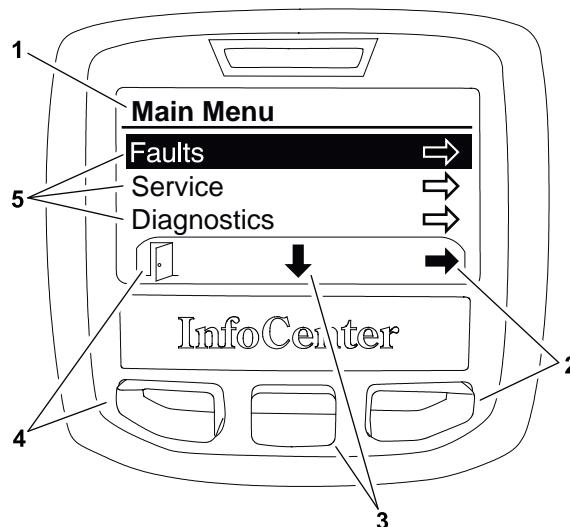
- | | |
|--------------------------|------------------------|
| 1. Speed control setting | 4. Menu/back button |
| 2. Left/right button | 5. Fault log indicator |
| 3. Down button | 6. Battery indicator |

Main Information Screen (continued)

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

- Battery charge indicator
- Speed control setting


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



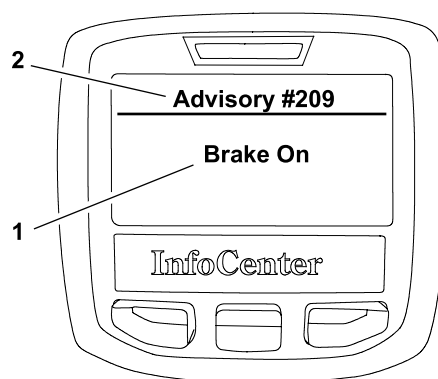
g339630

Figure 38

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

The main menu and additional information screens can be accessed from the InfoCenter main information screen by pressing and releasing the menu/back button (as indicated by  at the bottom of the screen) on the display. Once to the main menu screen ([Figure 38](#)), navigation to the menu items can occur. For information on the main menu and menu item screens; refer to [Main Menu Screen \(page 5–14\)](#).

Operator Advisories



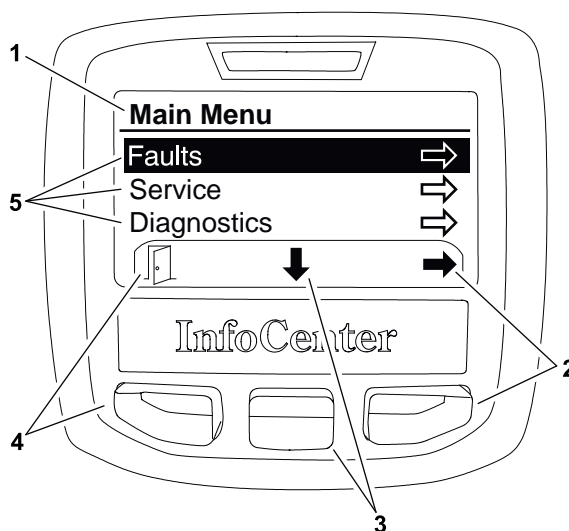
g339631

Figure 39

- | | |
|------------------|----------------------------|
| 1. Advisory name | 2. Advisory identification |
|------------------|----------------------------|

Operator advisories are automatically displayed by the InfoCenter when a machine function requires additional action (Figure 39). An advisory will not be logged into the fault log. (Refer to [Operator Advisories \(page 3–3\)](#)).


Main Menu Screen



g339630

Figure 40

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

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

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

- Faults
- Service
- Diagnostics

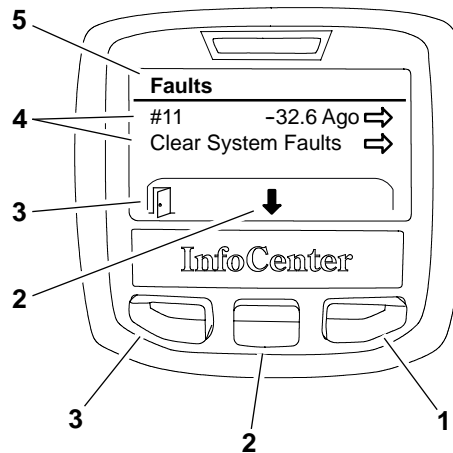
Main Menu Screen (continued)

- Settings
- About

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

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

Faults Screen



g339627

Figure 41

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

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

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

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

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

Service Screen

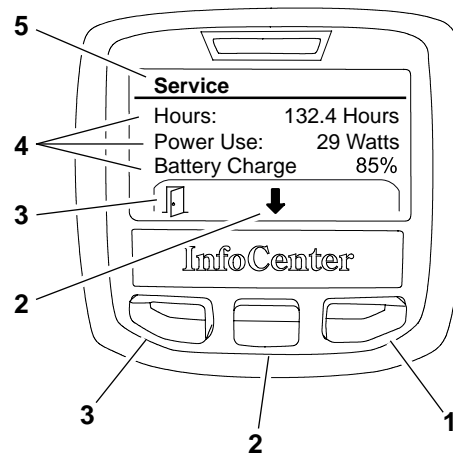



Figure 42

- | | |
|----------------------|------------------|
| 1. Left/right button | 4. Service items |
| 2. Down button | 5. Service menu |
| 3. Menu/back button | |

The service screen (Figure 42) contains the following machine information:

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

Values listed for service menu items cannot be changed.

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

Diagnostics Screen

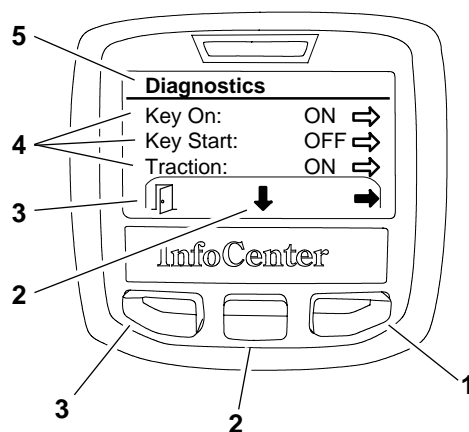


Figure 43

- | | |
|----------------------|----------------------|
| 1. Left/right button | 4. Diagnostics items |
| 2. Down button | 5. Diagnostics menu |
| 3. Menu/back button | |

The diagnostics screen (Figure 43) lists the various states of the machine electrical components. The diagnostics screen should be used to check the operation of the machine switches and controls.

IMPORTANT

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

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


The diagnostics screen includes the following:

- **Key On** identifies that the key switch is in the RUN position.
- **Key Start** indicates that the key switch is in the START position or not.

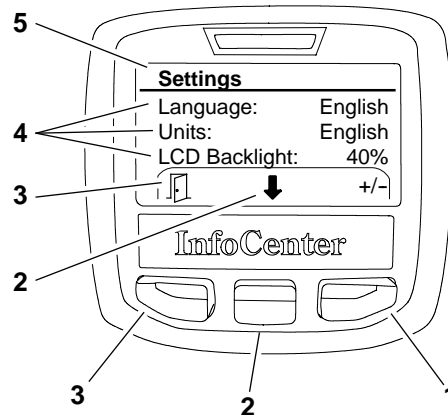
Note: The key start position can be verified in the diagnostics screen by rotating the switch to the ON position. The motor will re-initialize.
- **Traction** identifies that the traction bail is engaged or not engaged.
- **Throttle** identifies the throttle control setting (in volts) that is used by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

Diagnostics Screen (continued)

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

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

Settings Screen





g339633


Figure 44


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


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

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

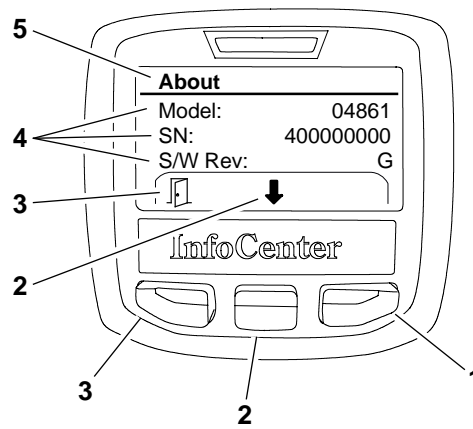
Language: Use the left/right button (as indicated by the  at the bottom of the screen) to select from numerous language options. Allow the desired selection to remain in view for 5 seconds.

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

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

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

About Screen




g339625

Figure 45

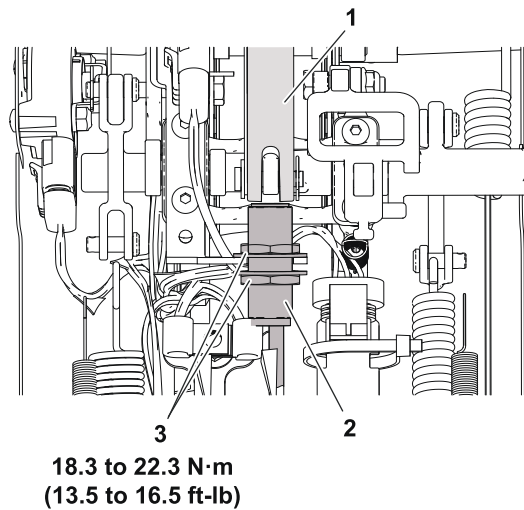
- | | |
|----------------------|----------------|
| 1. Left/right button | 4. About items |
| 2. Down button | 5. About menu |
| 3. Menu/back button | |

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

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

Adjustments

Traction Bail Proximity Sensor



g349622

Figure 46

- | | |
|---------------------|-------------|
| 1. Clutch bail link | 3. Jam nuts |
| 2. Proximity sensor | |

Adjusting the Traction Bail Proximity Sensor

1. Park the machine on a level surface. Ensure that the key switch is in OFF position and the traction control is in NEUTRAL.
2. Disconnect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).
3. Remove the bolts and washers that secures the control cover to the handle assembly. Remove the control cover from the machine.
4. Get access to the proximity sensor. Pull up and release the traction bail.
5. When the bail is open, adjust the proximity sensor gap to **2.3 to 3.8 mm (0.09 to 0.15 in)**.
6. If the clearance is incorrect, loosen the proximity sensor jam nuts and adjust the clearance.



7. After achieving the required clearance, torque tighten the proximity sensor jam nuts to **18.3 to 22.3 N·m (13.5 to 16.5 ft-lb)**.
8. Install the control cover to the handle assembly and secure with bolts and washers.
9. Connect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).

Testing the Electrical Components

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

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

For accurate resistance and/or continuity checks, electrically disconnect the component being tested from the circuit (e.g., unplug the key switch connector before doing a continuity check on switch). Individual components should be electrically isolated (e.g., disconnect all the leads or remove the leads from the circuit) from the circuit when tested.



CAUTION



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

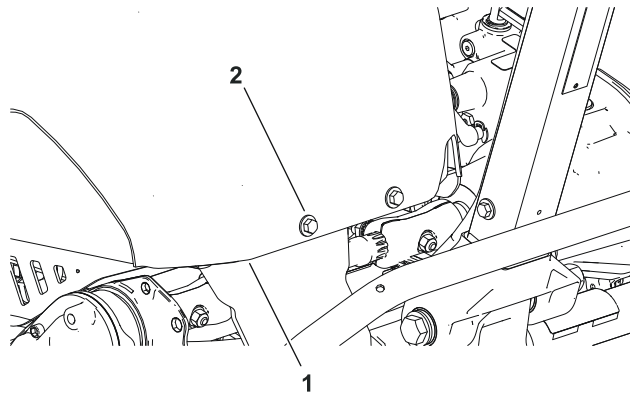


CAUTION



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

Fuses



g338648

Figure 47

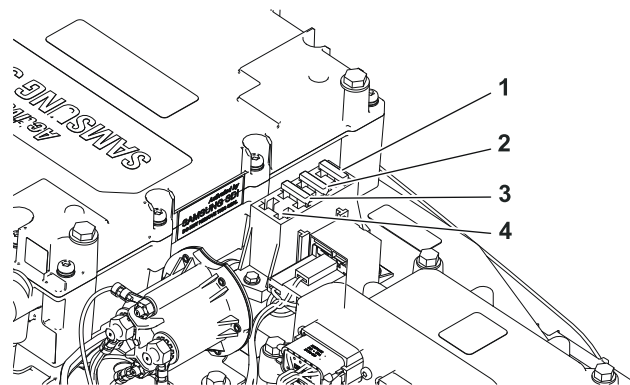
- | | |
|------------------|------------------------------|
| 1. Battery cover | 2. Washer head bolt (4 each) |
|------------------|------------------------------|

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

Accessing the Fuse

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

Fuse Identification and Function



g338649

Figure 48

- | | |
|---------------------|---------------------|
| 1. Fuse F1-1 (30 A) | 3. Fuse F1-3 (3 A) |
| 2. Fuse F1-2 (3 A) | 4. Fuse F1-4 (open) |

Refer to [Figure 48](#) to identify each individual fuse and its correct amperage. The fuses for the Greensmaster eFlex machines have the following functions:

Fuse F1-1 (30 A): Protects main power supply circuits.

Fuse F1-2 (3 A): Protects logic power supply circuits.

Fuse F1-3 (3 A): Protects optional LED work light circuit.

Fuse F1-4: This fuse block position is open.

Testing the Fuse

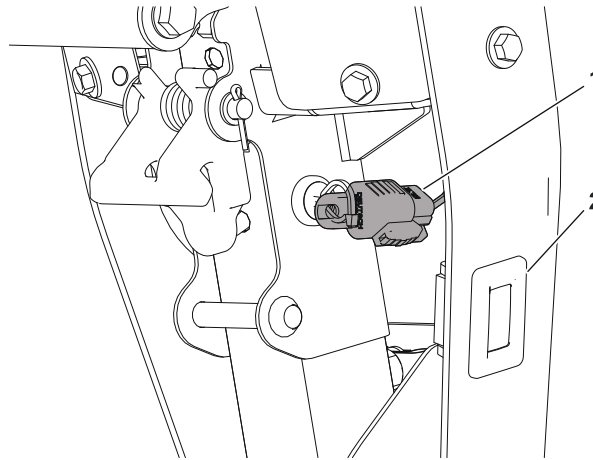
1. Access the fuse block as described above.
2. Carefully remove the fuse from the fuse block for testing.
3. The fuse should have continuity between the fuse terminals.

IMPORTANT

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

4. Carefully install the functional fuse into the fuse holder.
5. After you complete the fuse service, secure the battery cover to the machine with the 4 bolts.
6. Connect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).

CAN bus



g338222

Figure 49

1. DIAG connector
2. Hour meter

The machine controllers communicate with each other on a Controller Area Network (CAN) bus system. Using this network allows full integration of all the different electrical components of the machine, allowing them to operate together as one. The CAN bus system reduces the number of electrical components and connections used on the machine and allows the number of wires in the wire harness to be significantly reduced.

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

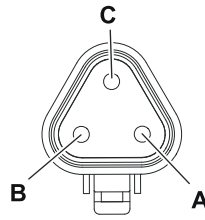
Each of the components that is controlled by the CAN bus link only needs four (4) wires to operate and communicate to the system: CAN High, CAN Low, power and ground. The key switch needs to be in the ON position for the components on the network to be activated.

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

Testing the CAN bus

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

Testing the CAN bus (continued)



g338672

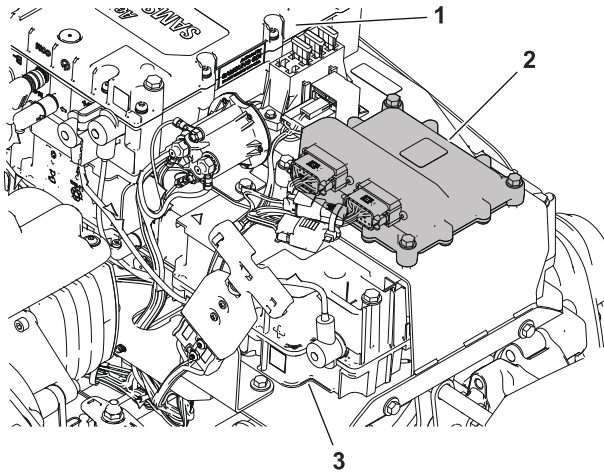
Figure 50

Harness	Connector	Pin	Wire Color	Expected Reading
Main	P14	A	Yellow	54 to 66 ohms
Main	P14	B	Green	

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

4. Refer to [CAN-bus Terminator Resistor \(page 5–38\)](#) and/or see electrical schematic and wire harness drawing in [Appendix A \(page A–1\)](#). If necessary, contact an Authorized Toro Distributor for assistance.

Toro Electronic Controller (TEC)



g338223

Figure 51

- | | |
|---------------------------|-------------------------|
| 1. Samsung SDI controller | 3. Lithium battery pack |
| 2. TEC | |

The Greensmaster machine use a Toro Electronic Controller (TEC) to manage the machine electrical functions. The controller is a microprocessor controlled device that senses the condition of various switches (inputs) and directs electrical power to control the appropriate machine functions (outputs) based on the inputs. The status of inputs to the controller as well as outputs from the controller can be monitored with the InfoCenter display on the console. If a problem exists that could prevent normal operation, the InfoCenter display will display an operator advisory or fault code to assist in identifying the problem.

The TEC is attached to the battery mount inside the battery cover; refer to [Figure 51](#).

IMPORTANT

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

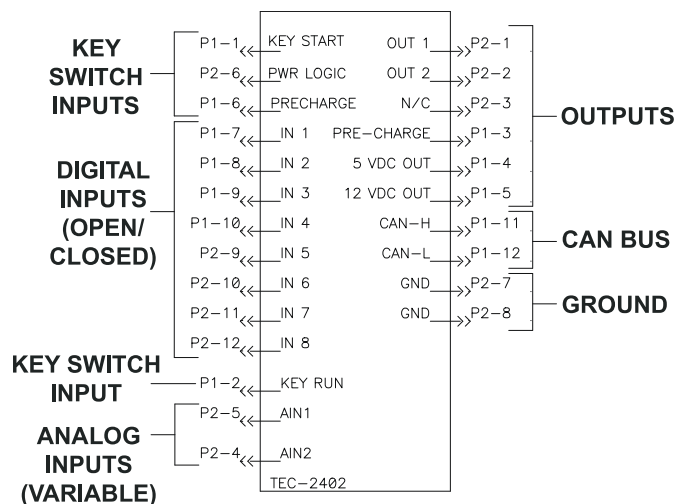
- **Disconnect the machine connector from the lithium battery pack.**
- **Disconnect the wire harness connectors from the Toro Electronic Controller.**

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

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

The TEC current output to the electric motor precharge circuit, main contactor, 12 VDC outputs (InfoCenter display and optional hour meter), and 5 VDC output (throttle potentiometer and clutch bail potentiometer) are controlled based on the inputs received by the controller.

Toro Electronic Controller (TEC) (continued)



g338695

Figure 52

The diagram in [Figure 52](#) depicts the connection terminal functions of the TEC. Two wire harness connectors attach to the controller with each of the connectors including 12 pins. The connector pins are listed in the diagram.

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

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

Lithium-Ion Battery Controller (BMS)

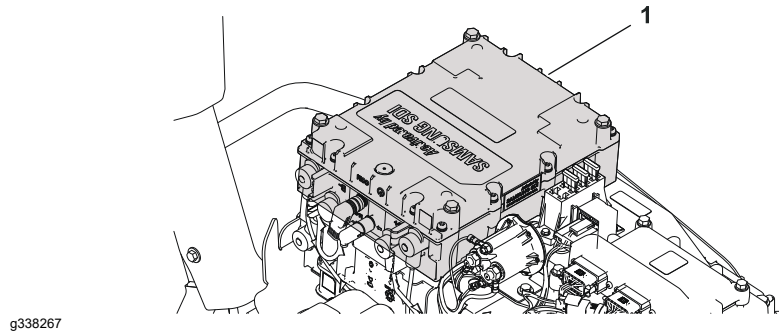


Figure 53

1. Lithium-ion battery controller

The machine uses a Lithium-ion battery controller or Battery Management System (BMS) to manage the lithium-ion battery. The lithium-ion battery communicate with the BMS through a sub-net via the battery interface harness. The battery interface harness includes a 4-pin connector at the battery and a 9-pin connector at the BMS. The BMS uses the sub-net to verify the presence and condition of the battery before allowing battery power to the machine. The BMS is also connected to the CAN bus which allows it to forward battery information to the rest of the machine. The BMS is attached to the battery mount inside the battery cover.

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

Testing the Lithium-Ion Battery Controller

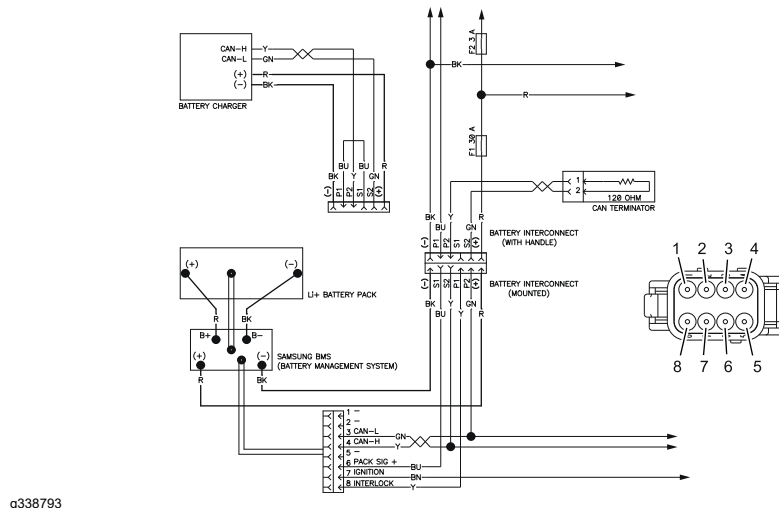
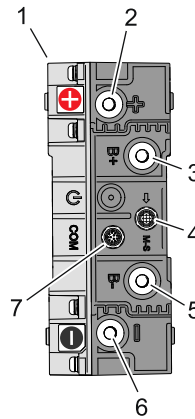


Figure 54

Testing the Lithium-Ion Battery Controller (continued)



g338794

Figure 55

- | | |
|-----------------------------------|--------------------------|
| 1. Lithium-ion battery controller | 5. B- terminal |
| 2. Positive (+) terminal | 6. Negative (-) terminal |
| 3. B+ terminal | 7. COM terminal |
| 4. M-S terminal | |

Although there is no method to test the solid state circuitry built into the controller directly, some aspects of the lithium-ion battery controller operation can be tested as follows; refer to [Figure 54](#).

1. With the battery connected to the BMS, the battery pack voltage can be tested across the BMS B+ and B- terminals.
2. With the battery connected to the BMS, signal voltage from the BMS to the key switch can be tested at the controller wire harness connector pin 6 and the BMS B- terminal.
3. An audible “Click” should come from the BMS shortly after the key switch is set to the ON position. The “Click” sound indicates the contactor inside the BMS has closed and battery power should be available to the machine.
4. Once the BMS internal contactor has closed, battery pack voltage can be tested across the BMS positive (+) and negative (-) terminals.
5. If CAN bus communication with the controller is suspect, the CAN bus wiring should be checked for corrosion or damage and cleaned or repaired as necessary. The lithium-ion battery controller CAN bus transceiver can also be tested if necessary using the controller wire harness connector pins 3 and 4, the normal resistance must be 50k to 55k ohms.

Electric Motor

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

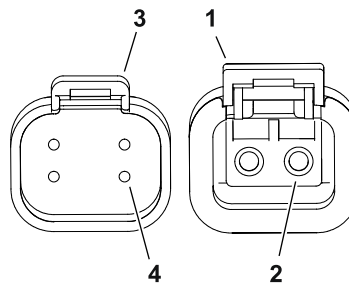
To operate, the electric motor requires 48V logic power (supplied by the logic relay) and a connection to the 48V power bus (supplied by the main contactor when energized).

The electric motor controller is not serviceable. Refer to [Appendix A \(page A–1\)](#) for circuit wiring information.

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

Testing the Electric Motor

1. Park the machine on a level surface and make sure that the clutch bail in the NEUTRAL position. Turn the key switch to the OFF position and remove the key from the key switch.
2. Disconnect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).
3. Locate and disconnect the electric motor cable electrical connections at the machine wire harness. Check the motor and the harness connector for damage or corrosion and clean or repair as necessary.
4. Use a multimeter (ohms setting) measure the resistance between the ground terminal (black wire) and the pin two in four pin connector. Resistance should be approximately 18.8 K-ohms.



g289715

Figure 56

- | | |
|-------------------------------------|-------------------------------------|
| 1. Electric motor connector – 2 pin | 3. Electric motor connector – 4 pin |
| 2. Ground terminal | 4. Pin 2 |
-
5. If electric motor removal, installation, disassembly or assembly is required; refer to [Electric Motor \(page 5–41\)](#).
 6. If the motor tests correctly and a problem still exists, check the rear wheel traction motor circuit wiring; refer to [Appendix A \(page A–1\)](#).
 7. After testing is complete, secure the electric motor wire harness connectors.
 8. Connect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).

Key Switch

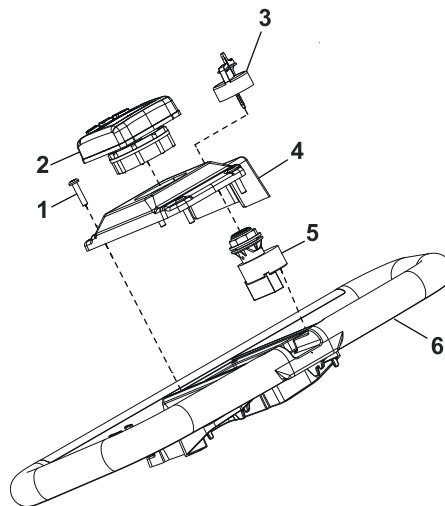


Figure 57

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

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

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

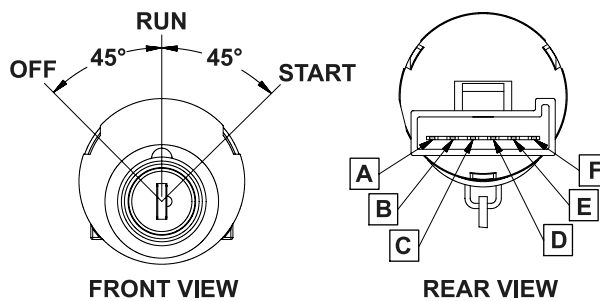
Note: If the eFlex machine is sitting idle for 5 minutes with the key switch in the ON position, the machine will shut off.

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

Testing the Key Switch

1. Park the machine on a level surface and make sure that the clutch bail in the NEUTRAL position. Turn the key switch to the OFF position and remove the key from the key switch.
2. Disconnect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).
3. Remove the InfoCenter mount from the handle to access the key switch; refer to [Figure 57](#)
4. Disconnect the wire harness electrical connector from the key switch.

Testing the Key Switch (continued)



g190999

Figure 58

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

Circuit Logic Table

Switch Position	Circuits
OFF	None
ON	B+C+F, D+E
START	A+B+C

6. Replace the key switch if necessary.
7. After you complete the testing, connect the wire harness electrical connector to the key switch.
8. Install the InfoCenter mount to the handle; refer to [Figure 57](#).
9. Connect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).

Throttle Potentiometer and Clutch Bail Potentiometer

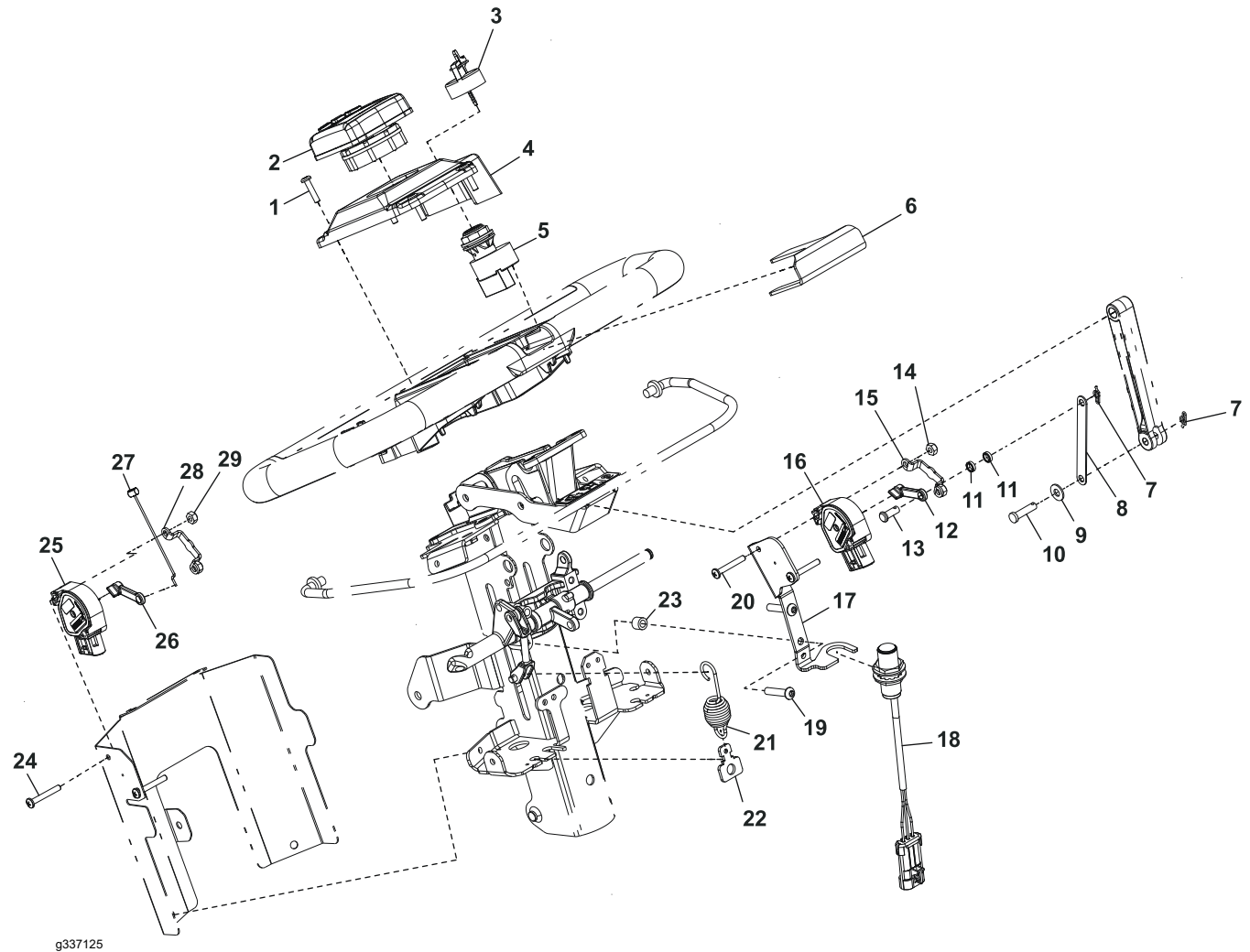


Figure 59

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

The throttle and clutch bail potentiometers controls the electric motor speed which determines the traction speed. The TEC uses the potentiometers setting as an input to determine the necessary signal output for the motor controller for correct electric motor speed. The throttle potentiometer is attached to the bottom handle cover and clutch bail potentiometer is attached to the upper receiver weldment; refer to (Figure 59).

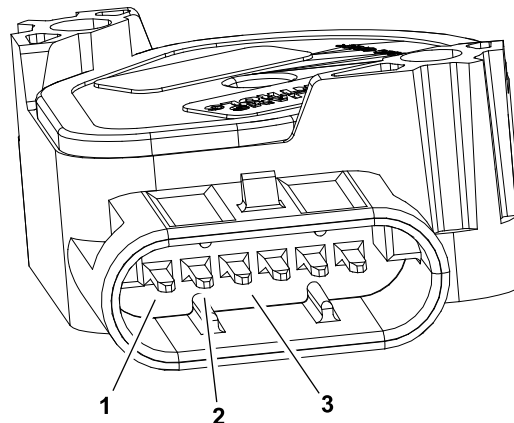
Checking the Operation of Throttle and Clutch Bail Potentiometers

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

Testing the Throttle and Clutch Bail Potentiometers

1. Park the machine on a level surface and make sure that the clutch bail is in the NEUTRAL position. Turn the key switch to the OFF position and remove the key from the key switch.
2. Disconnect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).
3. Remove the handle cover from the handle to get access to the throttle and clutch bail potentiometers.
4. Disconnect the machine wire harness connector from the potentiometer to be tested, and remove the potentiometer from the machine ([Figure 59](#)).

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



g202576

Figure 60

1. Terminal A
 2. Terminal B
 3. Terminal C
-
5. Use a multimeter, measure the resistances between the potentiometer terminals as follows ([Figure 60](#)).
 - A. Check that the resistance between the terminals B and C is approximately 5,000 ohms. Record the measured resistance.
 - B. Measure the resistance between the terminals A and C and then measure the resistance between the terminals A and B. Record these resistances. The total of the 2 measured resistances should be approximately 5,000 ohms.
 - C. Rotate the reel speed potentiometer to other settings and repeat the step B. The total of the 2 resistances should consistently be approximately 5,000 ohms.
 - D. If measured resistances are incorrect, replace the speed control potentiometer.

Testing the Throttle and Clutch Bail Potentiometers (continued)

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

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

7. Connect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).

Main Contactor

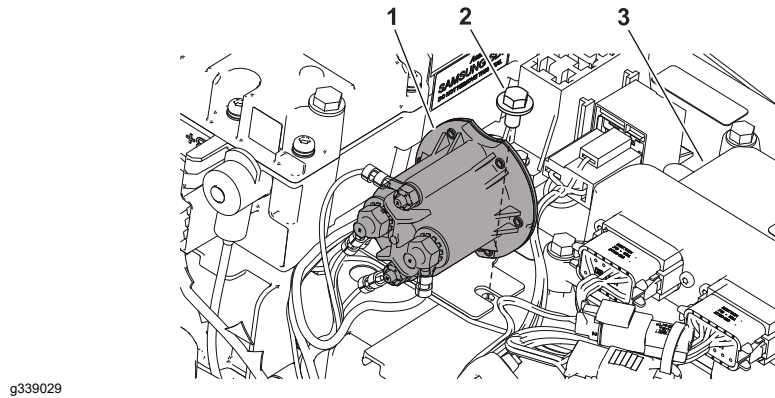


Figure 61

- | | |
|------------------|--------|
| 1. Contactor | 3. TEC |
| 2. Bolt (2 each) | |

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

The contactor is attached to the battery mount under the battery cover; refer to [Figure 61](#).

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

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

Testing the Main Contactor

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

CAN-bus Terminator Resistor

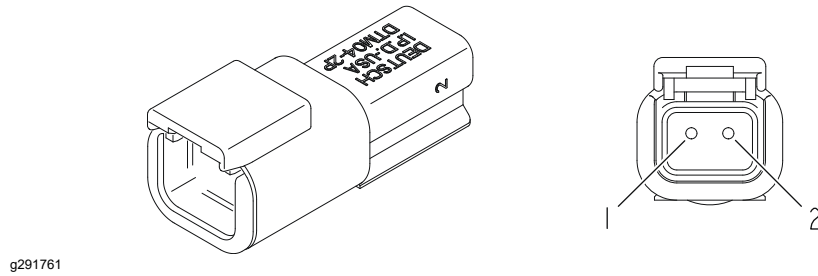


Figure 63

The system communication between the electrical components on the Greensmaster eFlex machines is accomplished on a CAN-bus communication system. The 2 specially designed, twisted cables form the bus for the networks used on the eFlex. These wires provide the data pathways between the machine components. At the ends of the twisted pair of bus cables are 120 ohm terminator resistors.

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

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

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

IMPORTANT

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

Testing the CAN-bus Terminator Resistor

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

Relay

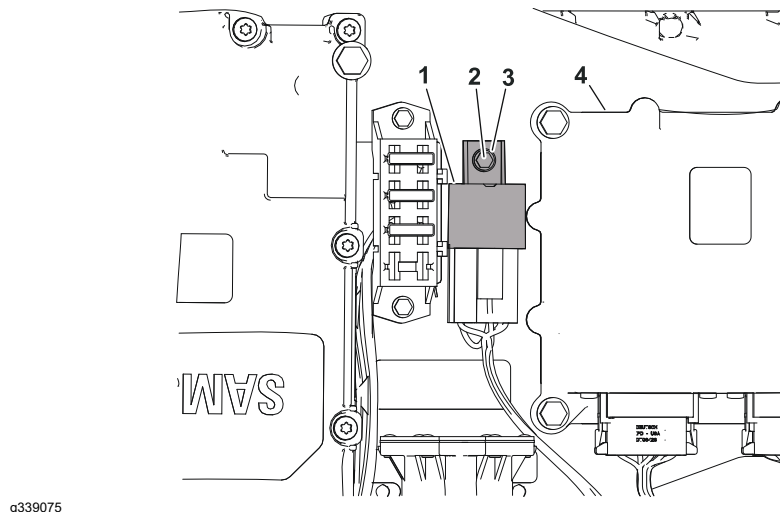


Figure 64

- | | |
|----------|-----------|
| 1. Relay | 3. Washer |
| 2. Bolt | 4. TEC |

The relay used on the eFlex machine is 4 terminal 48 V relay and located inside the battery cover and next to TEC controller; refer to [Figure 64](#).

Testing the Relay

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

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

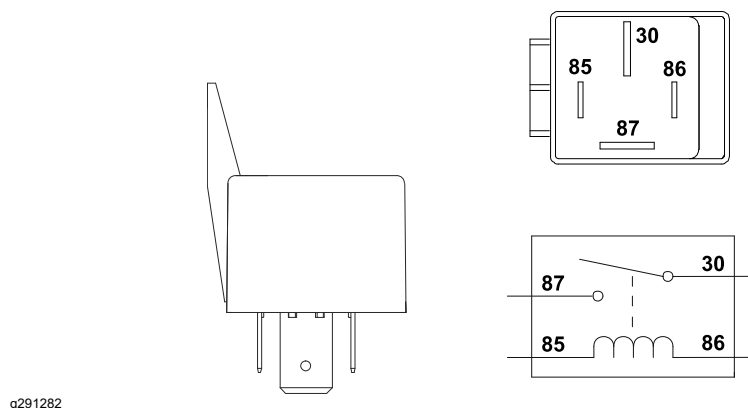


Figure 65

Testing the Relay (continued)

5. Using a multimeter (ohms setting), measure the coil resistance between terminals 85 and 86. The resistance should be from 990 to 1210 ohms.
6. Verify infinite resistance (no continuity) exists between terminals 30 and 87.
7. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +48 VDC to terminal 85 of the relay. The relay should make and break continuity between terminals 30 and 87 as +voltage is applied and removed from terminal 85.
8. Replace the relay as necessary.
9. If the relay tests correctly and a circuit problem still exists, check the wire harnesses; refer to [Appendix A \(page A-1\)](#).
10. Install the relay and connect the wire harness.
11. Install the battery cover onto the battery mount. Secure the battery cover with four bolts.
12. Connect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5-3\)](#).

Service and Repairs

Electric Motor

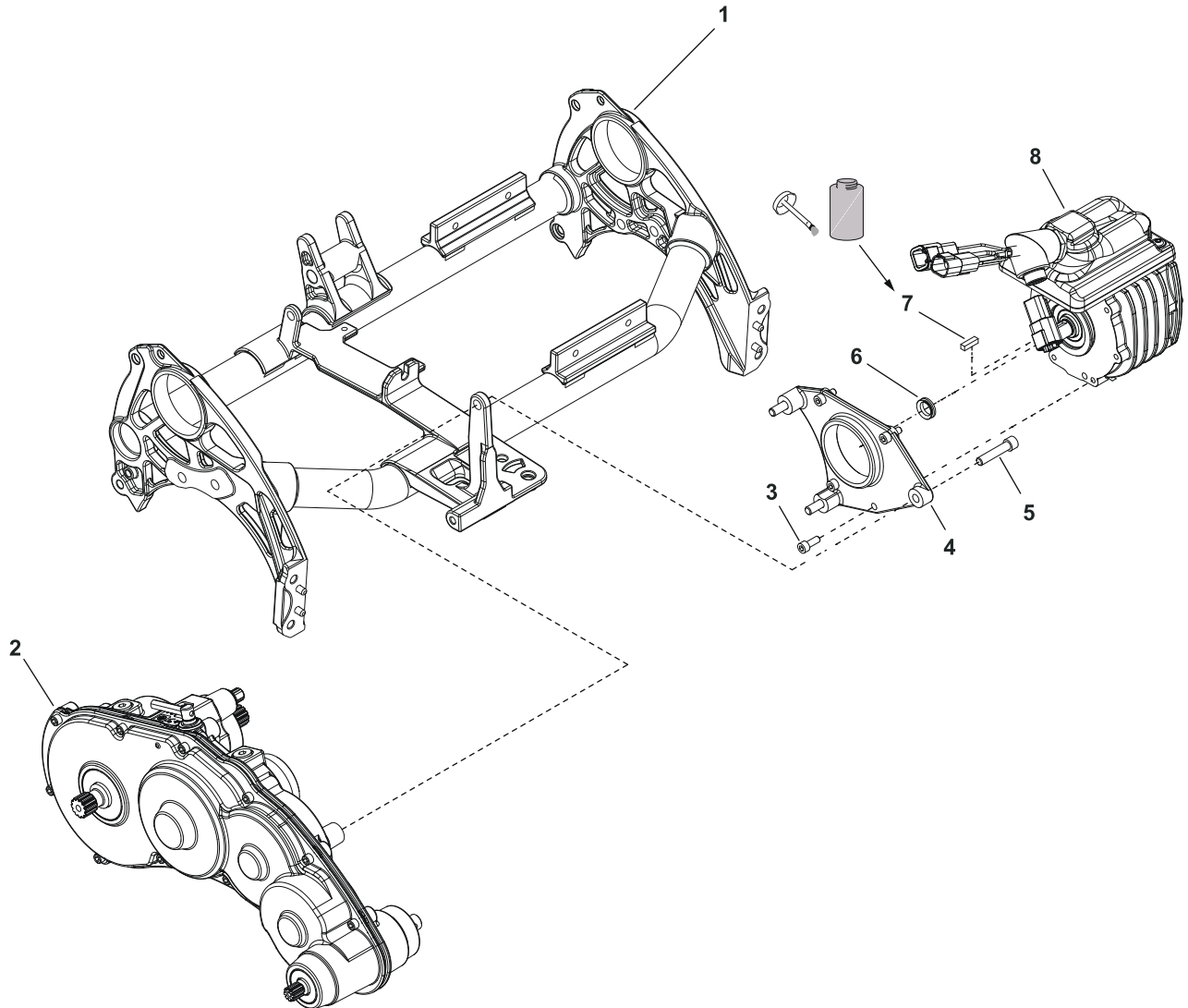


Figure 66

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

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

Removing the Electric Motor

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

Removing the Electric Motor (continued)

5. Remove the 4 socket-head screws (item 3 in [Figure 66](#)) that secure the electric motor to the motor adaptor (4).
6. Carefully slide the electric motor from the transmission, and remove the motor from the machine.
7. Remove the key (7) from the motor shaft.
8. Remove and discard the closed cell foam seal (item 6 in [Figure 66](#)) from the motor shaft.

Installing the Electric Motor

1. Install the closed cell foam seal (6) onto the electric motor shaft.
2. Apply a coat of anti-seize to the key (7) and install the key onto the motor shaft..
3. Position the electric motor to the transmission, align the key of the motor shaft to the transmission coupler, and insert the motor shaft into the coupler. Slide the motor fully to the motor adaptor (4).
4. Secure the electric motor to the motor adaptor (4) with the 4 socket-head screws (3).
5. Connect the electric motor connections to the machine wire harness.
6. Connect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).

Servicing the Electric Motor

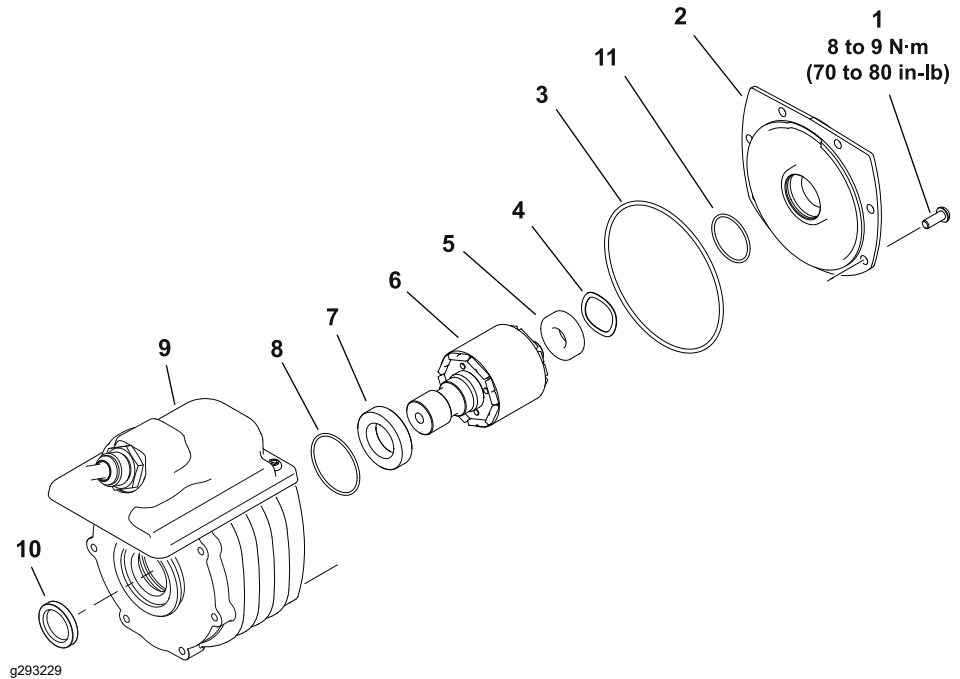


Figure 67

- | | |
|-----------------------|---------------------|
| 1. Cap screw (6 each) | 7. Bearing |
| 2. Motor cover | 8. O-ring |
| 3. O-ring | 9. Housing assembly |
| 4. Wave washer | 10. Lip seal |
| 5. Bearing | 11. O-ring |
| 6. Rotor | |

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

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

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

Note: When servicing the electric motor, use a clean work space with a non-metal surface. The motor rotor includes very powerful magnets that can cause the rotor to move unexpectedly if working on a metal surface. Also, any metallic debris that gets attracted to the rotor can damage the motor after assembly.

Disassembling the Electric Motor

Refer to [Figure 67](#) for this procedure.

1. Inspect the electric motor cable for wear or damage. Replace cable components or complete electric motor assembly if necessary.
2. Carefully remove and discard the lip seal from the housing assembly.
3. Remove the six cap screws that secure the motor cover to rear of motor housing. Do not remove the motor cover at this time.

Disassembling the Electric Motor (continued)

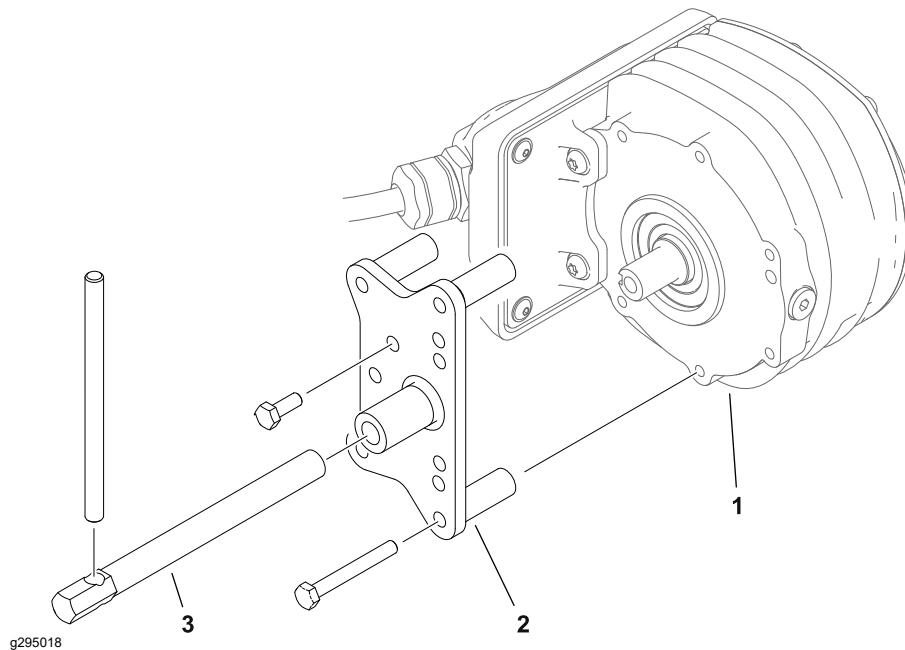


Figure 68

1. Electric motor housing
2. Motor rotor tool base plate
3. Motor rotor tool shaft

4. Secure the base plate of the motor rotor tool (Toro part number 139-8420) to the housing with four M6 – 1.0 X 50 cap screws.
5. Install the rotor tool shaft into the base plate and turn it in against the rotor shaft.



CAUTION



The rotor magnets are very powerful and can cause the rotor to shift position very rapidly during removal. Be cautious during rotor removal to prevent component damage or personal injury.

6. Turn the rotor tool shaft to push the rotor and cover assembly from the housing assembly. Support the rotor to prevent it from falling during removal.
7. Remove the motor cover and wave washer from the rotor assembly.
8. Remove and discard the O-rings from the motor cover.
9. Remove and discard the O-ring from the motor housing.
10. If necessary, remove and discard the bearings from the rotor.
11. Inspect the electric motor components for wear or damage. Replace components or complete electric motor assembly if necessary.

Assembling the Electric Motor

Refer to [Figure 67](#) for this procedure.

1. Make sure that motor components are cleaned before assembly.
2. If the bearings were removed from the rotor, install new bearings. Make sure the new bearings are fully pressed onto the rotor shaft.
3. Lubricate a new O-ring with dielectric lubricant and install it into the groove in the housing bearing bore.

Assembling the Electric Motor (continued)

4. Lubricate new O-rings with dielectric lubricant and install the O-rings into the grooves in the motor cover. Place the wave washer in the cover bearing bore and fit the rotor assembly into the cover.
5. Secure the base plate of the motor rotor tool to the housing with four M6 – 1.0 X 50 cap screws.
6. Install the rotor tool shaft into the base plate and turn it in so the end of the shaft prevents the rotor body from entering the housing assembly.

IMPORTANT

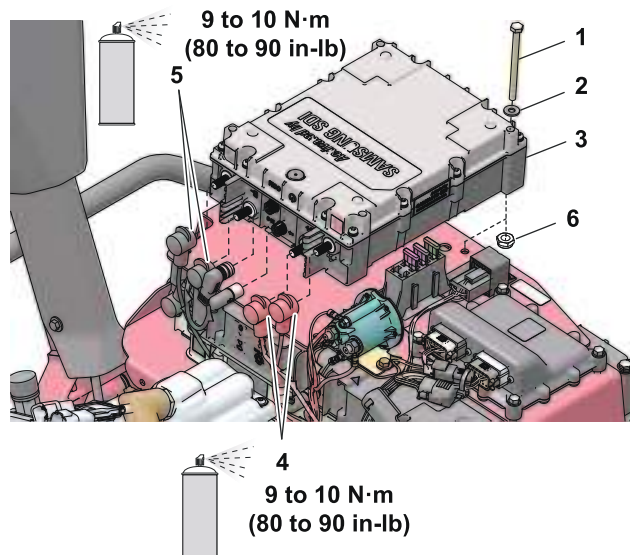
The rotor magnets are very powerful and can cause the rotor to shift position very rapidly during installation. Be cautious during rotor installation to prevent component damage or personal injury.

7. While supporting the rotor and cover assembly, slowly turn the rotor tool shaft to allow the rotor to be drawn into the housing assembly. Once the rotor and cover assembly is fully seated in the housing, remove the rotor tool base plate.



8. Secure the cover to the housing with the six cap screws and tighten the screws from **8 to 9 N·m (70 to 80 in-lb)**.
9. Make sure that rotor rotates without binding before installing the motor assembly.

Lithium-Ion Battery Controller (BMS)



g349591

Figure 69

- | | |
|-----------------------------------|--------------------------------|
| 1. Bolt (4 each) | 4. Positive (+) battery cables |
| 2. Washer (4 each) | 5. Negative (-) battery cables |
| 3. Lithium-ion battery controller | 6. Nut (4 each) |

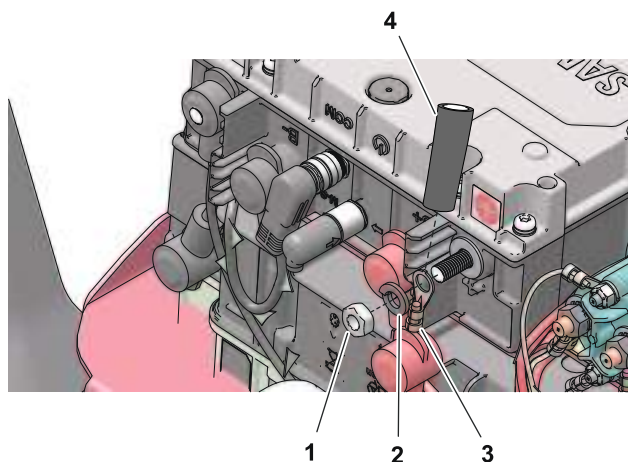
Removing and Installing Lithium-Ion Battery Controller (BMS)



CAUTION



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



g349592

Figure 70

- | | |
|-----------|-------------------------------------|
| 1. Nut | 3. Battery cable terminal (typical) |
| 2. Washer | 4. 1/2 inch ID rubber hose |

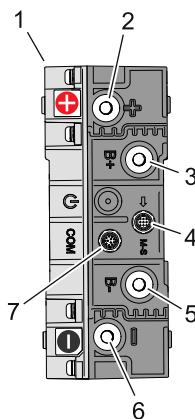


CAUTION



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

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



g338794

Figure 71

- | | |
|-----------------------------------|--------------------------|
| 1. Lithium-ion battery controller | 5. B- terminal |
| 2. Positive (+) terminal | 6. Negative (-) terminal |
| 3. B+ terminal | 7. COM terminal |
| 4. M-S terminal | |
4. Label and disconnect the negative (-) battery cable, positive (+) battery cable from the lithium-ion battery controller B- and +B terminals.
 5. Label and disconnect the battery interface harness and the machine wire harness connector from the lithium-ion battery controller M-S and COM terminals.
 6. Label and disconnect the machine wire harness negative (-) and positive (+) cables from the lithium-ion battery controller negative (-) and positive (+) terminals.
 7. Remove the four nuts, bolts and washers that secures the BMS to battery mount.
 8. Carefully remove the BMS from the machine.



CAUTION



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

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



10. Tighten the power supply and battery cable fasteners from **9 to 10 N·m (80 to 90 in-lb)**, then apply battery terminal protector Toro Part No. 107-0392 or a light layer of grease to the battery terminals and cable connectors to reduce corrosion.

Lithium-Ion Battery Pack

The Greensmaster eFlex 1021 is powered by a maintenance free lithium-ion battery. The battery consists of numerous cells. The battery is located inside the battery mount. The battery is managed by the lithium-ion battery controller (BMS); refer to [Lithium-Ion Battery Controller \(BMS\)](#) (page 5–8).



WARNING



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

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

IMPORTANT

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

Caring for the Lithium-Ion Battery

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

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

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

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

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

Storing the Lithium-Ion Battery

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

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

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

Shipping and Transporting the Lithium-Ion Battery

The US Department of Transportation and international transportation authorities require that lithium-ion battery be shipped using special packaging and only be handled by carriers certified to haul them. Use the original packaging whenever possible when shipping lithium-ion battery in the USA. If the original packaging is damaged or not available, use a Battery Shipping Kit; refer to [Special Tools \(page 2–13\)](#). Contact the appropriate government body in your country for detailed regulations on shipping the lithium-ion battery.

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

IMPORTANT

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

Charging the Lithium-Ion Batteries



WARNING



When charging lithium-ion battery:

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

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

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

Refer to the *Operator's Manual* for battery charging and battery charger operation information. Refer to Battery Charger Error and Fault Codes for battery charger troubleshooting information.

Removing the Lithium-Ion Battery



WARNING



When removing or installing the battery:

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

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

Removing the Lithium-Ion Battery (continued)



WARNING



When removing or installing the battery:

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

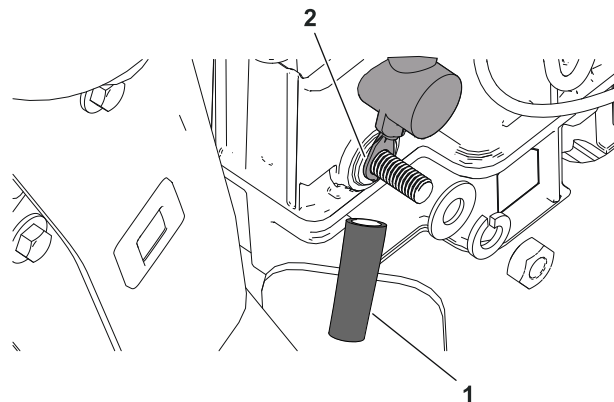
Failure to follow these recommendations may result in personal injury and property damage.



CAUTION



To prevent accidentally shorting disconnected battery cables across other components or tools, insulate the battery cable terminals with 76 mm (3 inch) lengths of 1/2 inch internal diameter rubber hose immediately after disconnecting the cables. Failure to do so may result in personal injury and property damage; refer to [Figure 72](#).



g339372

Figure 72

1. Battery cable terminal (typical)

2. 1/2 inch ID rubber hose

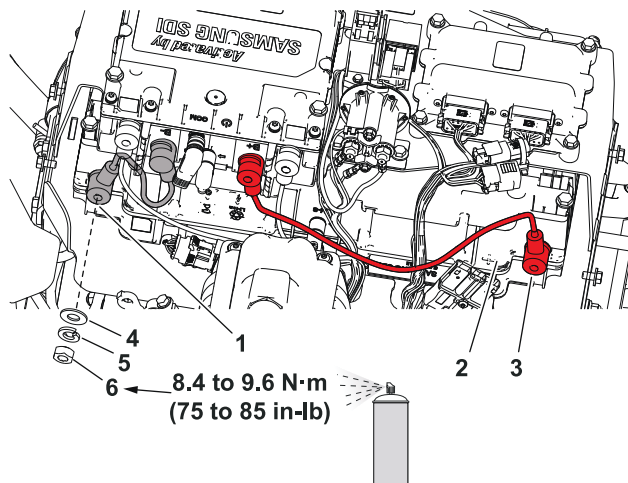


CAUTION



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

Removing the Lithium-Ion Battery (continued)

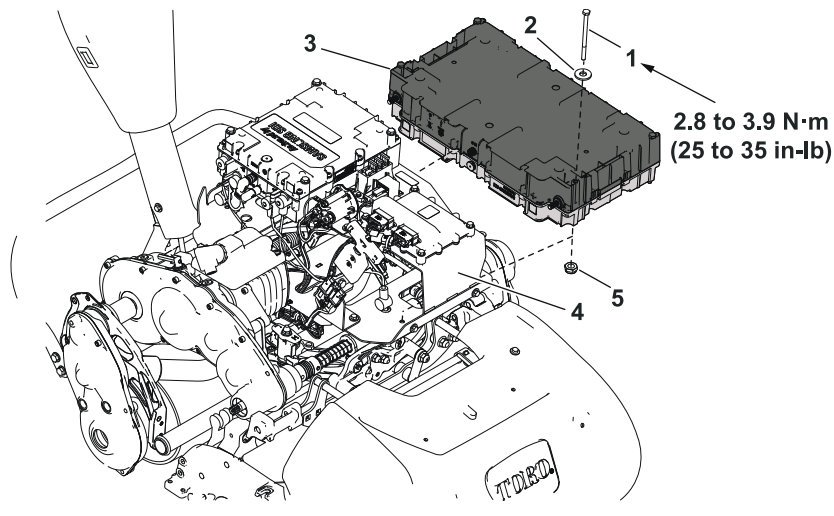


g339409

Figure 73

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

1. Park the machine on a level surface and make sure that the clutch bail is in the NEUTRAL position. Turn the key switch to the OFF position and remove the key from the key switch.
2. Disconnect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5-3\)](#).
3. Remove the four bolts that secure the battery cover to the battery mount. Remove the battery cover from the machine.
4. Label and disconnect the negative (-) battery cable, positive (+) battery cable, and battery interface harness from the lithium-ion battery; refer to [Figure 73](#).



g339388

Figure 74

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

5. Remove the four nuts (item 5 in [Figure 74](#)), bolts (1) and washers (2) that secure the battery to the battery mount.

Removing the Lithium-Ion Battery (continued)



CAUTION



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

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

Installing the Lithium-Ion Battery



CAUTION



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

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

IMPORTANT

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



2. After installing the battery into the battery mount, secure the battery with four bolts, washers and nuts.
3. Torque tighten the bolts (1) from **2.8 to 3.9 N·m (25 to 35 in-lb)**.
4. Using the labels that attached during the removal, connect the battery interface cable, positive (+) battery cable and negative (-) battery cable onto the battery pack.
5. Tighten the battery cable fasteners (item 6 in [Figure 73](#)) from **8.4 to 9.6 N·m (75 to 85 in-lb)**, then apply battery terminal protector **Toro Part No. 107-0392** or a light layer of grease to the battery terminals and cable connectors to reduce corrosion.
6. Install the battery cover onto the battery mount. Secure the battery cover with four bolts.
7. Connect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5-3\)](#).



Controls, Wheels and Accessories

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General Information

Operator's Manual

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

Adjustments

Adjusting the Reel Cable

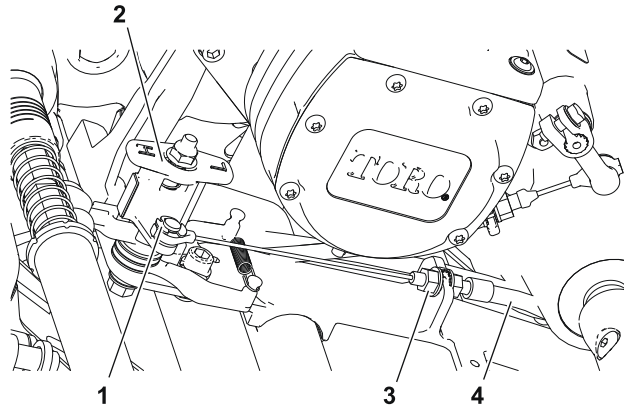


Figure 75

- | | |
|-----------------------|---------------|
| 1. Retaining ring | 3. Jam nut |
| 2. Reel selector knob | 4. Reel cable |

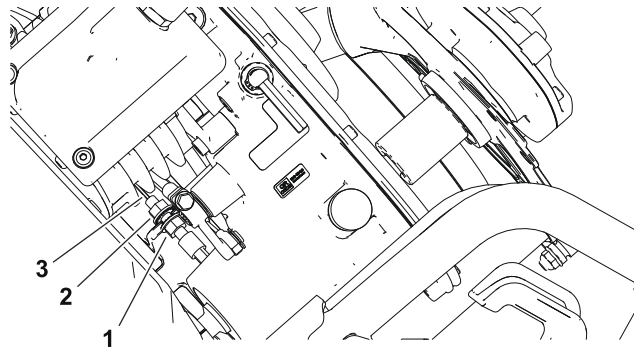


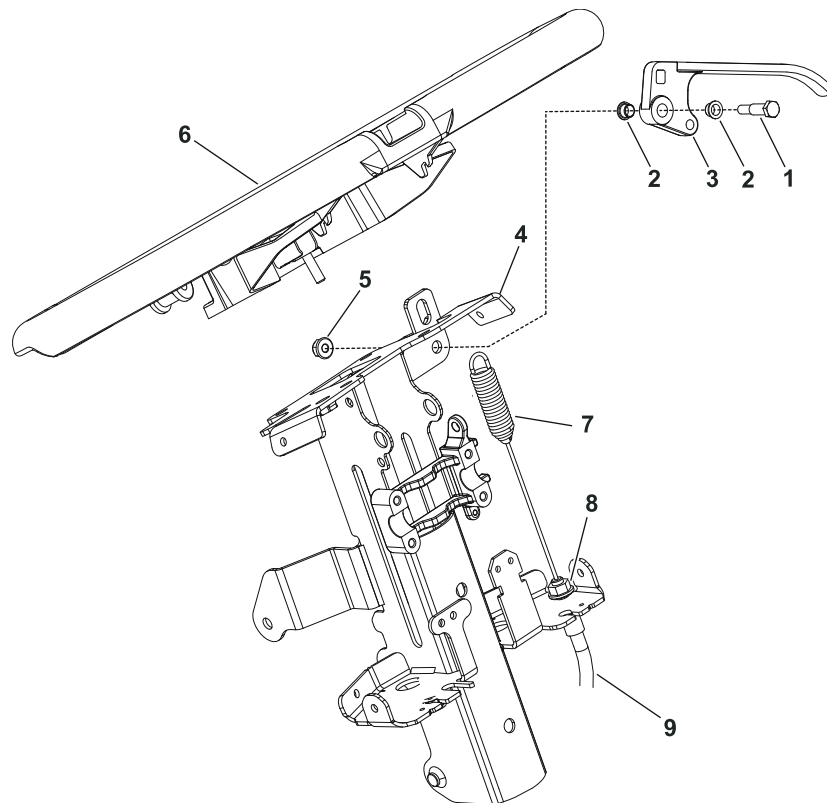
Figure 76

- | | |
|------------------|---------------|
| 1. Rear jam nut | 3. Reel cable |
| 2. Front jam nut | |

1. Park the machine on a level surface. Ensure that the key switch is in OFF position and the traction control is in NEUTRAL and parking brake is released.
2. Disconnect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).
3. To remove slack from the reel cable, perform the following steps:
 - A. Move the reel selector knob to the high-reel-speed position; refer to [Figure 75](#).
 - B. Loosen the rear jam nut and tighten the front jam nut; refer to [Figure 76](#).
4. Connect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).

Service and Repairs

Replacing the Brake Cable



g336874

Figure 77

- | | | |
|----------------------------|----------------------------|-----------------------|
| 1. Shoulder screw | 4. Upper receiver weldment | 7. Brake cable spring |
| 2. Flange bushing (2 each) | 5. Flange nut | 8. Jam nut |
| 3. Lever | 6. Handle assembly | 9. Brake cable |

Removing the Brake Cable

Note: Refer to [Figure 77](#) during this procedure.

1. Park the machine on a level surface. Ensure that the key switch is in OFF position and the traction control is in NEUTRAL and parking brake is released.
2. Disconnect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).

Removing the Brake Cable (continued)

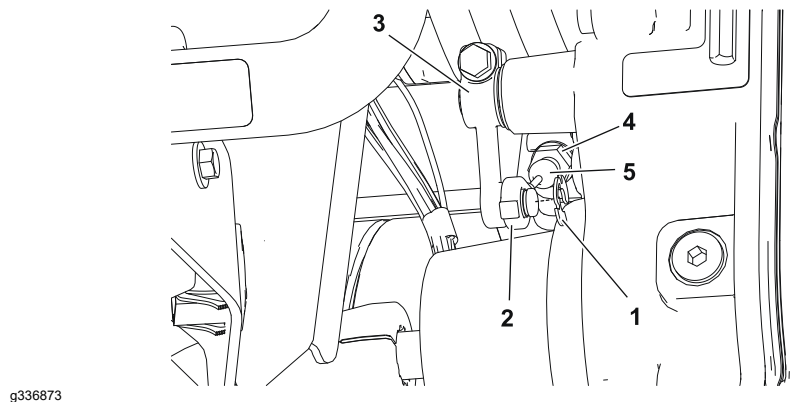


Figure 78

- | | | |
|-------------------|----------------|----------------|
| 1. Retaining ring | 3. Brake lever | 5. Brake cable |
| 2. Cable eyelet | 4. Jam nut | |

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

Installing the Brake Cable

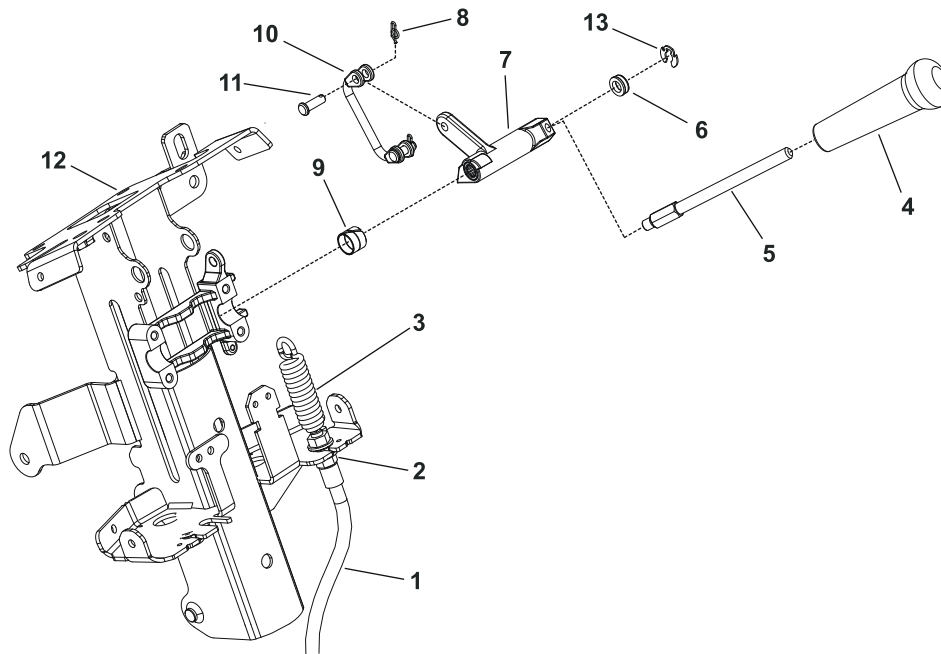
1. Secure the brake cable (9) to the brake lever assembly as follows:
 - A. Install the cable spring (7) to the spring anchor on the brake lever assembly (3).
 - B. Slide the brake cable into the shift mount bracket slot. Ensure that the jam nut (8), flat washer and lock washer are both sides of the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

Installing the Brake Cable (continued)

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

3. Make final adjustment of the brake cable at the brake cable lever assembly. Adjust the cable jam nuts to remove the slack in the brake cable.
4. Check the brake cable adjustment; refer to *Operator's Manual*.
5. Install the lower cover and control cover to the handle assembly.
6. Connect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).

Replacing the Reel Cable



g336876

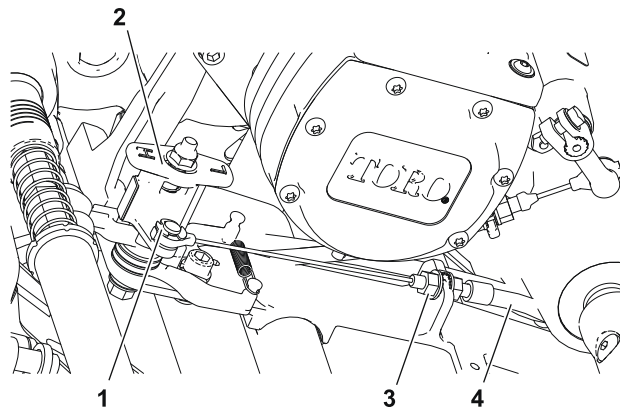
Figure 79

- | | | |
|--------------------------|------------------------|-----------------------------|
| 1. Reel cable | 6. V-ring seal | 11. Clevis pin |
| 2. Jam nut | 7. Reel lever assembly | 12. Upper receiver weldment |
| 3. Cable spring | 8. Cotter pin clip | 13. Retaining ring |
| 4. Knob | 9. Split bushing | |
| 5. Reel lever handle rod | 10. Clevis connector | |

Removing the Reel Cable

Note: Refer to [Figure 79](#) during this procedure.

1. Park the machine on a level surface. Ensure that the key switch is in OFF position and the traction control is in NEUTRAL.
2. Disconnect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).



g336875

Figure 80

- | | |
|---------------------------|---------------|
| 1. Retaining ring | 3. Jam nut |
| 2. Reel selector assembly | 4. Reel cable |

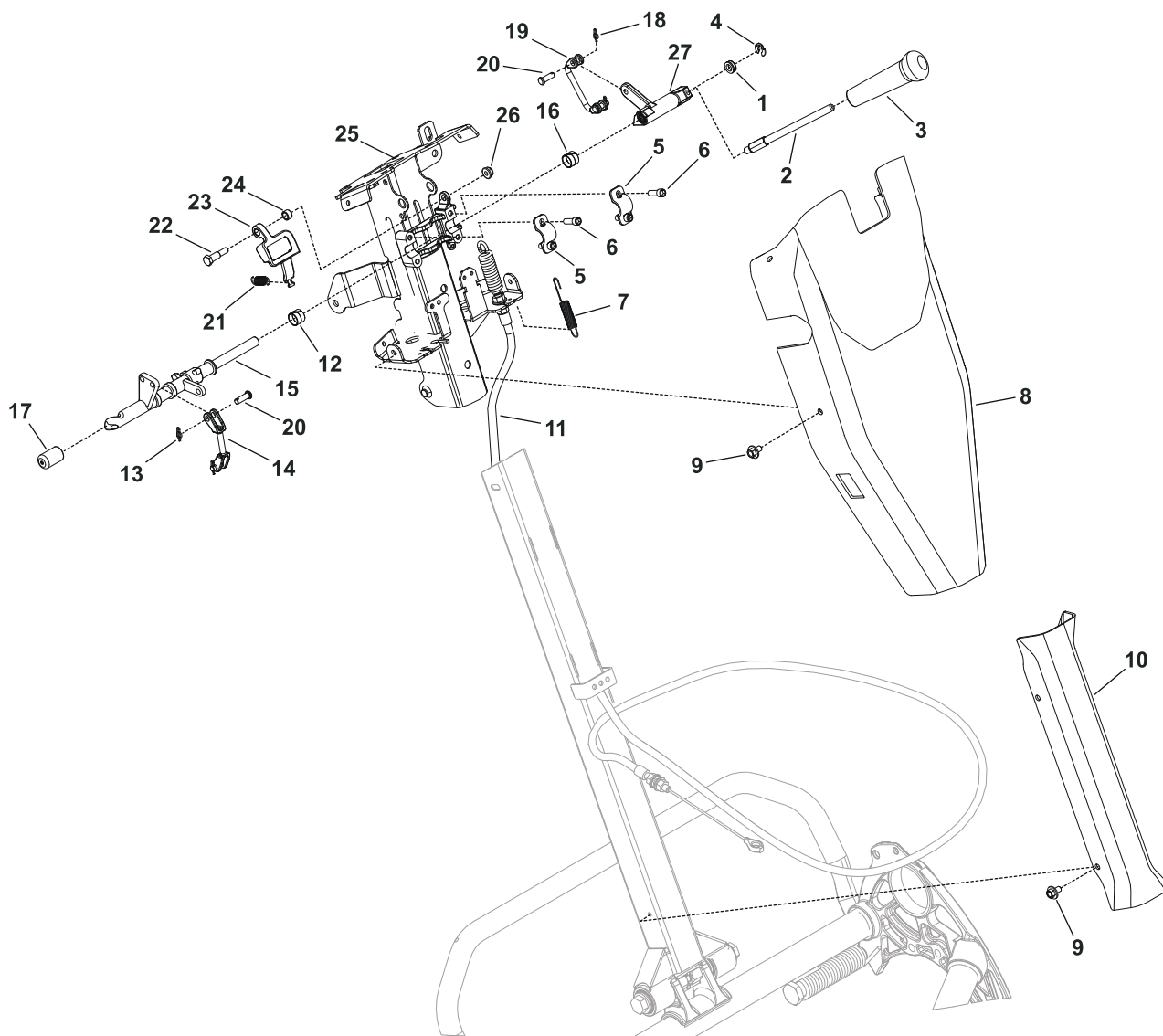
Removing the Reel Cable (continued)

3. Remove the reel cable (item 4 in [Figure 80](#)) from the reel selector assembly (2) as follows:
 - A. Loosen the front cable jam nut (3) and lift the reel cable (4) from the casting slot of the base.
 - B. Remove the retaining ring (1) that secures the reel cable eyelet to the reel selector assembly (2) and slide the reel cable eyelet from the selector assembly.
4. Remove the control cover and lower cover from the handle assembly to allow access to upper end of the reel cable.
5. Remove the reel cable (item 1 in [Figure 79](#)) from the traction bail assembly as follows:
 - A. Loosen the lower cable jam nut (2) that secures the reel cable (1) to the upper receiver weldment (12). Slide the cable from the upper receiver weldment.
 - B. Remove the cable spring (3) from the clevis connector (10) on the reel lever assembly (5). Note the orientation of cable spring hook on the shaft assembly for assembly purposes.
6. Remove the reel cable (1) from the machine.

Installing the Reel Cable

1. Secure the reel cable (item 1 in [Figure 79](#)) to the traction bail assembly as follows:
 - A. Install the cable spring (3) to the clevis connector (10) on the reel lever assembly (7). Orientate the cable spring hook end toward front of the machine.
 - B. Slide the cable (1) into the upper receiver weldment (12). Ensure that the jam nut (2), flat washer and lock washer are on both sides of the bracket. Adjust jam nuts so that equal amount of cable threads are visible above the jam nuts. Leave the jam nuts snug until final cable adjustment.
2. Route the reel cable to the reel selector assembly (item 2 in [Figure 80](#)) and install the reel cable (4) as follows:
 - A. Slide the cable eyelet to the reel selector assembly (2) and secure with a retaining ring (1).
 - B. Position the reel cable (4) to the casting slot of the base with a jam nut (3), flat washer and a lock washer on each side of the slot.
3. Make final adjustment of the reel cable at the reel cable lever assembly. Adjust the cable jam nuts to remove the slack in the clutch cable.
4. Check and adjust the reel cable; refer to [Adjusting the Reel Cable \(page 6–3\)](#).
5. Install the lower cover and control cover to the handle assembly.
6. Connect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).

Cutting Unit Drive Lever Assembly



g336962

Figure 81

- | | | |
|--------------------------------------|------------------------|------------------------------|
| 1. V-ring seal | 10. Lower handle cover | 19. Clevis connector |
| 2. Reel lever handle rod | 11. Reel cable | 20. Clevis pin (4 each) |
| 3. Knob | 12. Split bushing | 21. Extension spring |
| 4. Retaining ring | 13. Cotter pin clip | 22. Shoulder screw |
| 5. Control shaft clamp (2 each) | 14. Link assembly | 23. Reel lock lever assembly |
| 6. Socket head screw (4 each) | 15. Main control shaft | 24. Bail latch spacer |
| 7. Extension spring (2 each) | 16. Split bushing | 25. Upper receiver weldment |
| 8. Control cover | 17. Socket cap | 26. Flange nut |
| 9. Bolt and washer assembly (8 each) | 18. Cotter pin clip | 27. Reel lever assembly |

Disassembling the Cutting Unit Drive Lever Assembly

Note: Refer to [Figure 81](#) during this procedure.

1. Park the machine on a level surface. Ensure that the key switch is in OFF position and the traction control is in NEUTRAL.
2. Disconnect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).

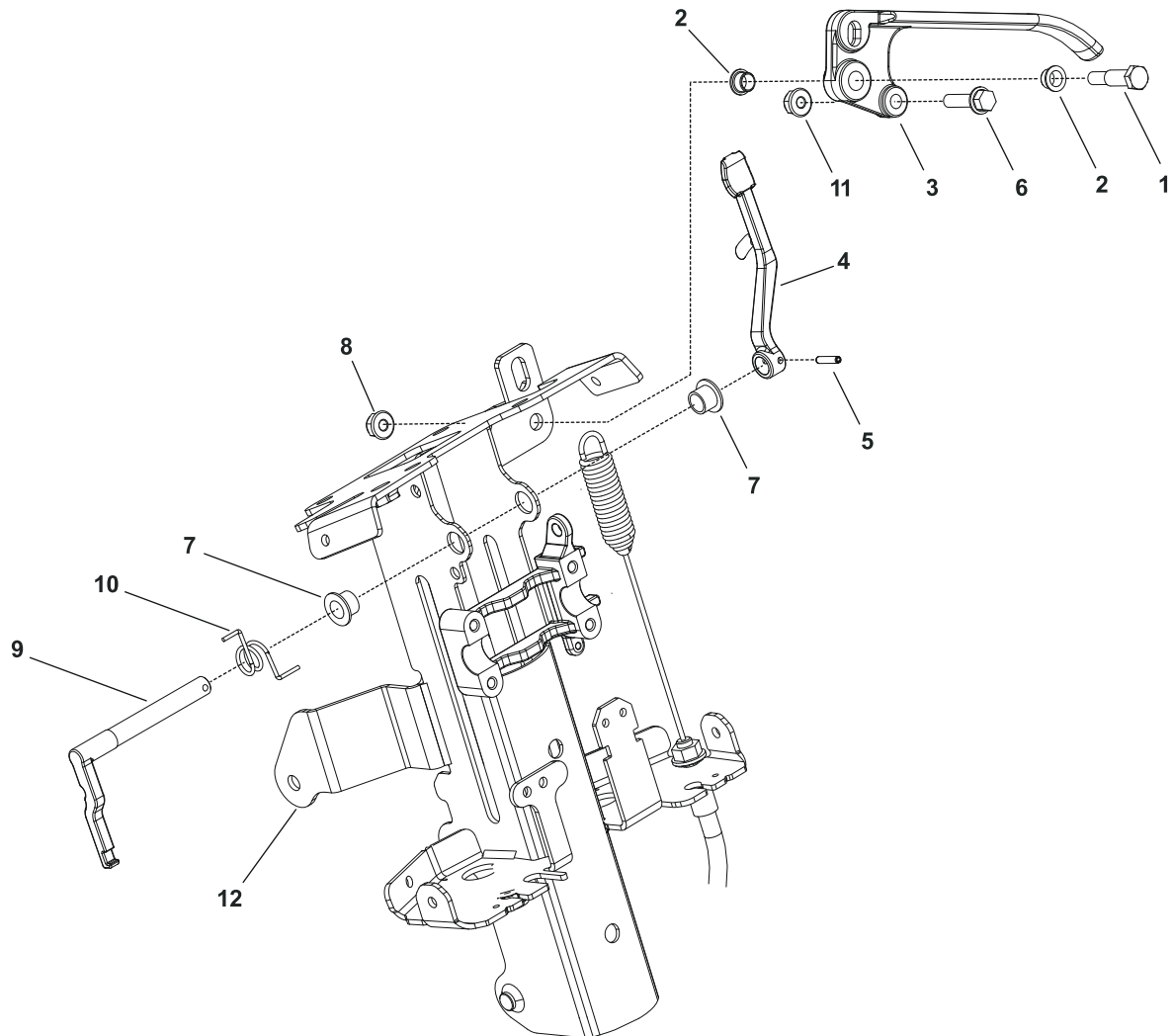
Disassembling the Cutting Unit Drive Lever Assembly (continued)

3. Remove the bolts and washers (item 9 in [Figure 81](#)) that secures the control covers (item 8 and 10) to the upper receiver weldment (25) and handle assembly.
4. Remove the reel lever handle rod (2) from the reel lever assembly (27).
5. If necessary, remove the reel lever knob (3) from the reel lever handle (2).
6. Remove the cotter pin (18) and clevis pin (20) that secures the link assembly (14) to the main control shaft (15).
7. Remove the cotter pin (18) and clevis pin (20) that secures the clevis connector (19) to the reel lever assembly (27).
8. Remove the extension spring (21) from the reel lock lever (23).
9. Remove the flange nut (26) and shoulder screw (22) that secures the reel lock lever (23) to the upper receiver weldment (25). Remove the reel lock lever (23) and bail latch spacer (24).
10. Remove the retaining ring (4) and V-ring seal (1) that secures the reel lever assembly (27) to the main control shaft (15). Slide and remove the reel lever assembly.
11. Remove the socket head screws (6) and control shaft clamps (5) that secures the main control shaft (15) to the upper receiver weldment (23).
12. Remove the main control shaft (15). If necessary, remove the split bushing (16 and 12) from the main control shaft.

Assembling the Cutting Unit Drive Lever Assembly

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

Brake Latch Shaft



g336961

Figure 82

- | | | |
|----------------------------|----------------------------|-----------------------------|
| 1. Shoulder bolt | 5. Roll pin | 9. Brake latch shaft |
| 2. Flange bushing (2 each) | 6. Bolt | 10. Torsion spring |
| 3. Lever | 7. Flange bushing (2 each) | 11. Flange nut |
| 4. Brake lock lever | 8. Flange nut | 12. Upper receiver weldment |

Disassembling the Brake Latch Shaft

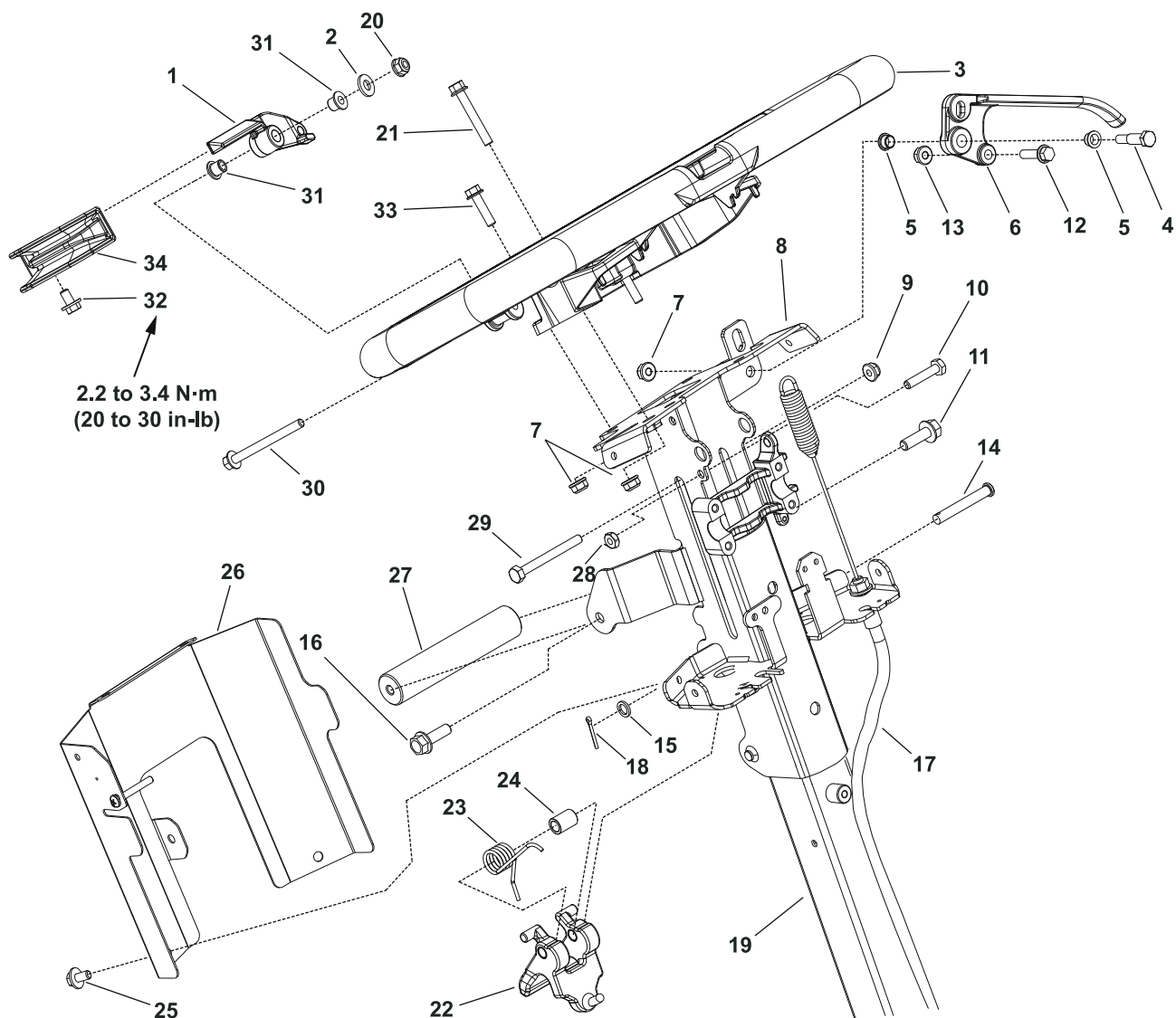
Note: Refer to [Figure 82](#) during this procedure.

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

Assembling the Brake Latch Shaft

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

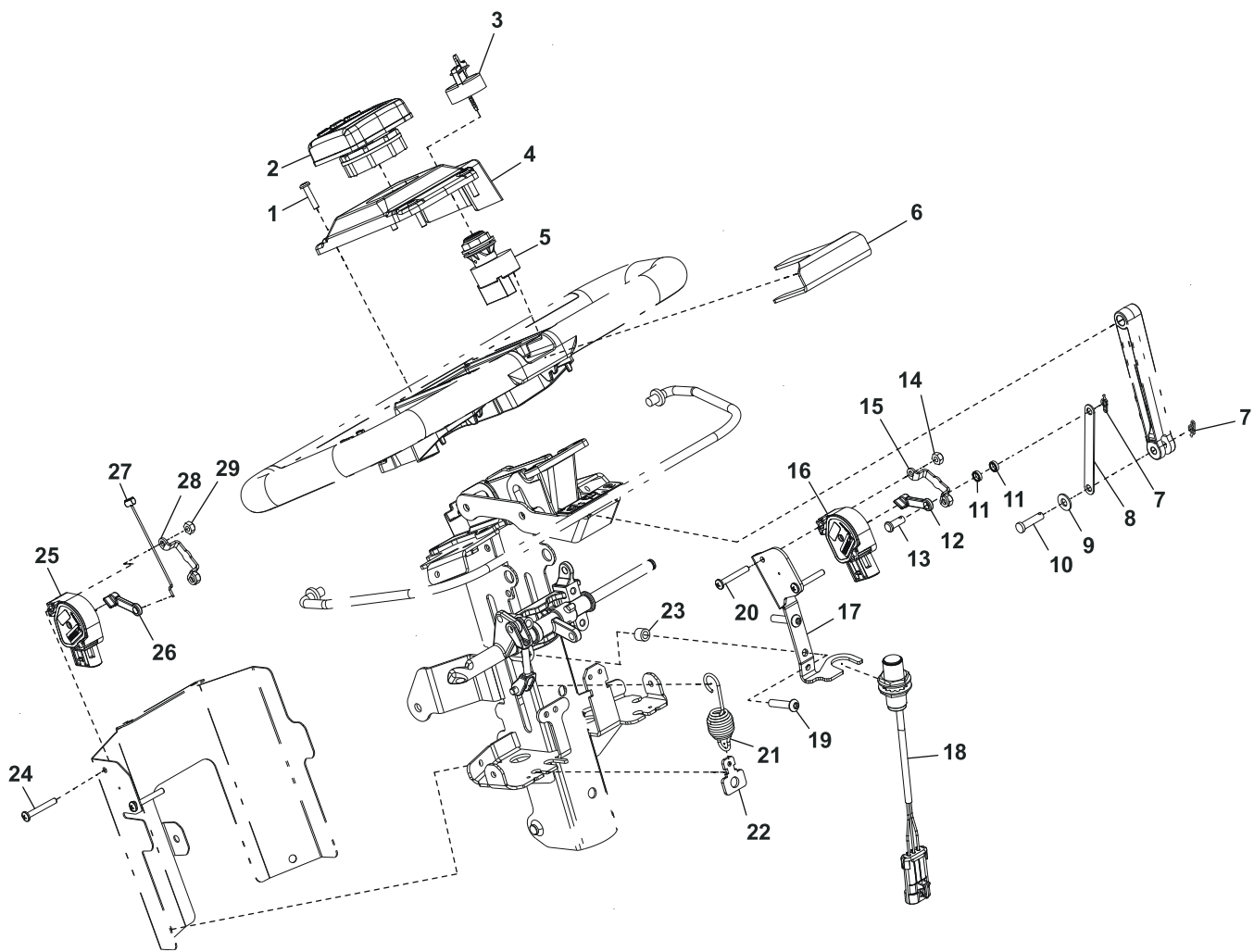
Handle Assembly



g337124

Figure 83

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



g337125

Figure 84

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

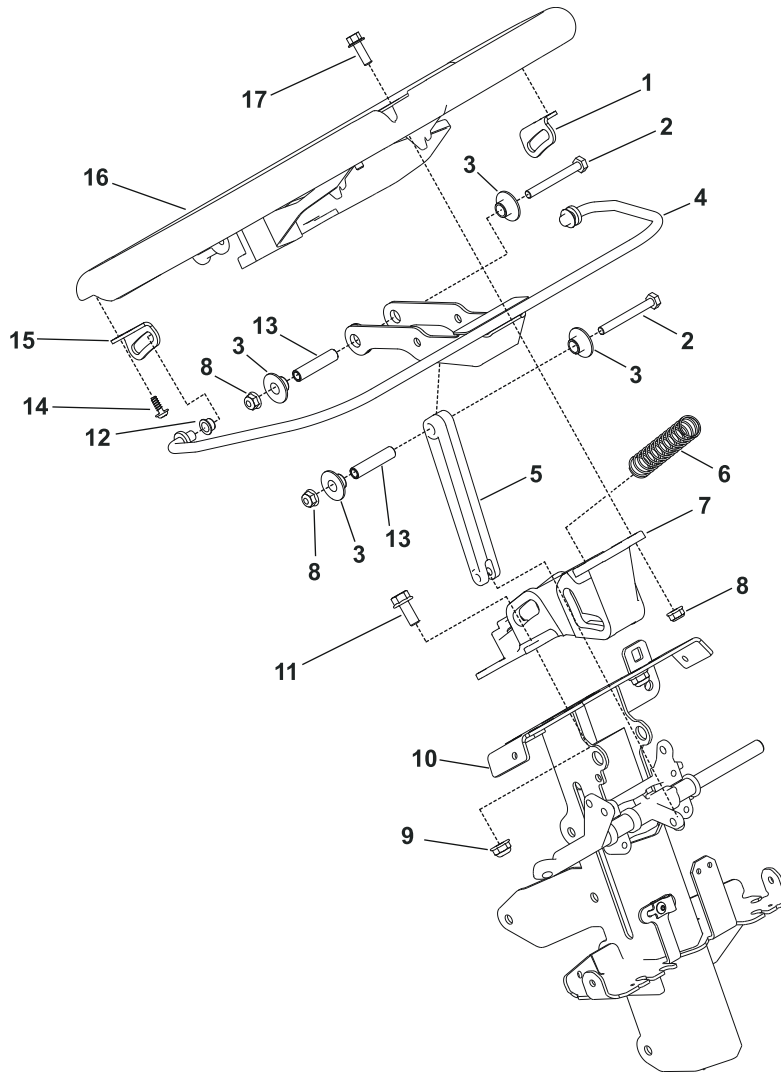
Disassembling the Handle Assembly

Note: Refer to [Figure 83](#) and [Figure 84](#) during this procedure.

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

Disassembling the Handle Assembly (continued)

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



g337168

Figure 85

- | | | |
|----------------------------|-----------------------------|--------------------------|
| 1. LH bail bracket | 7. Handle mount | 13. Spacer (2 each) |
| 2. Bolt (2 each) | 8. Flange nut (4 each) | 14. Delta screw (2 each) |
| 3. Flange bushing (4 each) | 9. Nut (2 each) | 15. RH bail bracket |
| 4. Clutch bail assembly | 10. Upper receiver weldment | 16. Handle |
| 5. Clutch bail link | 11. Bolt (2 each) | 17. Bolt (2 each) |
| 6. Compression spring | 12. Flange bushing (2 each) | |

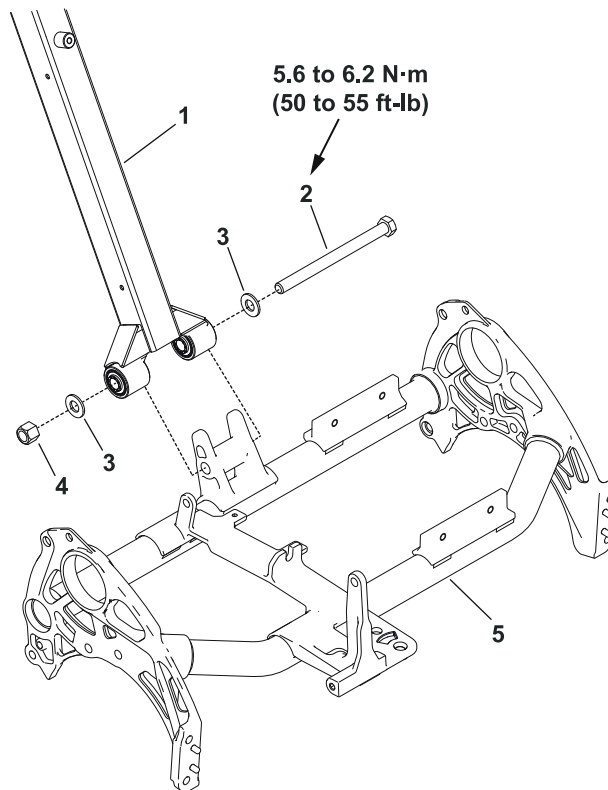
26. Remove the 2 nuts (item 8 in [Figure 85](#)) and 2 bolts (17) that secures the handle (16) to handle mount (7). Remove the handle from the clutch bail assembly and the handle mount.

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

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

Disassembling the Handle Assembly (continued)

29. Remove the flange nut (8) and bolt (2) that secure the clutch bail assembly (4) to the handle mount (7). Remove the clutch bail assembly from the handle mount. Remove the compression spring (6), 2 flange bushings (3) and spacer tube (13) from the handle mount.
30. Remove the 2 nuts (9) and 2 bolts (11) that secures the handle mount (7) to the upper receiver weldment (15). Remove the handle mount from the upper receiver weldment.



g337210

Figure 86

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

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

Assembling the Handle Assembly



1. If removed, install the lower handle assembly (item 1 in [Figure 86](#)) onto the frame assembly (5) and secure with the bolt (2), washers (3) and nut (4).
2. Lift the lower handle assembly to maximum top position and torque tighten the bolt (2) to **5.6 to 6.2 N·m (50 to 55 ft-lb)**.
3. Install the handle mount (item 7 in [Figure 85](#)) to the upper receiver weldment (10) and secure with 2 bolts (11) and 2 nuts (9).
4. Position the clutch bail link (5) in the handle mount (7). Install the spacer tube (13) and 2 flange bushings (3) to the handle mount. Secure the clutch bail link to the handle mount with the bolt (2) and flange nut (8).

Assembling the Handle Assembly (continued)

5. Position the compression spring (6), spacer tube (13) and 2 bushings (3) into the handle mount (7). Install the clutch bail assembly (4) to the handle mount (7) and secure with the bolt (2) and flange nut (8).
6. If removed, install the LH and RH bail brackets (1 and 15) to the handle (16) with the 2 screws (14).
7. Install the clutch bail assembly (4) to the handle (16). Secure the handle to the handle mount (7) with the 2 bolts (17) and 2 nuts (8).
8. Position the spring spacer (Item 24 in [Figure 83](#)) and handle torsion spring (23) into the handle adjuster assembly (22). Install the handle adjuster assembly to the upper receiver weldment (8) with the clevis pin (14), bearing washer (15) and cotter pin (18).
9. If removed, install the lift assist handle (27) to the upper receiver weldment (8) and secure with the bolts (16 and 11).
10. Slide the upper receiver weldment (8) in to the lower handle assembly (19) and secure with the bolt (29) and flange nut (9).

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

11. Reposition the wire harness.
12. If removed, install the flange bushings (5), bolt (12) and flange nut (13) into the brake lever (6).
13. Position the brake lever (6) to the upper receiver weldment (8) and secure with the shoulder screw (4) and flange nut (7).
14. Install the InfoCenter mount (item 4 in [Figure 84](#)) onto the handle and secure with the 4 screws (1).
15. Install the wire harness.
16. If removed, install the flange bushings (item 31 in [Figure 83](#)) inside the throttle arm (1).
17. If removed, slide the throttle lever (34) onto the throttle arm (1) and secure with bolt (32).

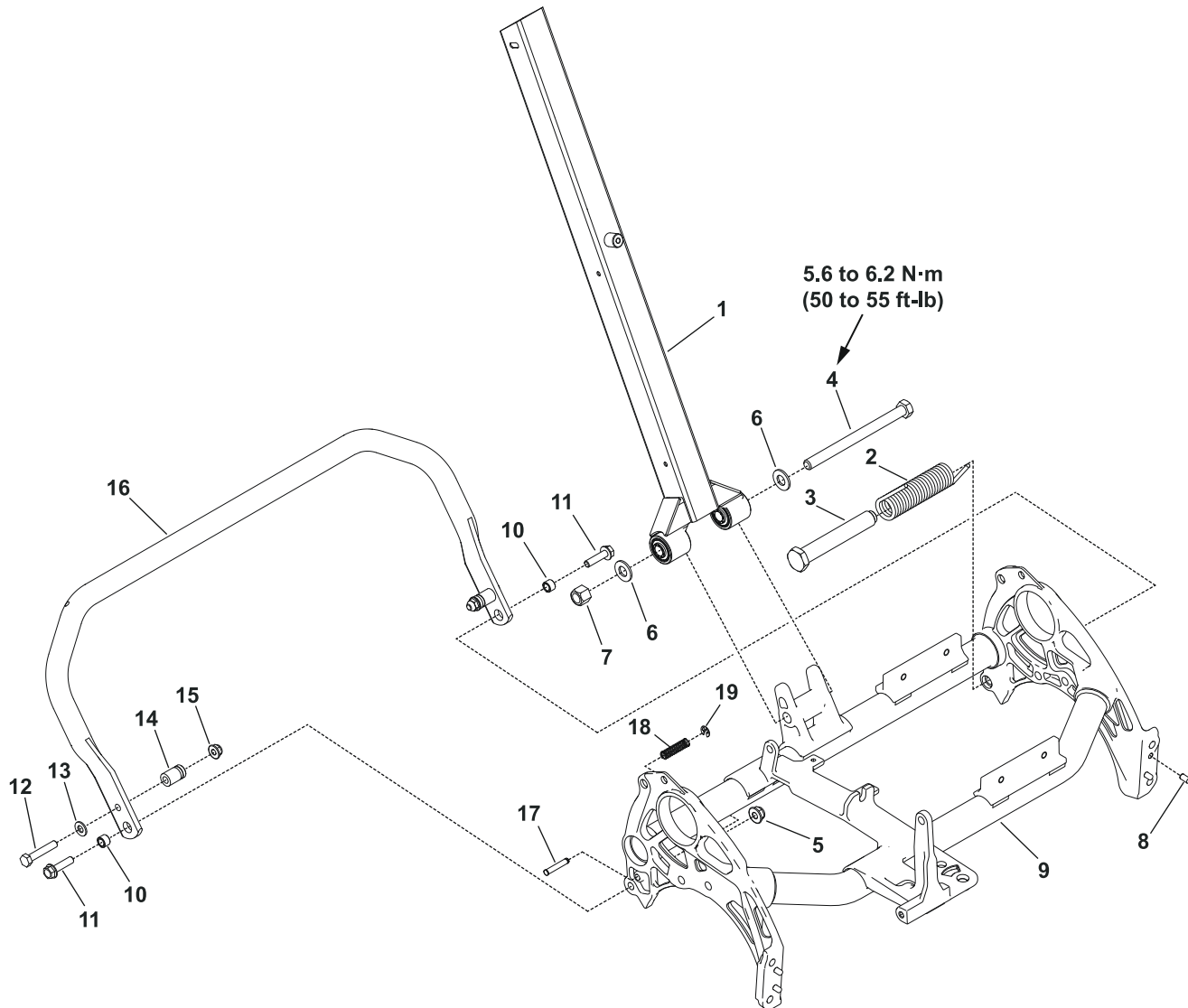


18. Torque tighten the bolt from **2.2 to 3.4 N·m (20 to 30 in-lb)**.
19. Install the throttle arm (1) to the handle assembly (3) and secure with bolt (30), washer (2) and nut (20).
20. Install the bolt (21) and 2 flange nuts (7) to the upper receiver weldment (8). Ensure that the head of the bolt is resting on the throttle arm (1).
21. Install the brake latch shaft; refer to [Assembling the Brake Latch Shaft \(page 6–12\)](#).
22. Install the clutch and reel drive lever assembly; refer to [Assembling the Cutting Unit Drive Lever Assembly \(page 6–10\)](#).
23. Install the reel cable; refer to [Installing the Reel Cable \(page 6–8\)](#).
24. Install the brake cable; refer to [Installing the Brake Cable \(page 6–5\)](#).
25. Install the throttle cable (27).
26. Adjust the traction bail proximity sensor; refer to [Adjusting the Traction Bail Proximity Sensor \(page 5–20\)](#).
27. Install the bottom control cover and re-position the wire harness to the upper receiver weldment and secure with the 2 screw and washer assemblies, 2 bolts and 2 nuts.

Assembling the Handle Assembly (continued)

28. Install the lower handle cover to the handle assembly and secure with the 4 bolts.
29. Install the control cover to the handle assembly and secure with the 4 bolts.
30. Connect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).

Kickstand



g337281

Figure 87

- | | | |
|--------------------------|------------------------------|------------------------|
| 1. Lower handle assembly | 8. Dowel pin (4 each) | 15. Nut (2 each) |
| 2. LH torsion spring | 9. Frame assembly | 16. Kickstand |
| 3. Spring mount pin | 10. Spacer (2 each) | 17. Kickstand lock pin |
| 4. Bolt | 11. Bolt (2 each) | 18. Compression spring |
| 5. Nut | 12. Bolt (2 each) | 19. E-ring |
| 6. Flat washer (2 each) | 13. Plain washer (2 each) | |
| 7. Lock nut | 14. Spring retainer (2 each) | |

Removing the Kickstand



CAUTION



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

The spring is under heavy load and may cause personal injury.

Removing the Kickstand (continued)

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

Installing the Kickstand

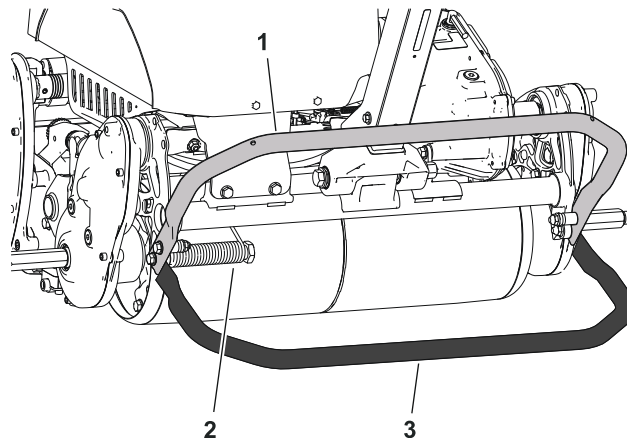
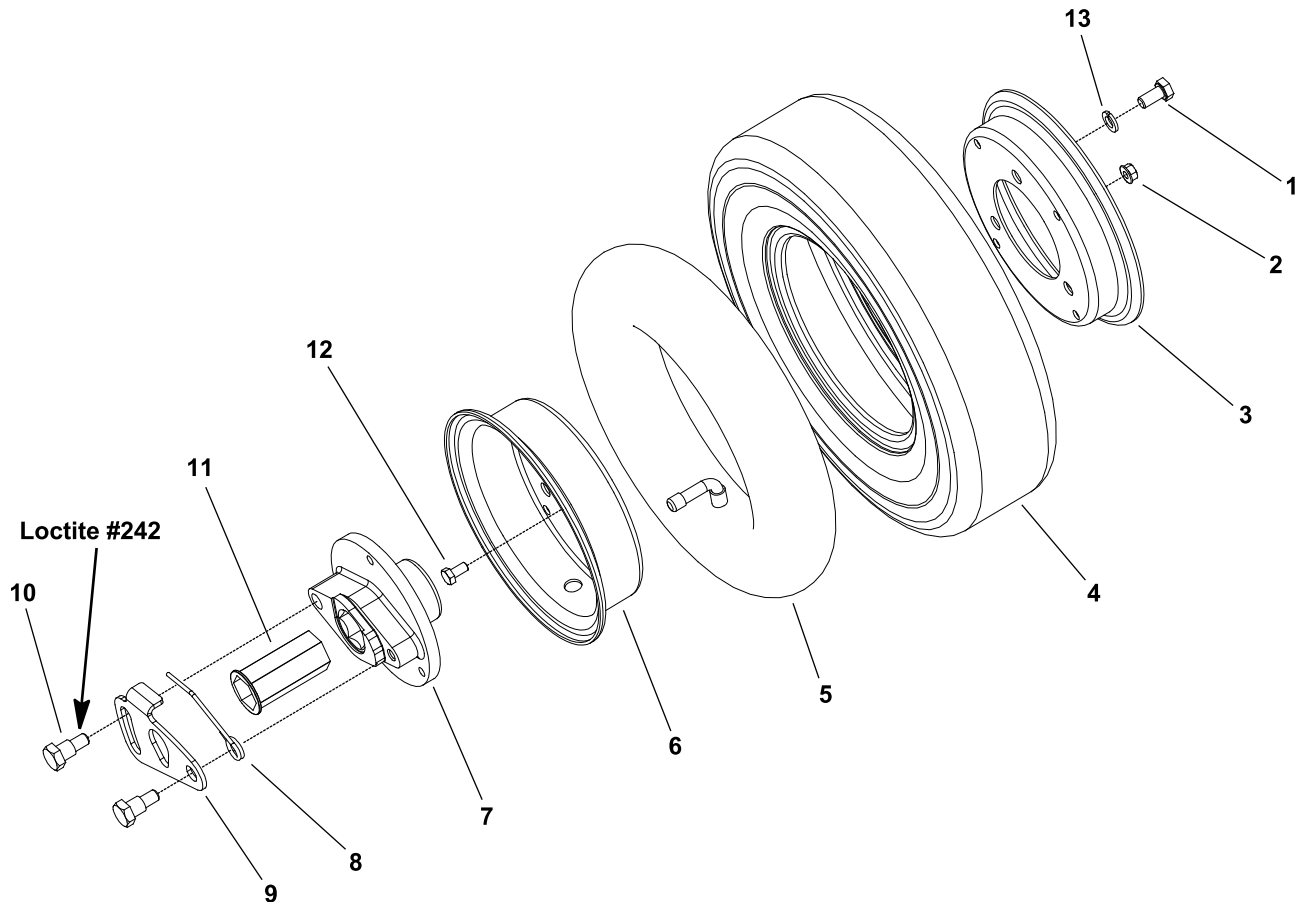


Figure 88

- | | |
|-----------------------|------------------------|
| 1. Kickstand (raised) | 3. Kickstand (lowered) |
| 2. Torsion spring | |

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

Transport Wheels (Optional)



g200275

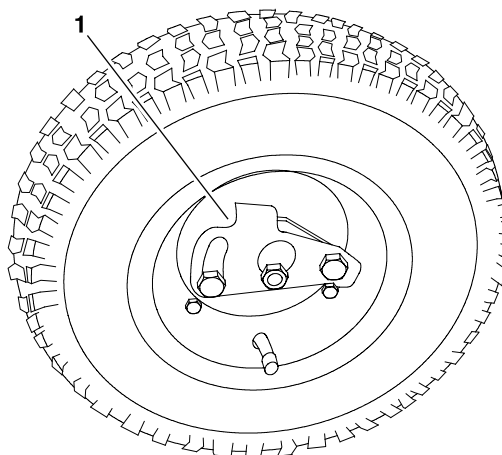
Figure 89

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

Removing the Transport Wheel

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

Removing the Transport Wheel (continued)



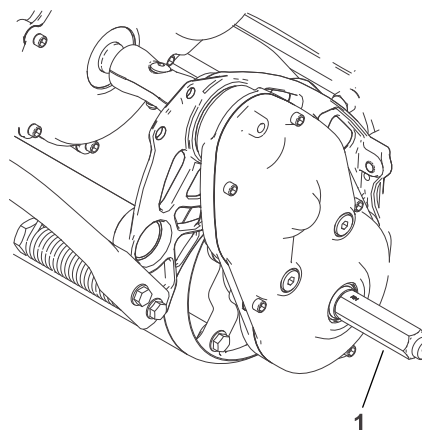
g200276

Figure 90

1. Wheel retaining lever

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

Disassembling the Transport Wheel



g261682

Figure 91

1. Wheel hex shaft

-
1. Ensure that the tire is fully deflated before disassembly of the wheel.
 2. Remove the 3 bolts and 3 lock washers from the shallow rim and hub. Remove the hub from the deep rim.
 3. Inspect the hub bushing. Replace the bushing, if worn or damaged.
 4. Remove the 4 bolts and 4 flange nuts from the deep rim and shallow rim. Remove the shallow rim from the deep rim.
 5. Separate the tire, tube and deep rim.
 6. If necessary, remove the shoulder screws, torsion spring, and retaining lever from the hub.

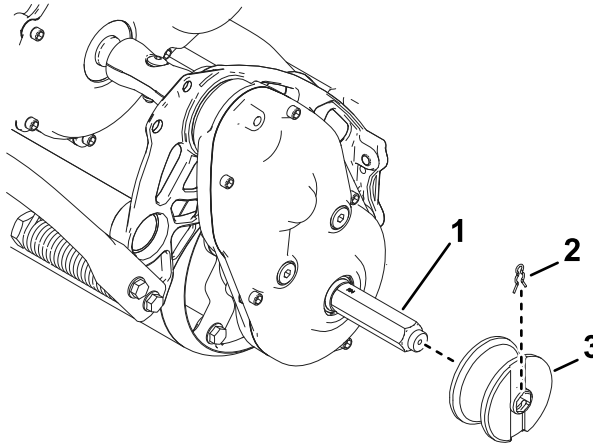
Assembling the Transport Wheel

1. If the shoulder screws were removed from the hub, apply Loctite #242 (or equivalent) to the threads of the shoulder screws. Secure the torsion spring and retaining lever to the hub with the shoulder screws.
2. Assemble the tire, tube, and deep rim.
3. Install the shallow rim into the tire. Align and secure the shallow rim to the deep rim with 4 bolts and 4 flange nuts. Tighten the fasteners.
4. Install the hub into the deep rim. Secure the hub to the deep rim with the 3 bolts and 3 lock washers. Tighten the fasteners.
5. Inflate the tire to **83 to 103 kPa (12 to 15 psi)**.

Installing the Transport Wheel

1. Ensure that the machine is parked on a level surface.
2. Support the machine onto the kickstand.
3. Slide the transport wheel completely onto the wheel hex shaft until the wheel retaining lever is secured into the groove onto the wheel hex shaft.

Rail Kit Wheels (Optional)



g261683

Figure 92

- | | |
|--------------------|-------------------|
| 1. Wheel hex shaft | 3. Rail kit wheel |
| 2. Wheel clip | |

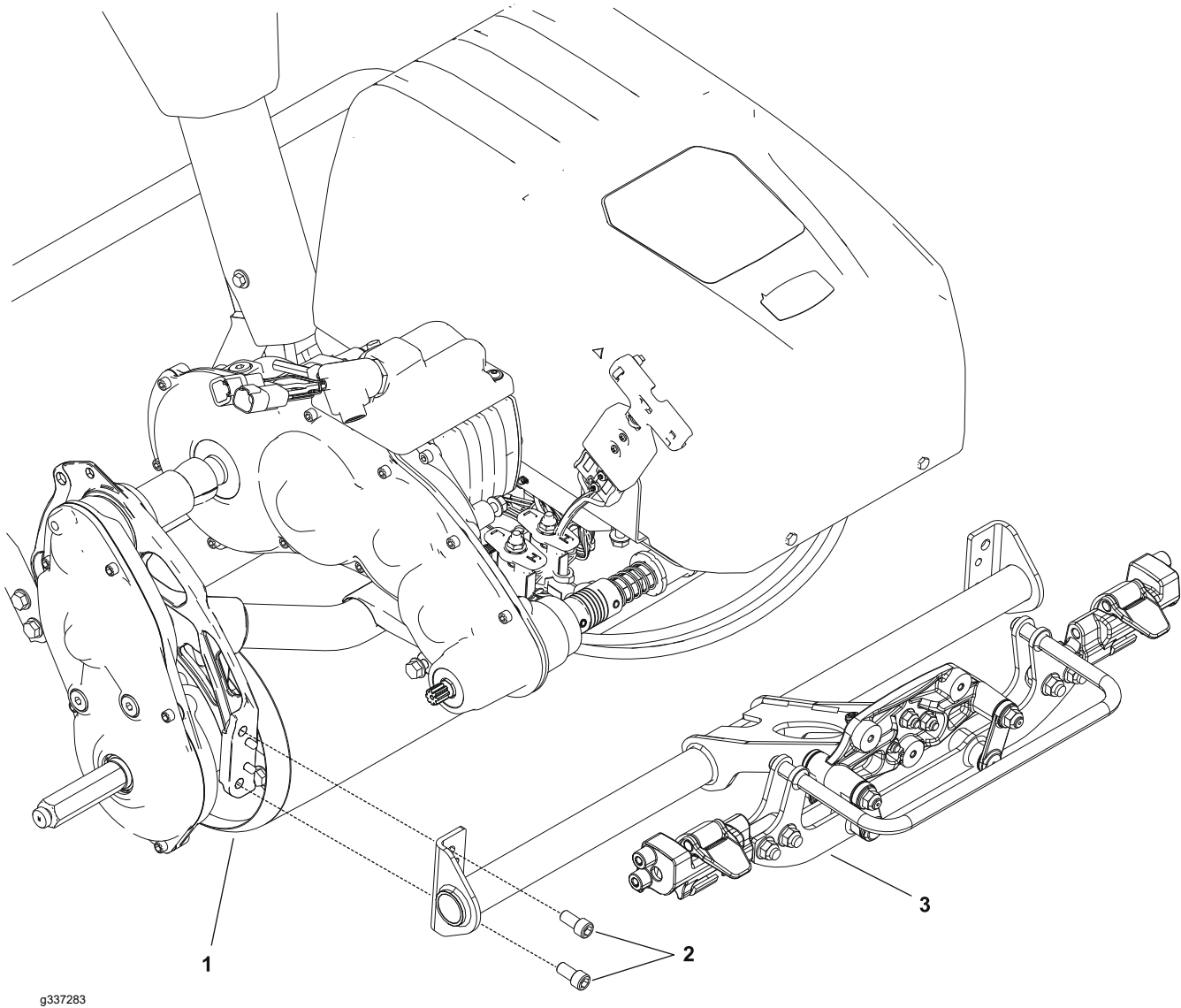
Removing the Rail Kit Wheel

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

Installing the Rail Kit Wheel

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

Flex Frame Assembly



g337283

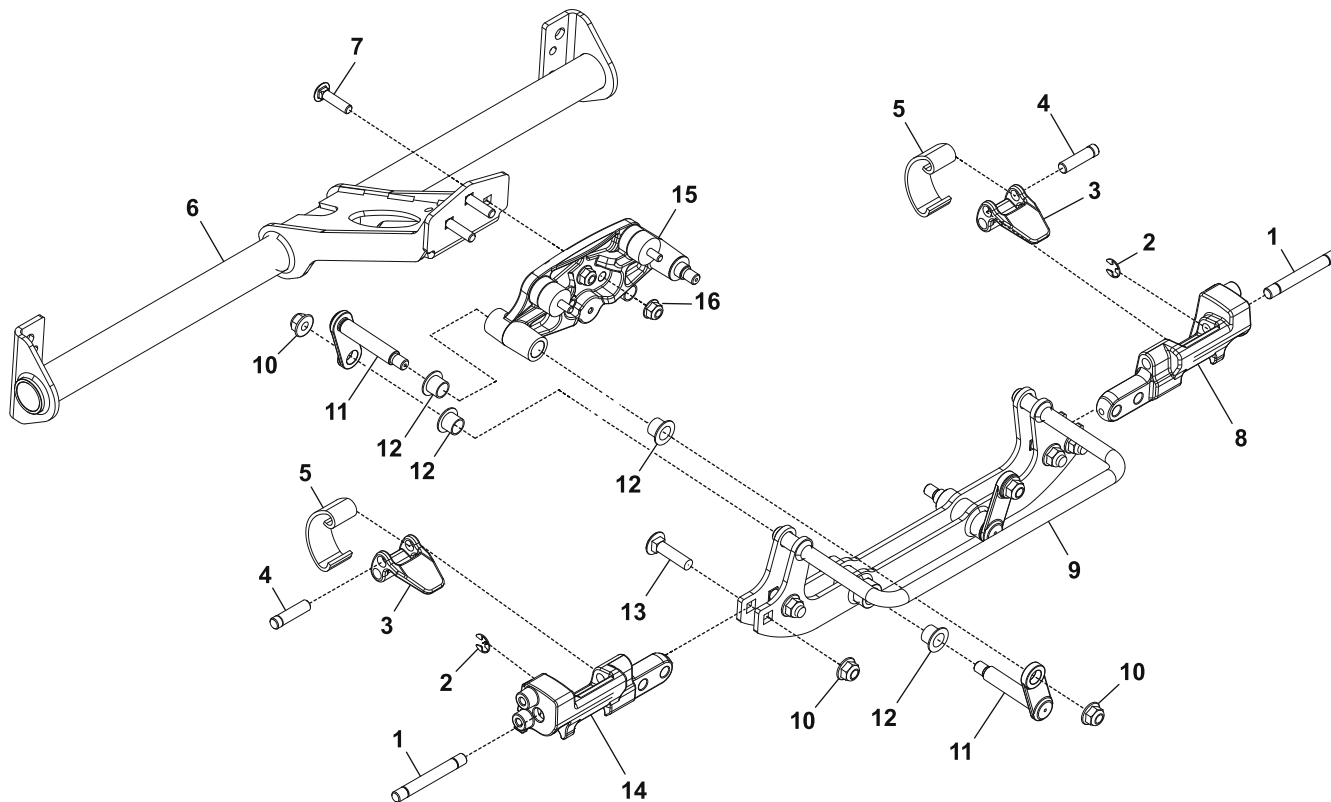
Figure 93

1. Machine assembly 2. Socket head screws (4 each) 3. Flex frame assembly

Removing the Flex Frame Assembly

1. Park the machine on a level surface. Ensure that the key switch is in OFF position and the traction control is in NEUTRAL.
2. Disconnect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5-3\)](#).
3. Remove the cutting unit from the machine; refer to *Operator's Manual*.
4. Remove the four socket head screws (2) that secures the flex frame assembly (2) to the machine assembly (1).
5. Slide and remove the flex frame assembly (2) from the machine assembly (1).

Disassembly of the Flex Frame Assembly



g337282

Figure 94

- | | | |
|-----------------------------|-----------------------------|----------------------------|
| 1. Pivot pin latch (2 each) | 7. Carriage bolt (3 each) | 13. Carriage bolt (4 each) |
| 2. E-ring (2 each) | 8. LH hub end | 14. RH hub end |
| 3. Lever (2 each) | 9. Roll frame assembly | 15. Frame link |
| 4. Pivot pin (2 each) | 10. Flange nut (8 each) | 16. Flange nut (3 each) |
| 5. Spring (2 each) | 11. Flex link (4 each) | |
| 6. Flex frame | 12. Flange bushing (8 each) | |

Disassemble the flex frame assembly using the [Figure 94](#) as a guide.

Assembly of the Flex Frame Assembly

Assemble the flex frame assembly using the [Figure 94](#) as a guide.

Installing the Flex Frame Assembly

1. Position the flex frame assembly onto the machine assembly.
2. Secure the flex frame assembly to the machine assembly with the four socket head screws.
3. Install the cutting unit onto the machine; refer to *Operator's Manual*.
4. Connect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).



DPA Cutting Units

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General Information

Cutting Unit Operator's Manual

The *Cutting Unit Operator's Manual* provides information regarding the operation, general maintenance, and maintenance intervals for the cutting units on your machine. Additionally, if optional kits have been installed on the cutting units (e.g. groomer), the *Installation Instructions* for the kit includes set-up, operation and maintenance information. Refer to the *Cutting Unit Operator's Manual* and the kit *Installation Instructions* for additional information when servicing the cutting units.

Supporting the Cutting Unit when Servicing

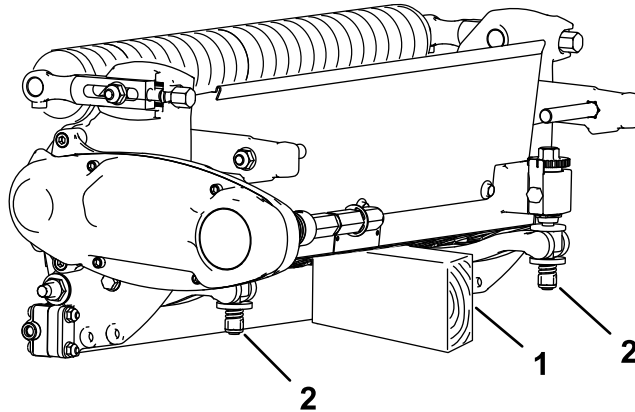


Figure 95

1. Support
2. Bedbar adjuster screw nuts

Whenever the cutting unit has to be tipped to expose the bedknife or cutting reel, support the rear of the cutting unit making sure the back of the bedbar adjuster screws are not resting on the work surface.

Adjustments

DPA Cutting Unit Characteristics



CAUTION



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

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

The dual point adjust (DPA) bedknife-to-reel adjustment system incorporated in this cutting unit simplifies the adjustment procedure needed to deliver optimum mowing performance. The precise adjustment possible with this design gives the necessary control to provide a continual self-sharpening action. This feature maintains sharp cutting edges, assures good quality of cut and greatly reduces the need for routine backlapping.

If a cutting unit is determined to be out of adjustment, complete the following procedures in the specified order to adjust the cutting unit properly.

1. Adjust the bedknife to reel contact; refer to the *Cutting Unit Operator's Manual*.
2. Adjust the bedknife after grinding, backlapping or disassembly; refer to the *Cutting Unit Operator's Manual*.
3. Adjust the height-of-cut; refer to the *Cutting Unit Operator's Manual*.
4. Adjust the cut-off bar; refer to the *Cutting Unit Operator's Manual*.

Leveling the Rear Roller

The precision machined components of the cutting unit frame keep the rear roller and cutting reel in alignment (parallel). If the side plates are disassembled a limited amount of side plate adjustment is possible to make sure that the rear roller and cutting reel remain parallel.

Note: Use a pie tape to measure the reel diameter taper; service limit 0.25 mm (0.01 inch). Leveling the rear roller of a cutting unit with a reel that exceeds the reel diameter taper limit is not recommended.

1. Ensure that the cutting unit bedknife is properly adjusted to the reel; refer to the cutting unit *Operator's Manual*.
2. Place the assembled cutting unit on a cutting unit bench plate so at least three of the reel blades contact the bench plate rib.

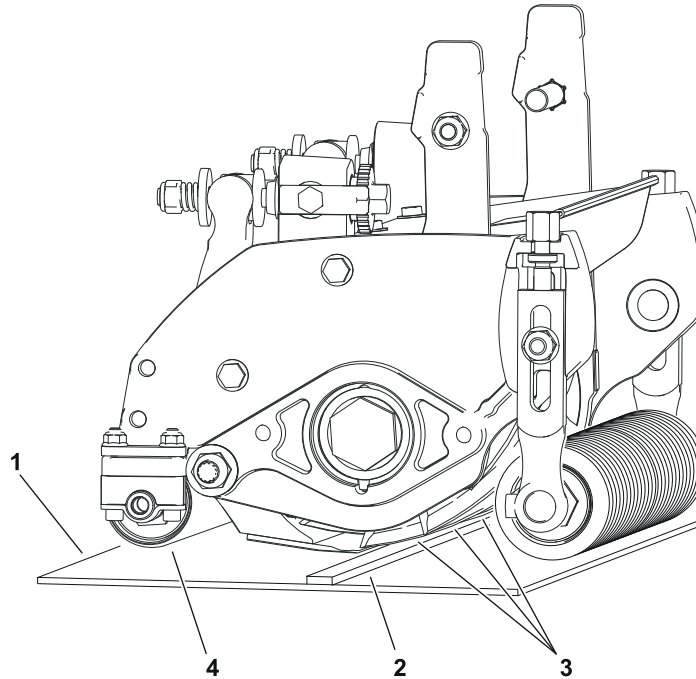


Figure 96

- | | |
|--------------------|------------------------------|
| 1. Bench plate | 3. Reel blade contacting rib |
| 2. Bench plate rib | 4. Rear roller |

3. Check if the rear roller is parallel to the cutting reel by trying to fit a 0.13 mm (0.005 in) shim between the rear roller and the bench plate at each end of rear roller. Rotate the roller and recheck the clearance at each end a few times to account for any roller run-out. If the shim will pass under the roller through the rollers entire rotation, the rear roller is not parallel to the reel or is high on one side and an adjustment should be made.

Note: If the cutting unit has an optional rear roller adjustment kit (eccentric roller shaft bushing), loosening the cutting unit side plate should not be necessary. Adjust the rear roller by loosening the rear roller clamp fasteners and rotating the eccentric bushing as necessary; refer to the rear roller adjustment kit *Installation Instructions* for additional information.

4. Loosen, but do not remove, the two shoulder bolts that secure the side plate to the frame on the side of the cutting unit where the rear roller is high (not contacting the bench plate).

Leveling the Rear Roller (continued)

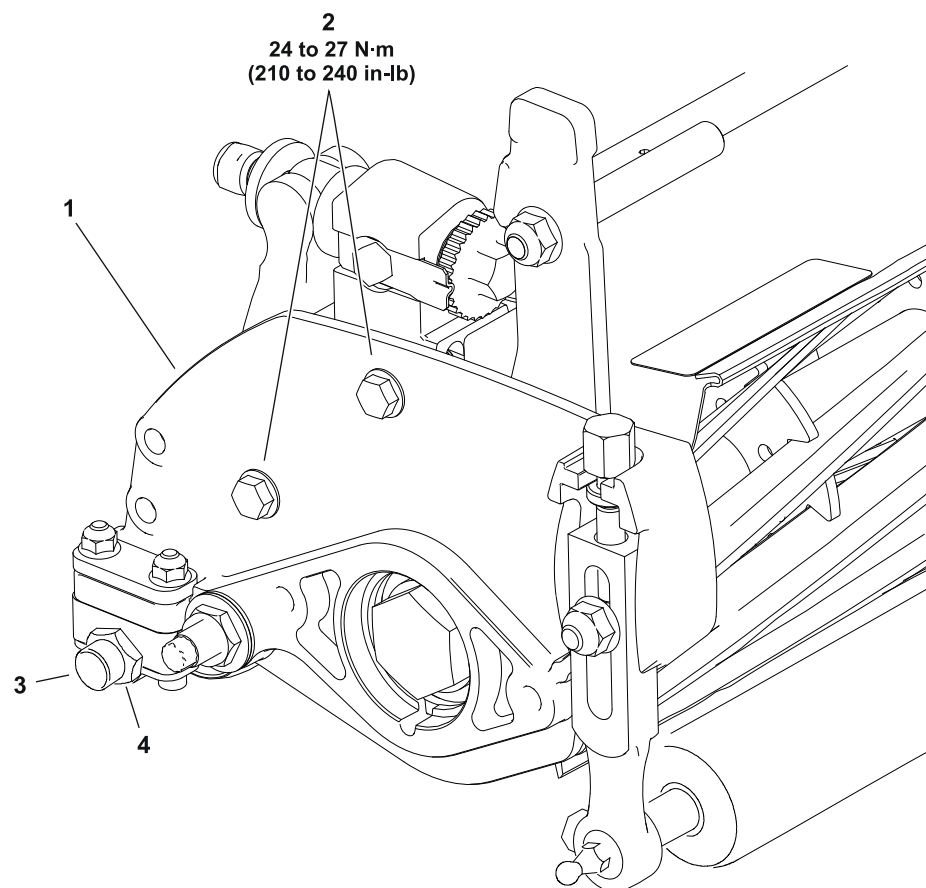


Figure 97

- | | |
|---------------------------|--|
| 1. Side plate | 3. Rear roller |
| 2. Shoulder bolt (2 each) | 4. Rear roller adjustment kit (optional) |



5. Adjust the position of the side plate so the rear roller contacts the bench plate at both ends, making the rear roller parallel to the reel. Tighten the shoulder bolts from **24 to 27 N·m (210 to 240 in-lb)**.
6. Recheck the clearance between the rear roller and the bench plate. If necessary, loosen and adjust second side plate on the side of the cutting unit where the rear roller is low (contacting the bench plate).
7. Complete the cutting unit set-up and adjustment procedure.

Bedbar Assembly

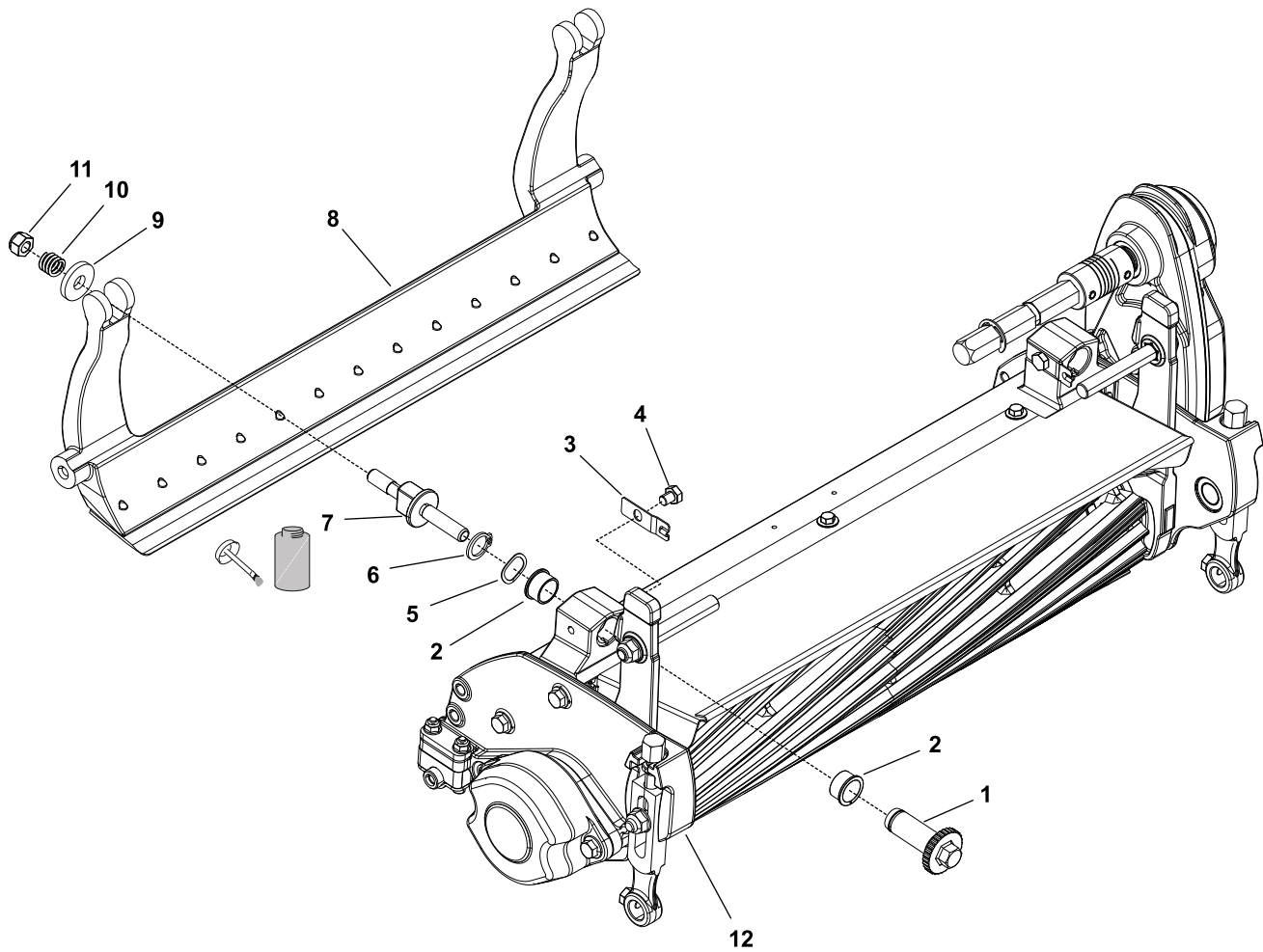


Figure 98

- | | | |
|-----------------------------------|-----------------------------------|------------------------|
| 1. Bedbar adjuster shaft (2 each) | 5. Wave washer (2 each) | 9. Washer (2 each) |
| 2. Keyed flanged bushing (4 each) | 6. Retaining ring (2 each) | 10. Compression spring |
| 3. Detent (2 each) | 7. Bedbar adjuster screw (2 each) | 11. Nut (2 each) |
| 4. Bolt (2 each) | 8. Bedbar assembly | 12. Side plate |

Removing the Bedbar

Note: Refer to [Figure 98](#) during this procedure.

1. Remove the cutting unit from the machine and place the cutting unit on a flat work surface; refer to *Operator's Manual*.
2. Loosen the nuts (11) on the end of each bedbar adjuster assembly (1) until the washers (9) are loose.
3. Tip the cutting unit to expose the bedknife and support the rear of the cutting unit; refer to [Supporting the Cutting Unit when Servicing \(page 7-2\)](#).

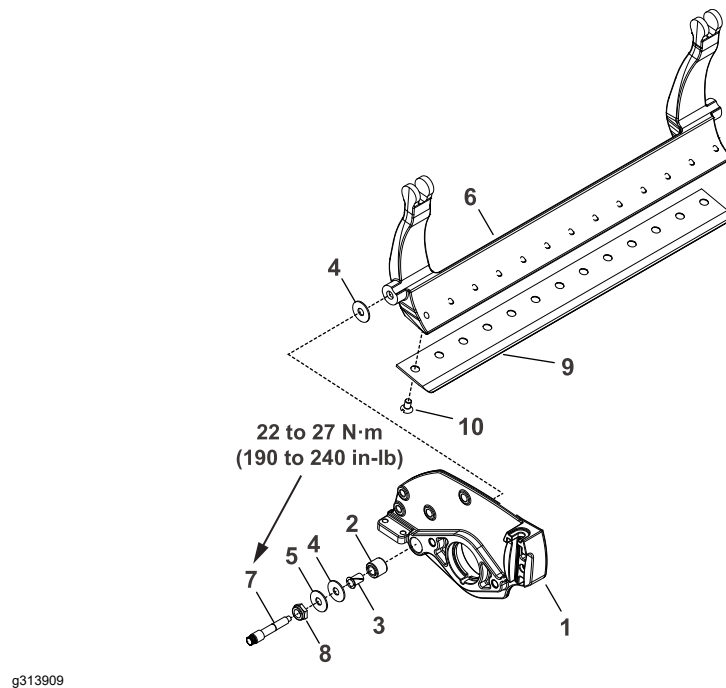


Figure 99

- | | |
|----------------------------|----------------------|
| 1. Side plate | 6. Bedbar |
| 2. Rubber bushing | 7. Bedbar pivot bolt |
| 3. Nylon bushing | 8. Lock nut |
| 4. Plastic washer (2 each) | 9. Bed knife |
| 5. Metal washer | 10. Screw (13 each) |

4. Loosen the locknuts (item 8 in [Figure 99](#)) on each bedbar bolt (7).
5. Remove the two bedbar bolts (item 7 in [Figure 99](#)), two flat washers (5) and four plastic washers (4) from the cutting unit side plates (1).



CAUTION



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

6. Remove the bedbar assembly (8) from the cutting unit.
7. Inspect the nylon bushings (item 3 in [Figure 99](#)) and rubber bushings (4) in the side plates for wear or damage. Replace the bushings if necessary.

Installing the Bedbar

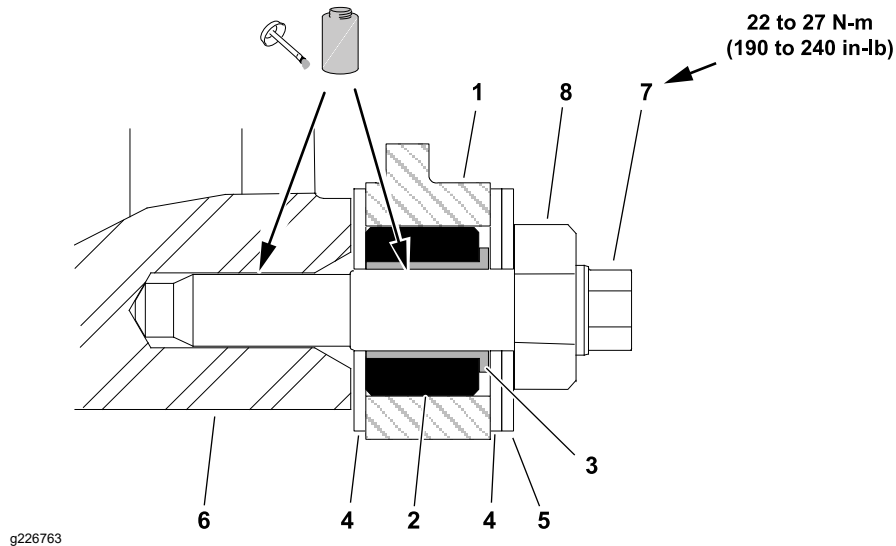


Figure 100

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

1. If rubber bushing (item 2 in Figure 100) was removed from either side plate, apply grease to outside surface of new bushing and install into side plate (1). The bushing (4) should be installed flush with the inside surface of the side plate; refer to Figure 100.
2. If removed, install the nylon bushings (4) with flange facing outward; refer to Figure 100.
3. Apply anti-seize lubricant to the threads and shank of each bedbar bolt (7); refer to Figure 100.



CAUTION



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

Note: If a new bedknife is attached to the bedbar, there may be interference between the bedknife and the reel when installing the bedbar. Turn the bedbar adjusting screws counterclockwise to increase bedknife clearance if necessary.

4. Position the bedbar assembly (8) into the cutting unit. Make sure that the top of each bedbar arm is between the washer (9) and adjuster screw flange (7).

IMPORTANT

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

5. Position one plastic washer (item 4 in Figure 100) between the bedbar (16) and each side plate (1).
6. Slide a metal washer (item 5 in Figure 100) onto the bedbar bolt (7).

Installing the Bedbar (continued)



7. Install the bedbar bolt assemblies (item 7 in [Figure 100](#)). Make sure that the washers are not caught on the threads of the pivot bolts. Torque tighten each bedbar bolt (7) from **22 to 27 N·m (190 to 240 in-lb)**.

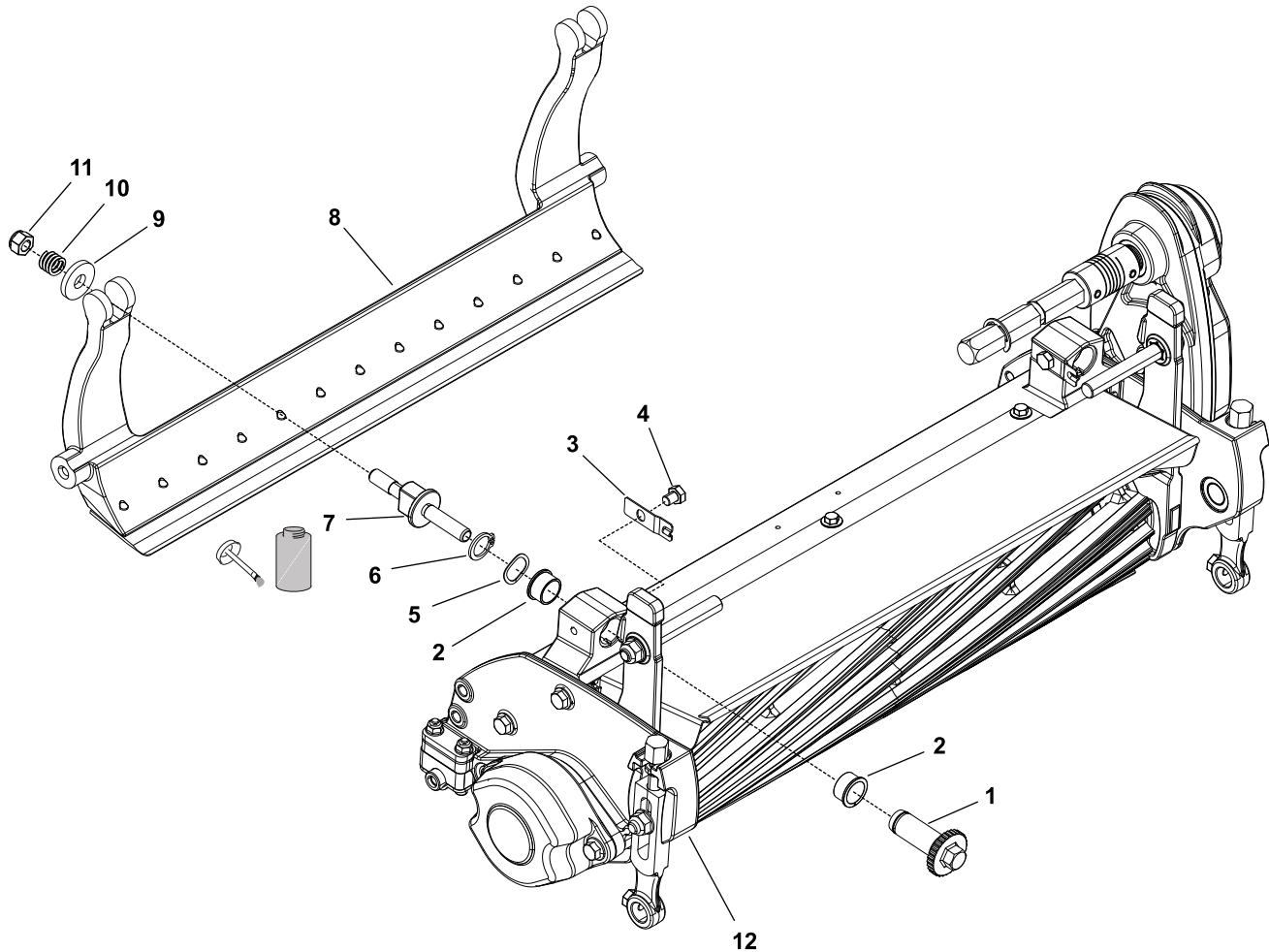
IMPORTANT

Do not over tighten the lock nuts as this can distort the side plates and affect reel bearing alignment. When the lock nut is correctly tightened, the inside washers may be loose.

8. Tighten both lock nuts (item 8 in [Figure 100](#)) until outside metal washers do not have any end play and can still be rotated.
9. Tighten the nut (item 11 in [Figure 98](#)) on each bedbar adjuster screw (7) until the adjuster spring (10) is fully compressed, then loosen the nut (11) to 1/2 turn.
10. Adjust the bedknife to reel contact; refer to the *Cutting Unit Operator's Manual*.

Servicing the Bedbar Adjuster

Removing the Bedbar Adjuster



g312976

Figure 101

- | | | |
|-----------------------------------|-----------------------------------|------------------------|
| 1. Bedbar adjuster shaft (2 each) | 5. Wave washer (2 each) | 9. Washer (2 each) |
| 2. Keyed flanged bushing (4 each) | 6. Retaining ring (2 each) | 10. Compression spring |
| 3. Detent (2 each) | 7. Bedbar adjuster screw (2 each) | 11. Nut (2 each) |
| 4. Bolt (2 each) | 8. Bedbar assembly | 12. Side plate |

Note: Refer to [Figure 101](#) during this procedure.

1. Remove bedbar; refer to [Removing the Bedbar \(page 7–7\)](#).
2. Remove the lock nut (11), compression spring (10) and washer (9) from the bedbar adjuster screw (7).

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

3. Unscrew the bedbar adjuster shaft (1) from the bedbar adjuster screw (7).
4. Remove the retaining ring (6) and wave washer (5) from the adjuster shaft (7) and remove the adjuster shaft.
5. Inspect the flange bushings (2) in the cutting unit side plate (12) and replace them if necessary.
6. Inspect the detent (3) and replace it if necessary.

Installing the Bedbar Adjuster

1. If previously removed, secure the detent (3) to the side plate (12) with the bolt (4).
2. If previously removed, align the key on the flange bushings (2) to the slots in the cutting unit side plate (12) and install.
3. Slide adjuster shaft (1) into flange bushings (2) and secure with a wave washer (5) and a retaining ring (6).

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

4. Apply anti-seize lubricant to the threads of the bedbar adjuster screw (7) that fit into adjuster shaft (1) (the left hand threads) and thread the bedbar adjuster screw into the adjuster shaft.
5. Install the washer (9), compression spring (10) and lock nut (11) onto the adjuster screw (7).
6. Install the bedbar (8); refer to [Installing the Bedbar \(page 7–8\)](#).

Bedknife

Removing the Bedknife

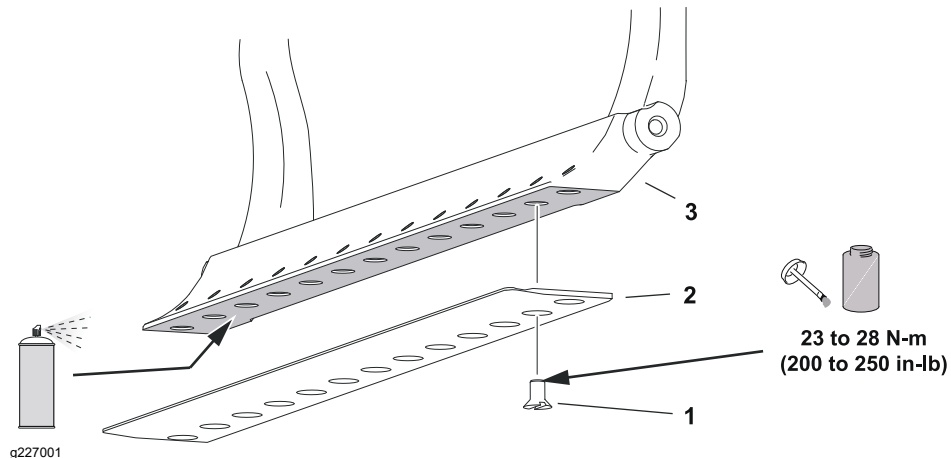


Figure 102

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

1. Remove the bedbar from the cutting unit; refer to [Removing the Bedbar \(page 7-7\)](#).
2. Remove screws from bedbar using a socket wrench and bedknife screw tool; refer to [Special Tools \(page 2-13\)](#). Discard the screws. Remove bedknife from the bedbar.
3. Refer to [Grinding the Bedknife \(page 7-14\)](#) for additional information.

Installing the Bedknife

1. Use a scraper to remove all rust, scale and corrosion from the bedbar surface under the bedknife. Lightly oil the bedbar surface before installing the bedknife.
2. Make sure that screw threads in bedbar (5/16-18UNC-2A) are clean.

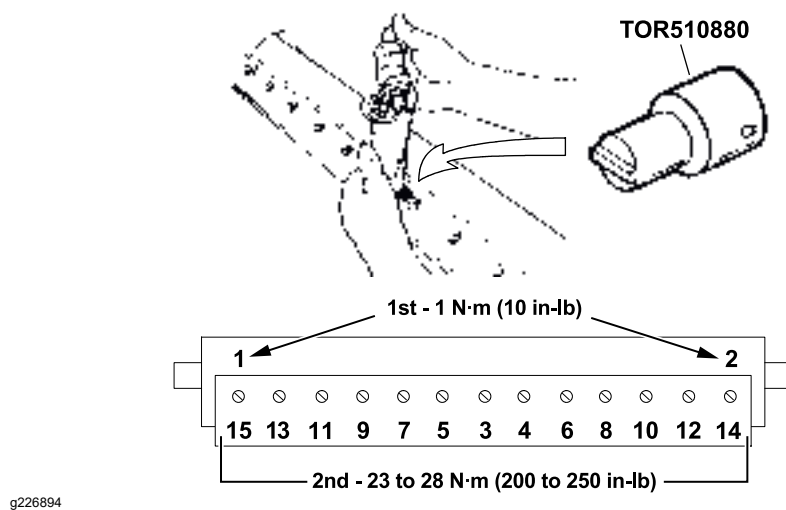


Figure 103

IMPORTANT

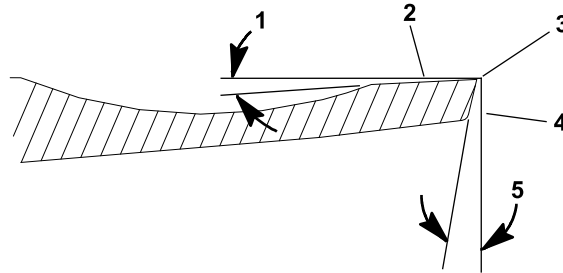
Do not use an impact wrench to tighten screws into the bedbar.

3. Use new screws to secure bedknife to bedbar. Apply anti-seize lubricant to the threads of new screws. Do not apply anti-seize lubricant to the taper of the screw heads.
4. Install all screws but do not tighten.
5. Using a torque wrench and bedknife screw tool, tighten the 2 outer screws to **1 N·m (10 in-lb)**.
6. Working from the center of the bedknife toward each end, tighten screws from **23 to 28 N·m (200 to 250 in-lb)**.
7. After installing the bedknife to bedbar, grind the bedknife.

Grinding the Bedknife

Bedknife Grinding Specifications

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

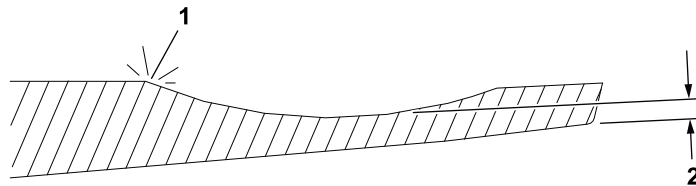


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Figure 104

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

Since there can be variations in the mounting surface of the bedbar, it is necessary to grind the bedknife after installing it to the bedbar. Follow the bedknife grinding specifications provided; refer to [Bedknife Grinding Specifications \(page 7–14\)](#). Grind only enough so the top surface of the bedknife is true; refer to [Figure 104](#).



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Figure 105

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

IMPORTANT

Do not grind the bedknife below its service limit; refer to [Figure 105](#). Operating the cutting unit with the bedknife below the service limit may result in poor after-cut appearance and reduce the structural integrity of the bedknife.

The bedknife service limit occurs when the reel contacts the back of the bedknife scallop during operation. Check for reel contact marks at the back of the bedknife scallop prior to grinding. The bedknife service limit may also occur when the bottom of the bedknife scallop is reached when grinding the bedknife.

When grinding the bedknife, be careful to not overheat the bedknife. Remove small amounts of material with each pass of the grinder. **Also, clean and dress grinding stone often during the grinding process.**

IMPORTANT

EdgeMax® bedknives are extremely hard. Using a diamond grinding wheel is recommended to prevent overheating or damaging the bedknife edge while grinding.

Because the top grind angle on bedknives is critical for edge retention, and therefore after-cut appearance, Toro has developed special service tools for accurately measuring the top grind angle on all bedknives; refer to [Angle Indicator and Magnetic Mount \(page 2–15\)](#).

1. Use Toro General Service Training Book, Reel Mower Basics (part no. 09168SL) and grinder manufacturer's instructions for bedknife grinding information.
2. After grinding the bedknife, install the bedbar assembly in the cutting unit; refer to [Installing the Bedbar \(page 7–8\)](#).

Note: Always adjust the cutting unit after grinding the reel and/or bedknife; refer to the *Cutting Unit Operator's Manual*. If a properly adjusted cutting unit does not cut paper cleanly after grinding, the grind angle may be incorrect. To extend the cutting unit performance by allowing the reel and the bedknife to hold their edge longer, an additional adjustment may be required after the first few minutes of operation as the reel and bedknife conform to each other.

Reel Assembly

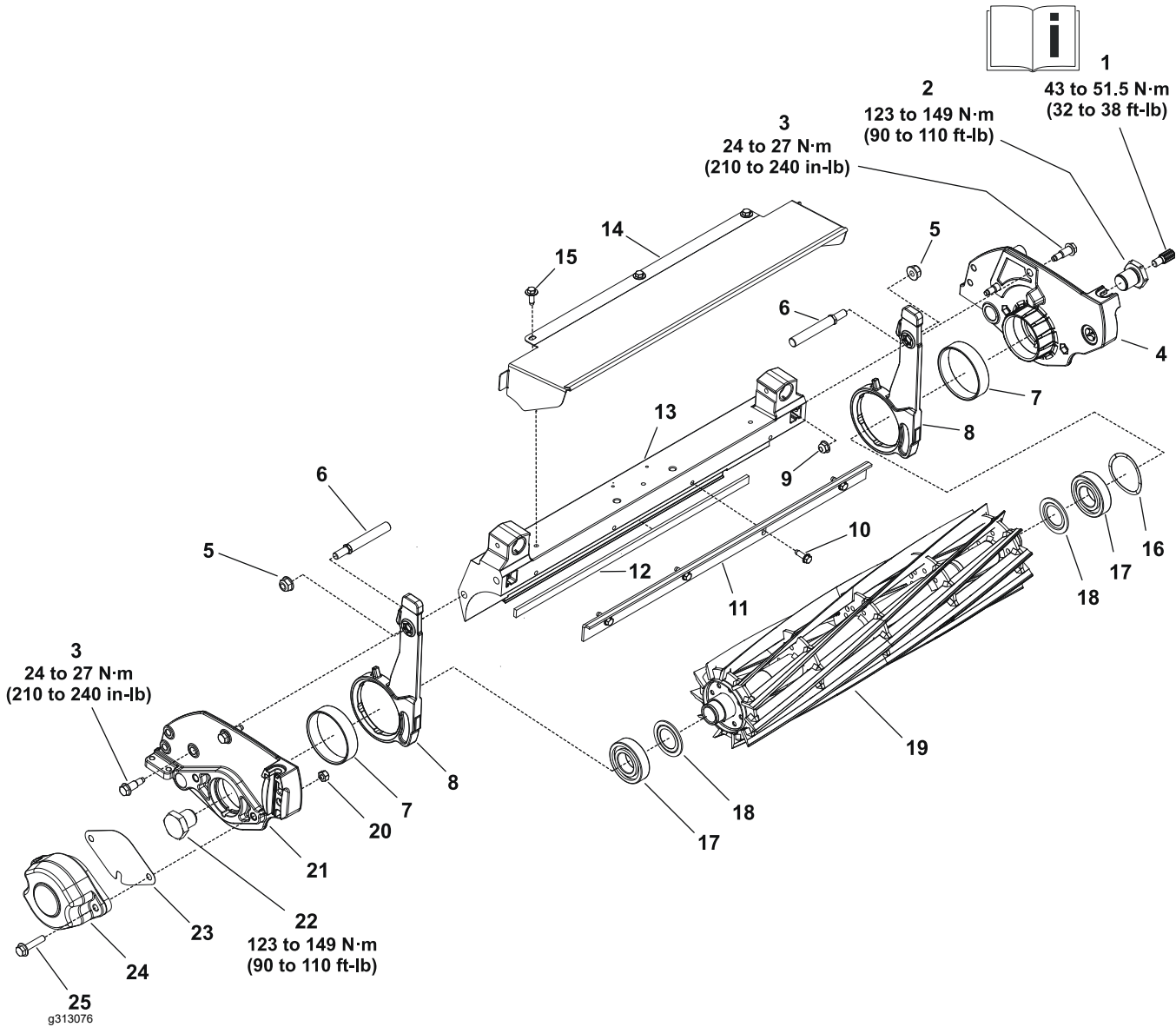


Figure 106

- | | | |
|-------------------------|----------------------|-------------------|
| 1. Drive spline | 10. Bolt | 19. Reel assembly |
| 2. Reel nut - LH | 11. Cutoff bar | 20. Nut |
| 3. Flange shoulder bolt | 12. Strip seal | 21. RH side plate |
| 4. LH side plate | 13. Crossmember | 22. Reel nut - RH |
| 5. Nut | 14. Grass shield | 23. Gasket |
| 6. Mount pin | 15. Bolt | 24. Counterweight |
| 7. Bushing | 16. Flat wire spring | 25. Bolt |
| 8. Pitch arm | 17. Sealed bearing | |
| 9. Flange nut | 18. Seal | |

This section provides the procedure for removing and installing the reel assembly (reel, reel bearing, bearing lock screw, reel nut and seals) from the cutting unit.

Removing the Reel Assembly

Note: Refer to [Figure 106](#) during this procedure.

Removing the Reel Assembly (continued)

1. Park the machine on a level surface. Ensure that the key switch is in OFF position and the traction control is in NEUTRAL.
2. Disconnect the battery pack; refer to [Connecting the Lithium Battery Pack \(page 5–3\)](#).
3. Remove the cutting unit assembly from the machine; refer to the traction unit *Operator's Manual*.
4. If the cutting unit is equipped with an optional groomer, remove the groomer gear box; refer to [Removing the Gear Box Assembly \(page 8–4\)](#).
5. Remove the reel drive assembly; refer to [Removing the Reel Drive Assembly \(page 4–7\)](#).
6. Remove the fasteners securing the counterweight (24) and gasket (23) to the RH side plate. Remove the counterweight and discard the gasket.



CAUTION

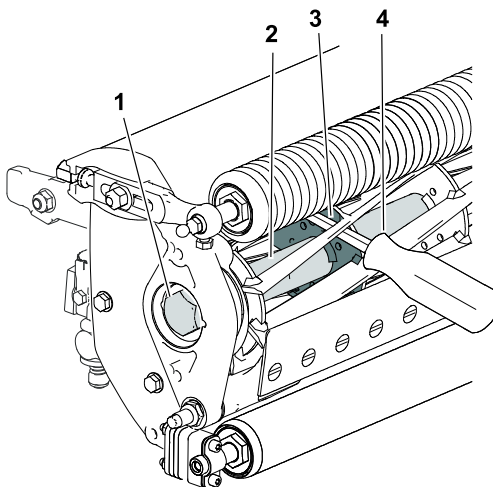


Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when removing the cutting reel.

IMPORTANT

If the reel bearings or seals are being replaced, the right and left reel nuts must be removed. Use the following procedure to restrain the reel and loosen the components before removing the rollers.

7. Loosen the RH reel nut and LH reel nut.
 - A. Tip up the cutting unit to access the bottom of the reel.



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Figure 107

- | | |
|------------------|-----------------------------|
| 1. Reel nut – RH | 3. Support plate, weld side |
| 2. Reel shaft | 4. Pry bar |

- B. Insert a long- handled pry bar (3/8 x 12 inch with screwdriver handle recommended) through the bottom of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move; refer to [Figure 107](#).

IMPORTANT

To avoid grinding the reel, do not contact the cutting edge of any blade with the pry bar as this may damage the cutting edge and/or cause a high blade.

- C. Move the pry bar against the weld side of the reel support plate closest to the reel nut being removed.

IMPORTANT

The LH reel nut (with drive shaft) on the left end of the cutting reel has left- hand threads. The reel nut on the right end of the cutting reel has right- hand threads.

- D. Rest the handle of the pry bar against the front roller and loosen the reel nut.
- E. Position the pry bar in the same manner on the opposite end of the reel and loosen the remaining reel nut.
- F. Tip the cutting unit back onto its rollers.
8. Remove the bedbar; refer to [Removing the Bedbar \(page 7–7\)](#).
9. Remove the front roller; refer to [Removing the Front Roller \(page 7–26\)](#).
10. Remove the rear roller; refer to [Removing the Rear Roller \(page 7–27\)](#).
11. Support the cutting reel to prevent it from shifting or falling and remove the 2 socket head screws (3) that secure the LH side plate (4) to the crossmember (13).
12. Remove the 2 socket head screws (3) that secure the RH side plate (21) to the crossmember (13).
13. Remove the crossmember (13) from the reel assembly (19).
14. If necessary, remove the three bolts (15) that secures the grass shield (14) to the crossmember (13). Remove the grass shield (14) from the crossmember (13).
15. Carefully slide the cutting reel assembly (with seals, bearings and reel nuts) from the side plates. Retrieve the flat wire spring from the reel bearing bore of the left side plate.
16. Thoroughly clean any grease and corrosion from the reel bearing bores in the side plates.
17. Inspect the remaining cutting unit components for corrosion, wear, or damage and replace the components as necessary.

Inspecting the Reel Assembly

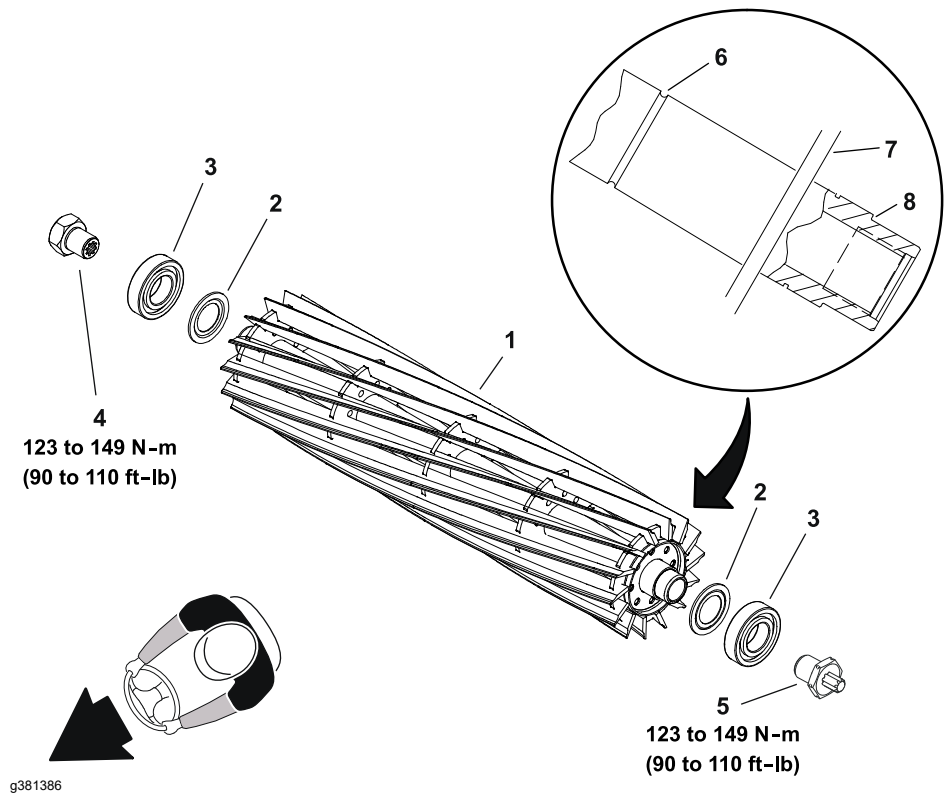


Figure 108

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

1. Remove the reel nuts from the cutting reel.
2. Slide the bearings and seals from the reel shaft. Discard the seals and inspect the reel bearings to insure that they spin freely and have a minimal amount of axial play.
3. Inspect the reel as follows:
 - A. Place the reel shaft ends in V-blocks and check the reel shaft for distortion.
 - B. Check the threads in the ends of the reel shaft.
 - C. Check the reel blades for bending or cracking.
 - D. Check the service limit of the reel diameter; refer to [Preparing the Reel for Grinding \(page 7-24\)](#).
4. Replace the reel if damage is evident.

IMPORTANT

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

5. Slide the new flocked seals and the bearings onto the reel shaft until they contact the shoulder of the reel shaft.

Inspecting the Reel Assembly (continued)

Note: The reel nut on the left end of the cutting reel has a black finish and has left-hand threads. The left end of the cutting reel shaft is identified with a groove cut just inside of the left-most reel spider. Tighten the reel nuts to the specified torque once the cutting reel is installed in the cutting unit.

6. Inspect the LH reel nut and spline adapter:

- A. Ensure that the spline adapter is not loose or damaged.

Note: The spline adapter was installed at the factory with high strength thread locking compound. Heat the LH reel nut prior to removing the spline adapter.

- B. If removing the spline adapter is necessary, use a reel nut from a current riding Greensmaster cutting unit as a tool; refer to [Spline Adapter Tool \(page 2–14\)](#).

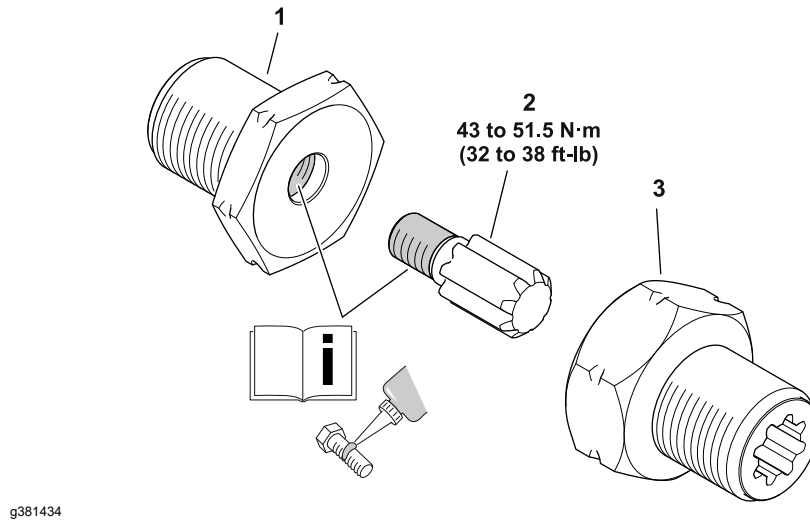


Figure 109

- | | |
|-------------------|--|
| 1. LH reel nut | 3. Tool (riding Greensmaster reel nut) |
| 2. Spline adapter | |

- C. Clean and inspect the spline adapter threads and the internal threads of the LH reel nut. Replace the spline adapter or LH reel nut if necessary.

IMPORTANT

Use high strength thread locking compound (Loctite 271 or equivalent) OR factory applied thread locking compound (patch lock) to lock the spline adapter in place. Combining the two compounds will not hold the spline adapter in position sufficiently.

- D. **If installing a used spline adapter:** Remove any residual thread locking compound from the spline adapter threads and the internal threads of the LH reel nut. Apply a liberal amount of high strength thread locking compound (Loctite 271 or equivalent) to the threads of the spline adapter and the internal threads of the LH reel nut prior to installation.

If installing a new spline adapter without factory applied thread locking compound (patch lock): Remove any residual thread locking compound from the internal threads of the LH reel nut. Apply a liberal amount of high strength thread locking compound (Loctite 271 or

Inspecting the Reel Assembly (continued)

equivalent) to the threads of the spline adapter and the internal threads of the LH reel nut prior to installation.

If installing a new spline adapter with factory applied thread locking compound (patch lock): Remove any residual thread locking compound from the internal threads of the LH reel nut.



- E. Use a reel nut from a current riding Greensmaster cutting unit to install the spline adapter. Tighten the spline adapter from **43 to 51.5 N·m (32 to 38 ft-lb)**.

- 7. Install the reel nuts finger tight.

Installing the Reel Assembly

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



CAUTION



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

- 2. Apply a thin coat of grease to the outside of the cutting reel bearings and carefully slide the cutting reel assembly into the right side plate. Make sure that the reel bearing is fully seated in the RH side plate, and that the reel nut on the left (exposed) end of the cutting reel has a black finish.
- 3. If removed, install the grass shield (14) to the crossmember (13) and secure with the three bolts (15).
- 4. Place the flat wire spring into bearing bore of LH side plate and carefully slide the left side plate onto the cutting reel assembly as far as possible.



- 5. Install the four shoulder bolts (3) that secure the RH and LH side plates (4 and 21) to the crossmember (13). Tighten the shoulder bolts (3) from **24 to 27 N·m (210 to 240 in-lb)**.
- 6. Install the rear roller; refer to [Installing the Rear Roller \(page 7-27\)](#).
- 7. Install the front roller; refer to [Installing the Front Roller \(page 7-26\)](#).
- 8. Install the bedbar assembly; refer to [Installing the Bedbar \(page 7-8\)](#).
- 9. If loosened during cutting reel service, tighten the RH reel nut and the LH reel nut.

Installing the Reel Assembly (continued)

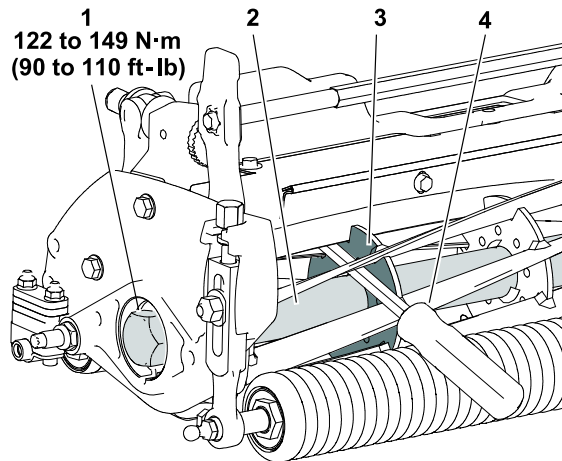


Figure 110

- | | |
|----------------|-----------------------------|
| 1. RH reel nut | 3. Support plate, weld side |
| 2. Reel shaft | 4. Pry bar |

-
- A. Insert a long- handled pry bar (3/8 x 12 inch with a screwdriver handle recommended) through the front of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move; refer to [Figure 110](#).

IMPORTANT

To avoid grinding the reel, do not contact the cutting edge of any blade with the pry bar as this may damage the cutting edge and/or cause a high blade.

- B. Move the pry bar against the weld side of the reel support plate closest to the reel nut being tightened.

IMPORTANT

The reel nut on the left end of the cutting reel has left- hand threads. The reel nut on the right end of the cutting reel has right- hand threads.



- C. Rest the handle of the pry bar against the front roller and tighten the reel nut from **123 to 149 N·m (90 to 110 ft-lb)**.
- D. Position the pry bar in the same manner on the opposite end of the reel and tighten the remaining reel nut from **123 to 149 N·m (90 to 110 ft-lb)**.
10. Check to make sure the rear roller and cutting reel are parallel; refer to [Leveling the Rear Roller \(page 7-4\)](#).
11. Install the reel drive assembly; refer to [Installing the Reel Drive Assembly \(page 4-9\)](#). Grease the splines with high temp Mobil XHP-222 grease or equivalent.
12. Install the cutting unit assembly to the machine; refer to the traction unit *Operator's Manual*.

Installing the Reel Assembly (continued)

13. Use a new gasket and install the counterweight to the right side plate with the fasteners previously removed.
14. If the cutting unit is equipped with an optional groomer, install the groomer gear box; refer to [Installing the Gear Box Assembly \(page 8–11\)](#).
15. Adjust the cutting unit; refer to the cutting unit *Operator's Manual*.
 - A. Adjust the bedknife-to-reel contact.
 - B. Adjust the height-of-cut (rear roller height then front roller height).
 - C. Adjust the cut-off bar.
 - D. Adjust the optional groomer reel if equipped; refer to the universal groomer *Installation Instructions*.

Preparing the Reel for Grinding

Reel Grinding Specifications

Reel Diameter New (D)	128.5 mm (5.06 inch)
Reel Diameter Service Limit	114.3 mm (4.50 inch)
Reel Diameter Taper Limit (D1 – D2)	0.25 mm (0.01 inch)
Blade Land Width	0.8 to 1.2 mm (0.03 to 0.05 inch)
Blade Relief Angle	30° ±2°
Reel Shaft Diameter	34.9 mm (1.375 inch)

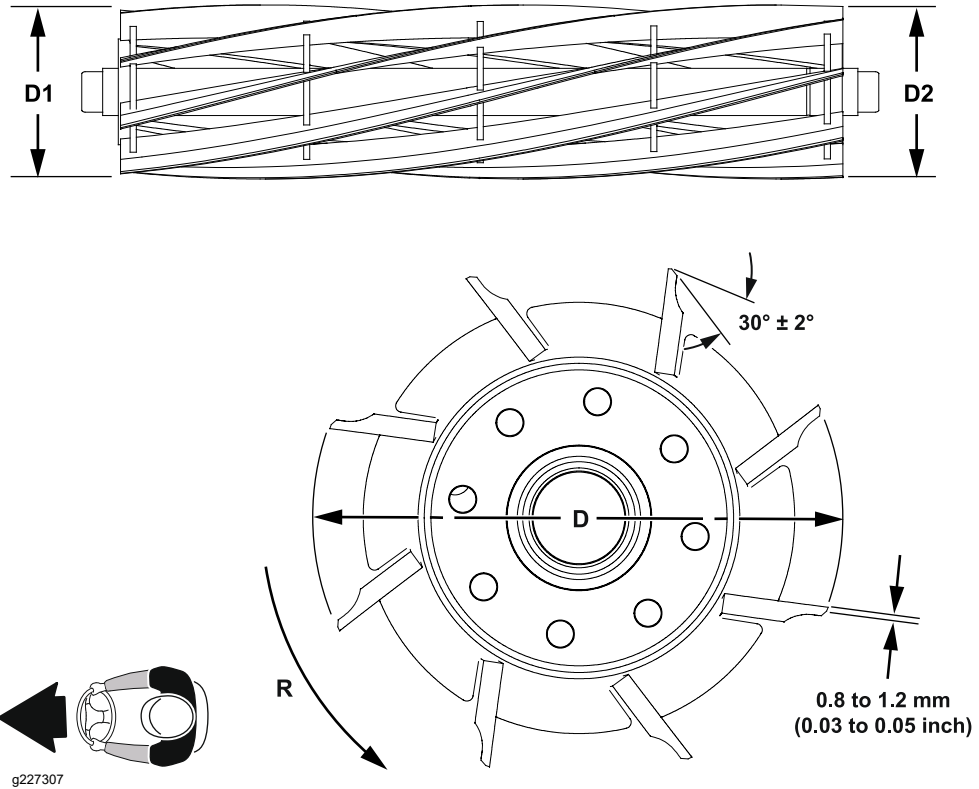


Figure 111

(R = Direction of Rotation)

Before grinding a cutting reel, make sure that all the cutting unit components are in good condition. Depending on the type of grinder used, faulty cutting unit components can affect the grinding results. When grinding, be careful to not overheat the cutting reel blades. Remove small amounts of material with each pass of the grinder.

Follow reel grinder manufacturer's instructions to grind cutting reel to Toro specifications; refer to [Reel Grinding Specifications \(page 7–24\)](#). Additional reel grinding information can be found in the *Cutting Unit Operator's Manual*. An additional resource is the Toro Basics Series Training Book, Reel Mower Basics (part no. 09168SL) found on the Service Reference Set available from your Authorized Toro Distributor.

Relief grind the reel blades to the minimum blade land width if the reel blade land width exceeds the service limit. Spin grind the reel to establish the specified blade land width or to restore the reel's cylindrical shape.

Preparing the Reel for Grinding (continued)

Note: Always adjust the cutting unit after grinding the reel and/or bedknife; refer to the *Cutting Unit Operator's Manual*. To extend the cutting unit performance by allowing the reel and the bedknife to hold their edge longer, an additional adjustment may be required after the first few minutes of operation as the reel and bedknife conform to each other.

Roller Assemblies

Removing the Front Roller

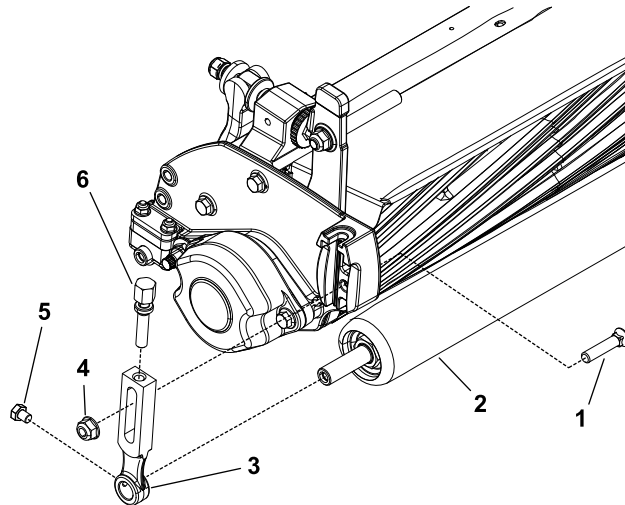


Figure 112

- | | |
|-------------------------------|---------------------------------|
| 1. Plow bolt (2 each) | 4. Lock nut (2 each) |
| 2. Front roller assembly | 5. Pinch bolt (2 each) |
| 3. Height-of-cut arm (2 each) | 6. Height-of-cut screw (2 each) |

Note: Refer to [Figure 112](#) during this procedure.

1. Remove the cutting unit from the machine and place it on a level work surface. Use an appropriate support to raise the front roller off of the work surface.
2. Loosen the pinch bolts that secure the front roller shaft to the front height-of-cut arms.
3. Remove the lock nut and plow bolt that secures one of the height-of-cut arms to the cutting unit side plate and remove the height-of-cut arm.
4. Slide the front roller assembly from the remaining height-of-cut arm.
5. Remove the remaining height-of-cut arm from the cutting unit if necessary.

Installing the Front Roller

Note: Refer to [Figure 112](#) during this procedure.

1. Place the cutting unit on a level work surface. Use an appropriate support to raise the front of the cutting unit off of the work surface.
2. Inspect the condition of both height-of-cut screws and replace them if necessary. Apply anti-seize lubricant to the threads of a new height-of-cut screw.

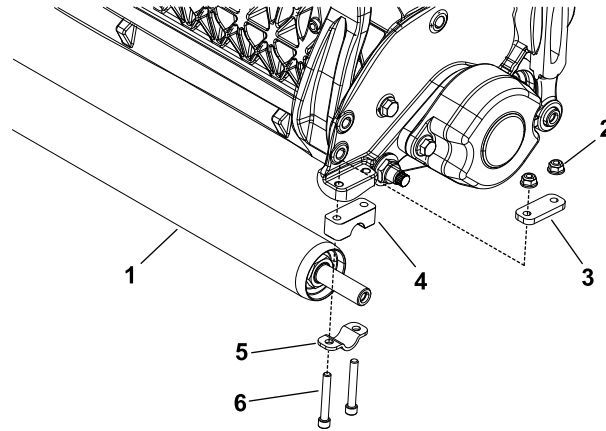
Note: When installing the height-of-cut arms, make sure tab of the side plate fits between the head and the washer of the height-of-cut screw.

3. Secure one of the height-of-cut arms to the side plate with a plow bolt and lock nut. The tab on the height-of-cut washer should be oriented downward and fit into the slot of the height-of-cut arm.
4. Slide the front roller shaft into the height-of-cut arm attached to the cutting unit.
5. Slide the remaining height-of-cut arm onto the other end of roller shaft. Secure the remaining height-of-cut arm to the side plate with a plow bolt, height-of-cut washer and lock nut.

Installing the Front Roller (continued)

6. Center the front roller in the cutting unit and tighten the pinch bolts that secure the front roller shaft to the height-of-cut arms.
7. Adjust the cutting unit height-of-cut; refer to the *Cutting Unit Operator's Manual*.

Removing the Rear Roller



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Figure 113

- | | |
|-------------------------|-------------------------------|
| 1. Rear roller assembly | 4. Spacer |
| 2. Flange nut (2 each) | 5. Shaft retainer |
| 3. Shim | 6. Socket head screw (2 each) |

Refer to [Figure 113](#) for this procedure.

1. Remove the cutting unit from the machine and place it on a level work surface. Place blocks under the bedbar to raise the rear roller off of the work surface.
2. Loosen the flange nuts that secure the rear roller retainer assemblies (flange nuts, socket head screws, shaft retainer, spacer and shims) to the cutting unit.

Note: On cutting units equipped with the optional High Height-of-Cut Kit, there will be additional roller shims installed between the rear roller and the cutting unit side plate.

3. Remove one of the rear roller retainer assemblies.
4. Slide the rear roller assembly from the remaining retainer assembly.
5. Remove the remaining retainer assembly from the cutting unit if necessary.

Installing the Rear Roller

Refer to [Figure 113](#) for this procedure.

1. Place the cutting unit on a level work surface. Place blocks under the bedbar to raise the rear of the cutting unit off of the work surface.

Note: Refer to the Cutting Unit Operator's Manual to determine the number of shims required for the desired height-of-cut range.

2. If previously removed, install one of the rear roller retainer assemblies (flange nuts, socket head screws, shaft retainer, spacer and shims) to the cutting unit.
3. Slide the rear roller shaft into the retainer assembly attached to the cutting unit.
4. Install the remaining rear roller retainer assembly.

Installing the Rear Roller (continued)

5. Center the rear roller in the cutting unit and tighten the flange nuts at each of the retainer assemblies.
6. Adjust the rear roller height; refer to the *Cutting Unit Operator's Manual*.

Disassembling the Roller

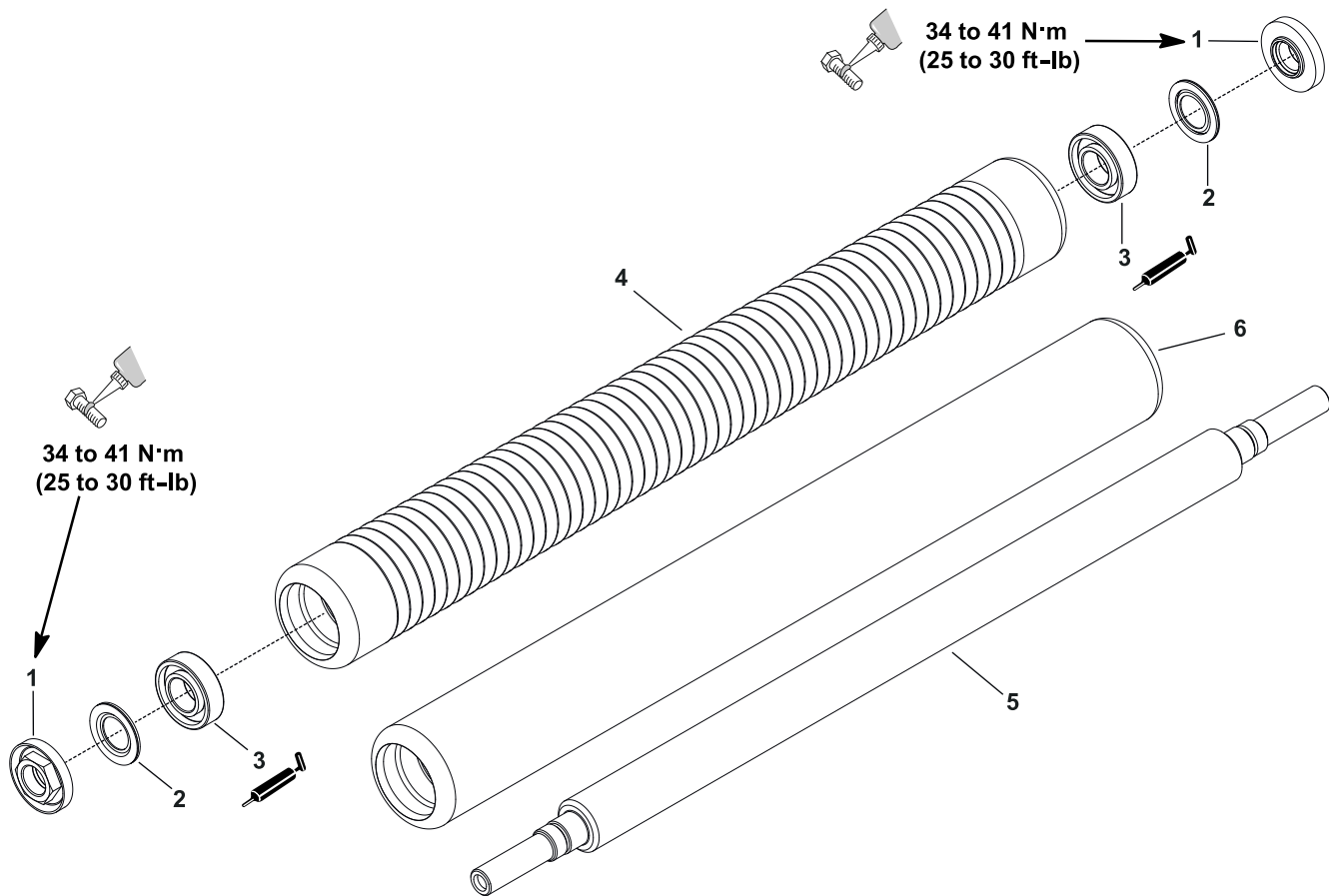


Figure 114

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

Note: The rear roller is a low drag roller.

1. To hold the roller shaft (5) stationary while removing the bearing lock nut (1), install a 3/8-24 UNF 2B screw with a jam nut into the threaded end of the roller shaft (5) and tighten the jam nut against the roller shaft. Remove the bearing lock nuts (1).
2. Carefully inspect the seating surface and threads of the bearing lock nuts (1) and replace them if damaged.
3. Loosely secure the roller assembly (4) in a bench vise and lightly tap on the roller shaft (5) to remove the sealing washers (2) and bearings (3). Discard the sealing washers (2).
4. Clean and carefully remove any corrosion from the bearing cavities of the roller.

Assembling the Roller

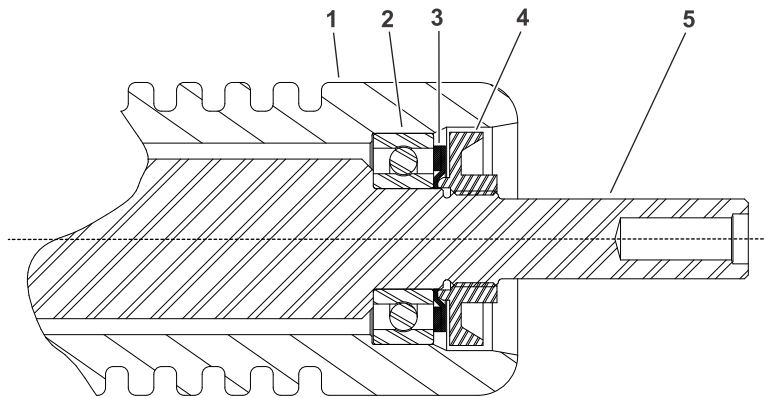


Figure 115

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

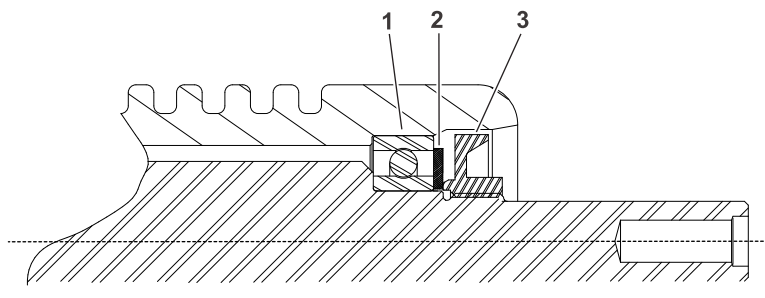


Figure 116

- | | |
|------------|---------------------|
| 1. Bearing | 3. Bearing lock nut |
| 2. Seal | |

Note: The rear roller is a low drag roller.

1. Press the bearing into the roller (support both inner and outer raceways).
2. Place the roller shaft into the roller.
3. Press the 2nd bearing into the roller (support both).



4. Install the sealing washer and bearing lock nut onto each end of the roller shaft. Tighten the lock nuts to **34 to 41 N·m (25 to 30 ft-lb)**.

Installing the Front Roller

1. Place the cutting unit on a level work surface. Use an appropriate support to raise the front of the cutting unit off of the work surface.
2. Inspect the condition of both height-of-cut screws (9) and replace them if necessary. Apply anti-seize lubricant to the threads of a new height-of-cut screw (9).

Note: When installing the height-of-cut arms (5), make sure that the tab of the side plate fits between the head and the washer of the height-of-cut screw (9).

3. Secure one of the height-of-cut arms (5) to the side plate with a plow bolt (1), height-of-cut washer (7) and lock nut (6). The tab on the height-of-cut washer should be oriented downward and fit into the slot of the height-of-cut arm.

Installing the Front Roller (continued)

4. Slide the front roller shaft (3) into the height-of-cut arm (5) attached to the cutting unit (10).
5. Slide the remaining height-of-cut arm (5) onto the other end of roller shaft. Secure the remaining height-of-cut arm to the side plate with a plow bolt (2), height-of-cut washer and lock nut.
6. Center the front roller (3) in the cutting unit and tighten the pinch bolts (8) that secure the front roller shaft to the height-of-cut arms.
7. Install the cutting unit assembly to the frame assembly; refer to *Operator's Manual*, (If necessary).
8. Adjust the cutting unit height-of-cut; refer to the *Cutting Unit Operator's Manual*.



Universal Groomer (Optional)

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General Information

Installation Instructions

The *Installation Instructions* for the groomer provides information regarding the set-up, operation, general maintenance procedures, and maintenance intervals for the groomer assembly on your Greensmaster machine. Refer to the *Installation Instructions* for additional information when servicing the groomer assembly.

Grooming Performance

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

IMPORTANT

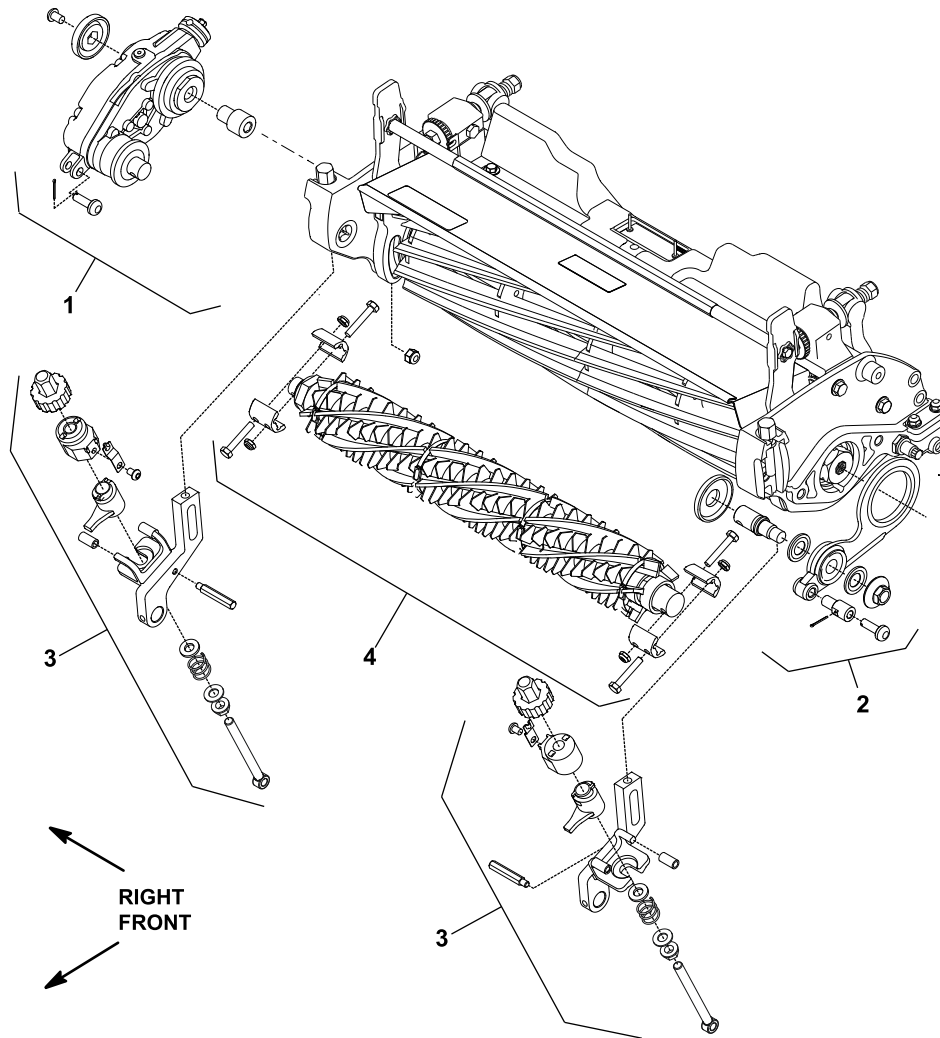
Improper or overaggressive use of the groomer (e.g., too deep or too frequent grooming) may cause unnecessary stress on the turf leading to severe turf damage. Use the groomer carefully. Read and understand the groomer operation instructions before operating or testing the groomer performance.

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

Variables that Affect the Use and Performance of the Groomer:

1. The growing season and weather conditions.
2. General turf conditions.
3. The frequency of grooming/cutting—number of cuttings per week and how many passes per cutting.
4. The height-of-cut.
5. The grooming depth.
6. The type of grass.
7. The amount of time that a groomer reel has been in use on a particular turf area.
8. The amount of traffic on the turf.
9. The overall turf management program—irrigation, fertilizing, weed control, coring, over-seeding, sand dressing, disease control, and pest control.
10. Stress periods for turf—high temperatures, high humidity, and unusually high traffic.

Service and Repairs



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Figure 117

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



CAUTION



Never work on the groomer with the machine running. Always stop the machine and wait for all machine movement to stop before working on the groomer.

The Gear Box Assembly

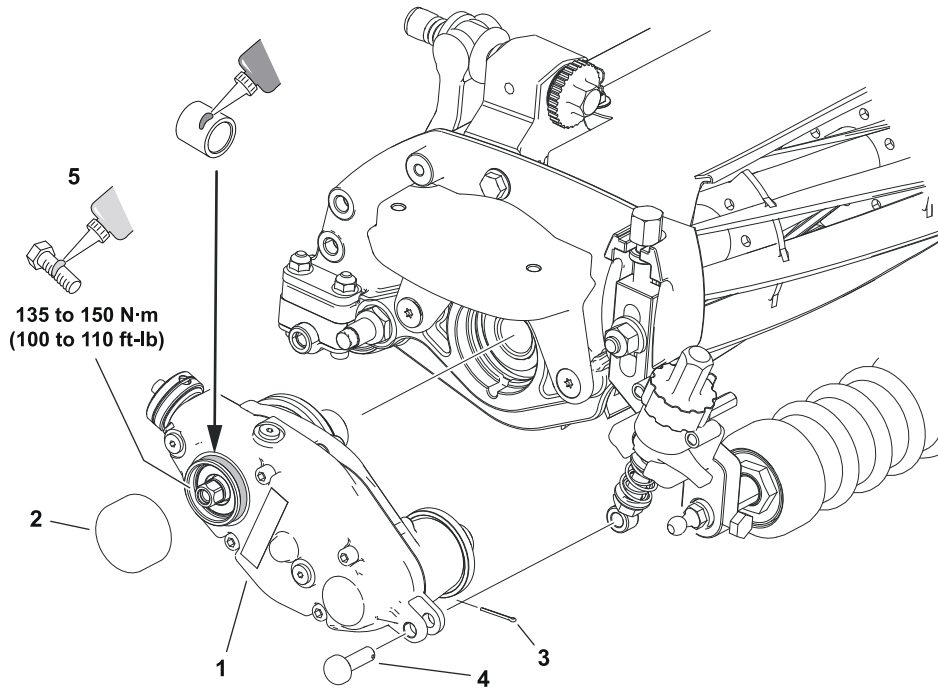


Figure 118

- | | | |
|----------------------|---------------|----------------|
| 1. Gear box assembly | 3. Cotter pin | 5. Input shaft |
| 2. Drive shield | 4. Clevis pin | |

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

Removing the Gear Box Assembly

Refer to [Figure 118](#) for this procedure.

1. Remove the cutting unit from the machine and place it on a level work surface; refer to *Operator's Manual*.
2. Remove the groomer reel assembly; refer to [Removing the Groomer Reel \(page 8–15\)](#).
3. Remove the drive shield.

Removing the Gear Box Assembly (continued)

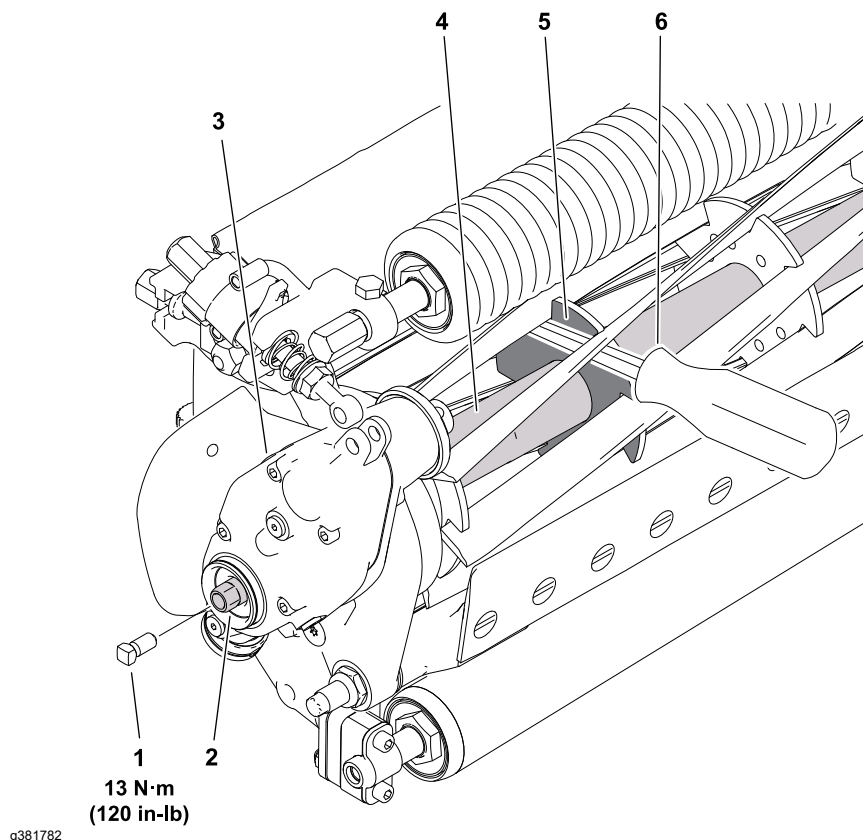


Figure 119

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

4. Install a 5/16–18 X 5/8 inch square head set screw (Toro p/n 1-803022) in the end of the drive shaft and tighten to **13 N·m (120 in-lb)**; refer to [Figure 119](#).
5. Remove the cotter pin and clevis pin from the height adjustment rod at the front of the groomer gear box. Discard the cotter pin.
6. Tip up the cutting unit to access the bottom of the reel to remove the drive shaft assembly.
7. Insert a long-handled pry bar (3/8 x 12 inch with screwdriver handle recommended) through the bottom of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move.

IMPORTANT

To avoid grinding the reel, do not contact the cutting edge of any blade with the pry bar as this may damage the cutting edge and/or cause a high blade.

8. Move the pry bar against the weld side of the reel support plate closest to the groomer gear box.

IMPORTANT

You must use a 6-point socket with a heavy wall to remove the gear box from the reel. Do not use an impact wrench. Groomer gear boxes installed on the right side of the cutting unit use a standard right hand thread; turn the drive shaft counterclockwise to remove the gear box.

9. Rest the handle of the pry bar against the front roller and turn the drive shaft counterclockwise to loosen it from the reel. Continue to unscrew the drive shaft and remove the gear box from the cutting unit.
10. If the hex head on the end of the drive shaft is damaged during removal:
 - A. Remove the drain/fill plug and drain the oil from the gear box.

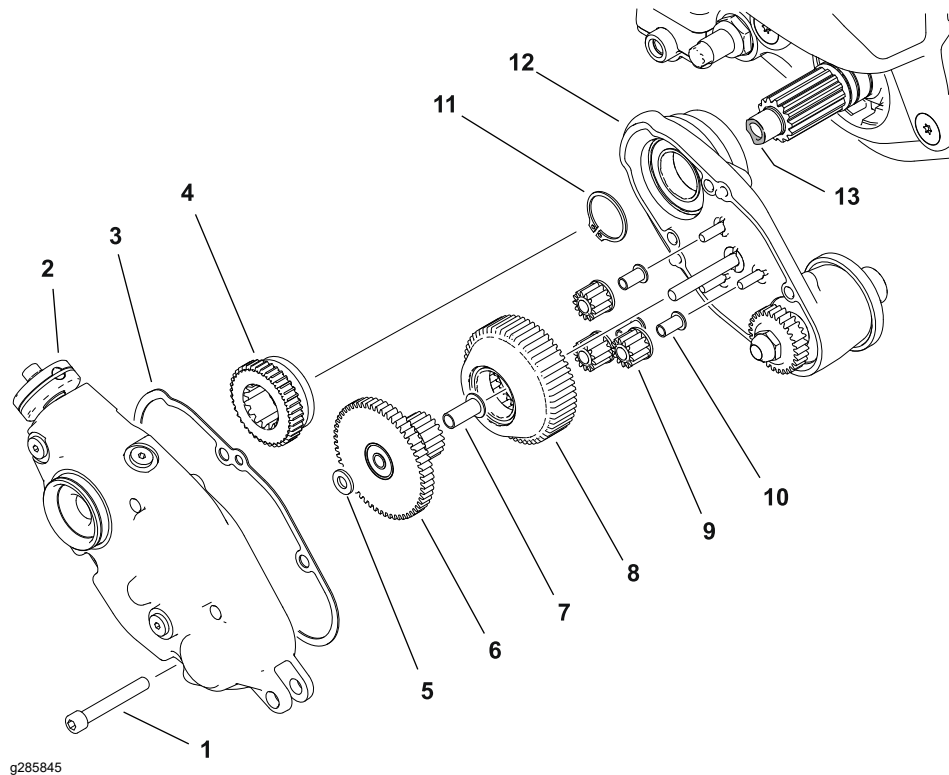


Figure 120

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

- B. Remove the 4 socket-head screws and remove the gear box cover assembly and driven gear. Remove and discard the cover gasket.
- C. Slide the thrust washer, ring gear and bushing from the gear box housing.
- D. Slide the sun gear, and planet gears and bushings from the pins on the gear box housing.

Removing the Gear Box Assembly (continued)

- E. Remove the retaining ring from the drive shaft.
- F. Slide the groomer housing assembly from the drive shaft.
- G. Tip up the cutting unit to access the bottom of the reel to remove the drive shaft assembly.

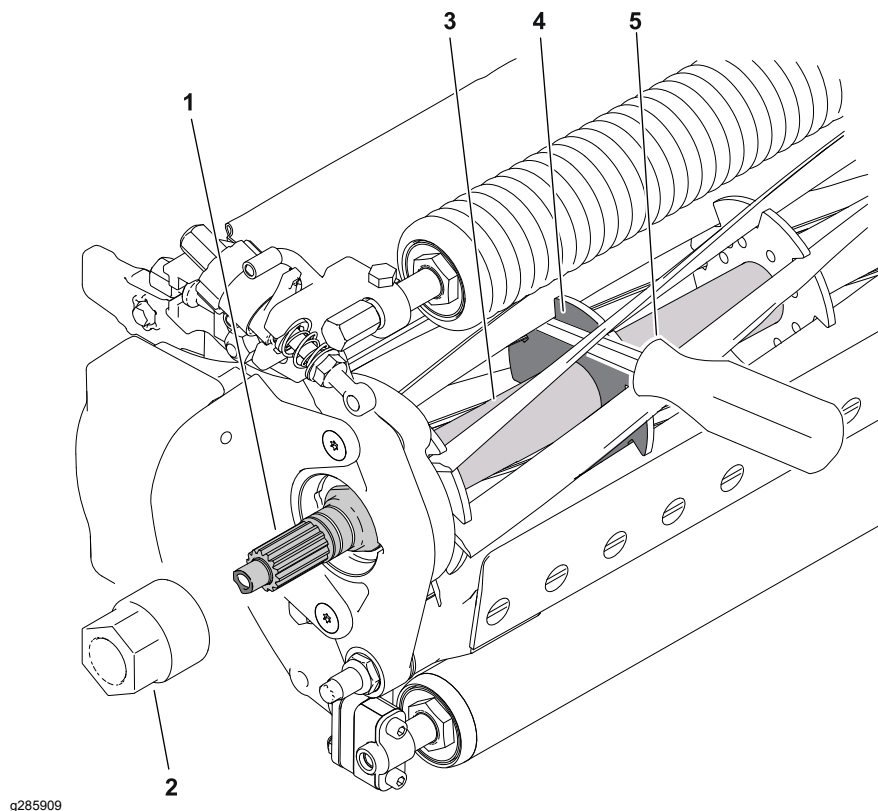


Figure 121

- | | |
|---------------------------------|------------------------------------|
| 1. Damaged input shaft assembly | 4. Weld side of reel support plate |
| 2. Drive shaft removal tool | 5. Pry bar |
| 3. Reel shaft | |

-
- H. Insert a long-handled pry bar (3/8 x 12 inch with screwdriver handle recommended) through the bottom of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move.

IMPORTANT

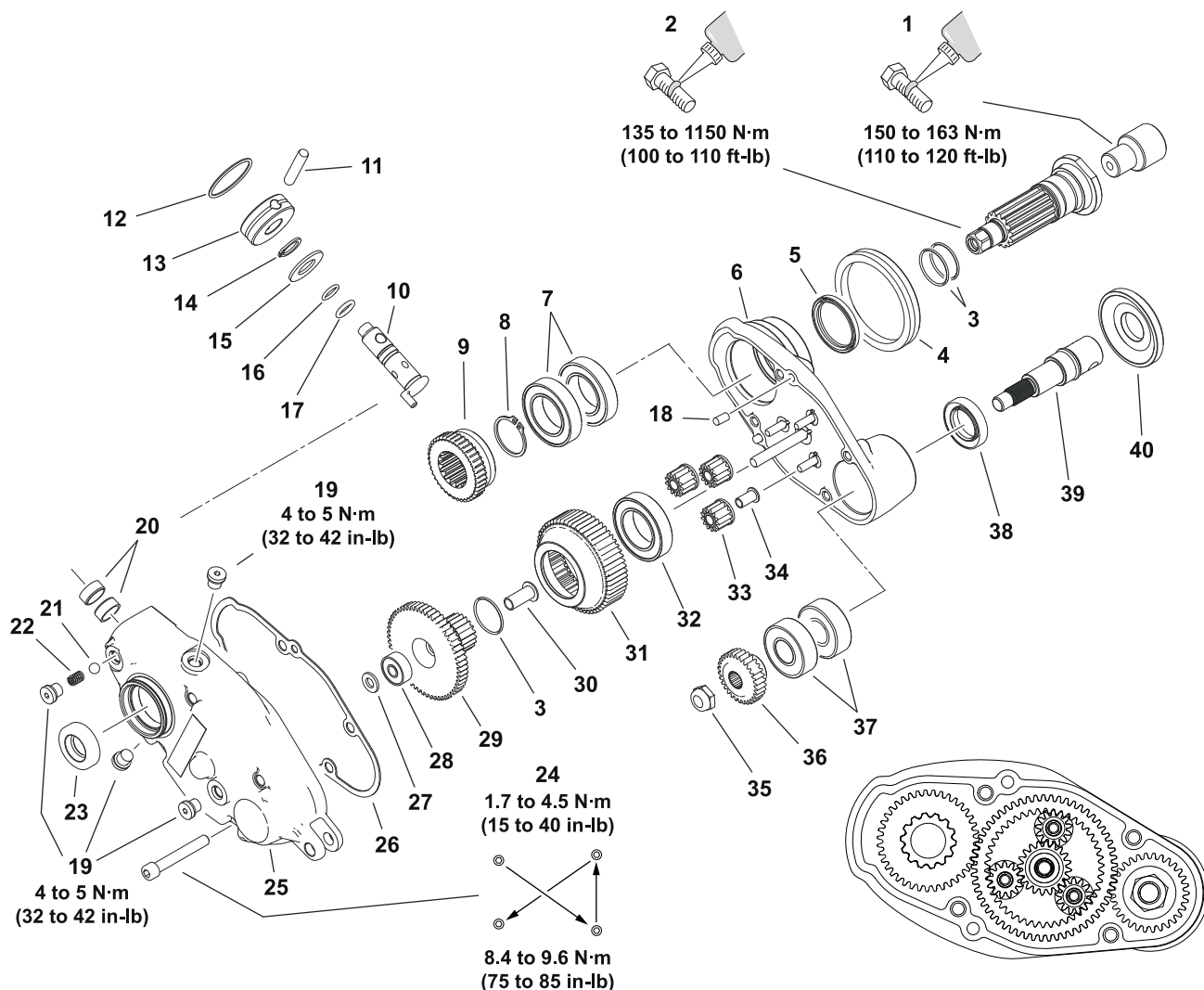
To avoid grinding the reel, do not contact the cutting edge of any blade with the pry bar as this may damage the cutting edge and/or cause a high blade.

- I. Move the pry bar against the weld side of the reel support plate closest to the drive shaft assembly.
 - J. Use the drive shaft removal tool on the large flats of the drive shaft assembly; refer to [Drive Shaft Removal Tool \(page 2–17\)](#).
 - K. Rest the handle of the pry bar against the front roller and turn the drive shaft counterclockwise to loosen it from the reel.
11. Tip the cutting unit back onto its rollers.

Removing the Gear Box Assembly (continued)

12. Clean the threads in the end of the reel shaft. A right-hand thread and left-hand thread tap is available to clean or repair the threads if necessary; refer to [Reel Thread Repair Taps \(page 2–15\)](#).

Servicing the Gear Box



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Figure 122

- | | | |
|---------------------------|--------------------------------|-----------------------------|
| 1. Drive adapter – silver | 15. Thrust washer | 29. Ring gear |
| 2. Input shaft | 16. O-ring | 30. Flange bushing |
| 3. O-ring (3 each) | 17. O-ring | 31. Sun gear |
| 4. V-ring | 18. Dowel pin (2 each) | 32. Bearing |
| 5. Oil seal | 19. Drain/fill plug (4 each) | 33. Planet gear (3 each) |
| 6. Groomer housing | 20. Straight bushing (2 each) | 34. Flange bushing (3 each) |
| 7. Ball bearing (2 each) | 21. Detent ball | 35. Locknut |
| 8. Retaining ring | 22. Detent spring | 36. Driver gear |
| 9. Driven gear | 23. Oil seal | 37. Bearing (2 each) |
| 10. Actuator shaft | 24. Socket-head screw (4 each) | 38. Oil seal |
| 11. Pin | 25. Groomer cover | 39. Driven shaft |
| 12. O-ring | 26. Cover gasket | 40. Shield |
| 13. Knob | 27. Thrust washer | |
| 14. Retaining ring | 28. Ball bearing | |

1. Remove the drain/fill plug and drain the oil from the gear box.
2. Remove the 4 socket-head screws and separate the gear box cover and housing. Remove and discard the cover gasket.

Servicing the Gear Box (continued)

3. Slide the sun gear, ring gear, and planet gears from the pins on the gear box housing.
4. Continue to disassemble the gear box as necessary.
5. If the drive adapter requires replacement, apply medium strength thread locking compound (Loctite 243 or equivalent) to the internal threads of the drive shaft and the larger threads of the drive adapter (reel end). Allow the thread locking compound to cure for 15 minutes before continuing this procedure.



CAUTION



Use the large 1.375 inch flats on the drive shaft to prevent the drive shaft from rotating during drive adapter removal and installation. DO NOT use the 0.5 inch hex head on the drive shaft for drive adapter removal or installation as drive shaft damage may occur.

Note: A special tool is available to hold the drive shaft if necessary; refer to [Adapter Wrench \(page 2–17\)](#).



6. Tighten the drive adapter from **150 to 163 N·m (110 to 120 ft-lb)**.
7. Carefully clean all the gasket material from the gear box housing and cover.
8. Inspect the V-ring, seals, bearings, gears, and bushings in the gear box assembly. Replace the damaged or worn components as necessary.
9. If the sun gear, ring gear, or the gear box housing bearings are replaced, press the bearings all the way to shoulder into the part.
10. If the flange bushings are replaced, ensure that the flange bushing is fully seated against the part.
11. Assemble the gear box.
 - Ensure that all the retaining rings and O-rings are fully seated in the ring groove during assembly.
 - Lubricate the seal lips and O-rings before installing the shafts.
 - Lubricate the planet gear and sun gear pins in the gear box housing with the gear oil prior to installing the gears.
12. Clean the gasket surface on the gear box housing and cover with the solvent and install new gasket.



13. Fit the gear box cover over dowel pins and install the 4 socket-head screws. Tighten the screws from **1.7 to 4.5 N·m (15 to 40 in-lb)**. In an alternating cross pattern, tighten the screws from 8.4 to 9.6 N·m (75 to 85 in-lb).
14. Fill the gear box with 80W–90 gear oil and tighten the drain/fill plug from **4 to 5 N·m (32 to 42 in-lb)**.

The gear box oil capacity is **50 ml (1.7 fluid ounces)**.
15. Operate the groomer gear box by hand to check for proper operation prior to installation.

Installing the Gear Box Assembly

Refer to [Figure 118](#) for this procedure.

1. Apply medium strength thread locking compound (Loctite 243 or equivalent) to the threads in the reel and allow the thread locking compound to cure for 15 minutes before continuing this procedure.
2. Insert a long-handled pry bar through the front of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move.

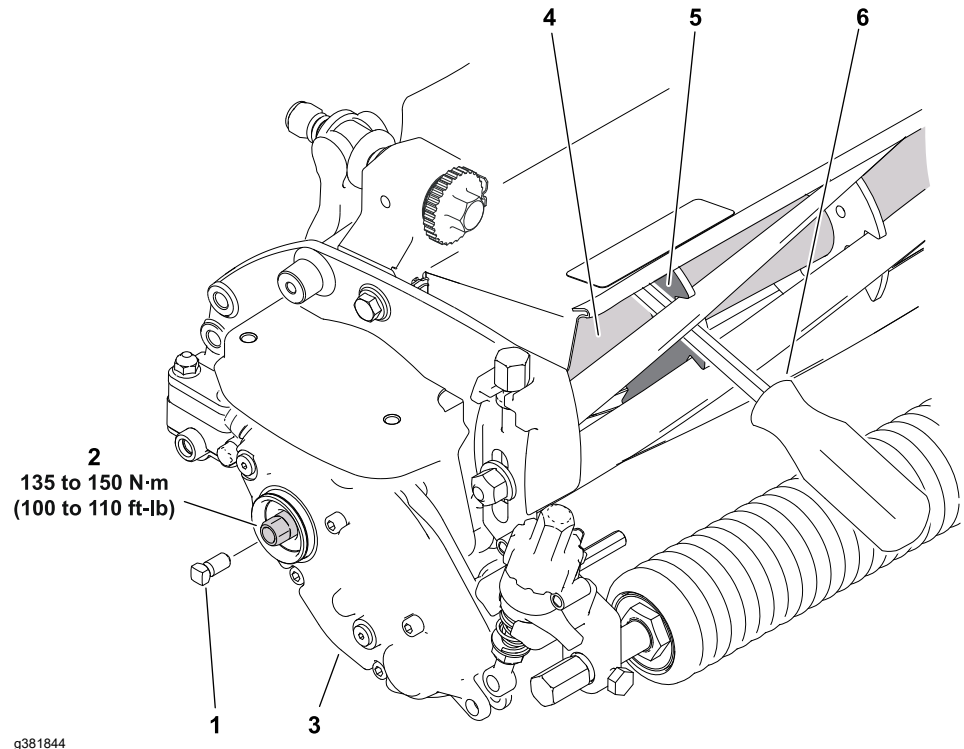


Figure 123

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

3. Move the pry bar against the weld side of the reel support plate closest to the gear box assembly and rest the handle of the pry bar against the front roller.
4. Position the gear box assembly against the cutting unit and turn the drive shaft assembly clockwise until it is seated against the reel.

IMPORTANT

You must use a 6-point socket with a heavy wall to install the gear box to the reel. Do not use an impact wrench. Groomer gear boxes installed on the right side of the cutting unit use a standard right hand thread; turn the drive shaft clockwise to install the gear box.



5. Tighten the drive shaft assembly from **135 to 150 N·m (100 to 110 ft-lb)**.
6. Remove the square head set screw from the end of the drive shaft.
7. Install the clevis pin and a new cotter pin to secure the height adjustment rod to the front of the groomer gear box.

Installing the Gear Box Assembly (continued)

8. Apply a retaining compound (Loctite 609 or equivalent) to the lip of the drive housing and install the drive shield.
9. Install the groomer reel assembly; refer to [Installing the Groomer Reel \(page 8–17\)](#).

Idler Assembly

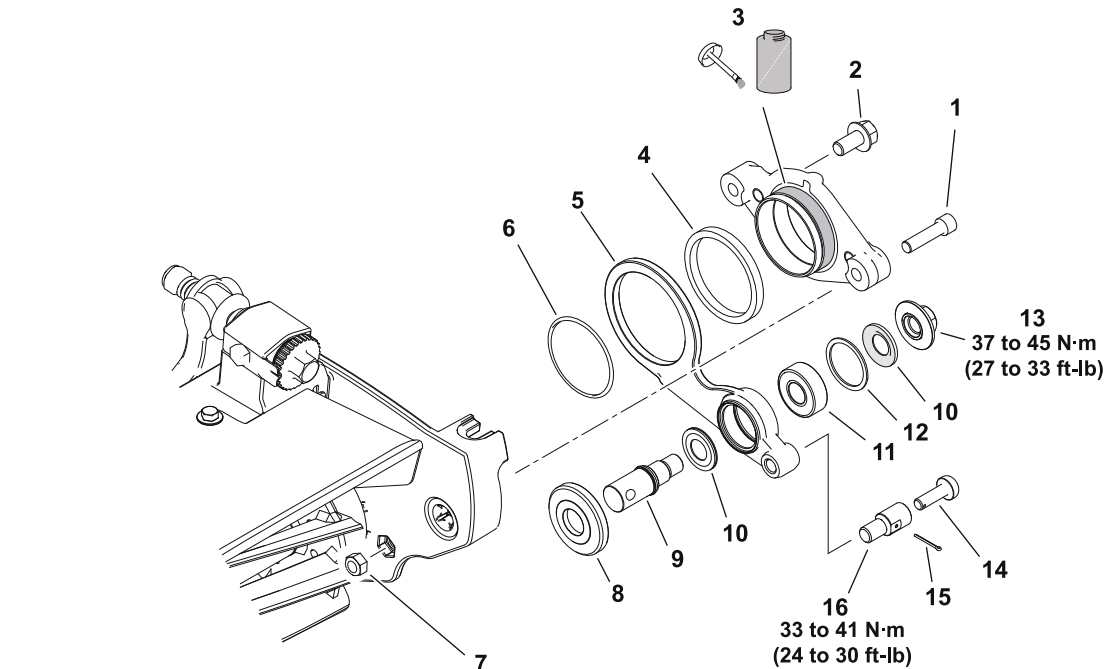


Figure 124

- | | | |
|-------------------------------|---------------------------|----------------|
| 1. Socket-head screw (2 each) | 7. Lock nut (2 each) | 13. Flange nut |
| 2. Bolt | 8. Shield | 14. Clevis pin |
| 3. Motor adapter | 9. Stub shaft | 15. Cotter pin |
| 4. Bushing | 10. Flocked seal (2 each) | 16. Collar |
| 5. Idler arm | 11. Bearing | |
| 6. O-ring | 12. Retaining ring | |

Note: The groomer idler assembly is located on the opposite side of the groomer gearbox assembly.

Removing the Idler Assembly

1. Remove the reel drive from the cutting unit; refer to [Removing the Reel Drive Assembly \(page 4–7\)](#).
2. Remove the groomer reel assembly; refer to [Removing the Groomer Reel \(page 8–15\)](#).
3. Remove the cotter pin and clevis pin from the height adjustment rod at the front of the idler arm. Discard the cotter pin.
4. Remove the two socket-head screws that secure the motor adapter to the cutting unit, and remove the adapter and idler assembly. Retrieve and discard the O-ring and lock nuts.
5. Inspect the shields, bearing, and bushing in the idler assembly. Remove and discard the components that are worn or damaged.

Installing the Idler Assembly

1. If the shields, bearing, or bushing was removed from the idler arm, install new components as follows:
 - A. Press the bushing into a groomer plate until the bushing is centered in the idler arm bore.
 - B. Press the bearing into the idler arm so that the bearing contacts the shoulder in idler arm bore and install the bearing retaining ring.

Installing the Idler Assembly (continued)



- C. Install the bearing shields with flocked side of shield toward the bearing.
- D. Check the idler arm orientation (left or right cutting unit) and insert the stub shaft (item 9 in [Figure 124](#)) through shields and bearing. Use the through hole in the shaft to prevent shaft from rotating, tighten the flange nut to **37 to 45 N·m (27 to 33 ft-lb)**.
- E. If the collar was removed from the idler arm, install the collar and tighten to **33 to 41 N·m (24 to 30 ft-lb)**.
- 2. Fit a new O-ring to the motor adapter.
- 3. Apply anti-seize lubricant to the outside diameter of the motor adapter and position the idler arm over the adapter.
- 4. Use new lock nuts and secure the motor adapter and idler arm to the cutting unit side plate.
- 5. Install the clevis pin and a new cotter pin to secure the height adjustment rod to the front of the idler arm.
- 6. Install the reel drive; refer to [Installing the Reel Drive Assembly \(page 4–9\)](#).

Groomer Reel

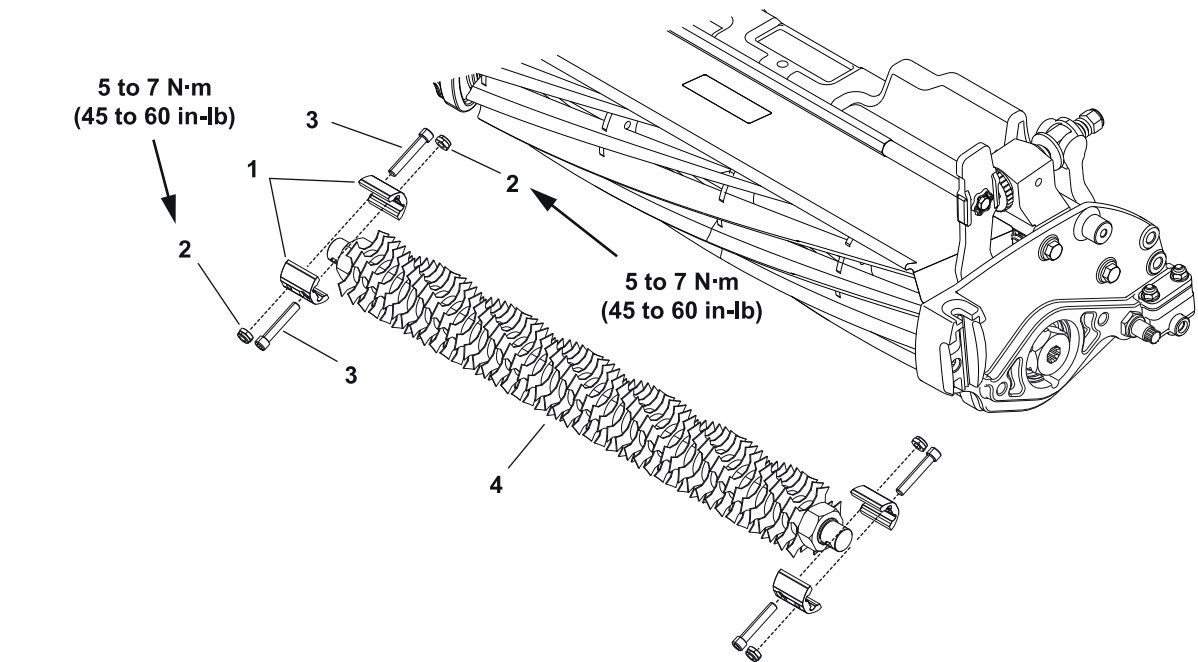


Figure 125

- | | |
|-------------------------|------------------|
| 1. Shaft clamp (4 each) | 3. Bolt (4 each) |
| 2. Jam nut (4 each) | 4. Groomer reel |

Remove the groomer reel to replace individual groomer blades or replace the shaft. The groomer reel can be reversed to provide additional blade life.

Removing the Groomer Reel



CAUTION

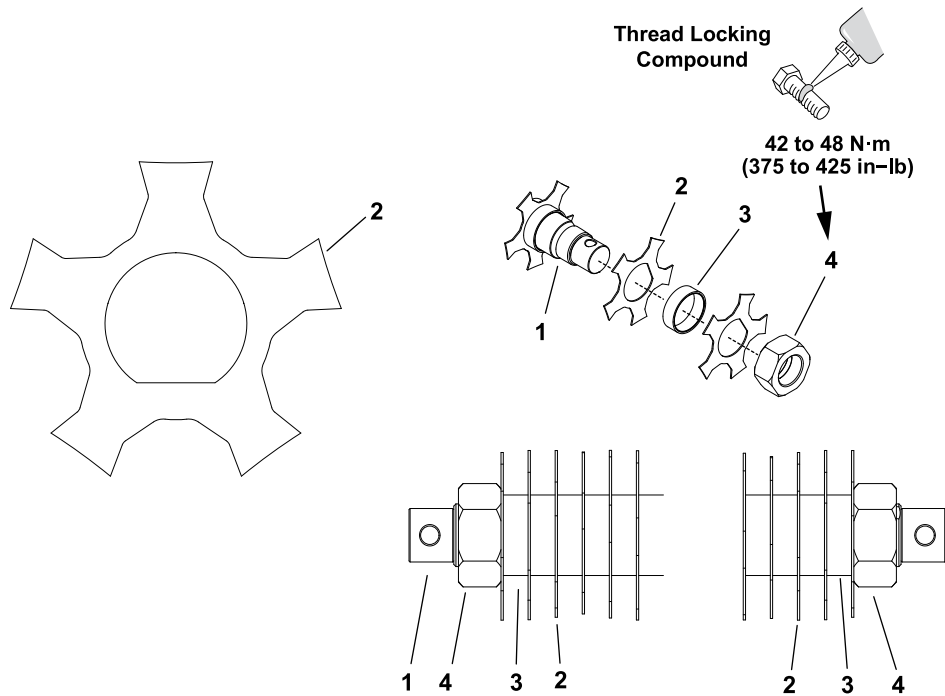


Contact with the reel or other cutting unit parts can result in personal injury.

Use heavy gloves when handling the groomer reel.

1. Carefully remove the 4 jam nuts, 4 bolts, and 4 shaft clamps that secure the groomer reel to the output and stub shafts.
2. Lift the groomer reel from the cutting unit.
3. Inspect the shields, stub shaft, driven shaft and shaft bearings for wear or damage and replace components as necessary; refer to [The Gear Box Assembly \(page 8–4\)](#) and [Idler Assembly \(page 8–13\)](#).

Servicing the Groomer Reel



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Figure 126

- | | |
|----------------------------|---------------------|
| 1. Groomer reel shaft | 3. Spacer (50 each) |
| 2. Groomer blade (51 each) | 4. Locknut (2 each) |

Inspect the groomer reel blades frequently for any damage and wear. Straighten the bent blades. Either replace the worn blades or reverse the individual blades to put the sharpest blade edge forward: refer to [Figure 126](#).

1. Remove the groomer reel from the cutting unit; refer to [Removing the Groomer Reel \(page 8–15\)](#).
2. Remove the lock nut from either end of the groomer reel shaft.
3. Remove the blades from the groomer shaft. If necessary, remove second lock nut from the shaft.
4. Inspect and replace worn or damaged components.
5. Assemble the groomer reel as follows:

Note: New lock nuts have an adhesive patch to prevent the lock nut from loosening. If a used lock nut is being installed, apply a medium strength thread locker (Loctite #242 or equivalent) to the threads of the lock nut.

- A. Install a lock nut on one end of the groomer reel shaft.
- B. Install a groomer blade against the lock nut.
- C. Install the remaining spacers and blades in an alternating manner making sure that all blades are separated by a spacer.

Servicing the Groomer Reel (continued)

- D. When all the blades have been installed, install the second lock nut onto the shaft. Center the blades and spacers on the shaft by adjusting the lock nuts.



- E. Use the through holes in shaft to prevent the shaft from rotating and tighten the second lock nut to **42 to 48 N·m (375 to 425 in-lb)**. After tightening the lock nut, spacers should not be free to rotate and the groomer blades should be centered on the shaft.

- 6. Install the groomer reel back onto the cutting unit; refer to [Installing the Groomer Reel \(page 8–17\)](#).

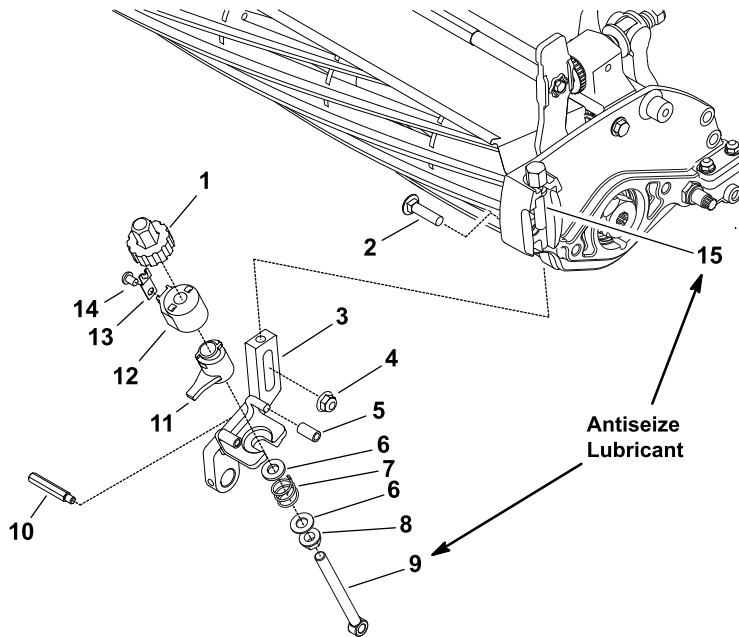
Installing the Groomer Reel

- 1. Position the groomer reel between the groomer driven and stub shafts.



- 2. Secure the groomer reel to the cutting unit with the 4 jam nuts, 4 bolts, and 4 shaft clamps. Tighten the bolts from **5 to 7 N·m (45 to 60 in-lb)**.
- 3. Check the groomer reel height and mower height-of-cut settings and adjust as necessary.

The Height Adjuster Assembly



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Figure 127

- | | | |
|--------------------------|--------------------------|----------------------------|
| 1. Height adjuster knob | 6. Washer (2 each) | 11. Quick up lever |
| 2. Carriage bolt | 7. Compression spring | 12. Quick up cover |
| 3. Height-of-cut bracket | 8. Flange nut | 13. Detent spring |
| 4. Flange nut | 9. Height adjustment rod | 14. Button-head screw |
| 5. Groomer hose | 10. Groomer pin | 15. Height adjustment bolt |

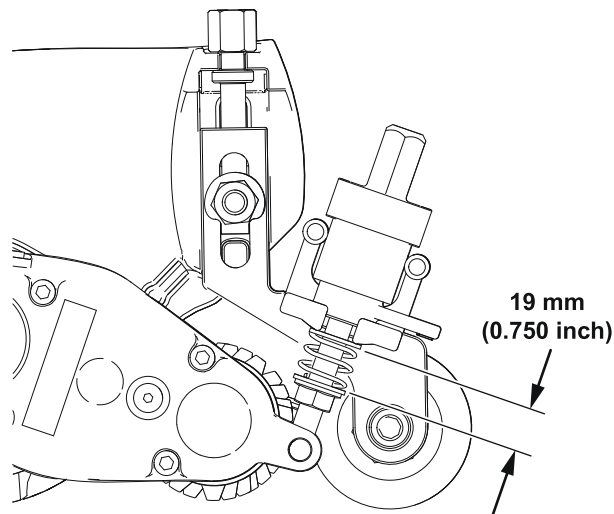
Note: Early universal groomers used 2 compression springs on non-adjustable height adjustment rods. Retrofitting the assemblies on each side of the cutting unit with new compression springs, height adjustment rods, and adding flange nuts to enable spring adjustment is recommended.

Disassembling the Height Adjuster

1. Park the machine on a clean and level surface, lower the cutting units completely to the ground, set the parking brake, and remove the key from the key switch.
2. Remove the cotter pins and clevis pins that secure the height adjustment rods to the groomer gear box and idler arm. Discard the cotter pins.
3. Loosen the 2 height adjustment bolts and 2 locknuts.
4. Remove the flange nut (item 4 in [Figure 127](#)) and carriage bolt that secure the height adjuster assembly to the cutting unit side plate, and remove the front roller and height adjuster from the cutting unit.
5. Disassemble the height adjuster assembly as necessary.
6. Clean all the components and inspect for wear or damage. Replace all the components that are worn or damaged.

Assembling the Height Adjuster

1. Apply anti-seize lubricant to the upper threads of the adjustment rod and lower threads of the height adjusters. Assemble the height adjuster assembly.
2. If both the height adjusters are removed, fit 1 height adjuster assembly to the cutting unit side plate and secure it with the carriage bolt and flange nut. Do not tighten the flange nut at this time. Ensure that the height adjustment bolt and 1 washer is above the slot in the side plate and 1 washer and locknut is below the slot in the side plate.
3. Position front roller between the height adjuster assemblies and secure height adjuster assembly to cutting unit side plate with carriage bolt and flange nut. Do not tighten the flange nut at this time. Ensure the height adjustment bolt and 1 washer is above slot in side plate and 1 washer and locknut is below slot in side plate.
4. Center the front roller between the height-of-cut brackets and tighten the front roller pinch bolts.
5. Install new cotter pins and clevis pins and secure the height adjustment rods to the groomer gear box and idler arm.
6. Adjust the cutting unit height-of-cut; refer to *Cutting Unit Operators Manual*.
7. Check the groomer reel height and adjust as necessary.
8. Adjust the flange nuts on the groomer height adjustment rods until the springs are compressed to 19 mm (0.750 inch).



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Figure 128

The Grooming Brush (Optional)

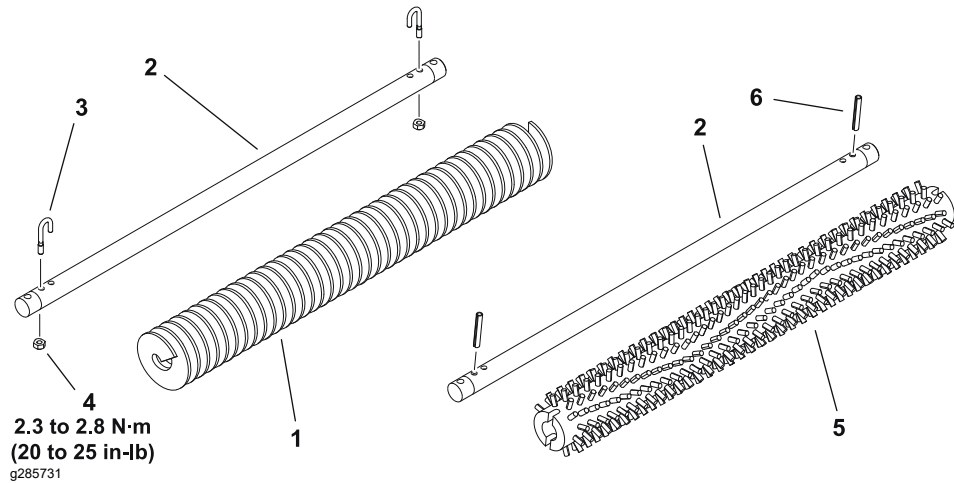


Figure 129

- | | |
|--------------------|----------------------|
| 1. Spiral brush | 4. Lock nut (2 each) |
| 2. Brush shaft | 5. Grooming brush |
| 3. J-bolt (2 each) | 6. Roll pin (2 each) |

The optional grooming brush attaches to the groomer in place of the groomer reel. The grooming brush is removed and installed from the groomer in the same manner as the groomer reel; refer to [Groomer Reel \(page 8–15\)](#).

The grooming brush element or shaft can be serviced separately.

To remove the spiral grooming brush from the shaft, remove the lock nut and J-bolt from both ends of the brush assembly and slide the brush from the shaft. When assembling the spiral brush to the shaft, make sure that the J-bolts are installed with the threaded portion on the outside of the brush and tighten the lock nuts from **2.3 to 2.8 N·m (20 to 25 in-lb)**.



Foldout Drawings

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Electrical Drawing Designations

Note: A splice used in a wire harness will be identified on the wire harness diagram by SP. The manufacturing number of the splice is also identified on the wire harness diagram (e.g., SP01 is splice number 1).

Wire Color

The following abbreviations are used for wire harness colors on the electrical schematics and wire harness drawings in this chapter.

ABBREVIATION	COLOR
BK	BLACK
BR or BN	BROWN
BU	BLUE
GN	GREEN
GY	GRAY
OR	ORANGE
PK	PINK
R or RD	RED
T	TAN
VIO	VIOLET
W or WH	WHITE
Y or YE	YELLOW

Numerous harness wires used on the Toro machines include a line with an alternate color. These wires are identified with the wire color and line color with either a / or _ separating the color abbreviations listed above (e.g., R/BK is a red wire with a black line, OR_BK is an orange wire with a black line).

Wire Size

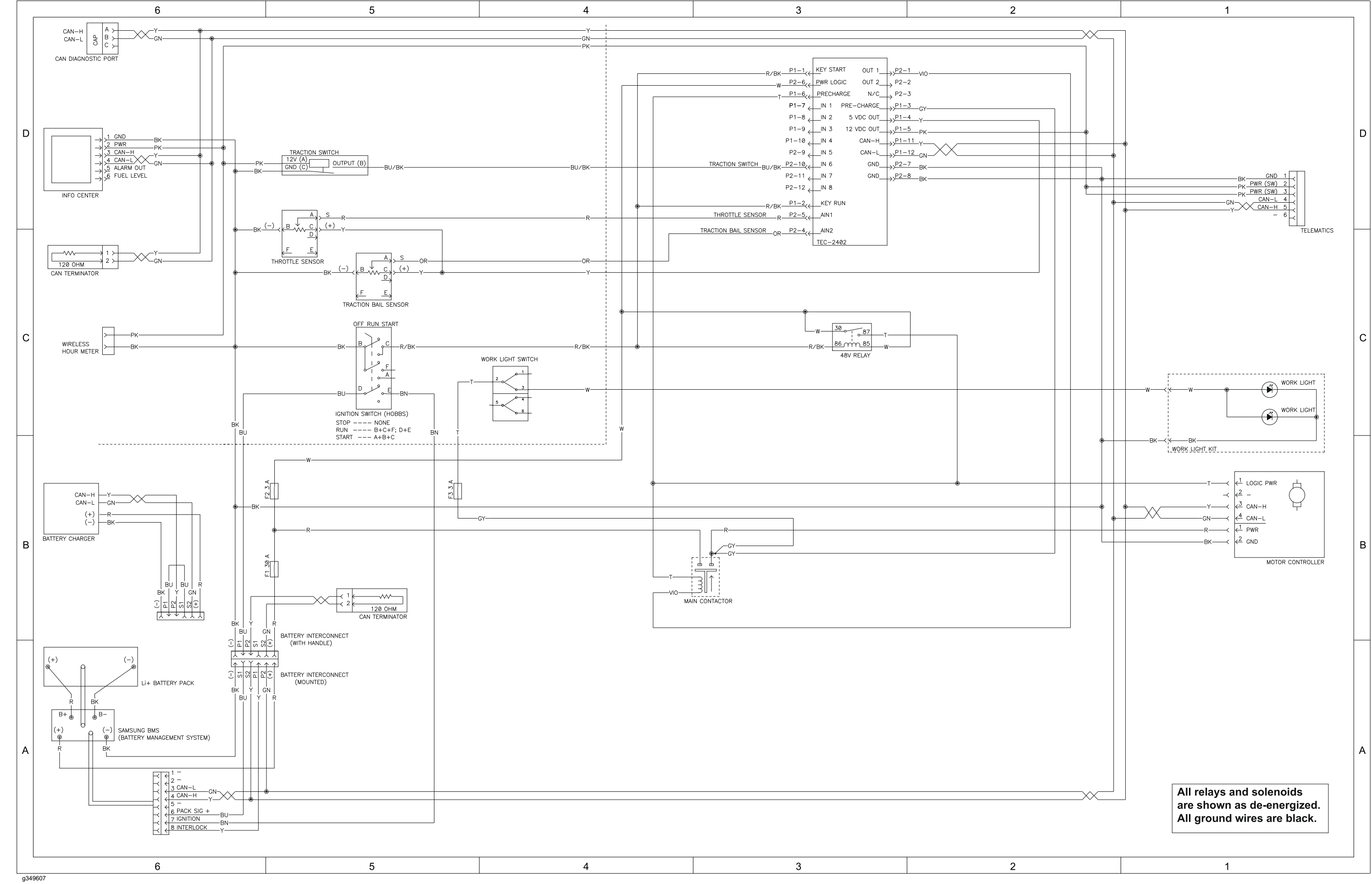
The individual wires of the electrical harness diagrams in this chapter identify both the wire color and the wire size.

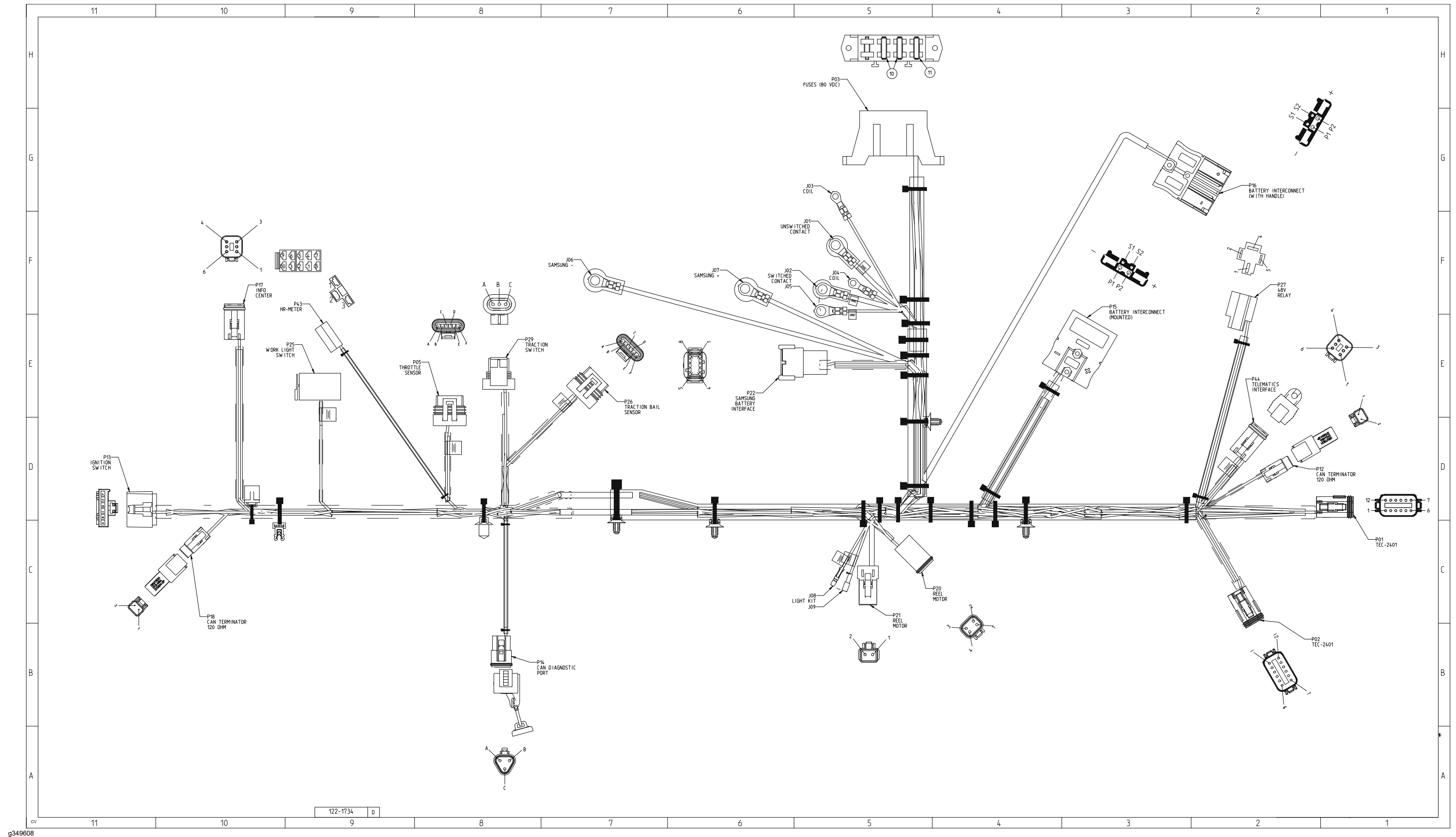
Examples:

- 16 BK = 16 AWG (American Wire Gauge) wire that has a black insulator
- 050 R = 0.5 mm metric wire that has a red insulator (AWG equivalents for metric wire appear in the following table)

AWG Equivalents for Metric Wire		
Diagram Label	Metric Size	AWG Equivalent
050	0.5 mm	20 GA
175	0.75 mm	18 GA
100	1.0 mm	16 GA
150	1.5 mm	14 GA

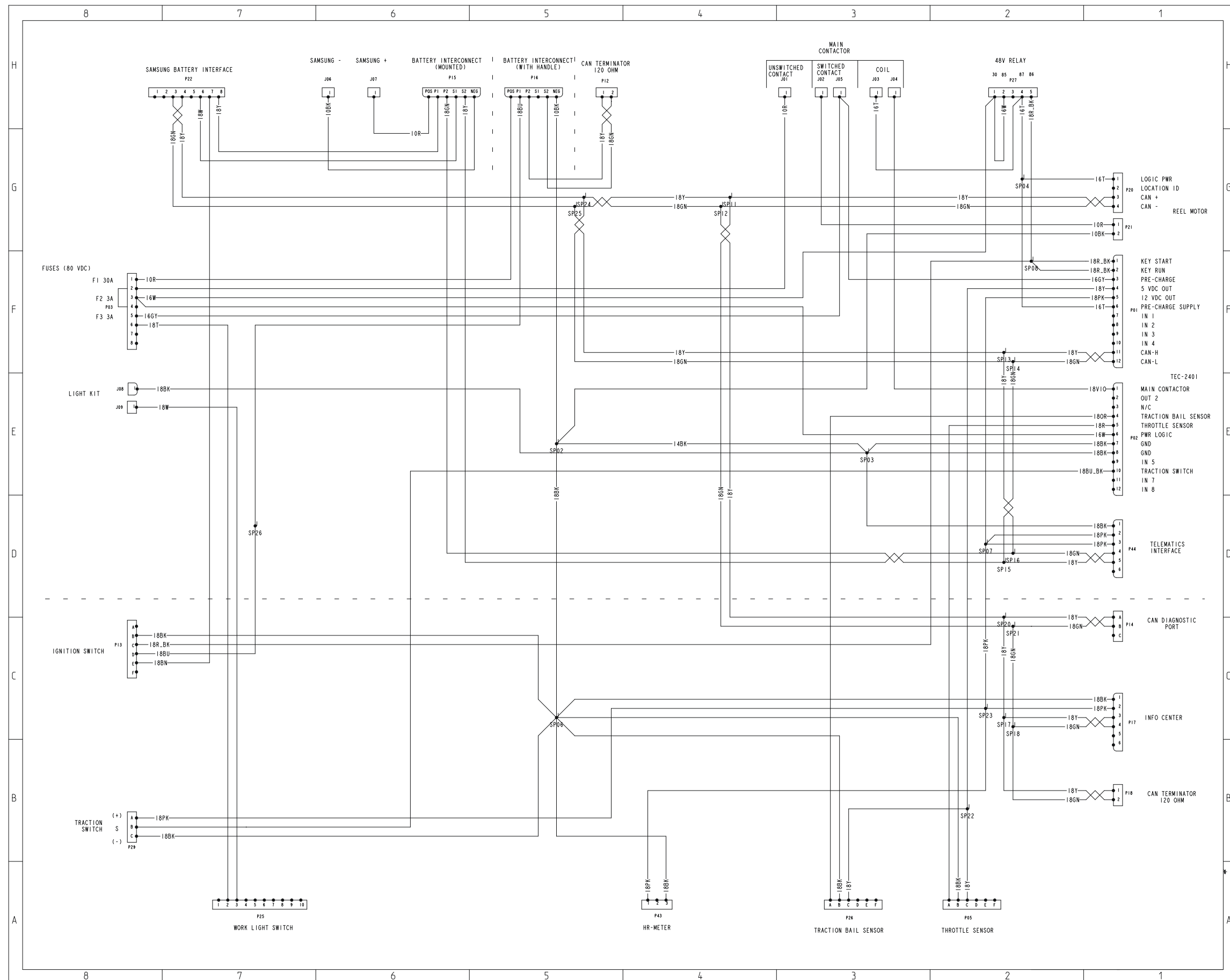
Electrical Schematic





g349608

Wire Harness Drawing



g349609



Count on it.