Form No. 20248SL Rev C

TORO

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Service Manual

Greensmaster® eFlex 1021

(Model 04861)

Revision History

Revision	Date	Description
A	05/2021	Initial issue.
B	01/2022	Cutting unit drive spline information
C	07/2022	Updated the reel drive, handle, bedknife, groomer drive gearbox, idler plate, groomer reel, height adjuster chapters

Revision History (continued)

Revision	Date	Description

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.

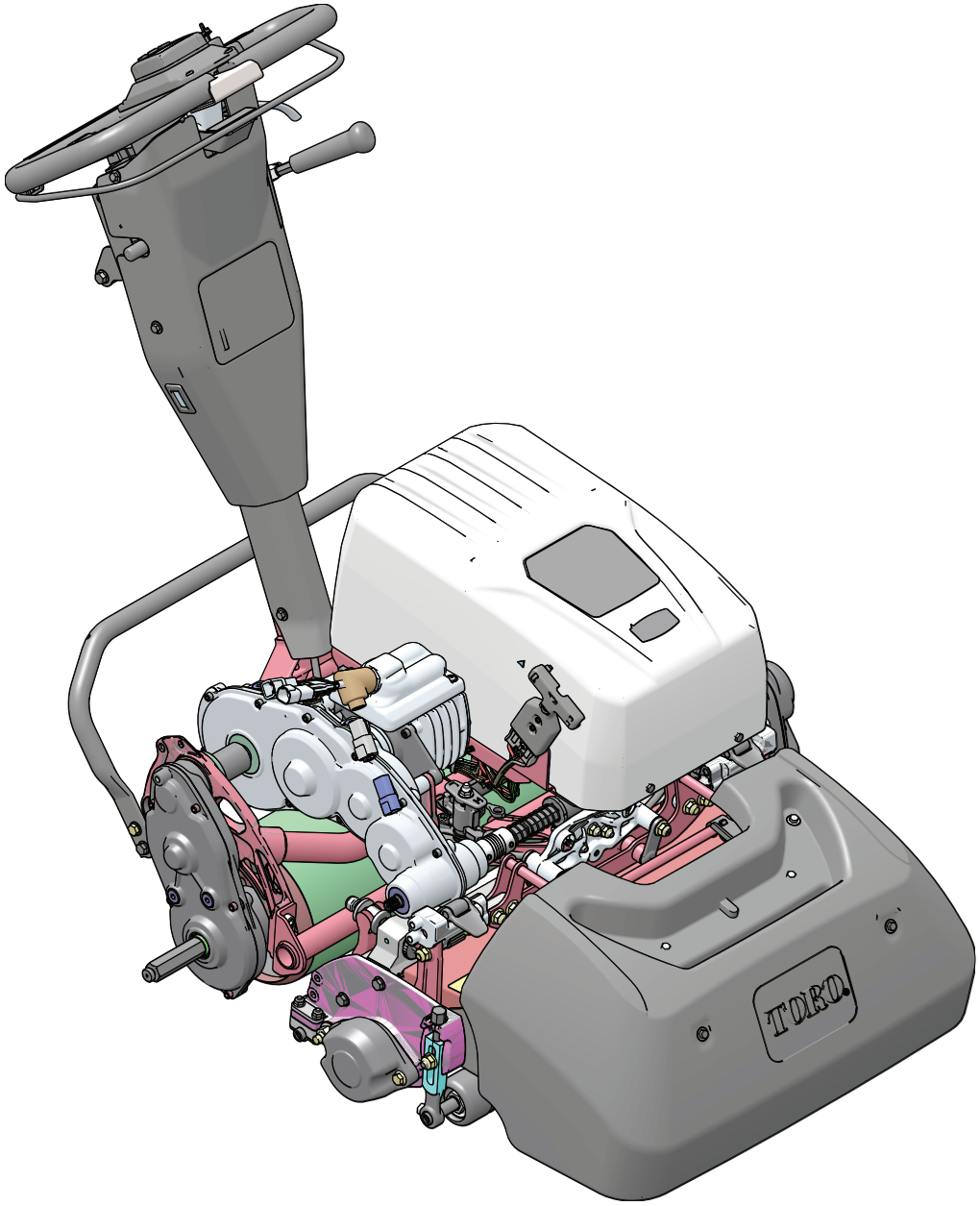

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Figure 1

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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Chapter 1

Safety

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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 adjusting or repairing 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.
  - When 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 overload lifts, hoists, and jacks.

- Do not work under a suspended load.
- Ensure chock blocks are used on equipment that can move.
- Use lifts or jacks and jack stands that are rated to support the total weight of the machine and any attachments.
- Do not rely on jacks to support the machine.
- If you are unfamiliar with any lifts, hoists, or jacks, do not use them until you know how to operate them correctly.

- **Using fire extinguishers…**

  Use the proper class of fire extinguisher in case of fire.

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

⚠ WARNING ⚠

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

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

Safety and Instructional Decals

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

Chapter 2

Specifications and Maintenance

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Specifications

Overall Dimensions

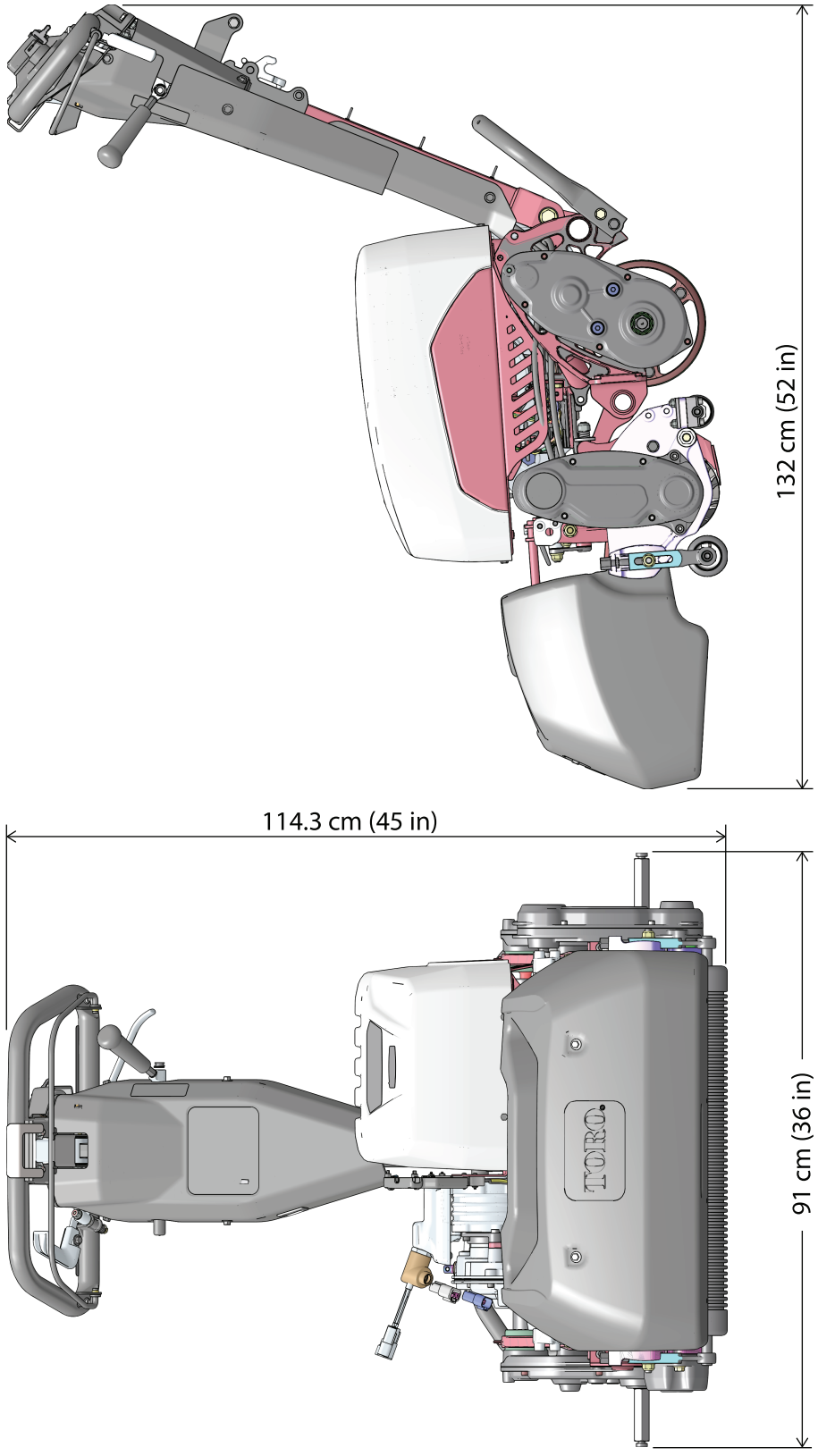

Figure 2

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 aluminum, 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 at right side 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 at the right side of the cutting unit.
Groomer height setting	**Height-of-cut range:** 0.8 to 15.7 mm (0.030 to 0.620 inch). **Height of groom range:** 0.381 to 19.1 mm (0.015 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., nylock nut), hardness of the surface underneath the head of the fastener, or similar condition which affects the installation.

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

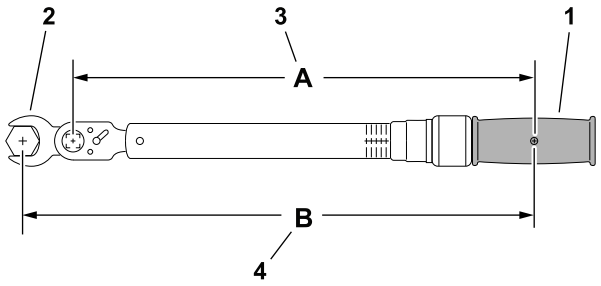

Figure 3

Torque Conversion Factor = A / B

1. Torque wrench
2. Drive-adapter wrench (crowsfoot)
3. A (effective length of torque wrench)
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

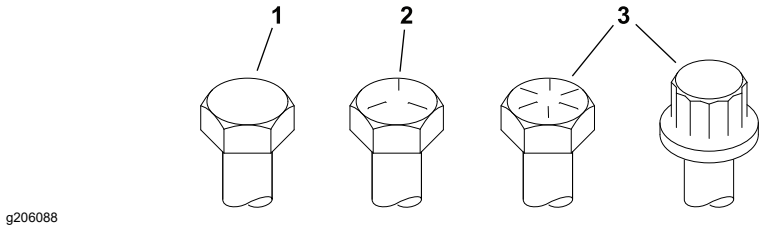

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Figure 4

Inch Series Bolts and Screws

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

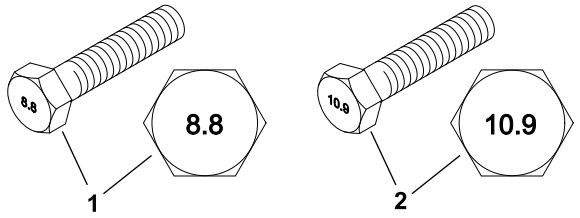

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Figure 5

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

in-lb X 11.2985 = N·cm

ft-lb X 1.3558 = N·m

N·cm X 0.08851 = in-lb

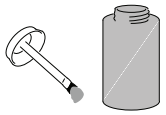
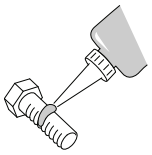
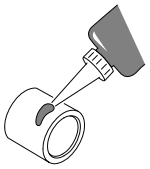
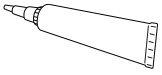
N·m X 0.7376 = ft-lb

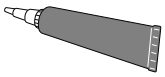
Shop Supplies

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.

ANTI-SEIZE LUBRICANT 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.	
GREASE Can be used to pre-fill (pack) bearings, boots and seals prior to assembly, ease installation of components during assembly, or fill cavities between moving parts through grease fittings after assembly. Unless otherwise noted, refer to the machine *Operator's Manual* or *Installation Instructions* for grease specifications.	
THREAD LOCKING COMPOUND (Thread Locker) 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. **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.	
RETAINING COMPOUND (bearings and sleeves) 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.	
ADHESIVE 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, moldings, and weather-stripping.	
THREAD SEALANT 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 firm 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.	

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

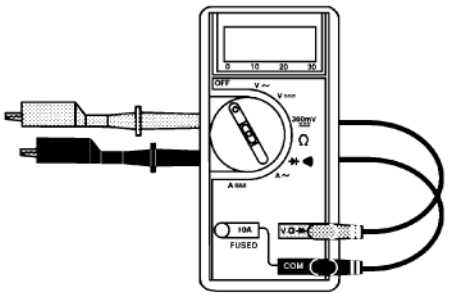
Special Tools

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

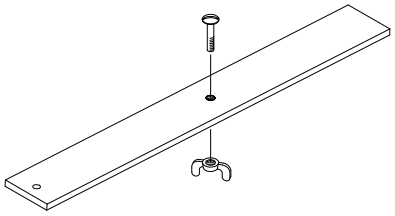
Use the dielectric gel to prevent corrosion of unsealed connection terminals. To ensure complete coating of the terminals, liberally apply the gel to the component and wire harness connector, plug the connector into the component, unplug the connector, apply the gel to both surfaces again, and connect 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

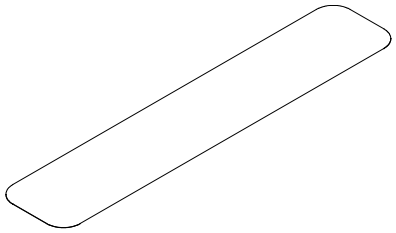
Use gauge bar to verify height-of-cut adjustment.



Cutting Reel Shim

Toro Part No. 125–5611

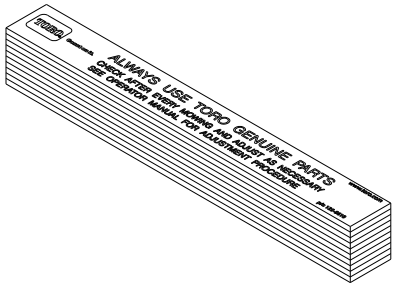
Use the 0.05 mm (0.002 in) shim like a feeler gauge to measure the gap between the reel and the bedknife during reel adjustment.



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

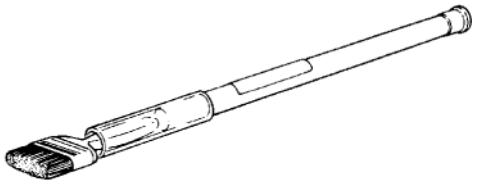
For applying lapping compound to cutting units while keeping hands a safe distance from the rotating reel.

Components for the brush assembly are also available individually.

Brush 36-4310

Handle 29-9080

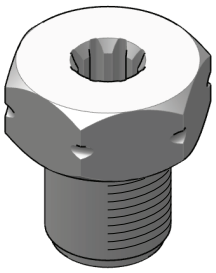
Handle cap 2410-18



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 developed these service tools for accurately measuring the top grind angle on all bedknives.

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

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

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

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

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

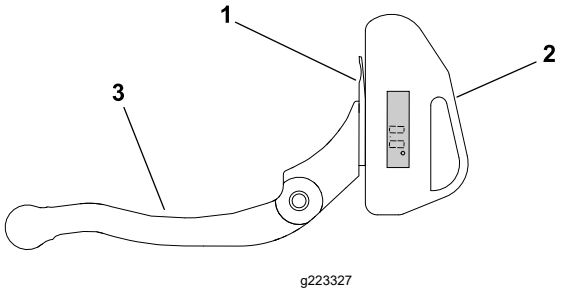


Figure 6

1. Bedknife
2. Angle Indicator
3. Bedbar

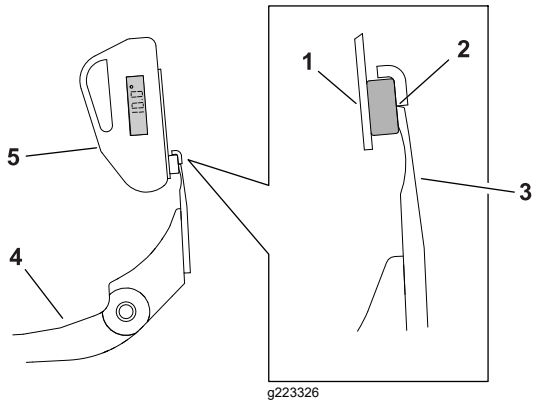


Figure 7

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

Bedknife Screw Tool

K-Line Part No. TOR510880A

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

IMPORTANT

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

Diameter/Circumference Measuring Tape

K Line Part No. TOR6023

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

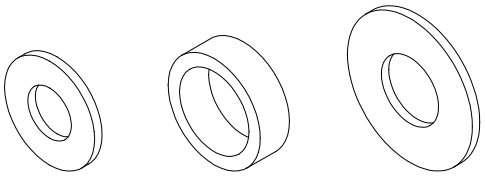
Roller Rebuilding Tools

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

Bearing installation washer: 107-8133 (black)

Seal installation spacer: 107-3505

Seal installation washer: 104-6126 (yellow)



K-Line Part No. TOR4105

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

Turf Evaluator Tool

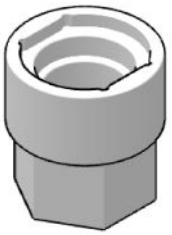
K Line Part No. 04399

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.



Syringe – 50cc (2 ounce)

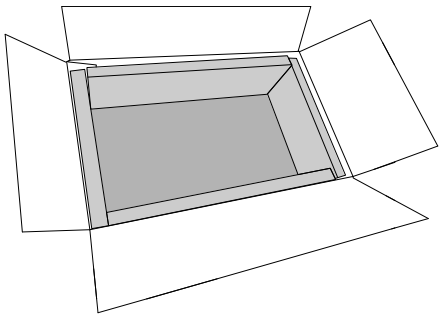
Toro Part No. 137-0872

Aids in accurately filling the optional Universal Groomer gearbox with oil.

Lithium-Ion Battery Shipping Kit

Toro Part No. 137–9650

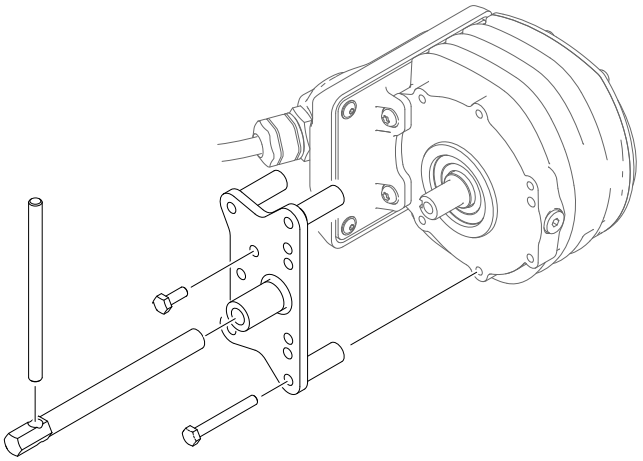
Use the original packaging or the battery shipping kit and a certified carrier to ship one of the lithium-ion batteries. The kit includes the appropriate carton, packing, labels, and instructions necessary to confirm to current lithium-ion battery shipping regulations in the USA.



Electric Motor Rotor Tool

Toro Part No. 139–8420

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



Lithium-Ion Battery Service Wire Harness

Toro Part No. 122–1947

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

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

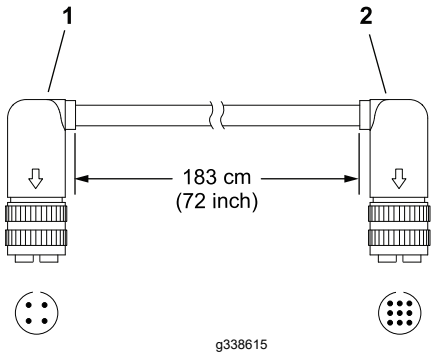


Figure 8

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

Chapter 3

Troubleshooting

Table of Contents

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

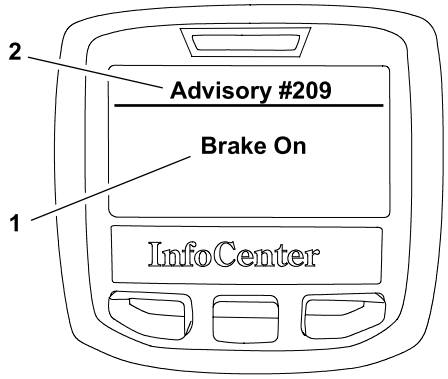


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Figure 9

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 were 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

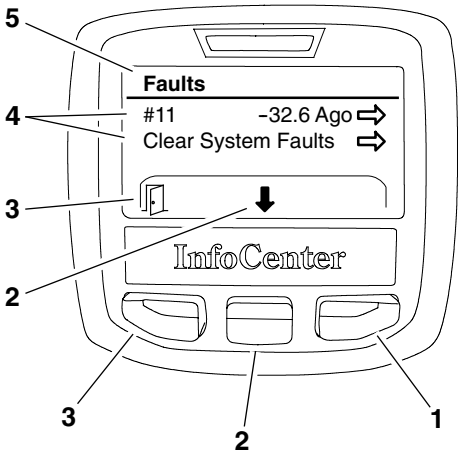

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Figure 10

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

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.	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.		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	Commun-ication 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.	1. Let machine cool. Note that this fault is not produced by a bad sensor. 2. Open the rear discharge of the cutting unit. 3. Reduce reel speed. 4. Reduce mow speed.
9	Internal Motor Fault	Motor	The motor detected an internal fault condition.		1. Verify the battery is charged. 2. Test for proper supply voltage at the motor and its controller. 3. Test the main contactor coil. 4. Replace the motor. 5. Replace the TEC.
10	Motor Stalled	Motor	Motor at zero RPM for more than 3 seconds. Insufficient torque to rotate motor.	Can occur during heavy cutting conditions or cutting unit malfunction.	1. Check cutting unit and motor mechanical resistance. 2. Check bedknife adjustment and condition of reel. 3. Motor will likely need replacing if the fault continues.
11	Software Incompatible		One of the devices in the system has software that is incompatible.		Use Toro DIAG to reprogram the machine.
12	Key Stuck On	Primary	The battery has detected the key switch in the START position for longer than allowed.		1. Verify the battery is charged. 2. Test the key switch wiring. 3. Test the key switch.
13	Internal Battery Fault	Battery Management System	Internal BMS detected fault.		1. Reboot the machine. 2. Disconnect and reconnect the battery. 3. Recharge the battery. 4. Replace the battery.

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.		1. Try rebooting machine, disconnect and reconnect the battery, look for short circuits in the harness. 2. Replace the TEC.
16	Contactor Fault	Primary	The bus voltage was high enough at power up to require a discharge before precharge. The bus failed to discharge below threshold in the required amount of time. At shutdown, the contactor opens and the bus discharges before shutting the machine down. This discharge failed to go below the threshold in the required amount of time.		Most likely cause is a shorted contactor.
17	Throttle Sensor Fault	Primary	The sensor signals are outside the expected range.	Traction is disabled.	1. Test the throttle sensor. 2. Test the throttle sensor circuit wiring and connector P05. 3. Replace throttle sensor.
18	Traction Bail Sensor Fault	Primary	The sensor signals are outside the expected range.	Traction is disabled.	1. Test the traction bail sensor. 2. Test the traction bail sensor circuit wiring and connector P26. 3. Replace traction bail sensor.

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
The controller has detected a fault.	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 remains active, 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 several 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, several 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 7–18).
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	A reel and/or bedknife that has rounded cutting edges or rifling (grooved or wavy appearance) cannot be corrected by tightening the bedknife to reel contact. Grind the reel to remove taper and/or rifling. Grind the bedknife to sharpen and/or remove rifling. A new bedknife must be ground or backlapped after installation to the bedbar. Refer to Grinding the Bedknife (page 7–14) for grinding information or the *Traction Unit Operator’s Manual* for backlapping information.
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	A variety of cutting unit rollers are available. Refer to the *Cutting Unit Parts Manual* for a listing of available accessories, or contact your local Authorized Toro Distributor for additional information. Ensure that the rollers rotate freely. Repair the roller bearings if necessary; refer to Roller Assemblies (page 7–27).
Cutting unit accessories	A variety of cutting unit accessories are available that can be used to enhance aftercut appearance. Refer to the *Cutting Unit Parts Manual* for a listing of available accessories, or contact your local Authorized Toro Distributor for additional information.

Factors Affecting Grooming

There are several 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.).

Chapter 4

Traction and Reel Drive Systems

Table of Contents

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

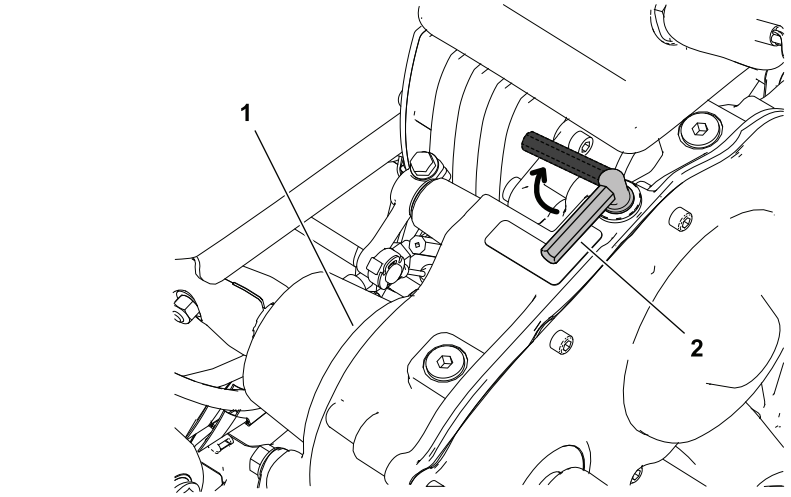

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Figure 11

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. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).
3. Locate the traction engage/disengage lever on top of the transmission gear box assembly.
4. To disengage the drum drive, rotate the traction engage/disengage lever to clockwise direction (away from the center of transmission gear box assembly).
5. To engage the drum drive, rotate the traction engage/disengage lever to anti-clockwise direction (towards the center of the transmission gear box assembly).
6. Connect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

Adjustments

Adjusting the Reel Drive Belt

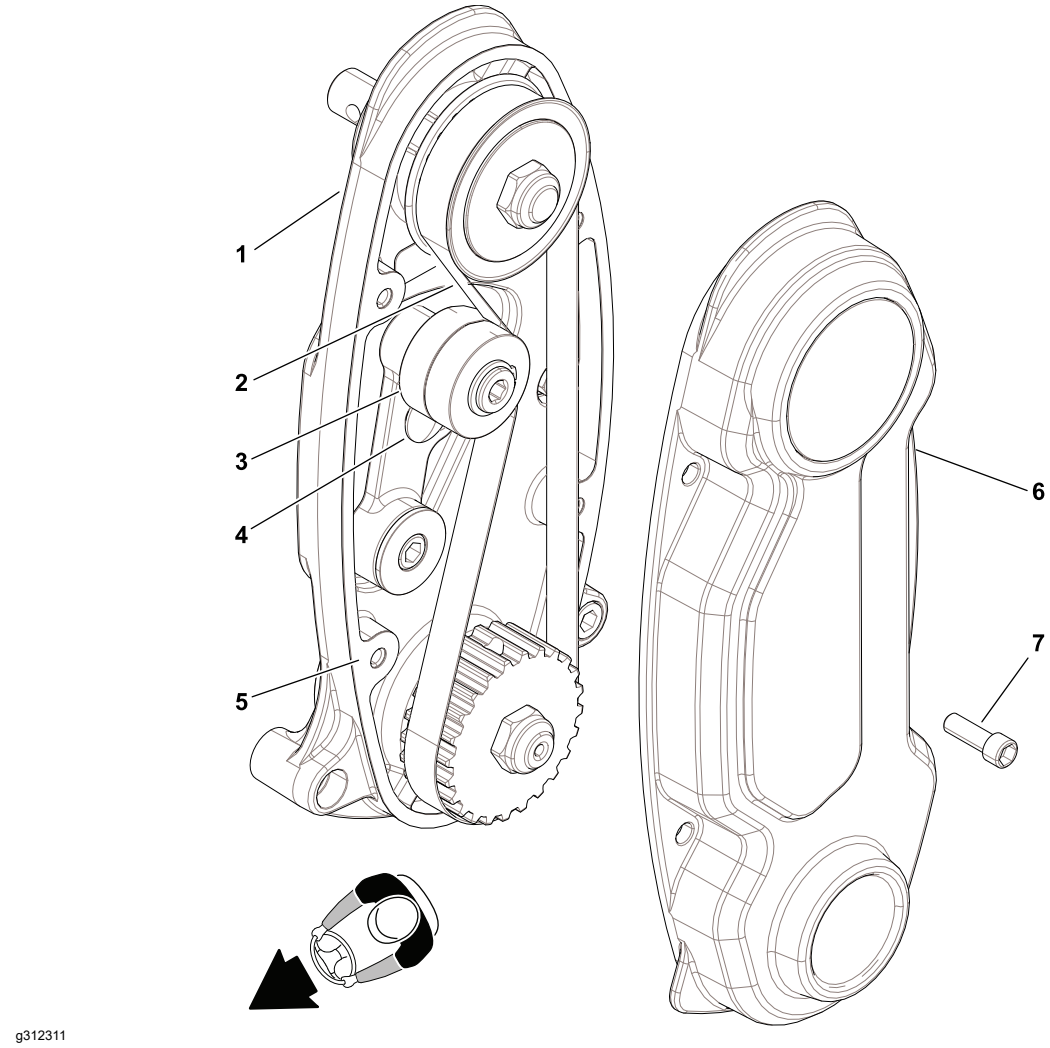

Figure 12

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

1. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).
3. Remove the 4 socket head screws (7) that secure the reel drive cover (6) to the reel drive housing (1), and remove the cover to expose the reel drive belt (2).
4. Check the tension of the belt (item 2 in Figure 12) by pressing it at mid span between pulleys with **18 to 22 N (4 to 5 lbs)** of force. If the belt deflects **6.35 mm (0.25 inch)**, belt tension is correct - continue operation. If belt tension is not correct, proceed to next step.

Adjusting the Reel Drive Belt (continued)

5. Adjust belt tension as follows:

   A. Loosen the nut securing carriage bolt (4) and the idler arm (3), and rotate the arm to remove tension from the belt (2).

   B. Use a beam-style torque wrench to apply **6 to 7 N·m (55 to 60 in-lb)** of force to the upper idler-arm socket-head screw as shown in Figure 13, and tighten the nut to secure the carriage bolt (4) and the idler arm (3). Check the belt tension; refer to step 4.

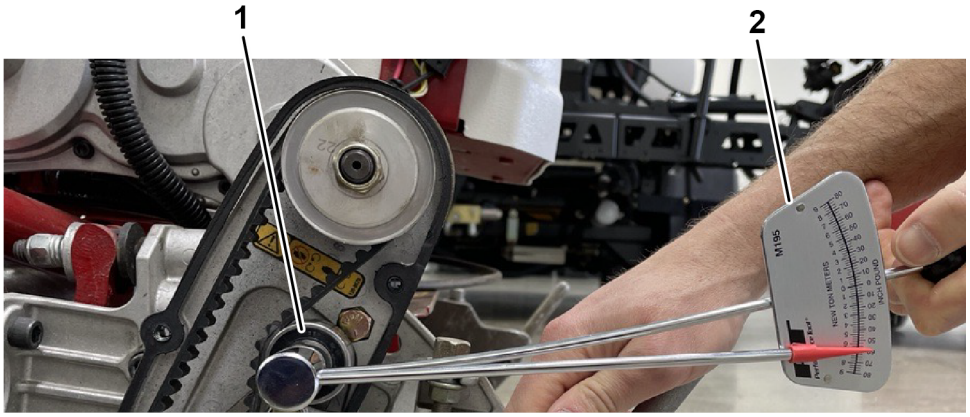

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Figure 13

1. Upper idler-arm socket-head screw
2. Beam-style torque wrench

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

   D. Initially torque the socket head screws to **1.7 to 4.5 N·m (15 to 40 in-lb)**. Then using an alternating pattern torque the screws to **9.6 to 10.7 N·m (85 to 95 in-lb)**.

6. Connect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

Service and Repairs

Reel Drive Belt

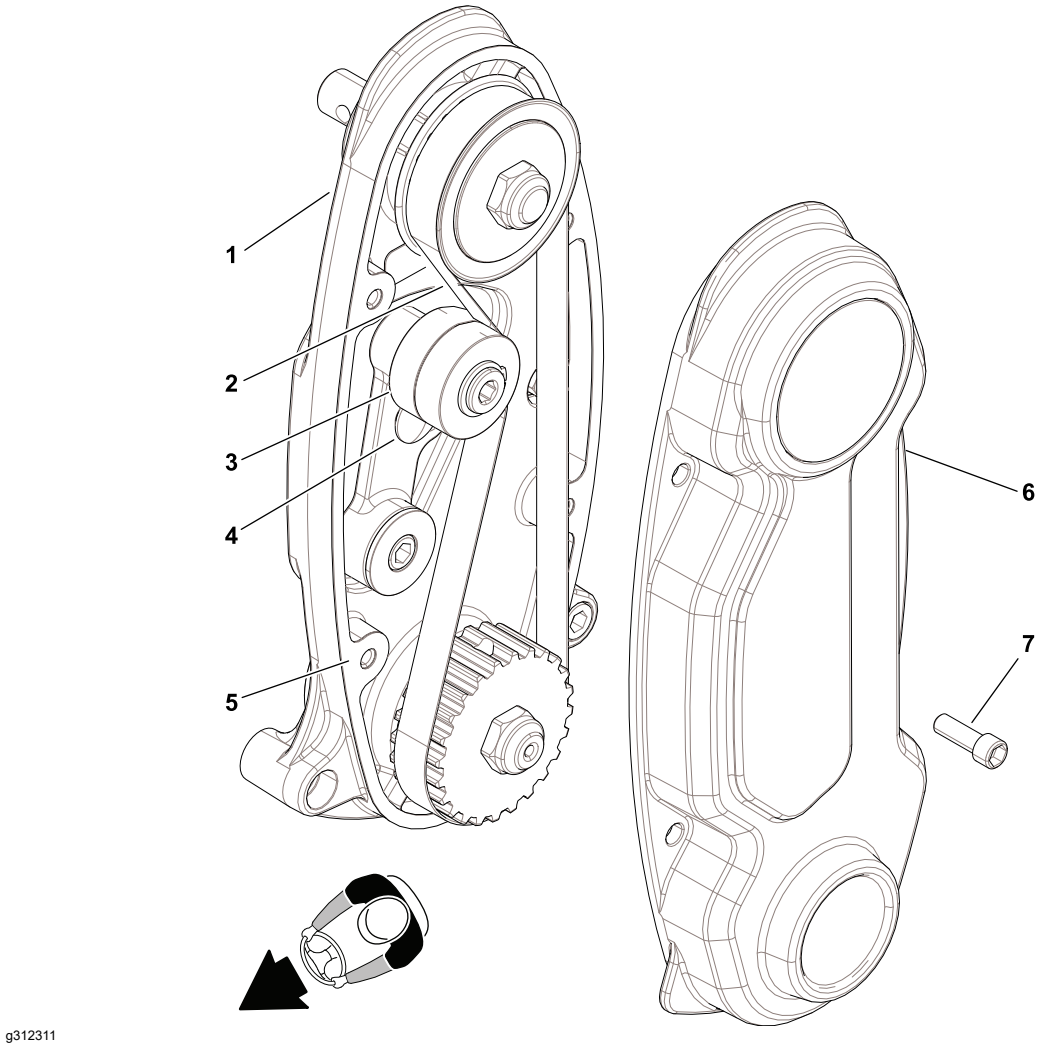

Figure 14

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

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 14 during this procedure.

1. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).
3. Remove the 4 socket head screws (7) that secure the reel drive cover (6) to the reel drive housing (1), and remove the cover to expose the reel drive belt (2).

Removing the Reel Drive Belt (continued)

4. Remove and inspect the reel drive gasket (5) from the reel drive housing (1). Replace the reel drive gasket (5) if it is worn or damaged.
5. Loosen the nut securing carriage bolt (4) and the idler arm (3), and rotate the arm to remove tension from the belt (2).
6. Remove the belt (2) from the pulleys.

Installing the Reel Drive Belt

1. Ensure that the nut and carriage bolt (4) are loose enough to freely move the idler arm (3).
2. Place the new drive belt (2) over the pulleys.
3. Adjust the reel belt tension; refer to Adjusting the Reel Drive Belt (page 4–3).
4. Align the reel drive gasket (5) to the reel drive housing (1), and install the reel drive cover (6) to the housing with the 4 socket head screws (7).

5. Initially torque the socket head screws to **1.7 to 4.5 N·m (15 to 40 in-lb)**. Then using an alternating pattern torque the socket head screws to **9.6 to 10.7 N·m (85 to 95 in-lb)**.
6. Connect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

Reel Drive Assembly

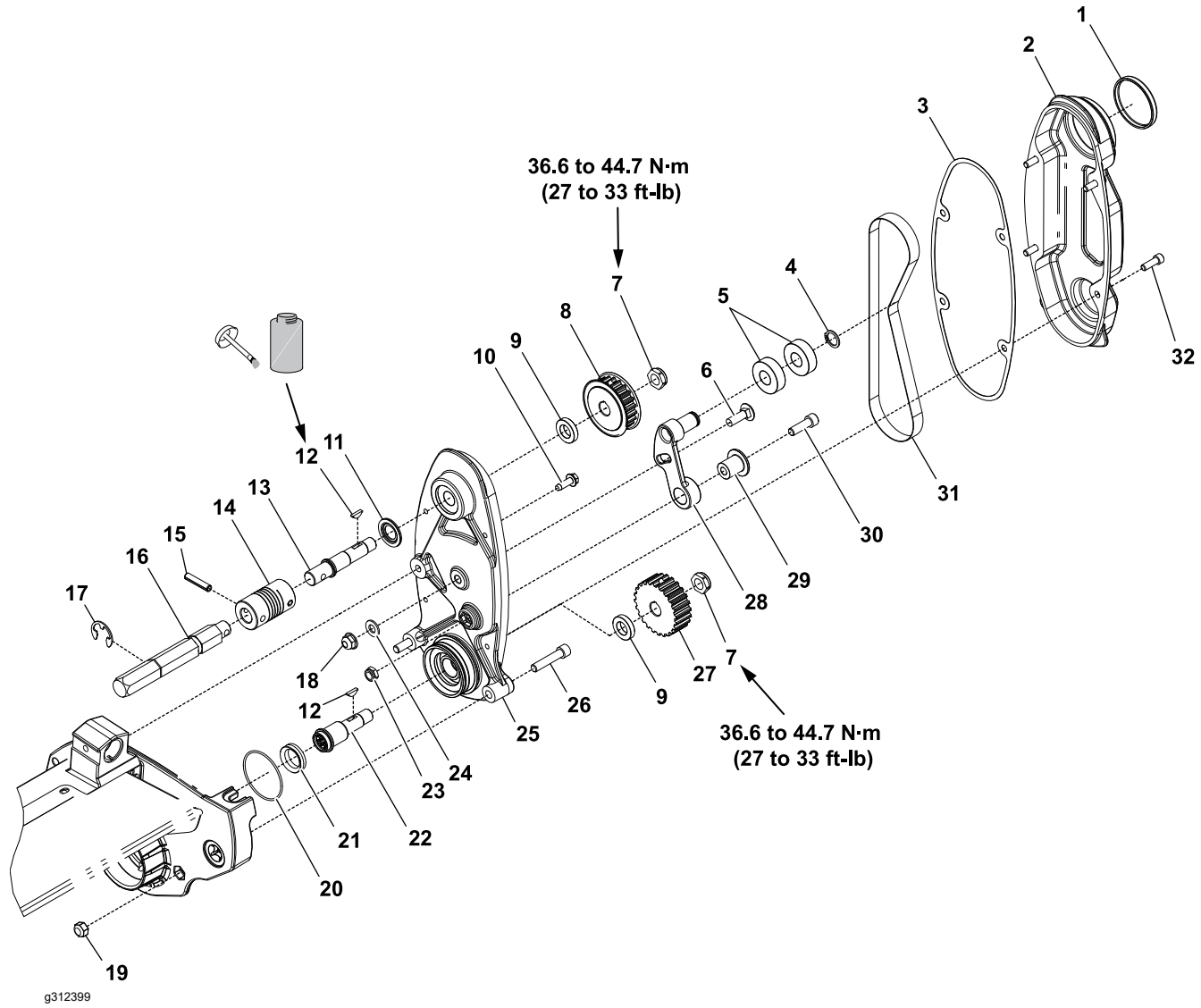

Figure 15

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

Removing the Reel Drive Assembly

Note: Refer to Figure 15 during this procedure.

1. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and

parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.

2. Disconnect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).
3. Remove the cutting unit from the machine; refer to *Operator's Manual*.
4. Remove the reel drive belt; refer to Removing the Reel Drive Belt (page 4–5).
5. Remove and discard the reel drive gasket (3) from the housing (25).
6. If necessary, remove the expansion plug (1) from the reel drive cover (2).
7. Remove the nuts (19), socket head screws (26) and bolt (10) that secures the reel drive housing (25) to the cutting unit.
8. Remove the reel drive housing assembly from the cutting unit.
9. Remove the V-ring seal (21) from the reel shaft driven (22).
10. Remove the nut (18) and washer (24) from the reel drive housing (25) and carriage bolt (6) from the idler arm (28).
11. Remove the socket head screw (30) that secures the idler arm (28) to the reel drive housing (25).
12. If necessary, remove the idler bushing (29) from the idler arm (28).
13. 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.
14. Remove the lock nut (7), reel pulley (27), hipro key (12) and spacer (9) from the reel shaft driven (22).
15. Slide and remove the reel shaft driven (22) from the reel drive housing (25).
16. Remove the lock nut (7), reel pulley (8), hipro key (12) and spacer (9) from the reel shaft driver (13).
17. Slide and remove the reel shaft driver (13), helical coupling (14) and coupler shaft (16) from the reel drive housing (25).
18. Remove and discard the bearing shield (11) from the reel drive housing (25).
19. Remove and discard the O-ring (20) from the reel drive housing (25).

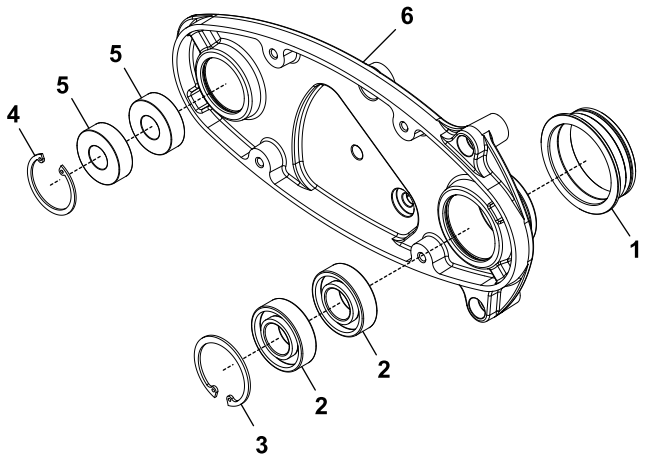

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Figure 16

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

Removing the Reel Drive Assembly (continued)

20. If necessary, remove the retaining rings (3 and 4) from the reel drive housing (6).
21. 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 15 during the procedure.

1. Use a press to install the 4 ball bearings (items 2 and 5 in Figure 16) into the reel drive housing (6).
2. Secure the ball bearings with 2 retaining rings (item 3 and 4 in Figure 16) into the reel drive housing (6).

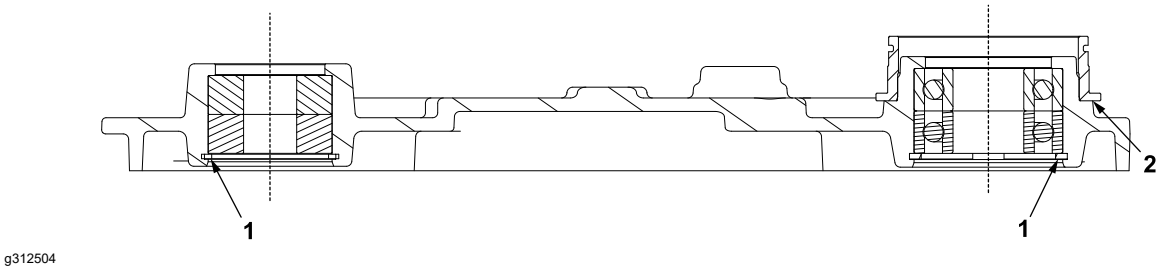

Figure 17

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 am (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).

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 Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

Drum Drive Gear Box Assembly

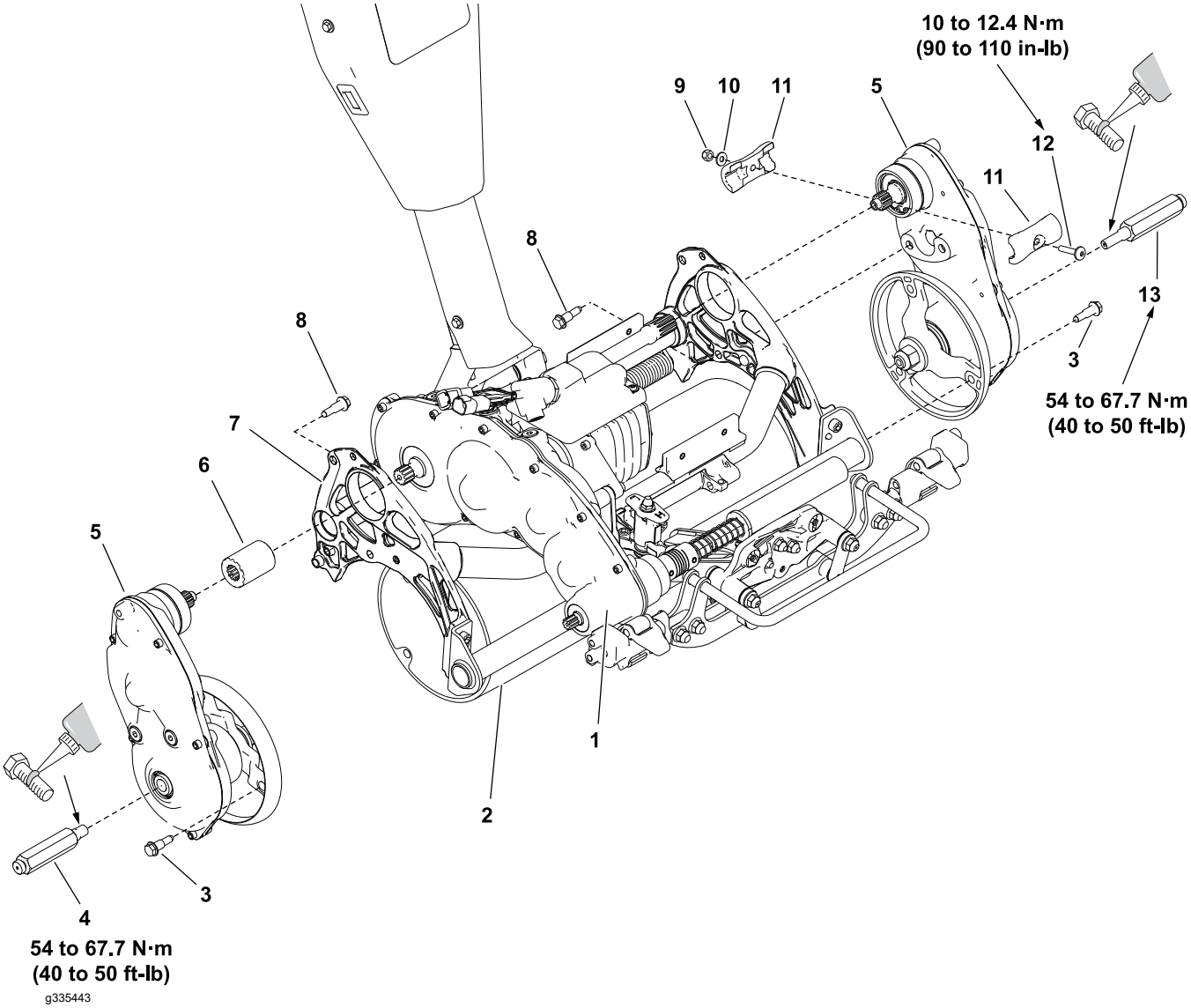

Figure 18

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 18 during this procedure.

1. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).
3. Remove the transport wheel if attached; refer to Removing the Transport Wheel (page 6–23).

Removing the Drum Drive Gear Box Assembly (continued)

Note: Support the machine on kickstand during this operation.

4. Move the traction engage/disengage lever to the disengage position to remove torque from the drum drive gears.
5. Remove the shoulder bolt (8) that secures the RH drum drive gear box assembly (5) to the frame assembly (7).
6. 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.
7. If necessary, slide and remove the drive tube (6) from the transmission gear box assembly (1).
8. If necessary, remove the RH hexagonal shaft (4) from the RH drum drive gear box assembly (5).
9. 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).
10. Remove the shoulder bolt (8) that secures the LH drum drive gear box assembly (5) to the frame assembly (7).
11. 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.
12. If necessary, remove the LH hexagonal shaft (13) from the LH drum drive gear box assembly (5).

Disassembly of Drum Drive Gear Box Assembly

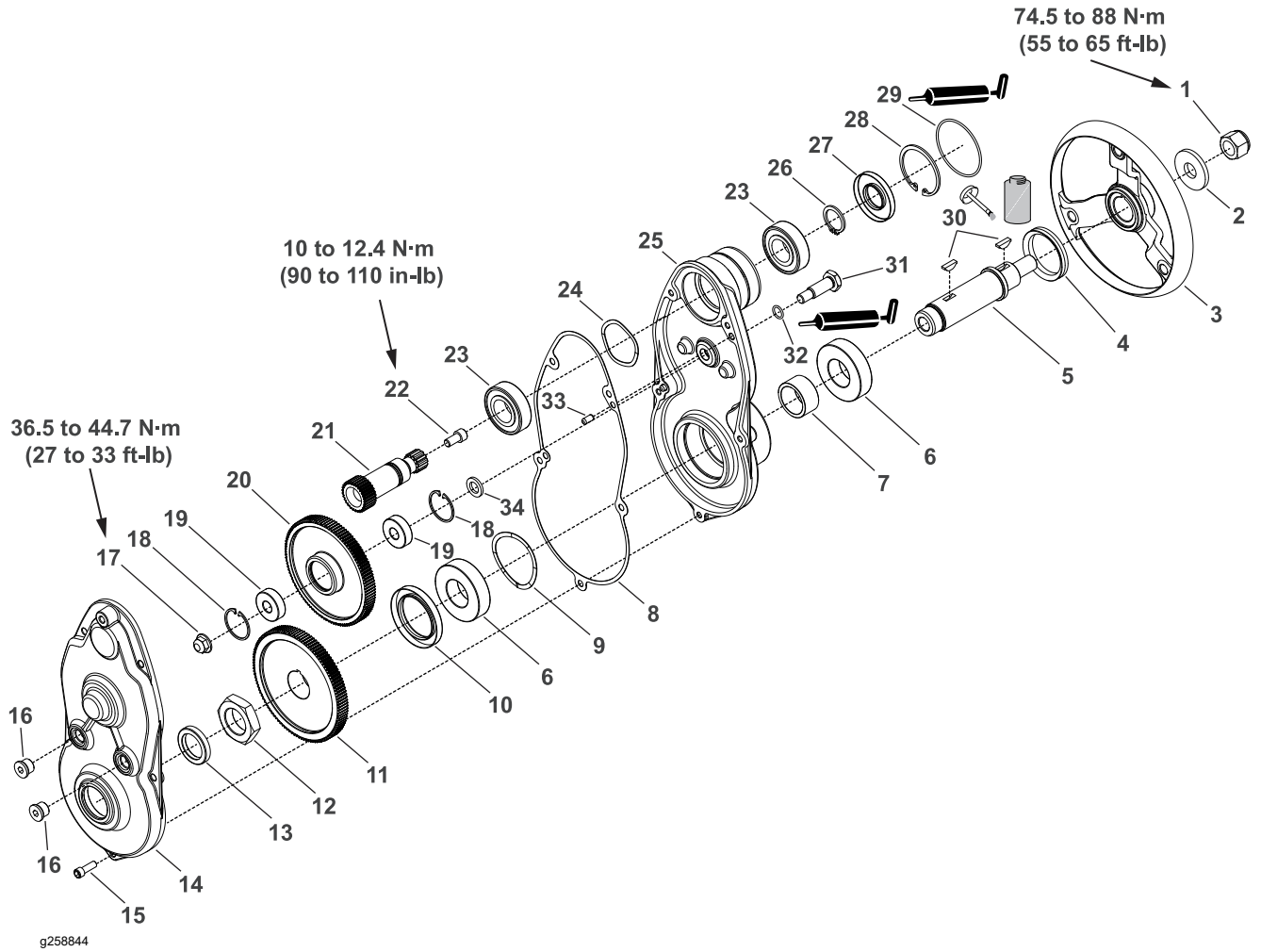

Figure 19

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

Note: Refer to Figure 19 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

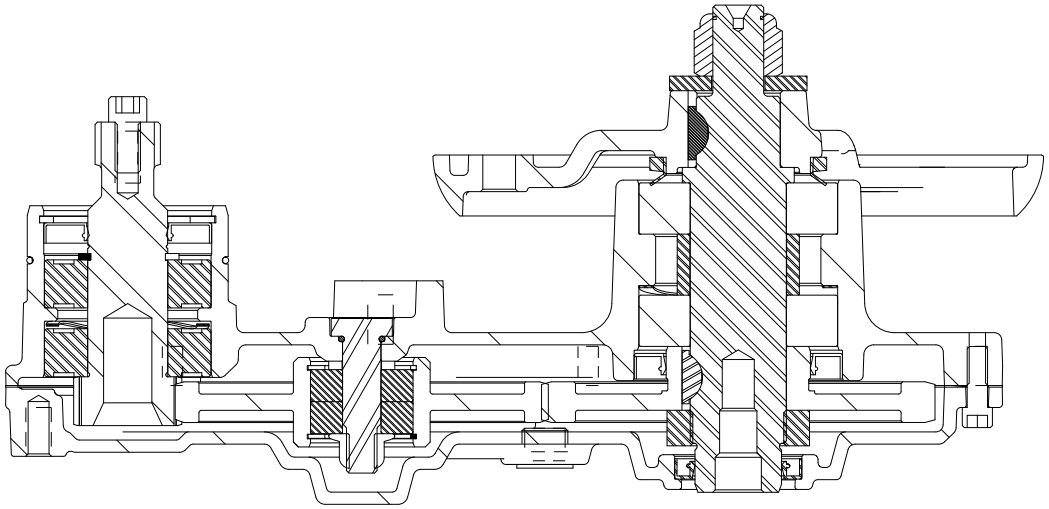

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Figure 20

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 18) 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 18) onto the transmission gear box assembly (1).
4. Install the LH and RH drum drive gear box assemblies (Item 5 in Figure 18) 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 6–25).
9. Connect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

Drum Assembly

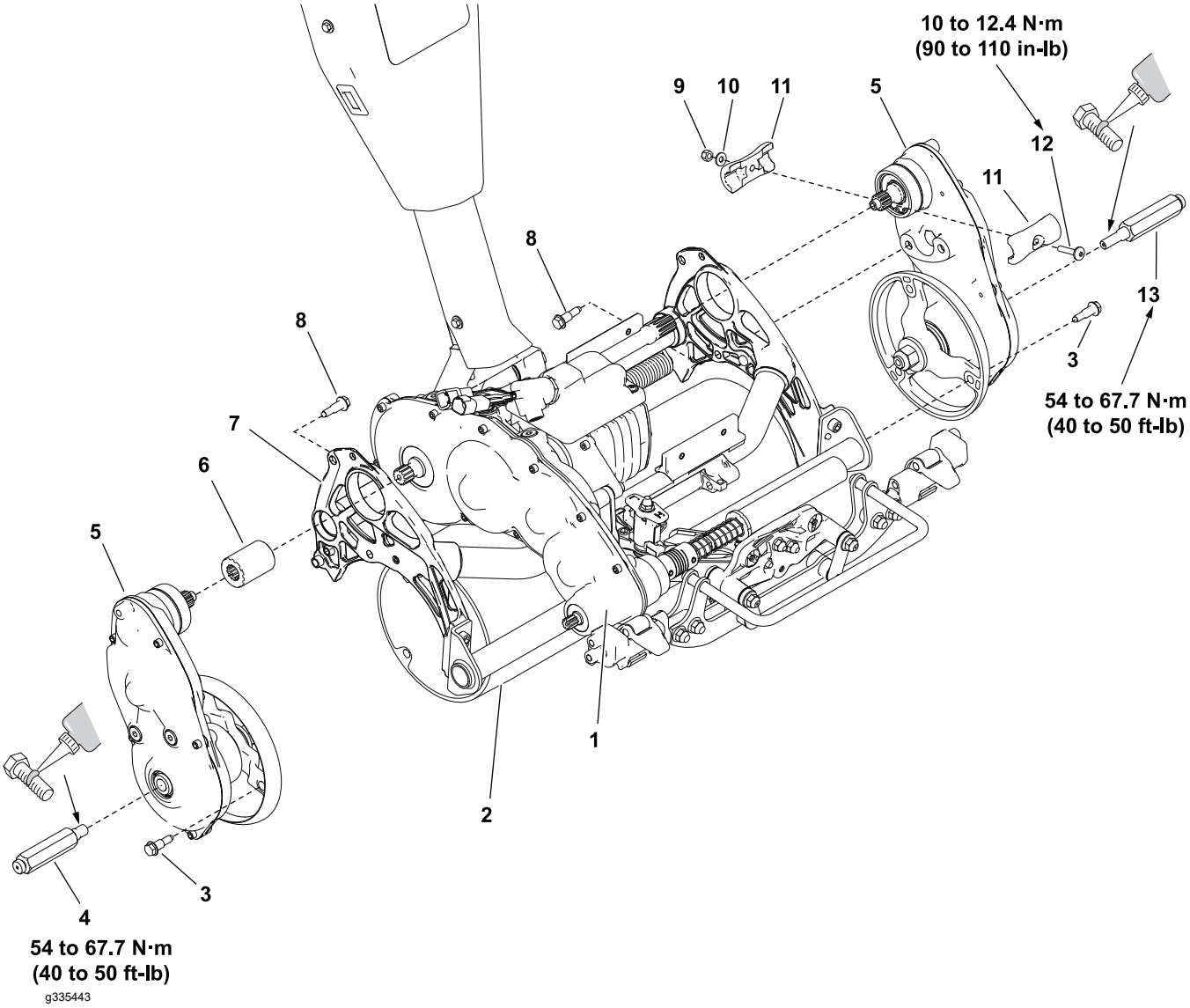


Figure 21

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 21 during this procedure.

1. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).
3. Remove the LH and RH drum drive gear box assemblies (item 5 in Figure 21); refer to Removing the Drum Drive Gear Box Assembly (page 4–12).
4. Remove the traction drum (2) from the frame assembly (7).

Disassembly of Drum Drive Assembly

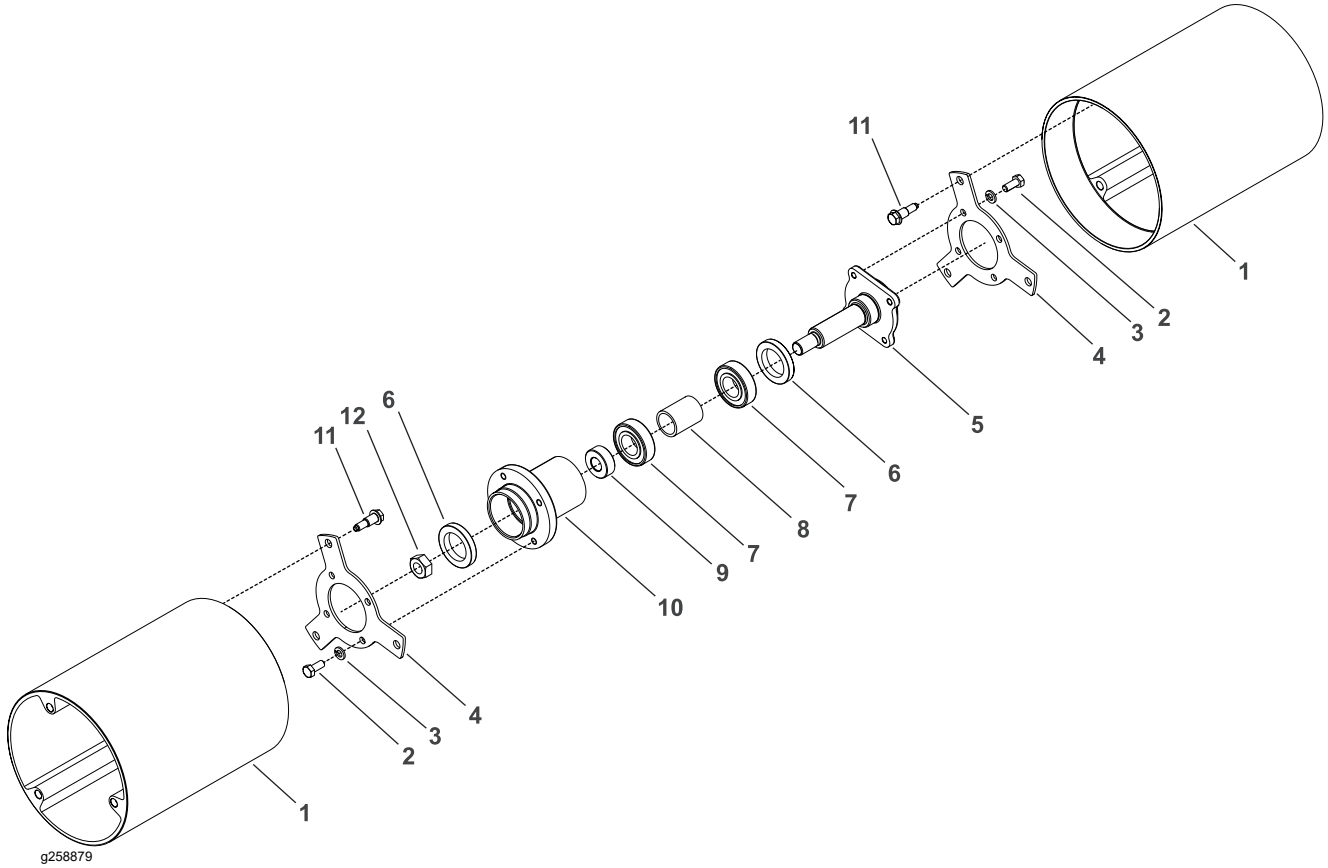


Figure 22

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

Note: Refer to Figure 22 during this procedure.

1. Remove the 4 bolts (item 2 in Figure 22) 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

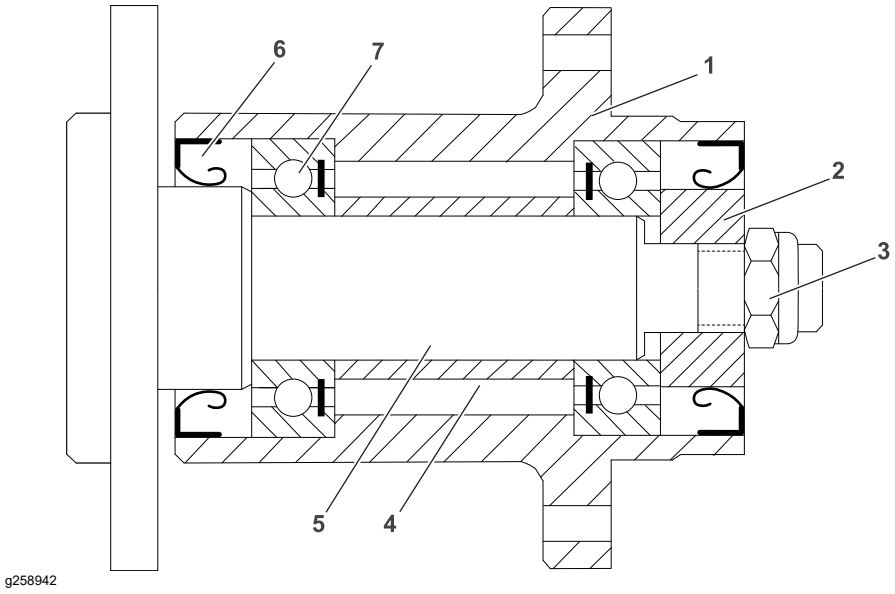


Figure 23

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

Note: The seal side of each bearing (item 7 in Figure 23) should face inside of the drum hub; refer to Figure 23.

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 (Figure 23.
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 22) 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. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).
3. Position the LH and RH drum drive gear box assembly (item 5 in Figure 21) and traction drum (2) onto the frame assembly (7).
4. 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 4–17).
5. Connect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

Transmission Gear Box Assembly

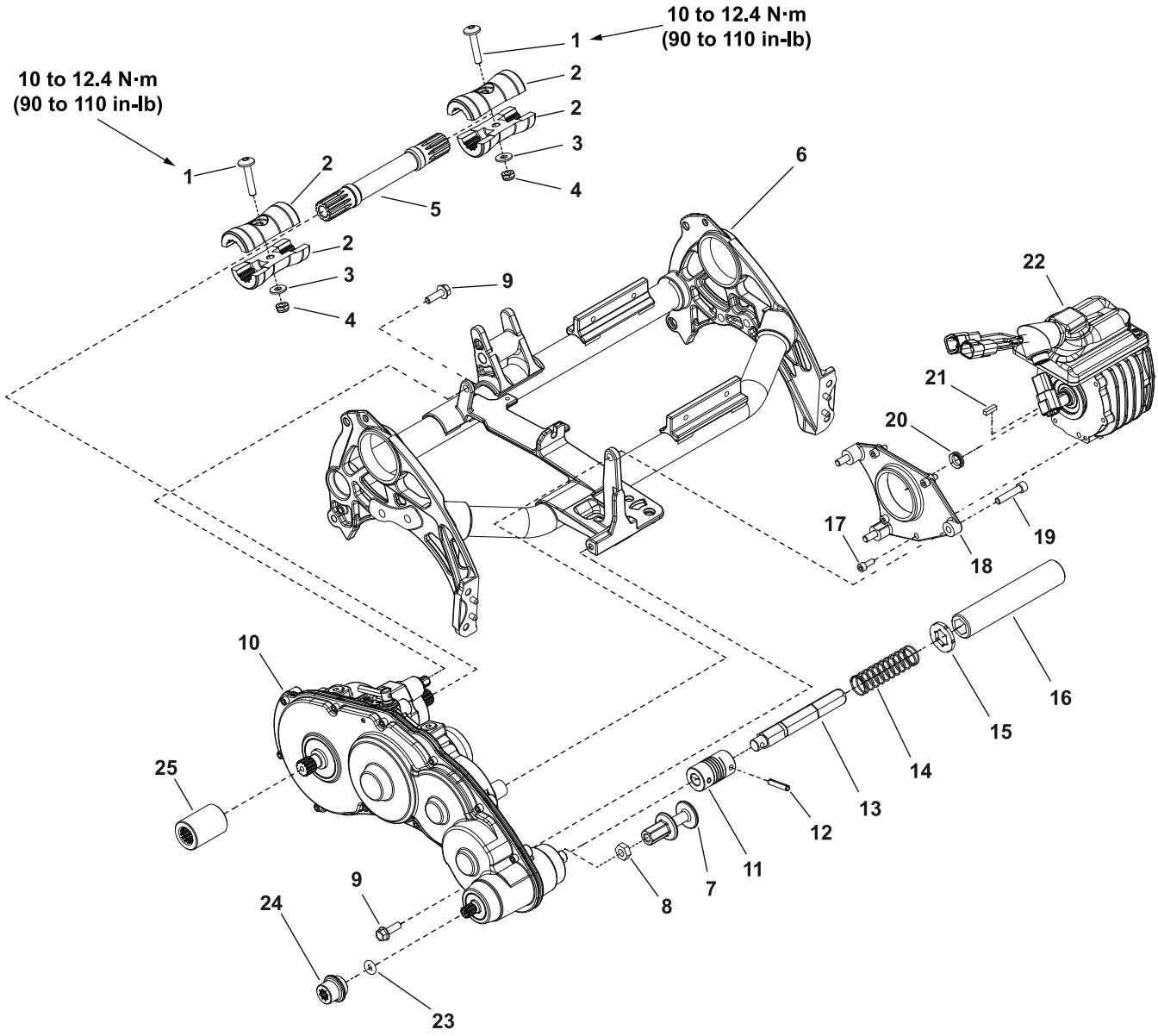


Figure 24

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

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

Removing the Transmission Gear Box Assembly

Note: Refer to Figure 24 during this procedure.

1. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).
3. Disconnect the brake cable; refer to Removing the Brake Cable (page 6–4).
4. Disconnect the reel cable; refer to Removing the Reel Cable (page 6–7).
5. Slide the collar lock (15) into the coupler shaft groove (13).
6. Slide the hex tube (16) to the coupler shaft (13) and disconnect the cutting unit from the transmission gear box assembly.
7. 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.
8. Remove the socket head screw (19) that secures the motor adaptor (18) and transmission gear box assembly (10) to the frame assembly (6).
9. 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).
10. 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

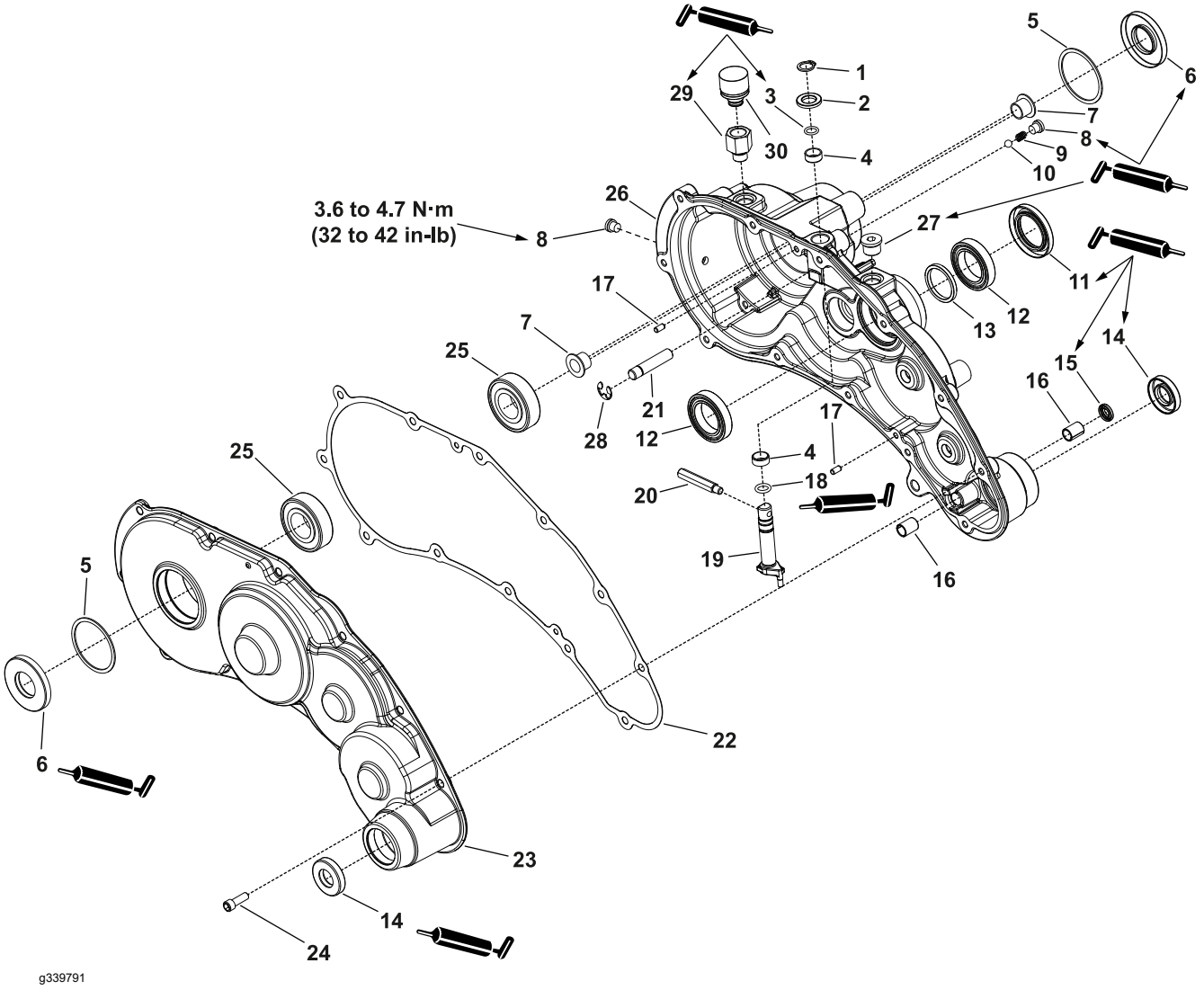


Figure 25

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

Note: Refer to Figure 25 during this procedure.

1. Remove the hollow hex plug (item 27 in Figure 25), 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).

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.

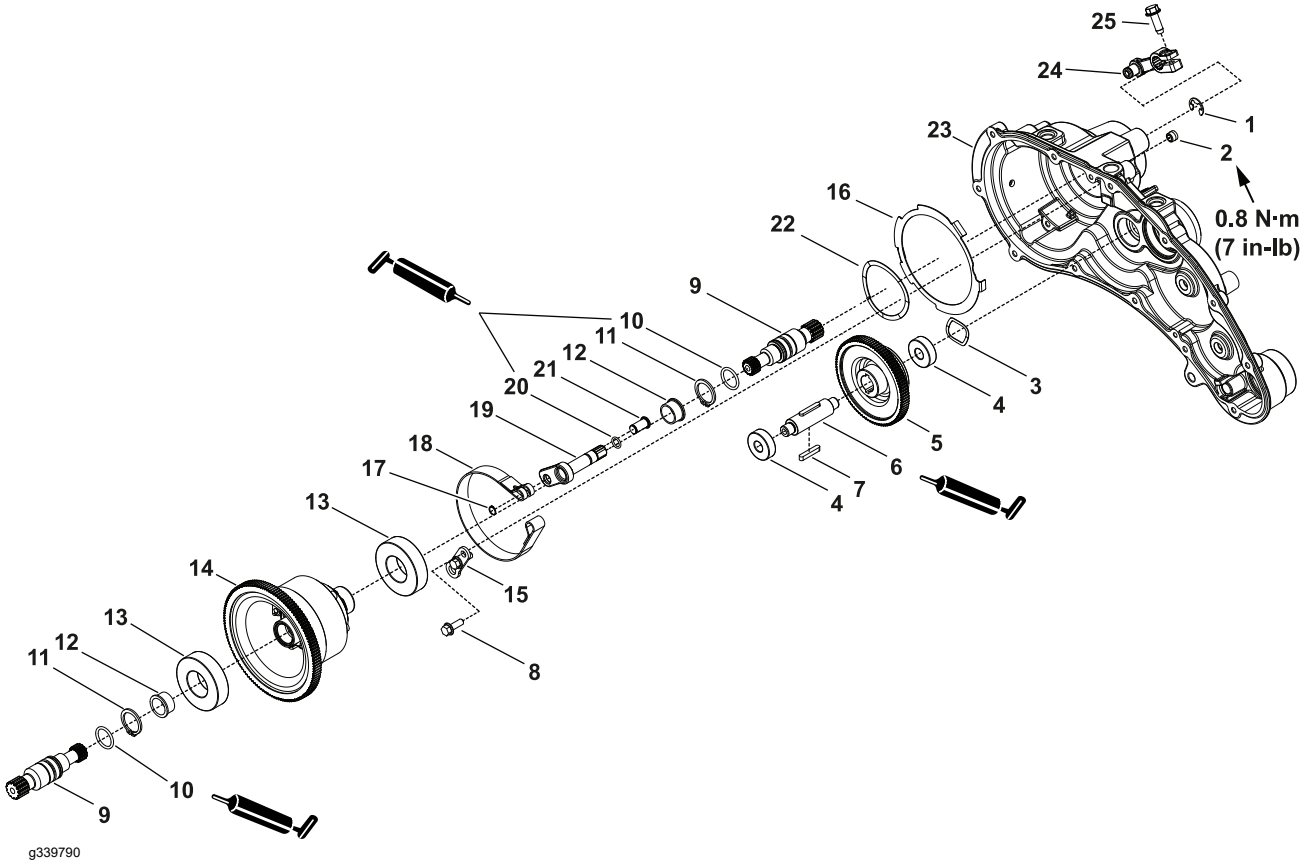


Figure 26

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 26) 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).

9. If necessary, disassemble the differential assembly (14); refer to Disassembly of Differential Assembly (page 4–34).
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).

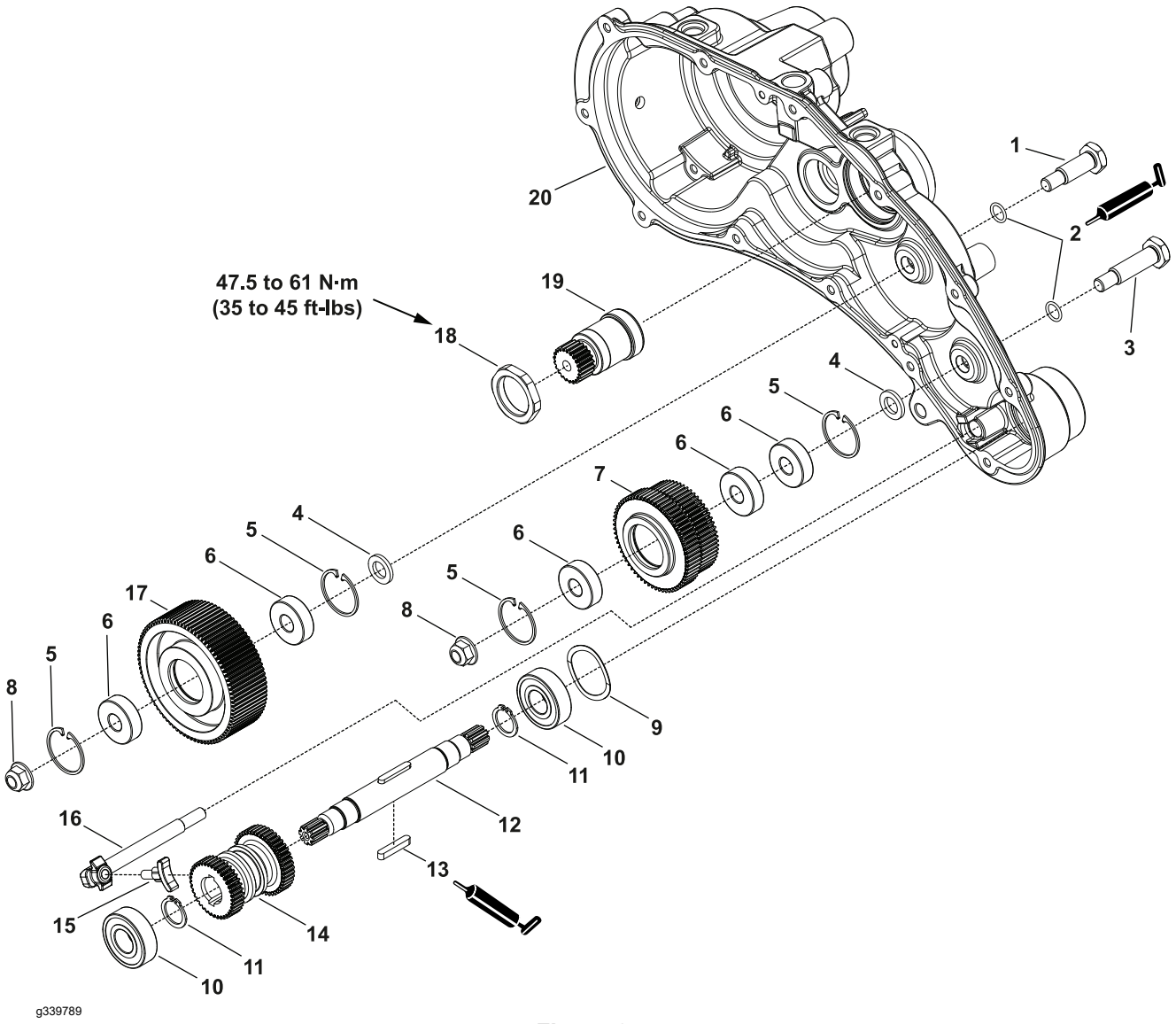


Figure 27

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

14. Slide and remove the reel clutch actuator (item 16 in Figure 27) 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).

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 25), detent spring (9) and detent ball (10) from the transmission housing assembly (26).
24. Loosen and remove the groomer pin (item 20 in Figure 25) from the traction selector shaft (19).
25. Remove the retaining ring (item 1 in Figure 25), 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 25) and O-ring (18) from the transmission housing assembly (26).
27. Remove oil seal (item 15 in Figure 25) and sleeve bushings (16) from the transmission housing (26). Discard the oil seal (15).
28. Remove the flange bushings (item 7 in Figure 25) from the transmission housing (26).
29. Remove the oil seals (item 6 in Figure 25), 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 25) 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 25) and new ball bearings (12 and 25) into the transmission housing (26).
2. Install the retaining ring (item 5 in Figure 25) into the transmission housing (26).
3. Install the new grease seal (item 11 in Figure 25) 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 25) 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 25) 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 25) into the transmission housing (26).
7. Insert the sleeve bushing (Item 16 in Figure 25) into the transmission housing (26) until the sleeve bushing is flush with the transmission housing.
8. Press the oil seal (item 15 in Figure 25) 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 25) and slide onto the groove of the traction selector shaft (19).
10. Insert the straight bushings (item 4 in Figure 25) 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 25) and slide onto the traction selector shaft (item 19 in Figure 25). Insert the traction selector shaft (item 19 in Figure 25) into the transmission housing (26).
12. Apply a coat of a grease to the O-ring (item 3 in Figure 25) 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 25) onto the traction selector shaft (19).
14. Install the detent ball (item 10 in Figure 25), detent spring (9) and plug (8) into the transmission housing assembly (26).

15. Insert the input shaft (item 19 in Figure 27) 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 27) 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 27) 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 27) into the spur gear (7) and secure with the 2 retaining rings (5).

19. Apply a coat of grease to the O-ring (item 2 in Figure 27) 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 27) 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 27) 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 27) and reel drive assembly (14) into the transmission housing assembly (20).
23. Insert the reel clutch shoe (item 15 in Figure 27) 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 26) as follows:
    A. Apply a coat of grease to the O-ring (item 20 in Figure 26) and slide the O-ring onto the brake lever.
    B. Place the brake lever (item 19 in Figure 26) 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 26) 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 26), 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 26) 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 26), 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 26); refer to Assembly of Differential Assembly (page 4–35).
30. Pack the differential assembly (item 14 in Figure 26) 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 26) 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 26) into the differential housing (14).
33. Insert the differential housing assembly (item 14 in Figure 26) into the transmission housing assembly (23).
34. Insert the square keys (item 7 in Figure 26) 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 26) into the neutral spur gear (5).
36. Use a press and insert the bearings (item 4 in Figure 26) onto the neutral slider shaft (6).

37. Insert the wave washer (item 3 in Figure 26) and neutral spur gear assembly (5) into the transmission housing assembly (23). Make sure that the traction selector shaft (item 19 in Figure 25) is engaged in shift selection neutral spur gear (item 5 in Figure 26).
38. Apply a coat of grease to ORB plug (item 8 in Figure 25) 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 25) 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 25) 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 25) into the transmission housing assembly (26).
45. Install the new transmission gasket (item 22 in Figure 25) 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 25) into the transmission gear box assembly (26).
48. Torque tighten the hollow hex plug (27) from **12.4 to 14.7 N·m (110 to 130 in-lb)**.
49. Apply a coat of grease to the adapter-vent (29). Install the adapter-vent (29) into the transmission gear box assembly (26).
50. Torque tighten the adapter-vent (29) from **12.4 to 14.7 N·m (110 to 130 in-lb)**.
51. Install the breather-vent (30) into the adapter-vent (29). Tighten the breather-vent (30) until the gasket contacts the adapter-vent and then tighten an additional 75º to 85º turn.

Installing the Transmission Gear Box Assembly

Note: Refer to Figure 24 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 Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

Differential Assembly

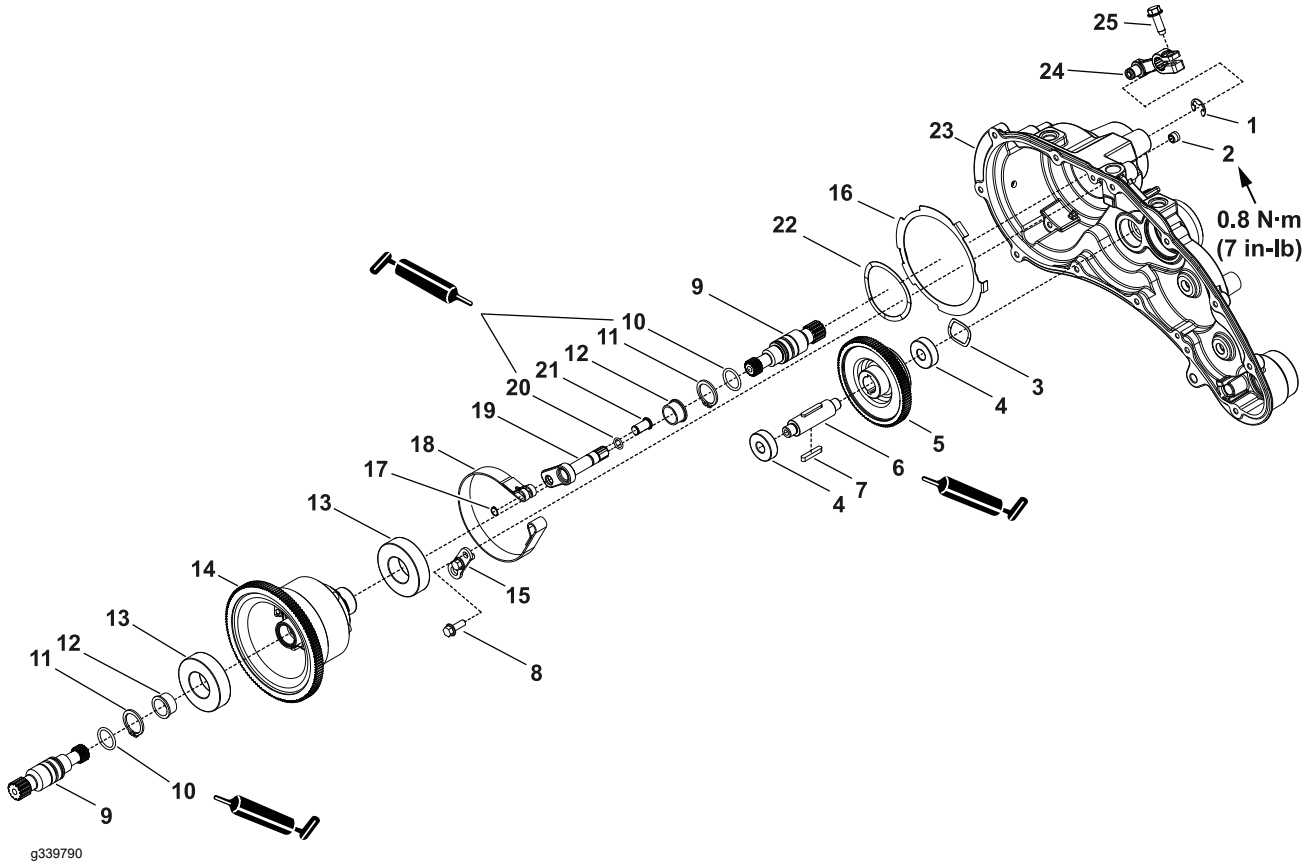


Figure 28

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

Removing the Differential Assembly

To remove the differential assembly from the transmission gear box assembly; refer to Disassembling the Transmission Gear Box Assembly (page 4–24).

Disassembly of Differential Assembly

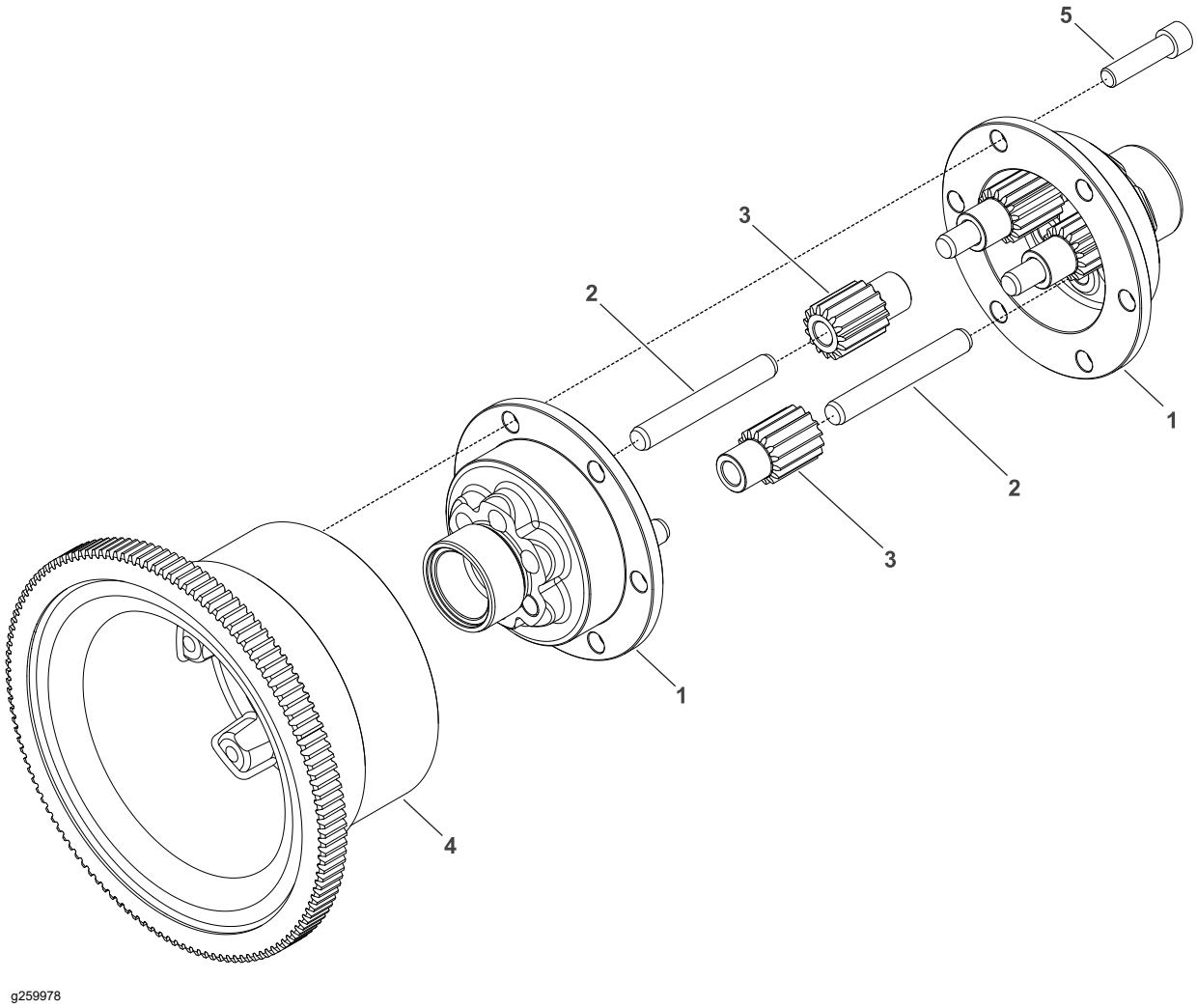


Figure 29

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

1. Remove the 6 socket head screws (item 5 in Figure 29) 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 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.

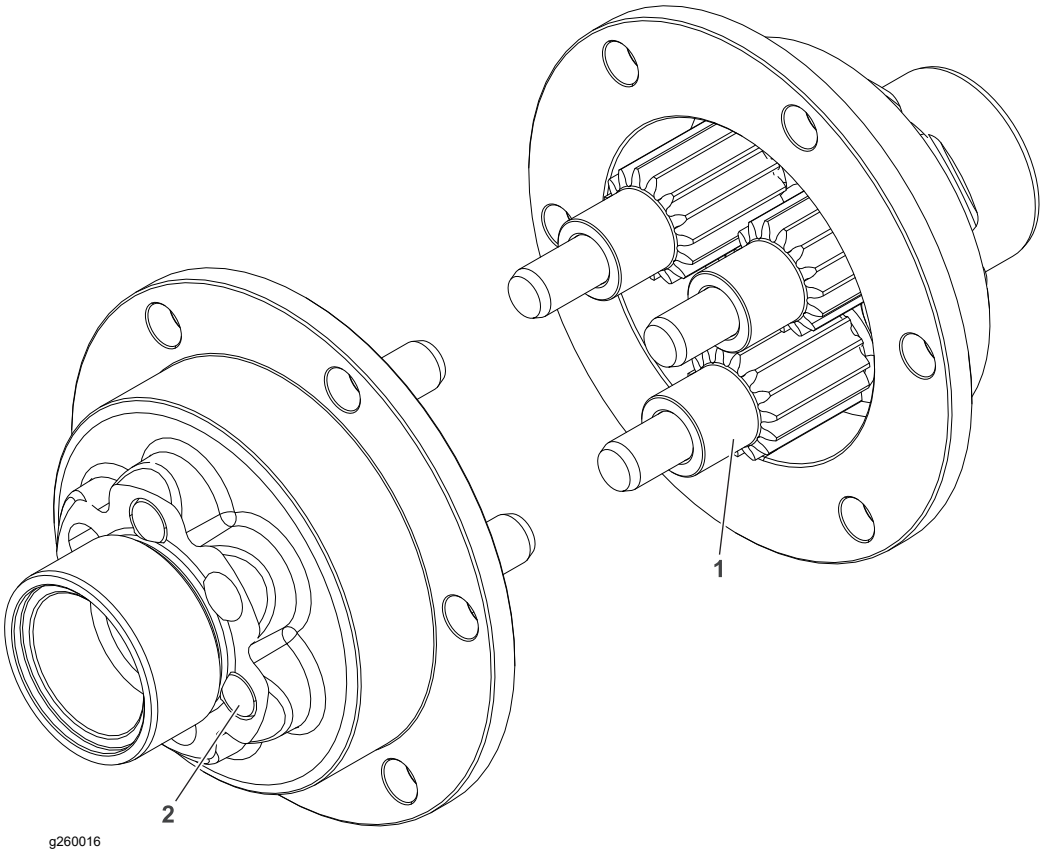


Figure 30

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 30.
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 4–29).

Chapter 5

Electrical System

Table of Contents

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 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).

Disconnecting and Connecting the Lithium Battery Pack

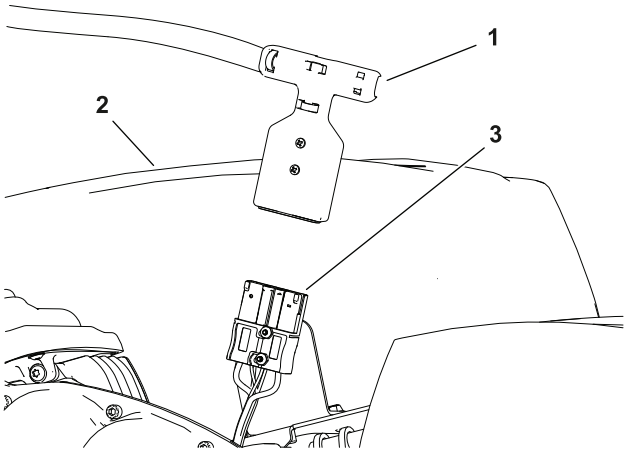
WARNING

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.



g338368

Figure 31

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

To prevent unexpected machine operation during service, disconnect the machine from the battery pack as the first step in any repair (Figure 31). 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.

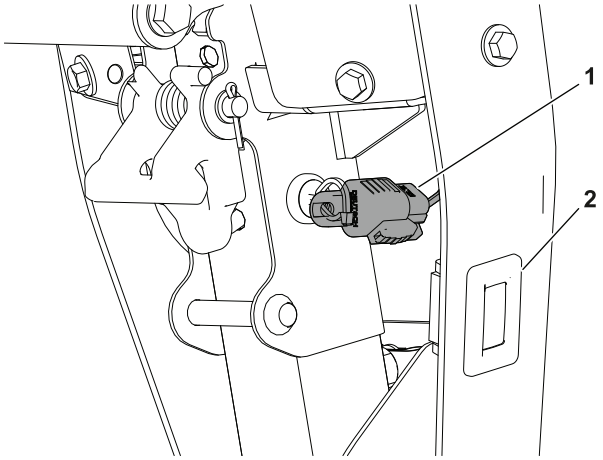
Start Process

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. The TEC and motor controller monitor the motor speed 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 32

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.

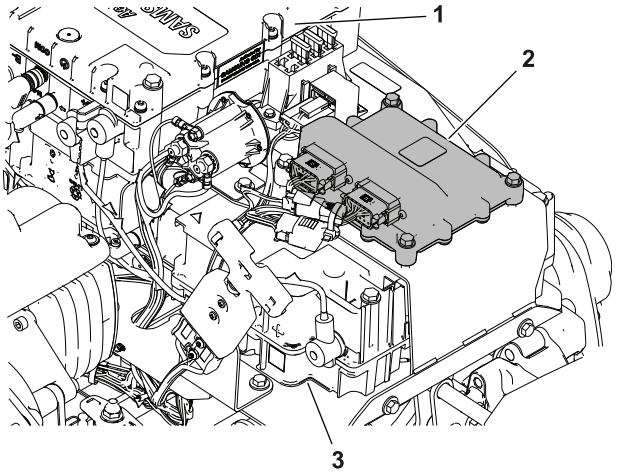
The InfoCenter, lithium-ion battery controller (BMS - Battery Management System), electric motor controller and TEC are on the CAN bus. Additional controllers may be added to the CAN bus in the future through the expansion port connector and/or the telematics connector.

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 32.

Toro Electronic Controller (TEC)



g338223

Figure 33

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

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 33.

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)

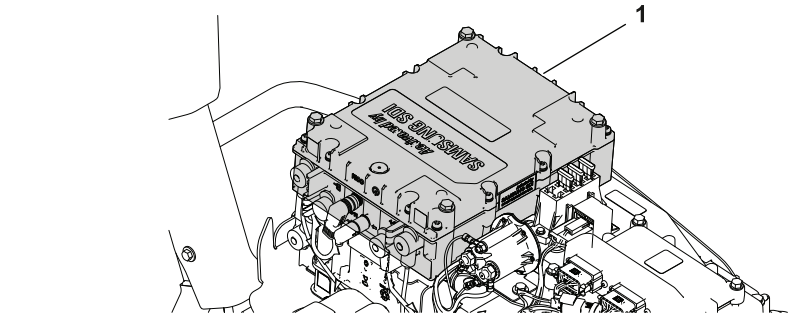


Figure 34

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 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: Except for 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.

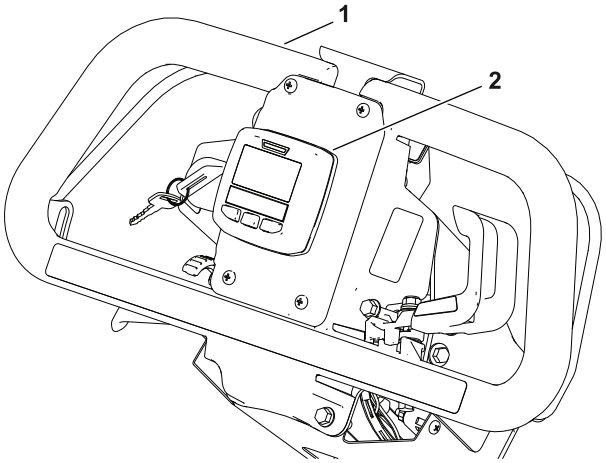
Lithium-Ion Battery Controller (BMS) (continued)

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 35

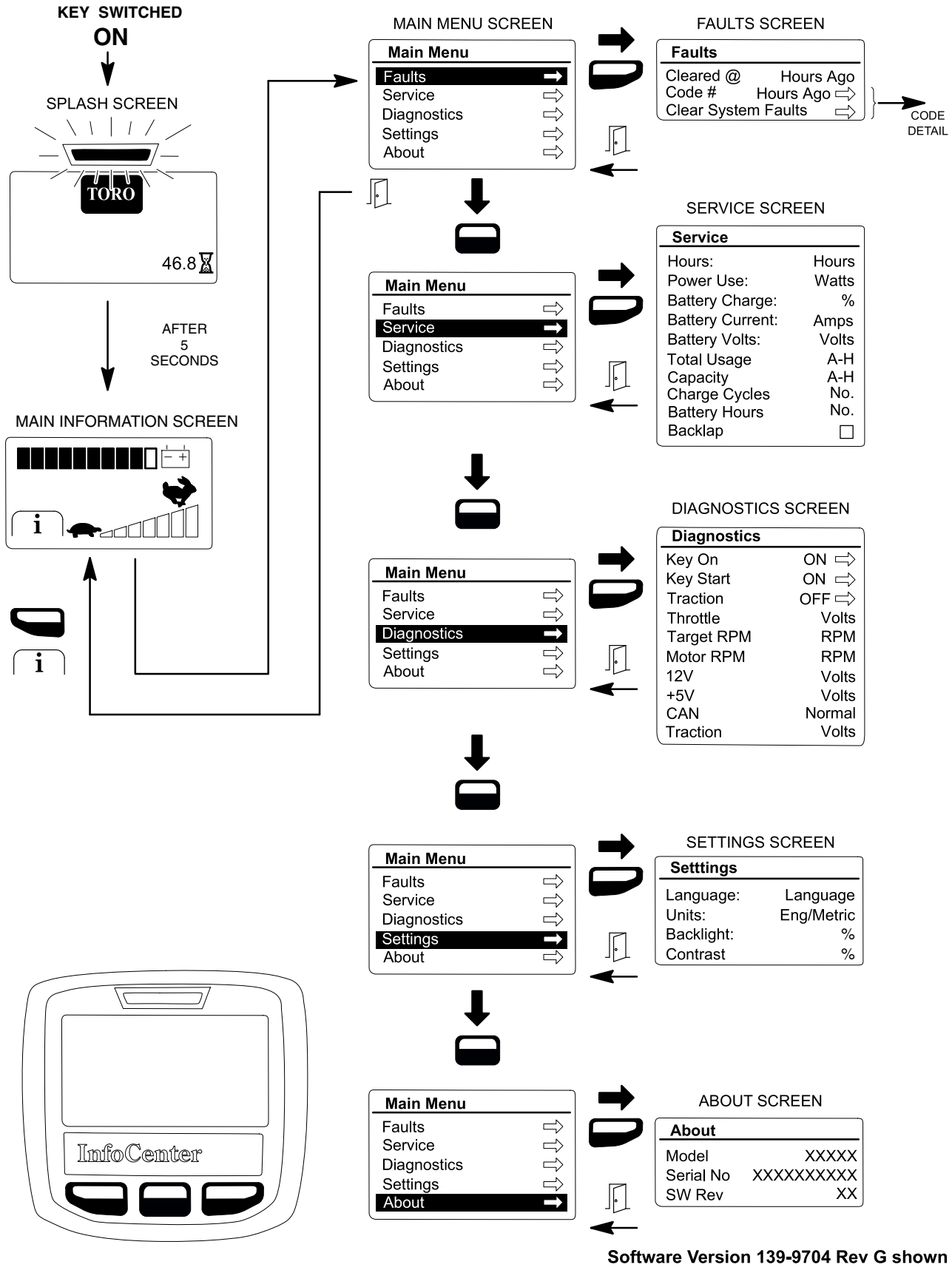
1. Handle
2. InfoCenter display

The InfoCenter display used on your Greensmaster eFlex is an LCD device that is located on the handle console (Figure 35). 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*.

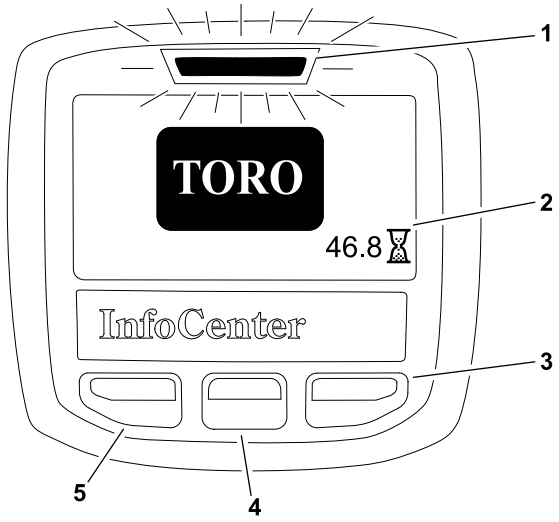
Note: If the InfoCenter display is replaced for any reason, the machine software must be updated; contact an Authorized Toro Distributor for assistance.



Software Version 139-9704 Rev G shown

Figure 36

Splash Screen



g339634

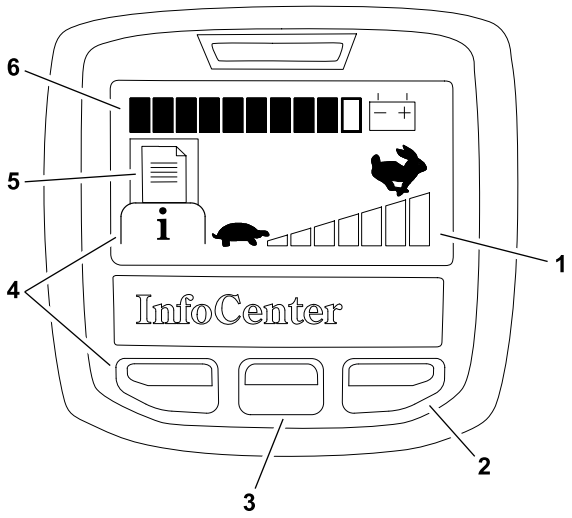
Figure 37

1. Fault indicator
2. Hour meter
3. Left/right button
4. Down button
5. Menu/back 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 37). 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 38

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

The InfoCenter main information screen (Figure 38) is displayed after the initial splash screen has been displayed for 5 seconds. The main information screen is the default screen as it will be displayed during normal machine operation. The main information screen provides the following information to the operator:

- Battery charge indicator
- Speed control setting

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

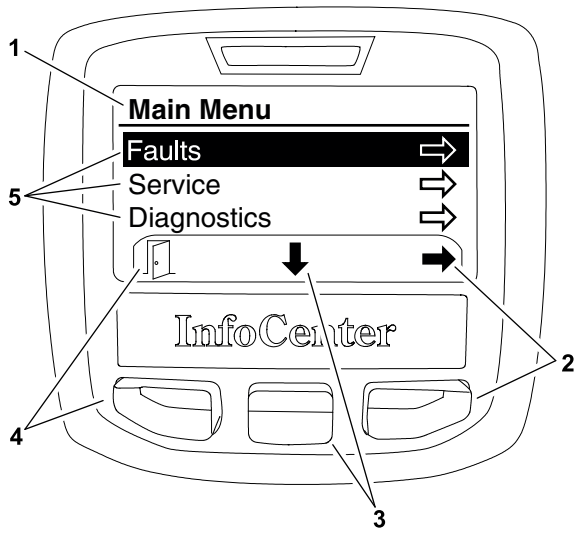
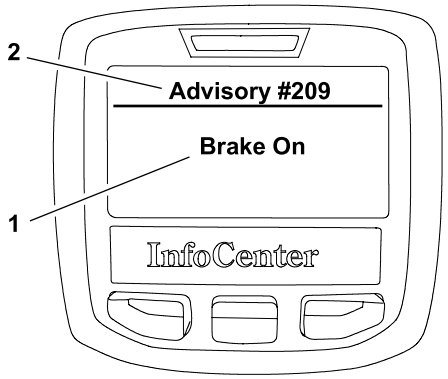


Figure 39

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

The main menu and additional information screens can be accessed from the InfoCenter main information screen by pressing and releasing the menu/back button (as indicated by [i] at the bottom of the screen) on the display. Once to the main menu screen (Figure 39), 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



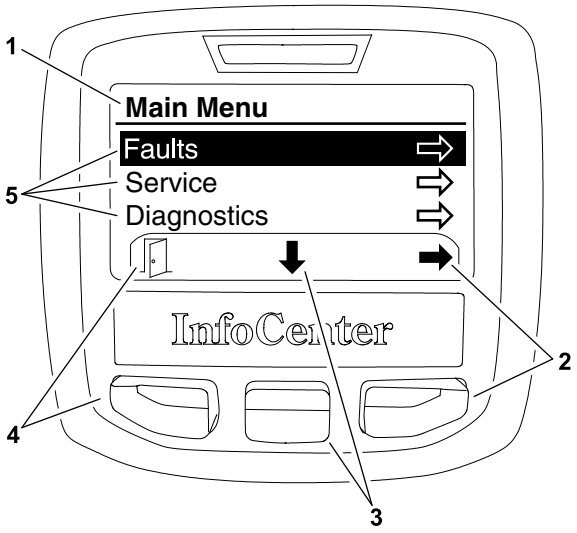
g339631

Figure 40

1. Advisory name
2. Advisory identification

Operator advisories are automatically displayed by the InfoCenter when a machine function requires additional action (Figure 40). An advisory will not be logged into the fault log. (Refer to Operator Advisories (page 3–3)).

Main Menu Screen



g339630

Figure 41

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

The main menu screen can be accessed from the InfoCenter main information screen by pressing and releasing the menu/back button (as indicated by [i] at the bottom of the screen) on the display. Once to the main menu screen (Figure 41), 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

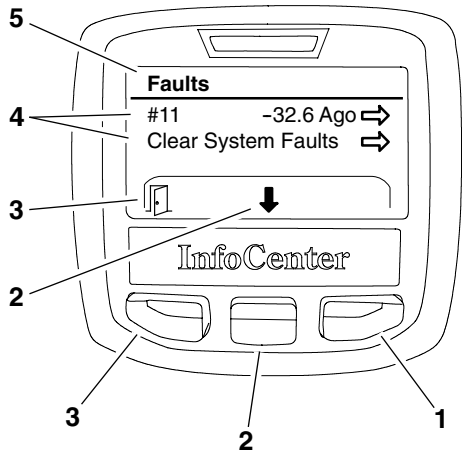


Figure 42

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

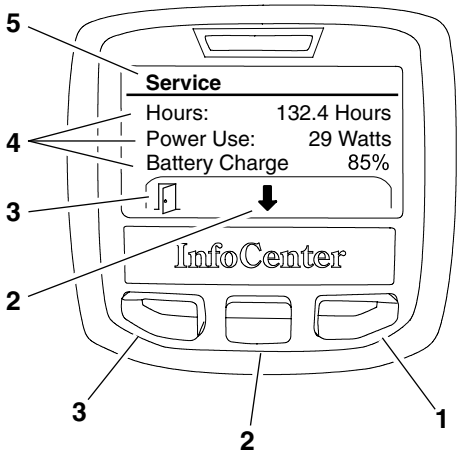
The faults screen (Figure 42) will list all the machine electrical faults that have occurred since the faults were last cleared from the InfoCenter. The faults will be identified by a number and when the fault occurred. The faults that might occur on the eFlex machine are listed in the Machine Faults (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



g339632

Figure 43

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

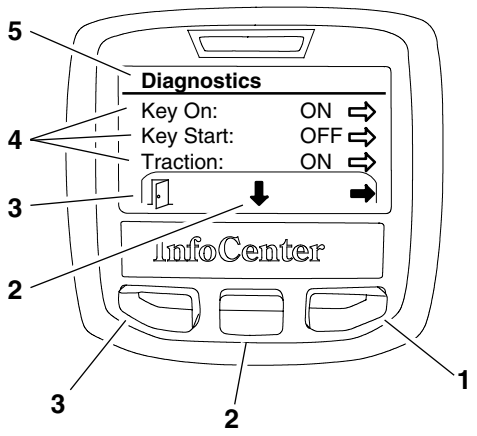
The service screen (Figure 43) contains the following machine information:

- **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



g339626

Figure 44

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

The diagnostics screen (Figure 44) 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

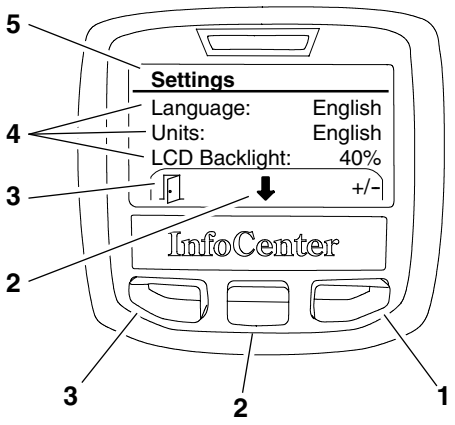


Figure 45

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

The settings screen (Figure 45) 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.

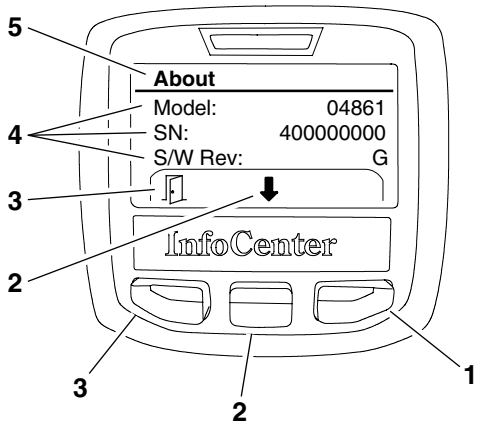
Language: Use the left/right button (as indicated by the ☰ at the bottom of the screen) to select from numerous language options. Allow the desired selection to remain in view for 5 seconds.

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 46

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

The about screen (Figure 46) 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

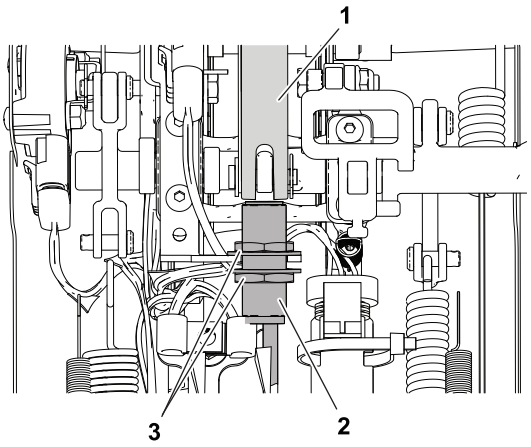


Figure 47

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

Adjusting the Traction Bail Proximity Sensor

1. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and 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 Disconnecting and 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.

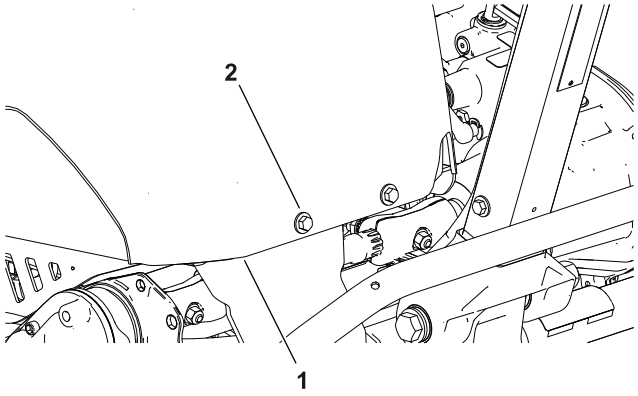
⚠ CAUTION ⚠

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 48

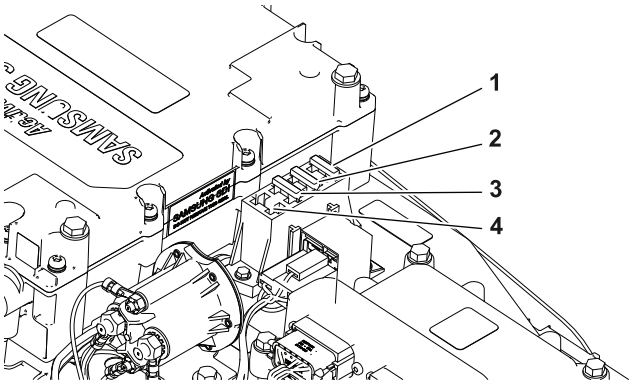
1. Battery cover
2. Washer head bolt (4 each)

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. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).
3. Remove the 4 bolts that secures the battery cover to the battery mount; refer to Figure 48. Remove the battery cover from the battery mount.

Fuse Identification and Function



g338649

Figure 49

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

Refer to Figure 49 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 Identification and Function (continued)

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

Testing the Fuse

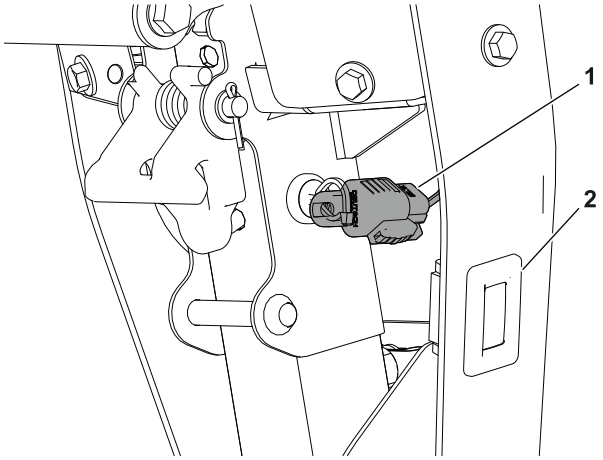
1. Access the fuse block as described above.
2. Carefully remove the fuse from the fuse block for testing.
3. The fuse should have continuity between the fuse terminals.

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 Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

CAN bus



g338222

Figure 50

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 wiring 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. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).
3. The Toro DIAG connector is located inside the upper cover assembly; refer to Figure 50.

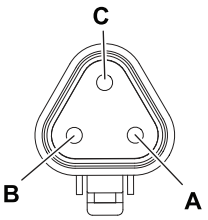


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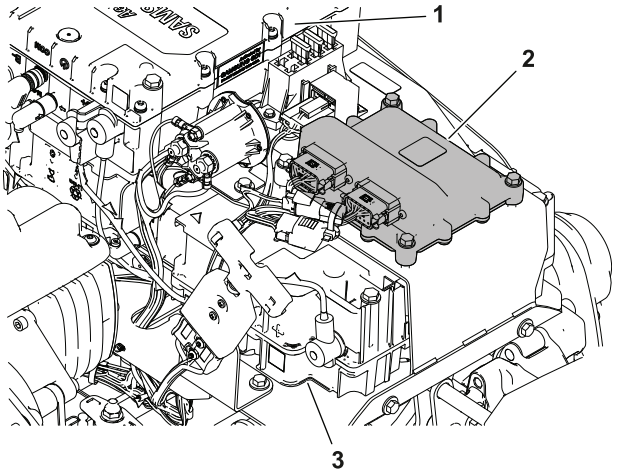
Figure 51

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 52

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

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 52.

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)

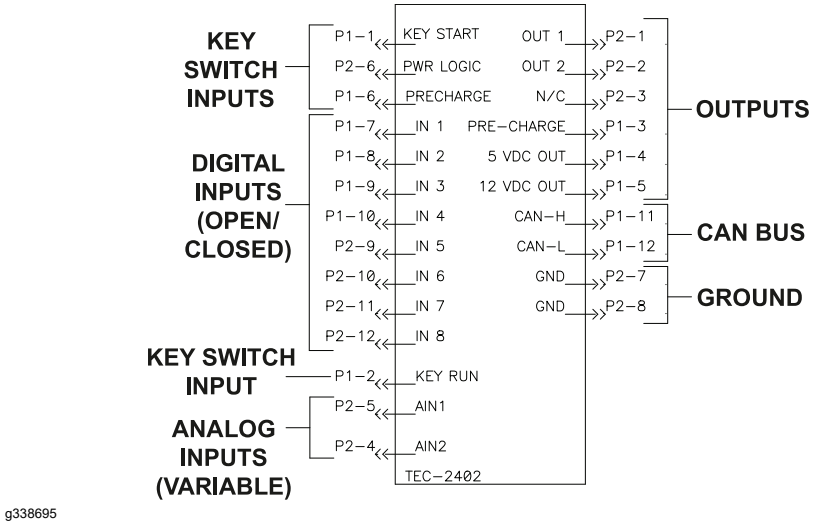


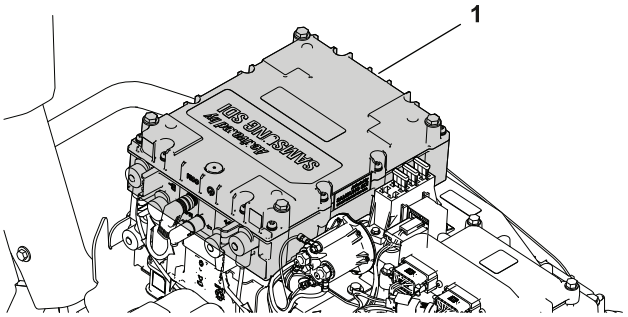
Figure 53

The diagram in Figure 53 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)



g338267

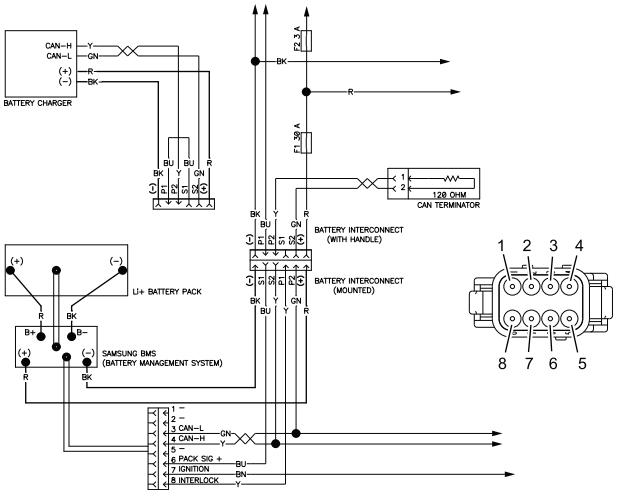
Figure 54

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.

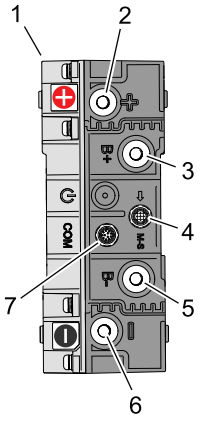
Note: If the Lithium–Ion Battery Controller is replaced for any reason, the machine software must be updated; contact an Authorized Toro Distributor for assistance.

Testing the Lithium-Ion Battery Controller



g338793

Figure 55



g338794

Figure 56

1. Lithium-Ion battery controller
2. Positive (+) terminal
3. B+ terminal
4. M-S terminal
5. B- terminal
6. Negative (–) terminal
7. COM 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 55.

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, by 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.

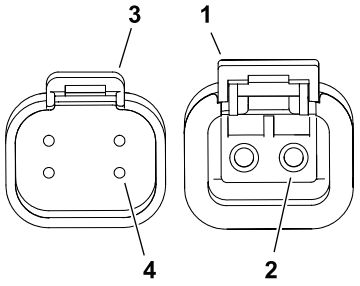
To operate, the electric motor requires 48V logic power (supplied by the logic relay) and a connection to the 48V power bus (supplied by the main contactor when energized).

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. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and 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 57

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

5. If electric motor removal, installation, disassembly or assembly is required; refer to Electric Motor (page 5–41).
6. If the motor tests correctly and a problem still exits, check the rear wheel traction motor circuit wiring; refer to Appendix A (page A–1).
7. After testing is complete, secure the electric motor wire harness connectors.
8. Connect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

Key Switch

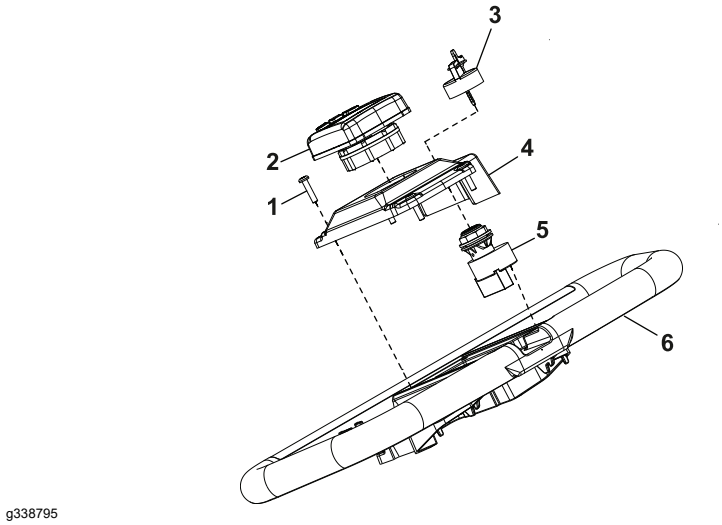


Figure 58

1. Screw (4 each)
2. InfoCenter display
3. Key
4. InfoCenter mount
5. Key switch
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 58).

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. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).
3. Remove the InfoCenter mount from the handle to access the key switch; refer to Figure 58
4. Disconnect the wire harness electrical connector from the key switch.

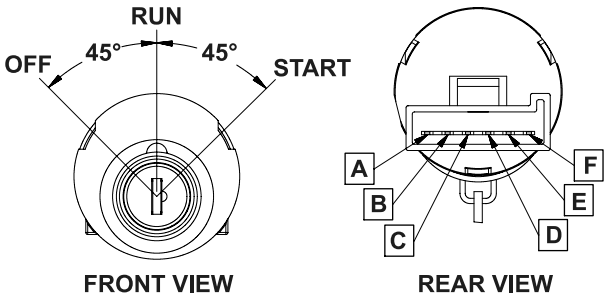


Figure 59

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 59. 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 58.
9. Connect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

Throttle Potentiometer and Clutch Bail Potentiometer

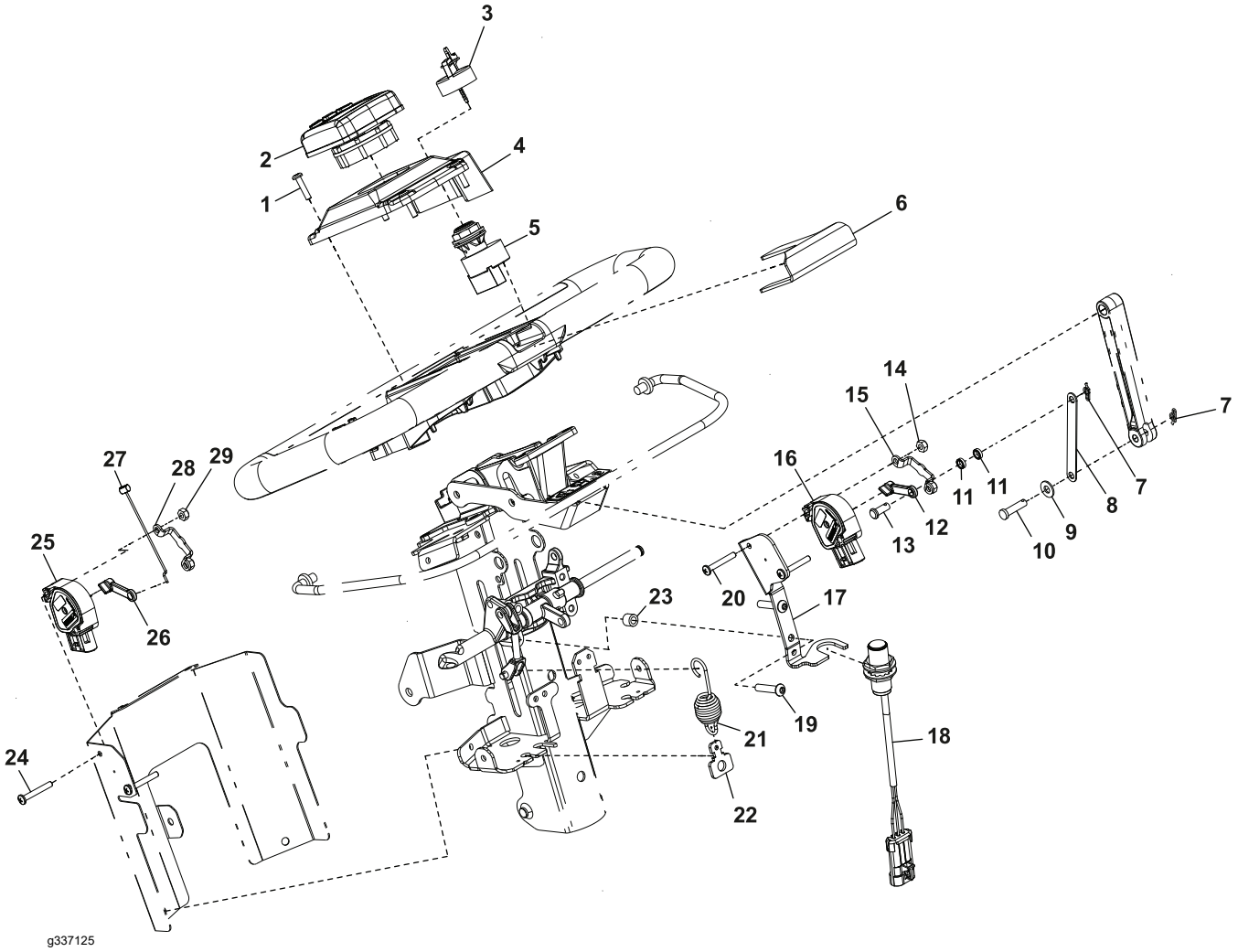


Figure 60

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 60).

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. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and 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 60).

   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.

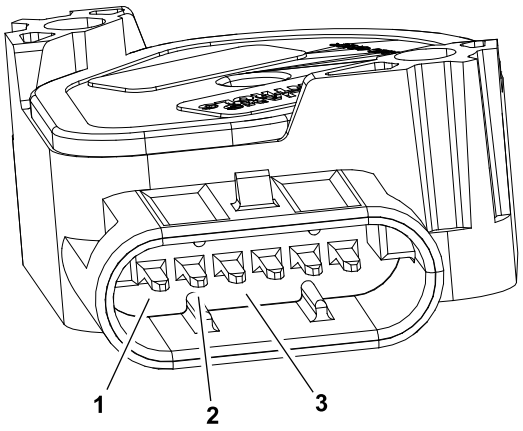


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Figure 61

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

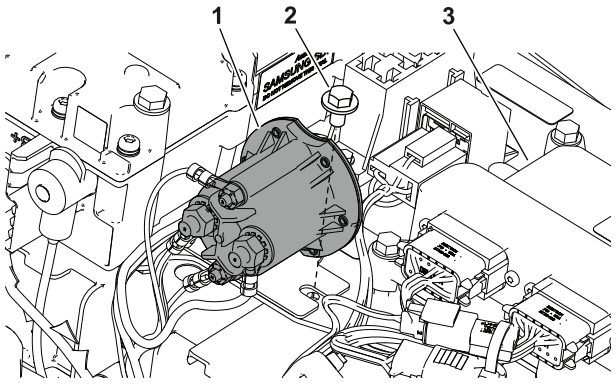
5. Use a multimeter, measure the resistances between the potentiometer terminals as follows (Figure 61).
   A. Check that the resistance between the terminals B and C is approximately 5,000 ohms. Record the measured resistance.
   B. Measure the resistance between the terminals A and C and then measure 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.

6. After you complete the testing, secure the potentiometers to the machine (Figure 60). 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 Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

Main Contactor



g339029

Figure 62

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

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 62.

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. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and 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.

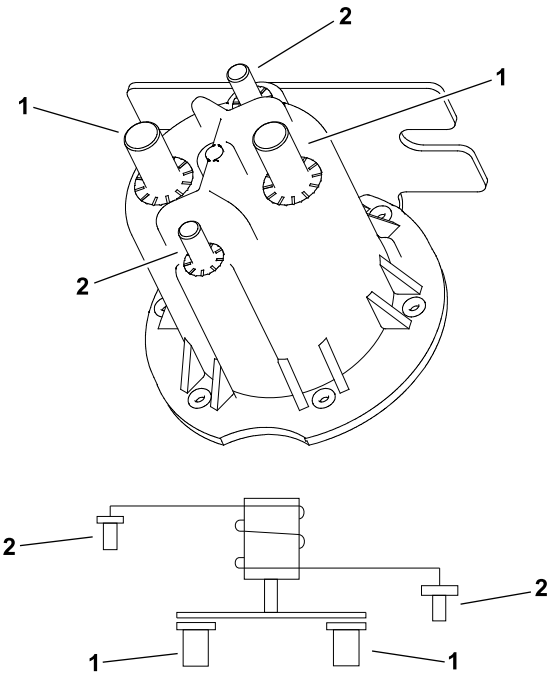


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Figure 63

1. Main contact post
2. Coil post

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

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

5. Measure the resistance across the contactor coil terminals. Resistance of the coil should be approximately 195 ohms.
6. With the contactor coil not energized, resistance across the contactor main terminals should be infinite ohms.
7. If testing determines that the main contactor is damaged, ensure that the battery pack is disconnected and then replace the main contactor.
8. After you complete the main contactor testing, install the battery cover onto the battery mount. Secure the battery cover with four bolts.
9. Connect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

CAN-bus Terminator Resistor

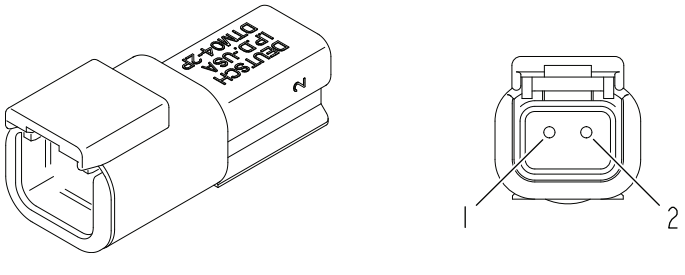

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Figure 64

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.

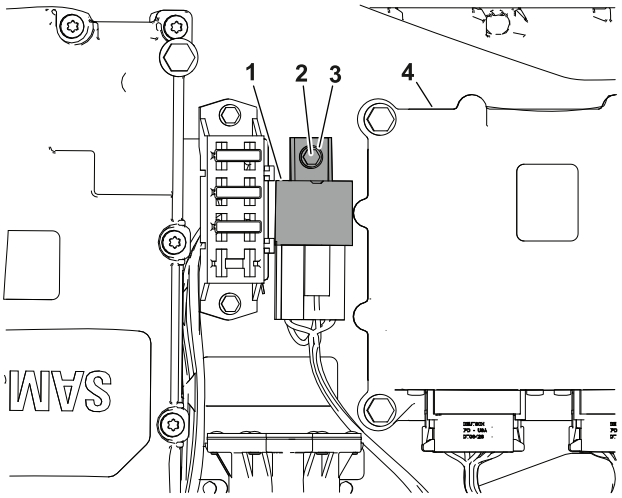
IMPORTANT

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 64) 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



g339075

Figure 65

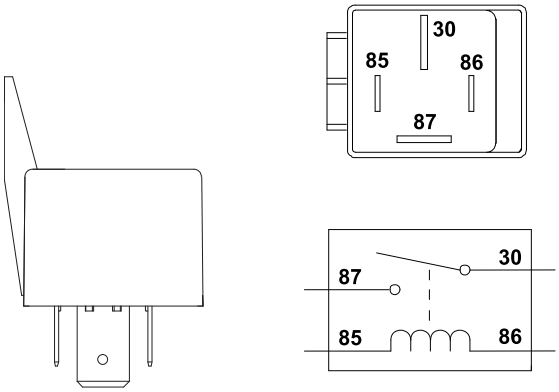
1. Relay
2. Bolt
3. Washer
4. TEC

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 65.

Testing the Relay

1. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and 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.



g291282

Figure 66

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 Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

Service and Repairs

Electric Motor

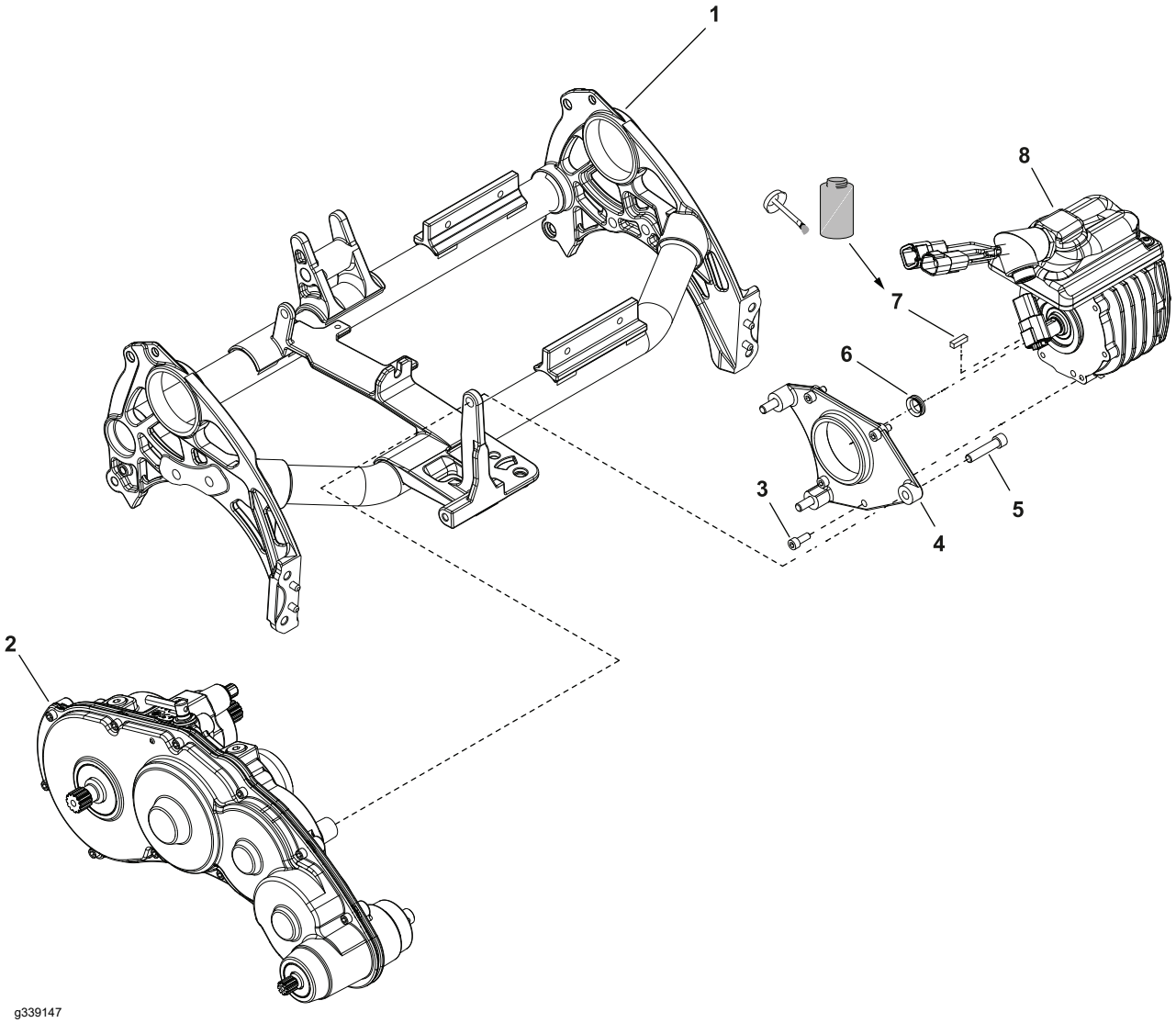


Figure 67

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. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).
3. Disconnect the electric motor connections from the machine wire harness.

Removing the Electric Motor (continued)

4. Support the electric motor to prevent it from falling.
5. Remove the 4 socket-head screws (item 3 in Figure 67) 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 67) 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 motor-shaft key of the 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 Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

Servicing the Electric Motor

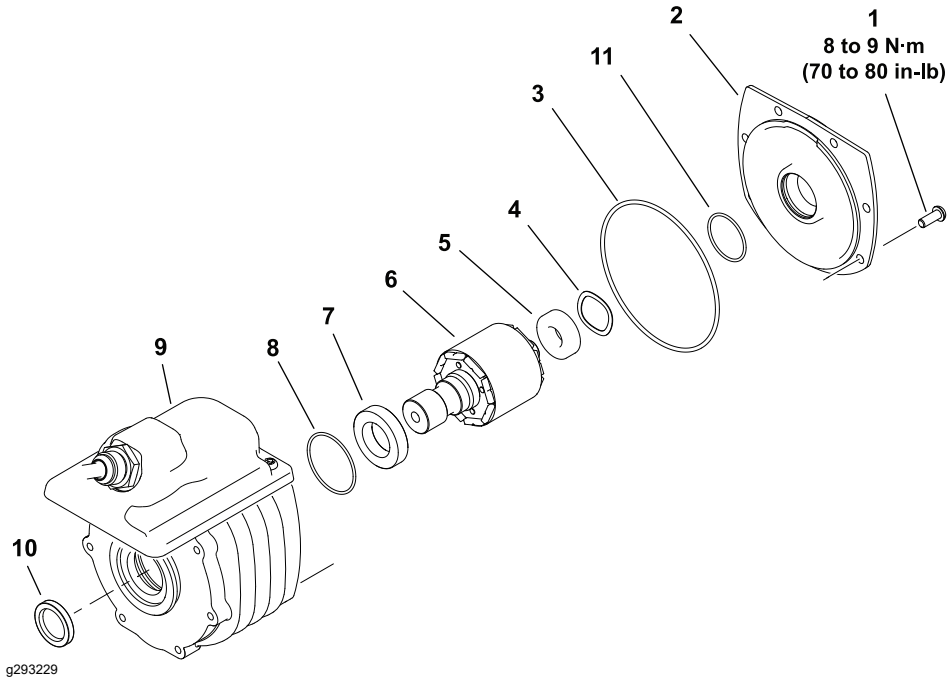


Figure 68

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

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 workspace 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 68 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.

Disassembling the Electric Motor (continued)

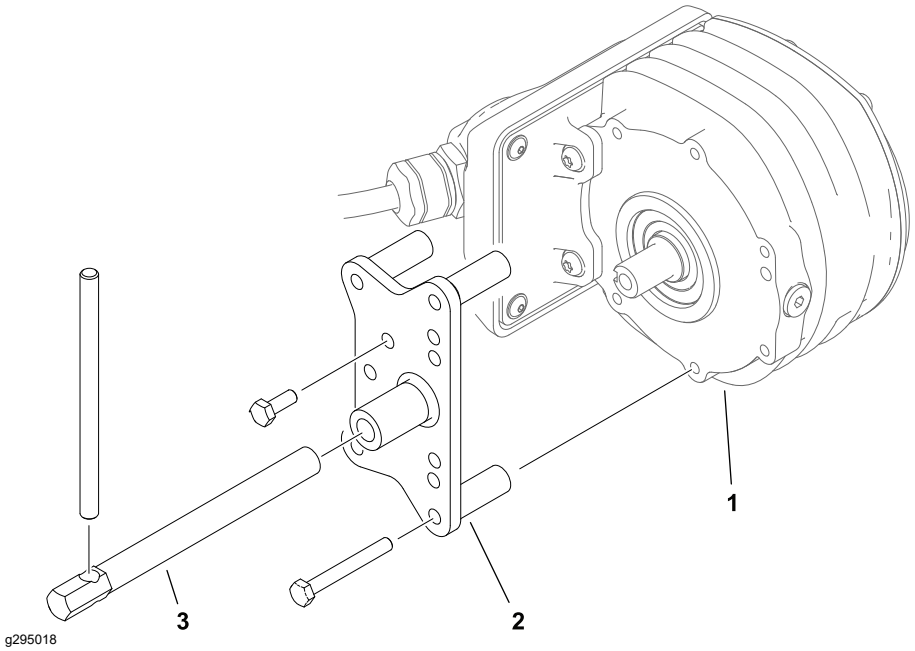


Figure 69

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 68 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.

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.

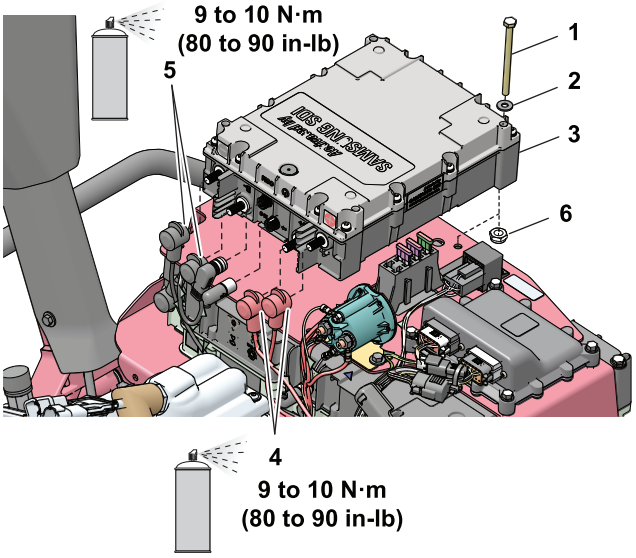
IMPORTANT

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

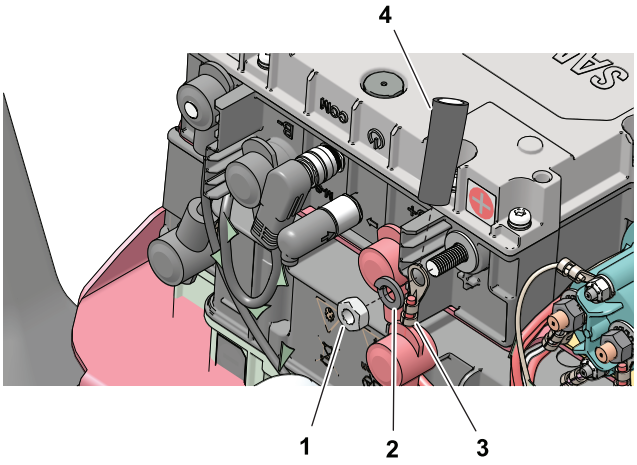
Figure 70

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

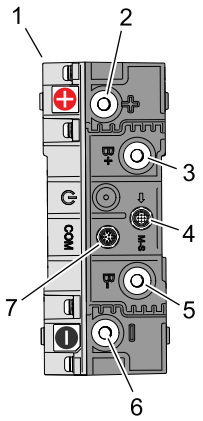
Figure 71

1. Nut
2. Washer
3. Battery cable terminal (typical)
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. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and 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 72

1. Lithium-Ion battery controller
2. Positive (+) terminal
3. B+ terminal
4. M-S terminal
5. B- terminal
6. Negative (–) terminal
7. COM 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 70 and Figure 72.

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.

WARNING

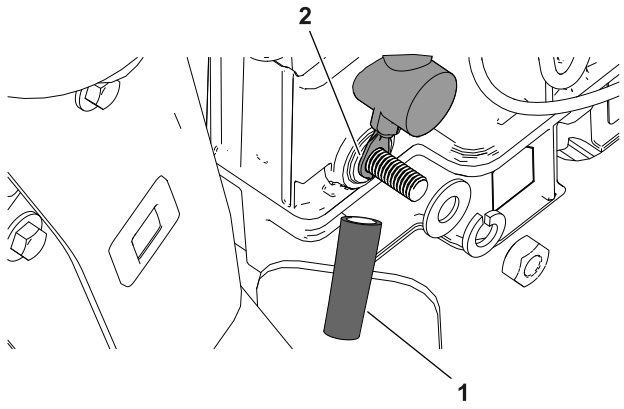
When removing or installing the battery:

- **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 73.



g339372

Figure 73

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.

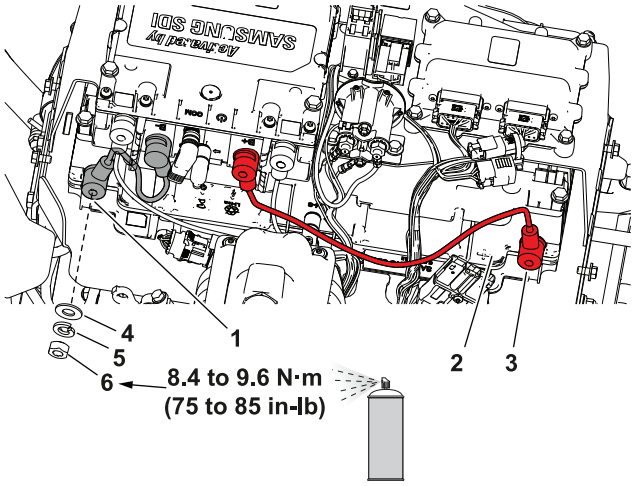


Figure 74

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

1. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).
3. Remove the four bolts that secures the battery cover to the battery mount. Remove the battery cover from the machine.
4. Label and disconnect the negative (-) battery cable, positive (+) battery cable, and battery interface harness from the lithium-ion battery; refer to Figure 74.

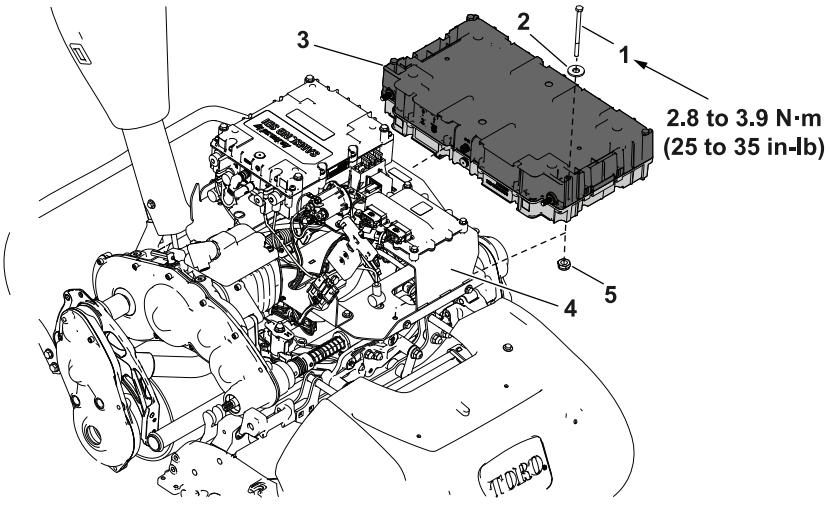


Figure 75

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

5. Remove the four nuts (item 5 in Figure 75), bolts (1) and washers (2) that secures the battery to the battery mount.

Removing the Lithium-Ion Battery (continued)

CAUTION

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

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

Installing the Lithium-Ion Battery

CAUTION

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

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

IMPORTANT

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

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

3. Torque tighten the bolts (1) from **2.8 to 3.9 N·m (25 to 35 in-lb)**.
4. Using the labels that attached during the removal, connect the battery interface cable, positive (+) battery cable and negative (-) battery cable onto the battery pack.
5. Tighten the battery cable fasteners (item 6 in Figure 74) 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 Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

Chapter 6

Controls, Wheels, and Accessories

Table of Contents

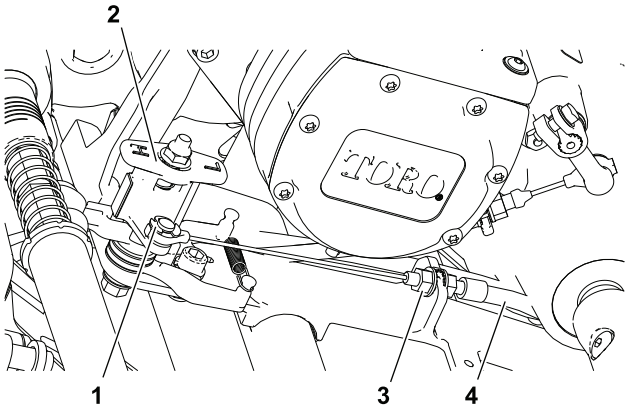
General Information

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

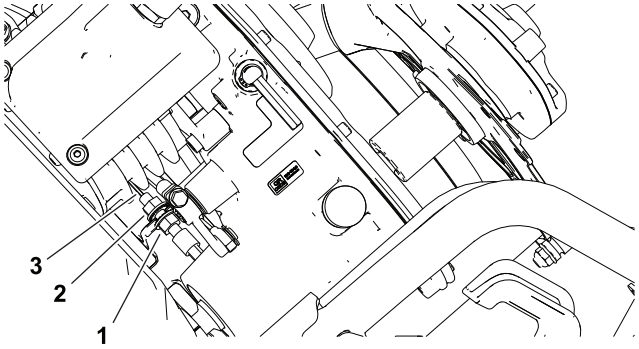
Adjusting the Reel Cable



g336875

Figure 76

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



g349621

Figure 77

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

1. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and 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 76.
   B. Loosen the rear jam nut and tighten the front jam nut; refer to Figure 77.
4. Connect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

Service and Repairs

Replacing the Brake Cable

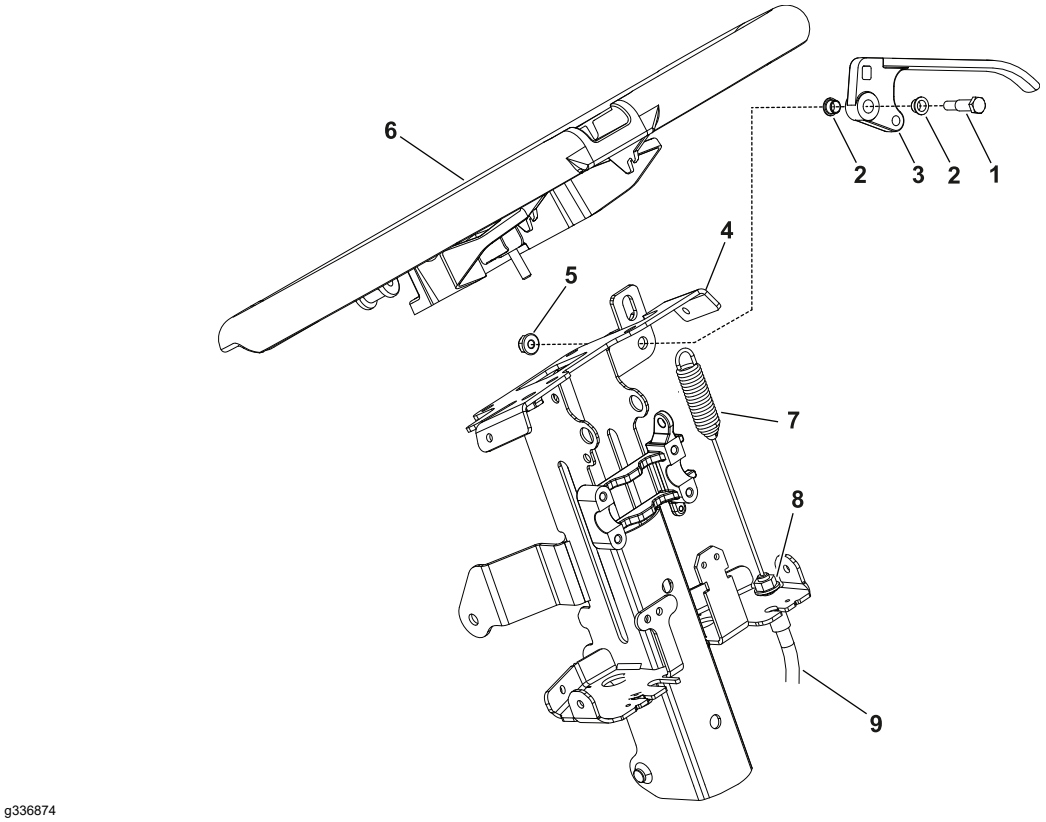


Figure 78

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

Removing the Brake Cable

Note: Refer to Figure 78 during this procedure.

1. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

Removing the Brake Cable (continued)

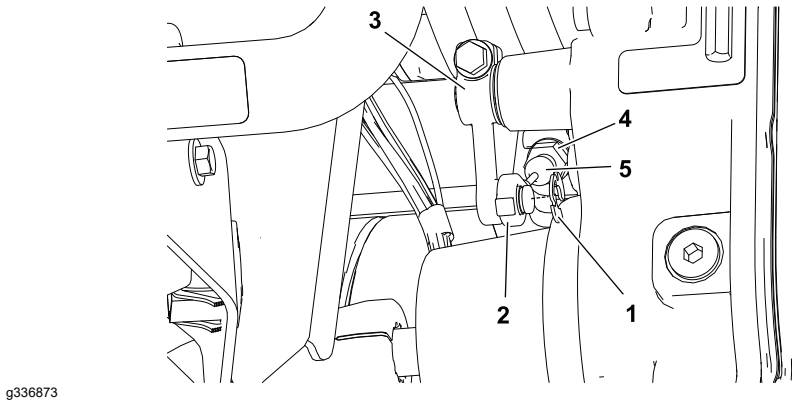


Figure 79

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

3. Remove the brake cable (item 5 in Figure 79) 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 78) 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

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 Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

Replacing the Reel Cable

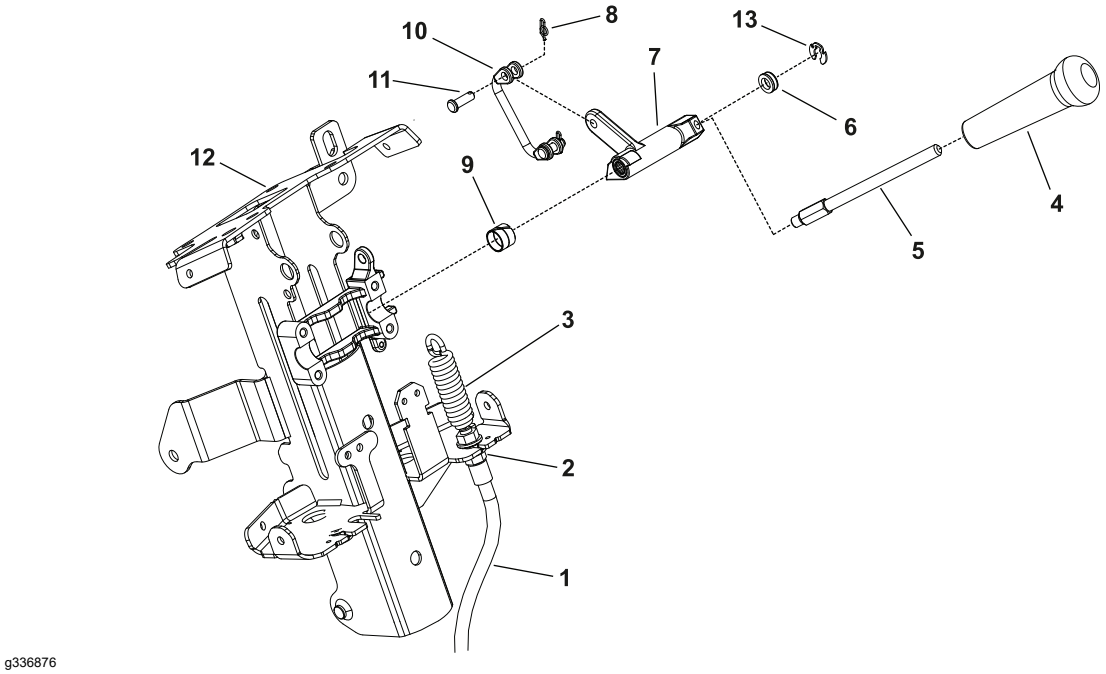


Figure 80

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

Removing the Reel Cable

Note: Refer to Figure 80 during this procedure.

1. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

Removing the Reel Cable (continued)

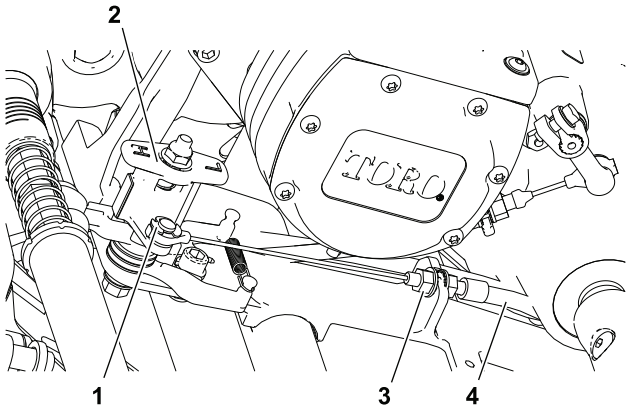


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Figure 81

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

3. Remove the reel cable (item 4 in Figure 81) 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 80) 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 80) 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 81) 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 Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

Cutting Unit Drive Lever Assembly

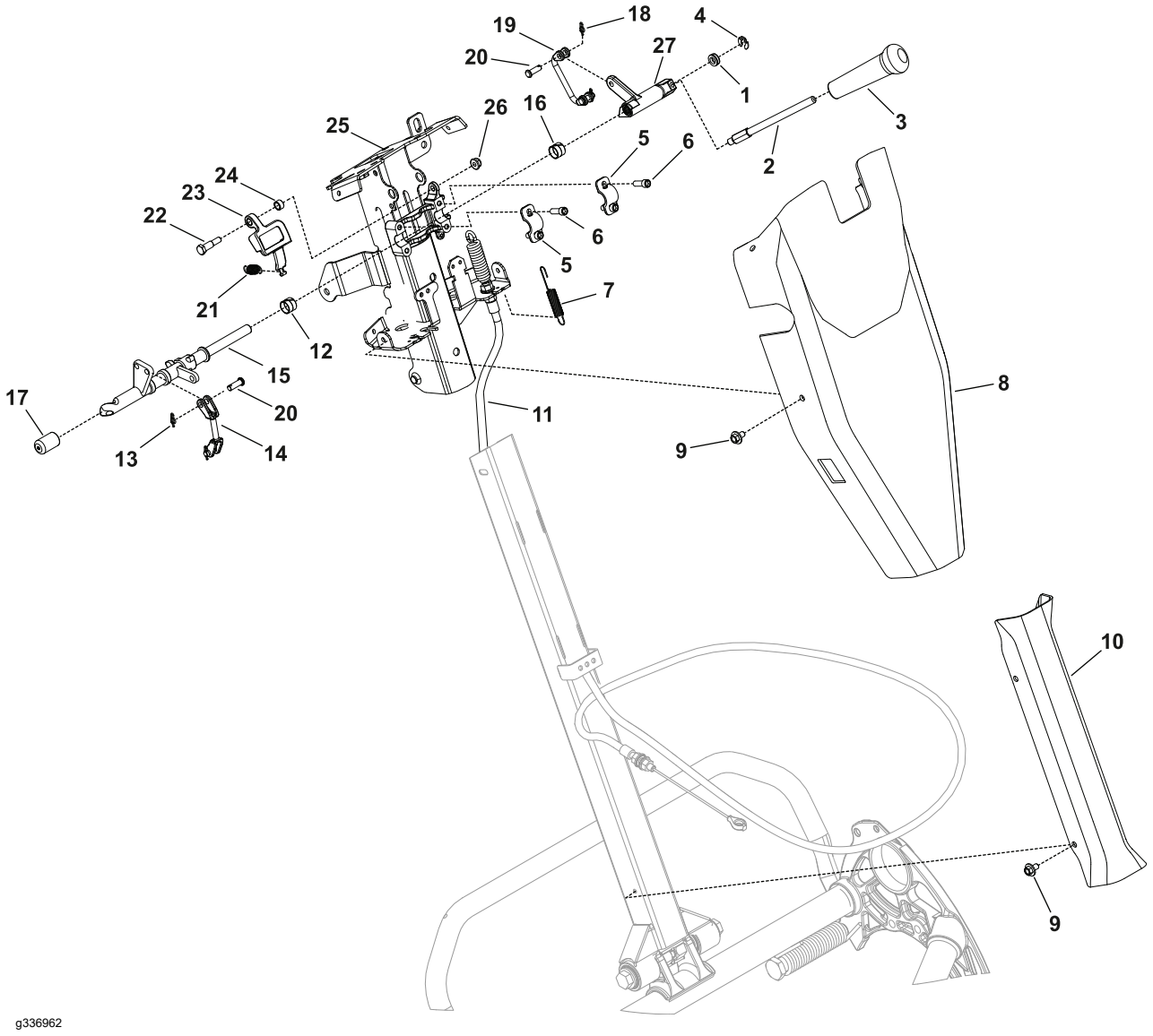

Figure 82

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 82 during this procedure.

1. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.

Disassembling the Cutting Unit Drive Lever Assembly (continued)

2. Disconnect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).
3. Remove the bolts and washers (item 9 in Figure 82) 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 82) 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 Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

Brake Latch Shaft

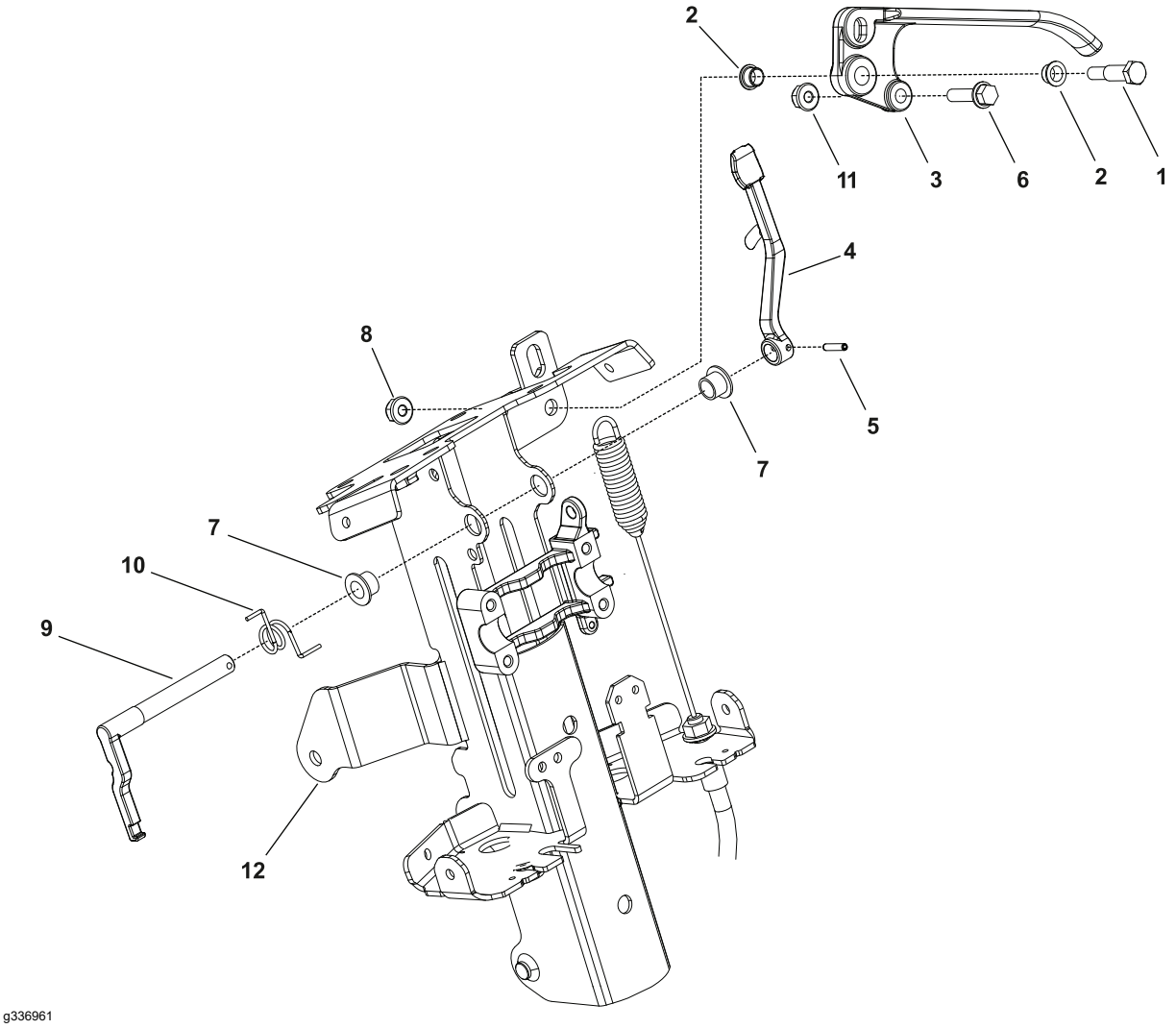

Figure 83

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 83 during this procedure.

1. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and 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).

Disassembling the Brake Latch Shaft (continued)

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 Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

Handle Assembly

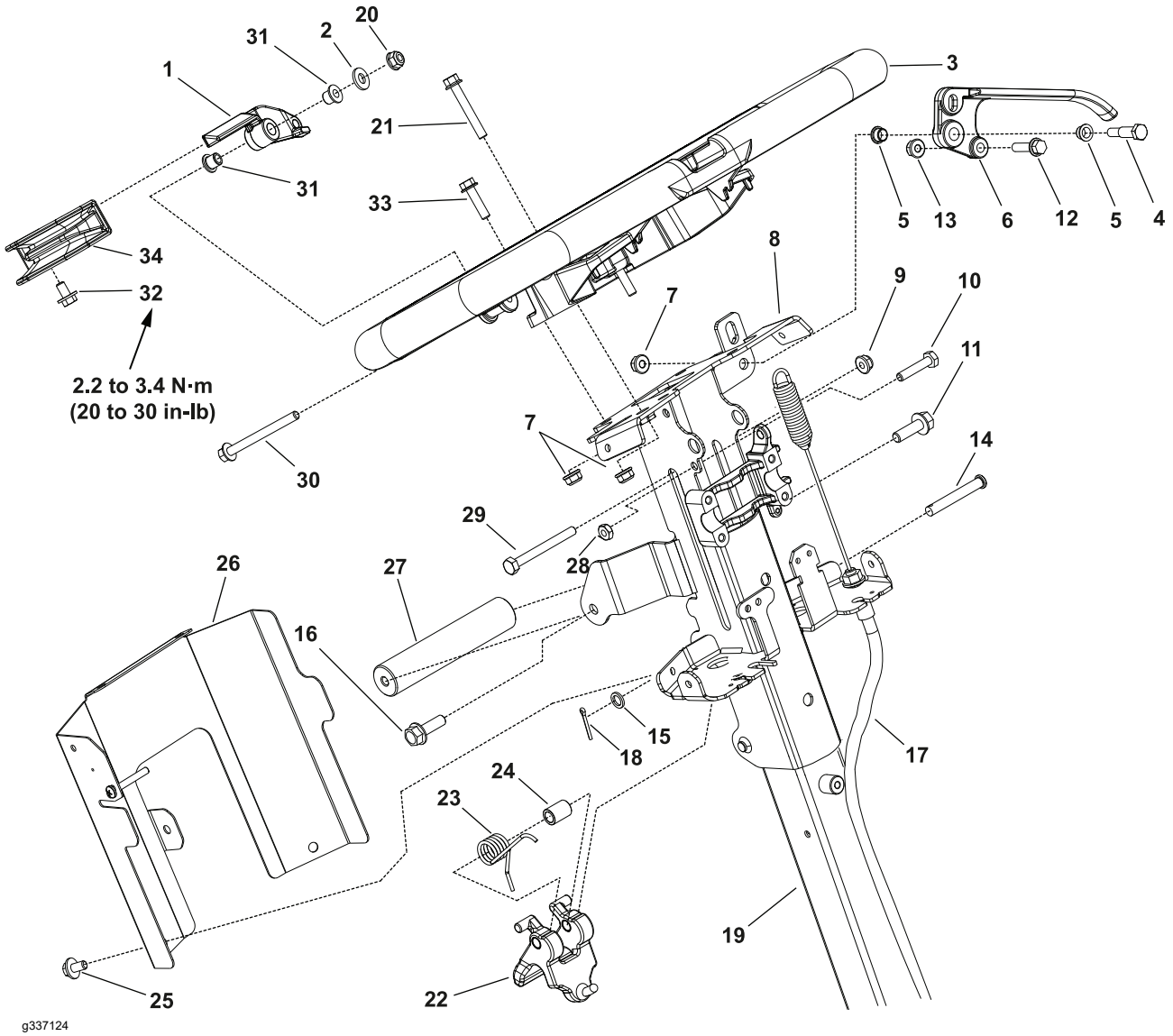

Figure 84

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

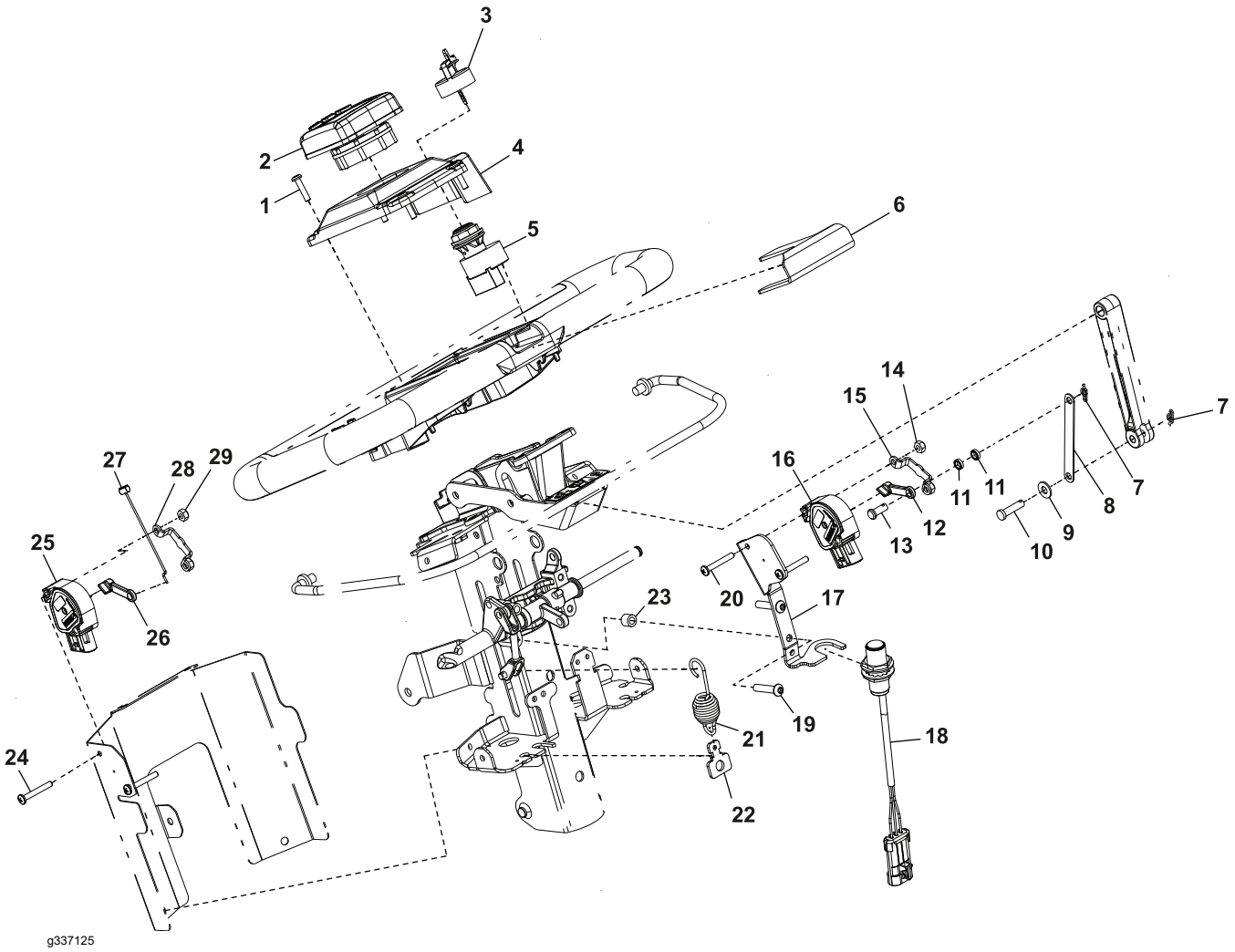

Figure 85

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

Disassembling the Handle Assembly

Note: Refer to Figure 82, Figure 84, Figure 85, Figure 86, and Figure 87 during this procedure.

1. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).
3. Remove the 4 bolts that secures the controls cover to the handle assembly, and remove the cover from the handle; refer to Figure 82.
4. Remove the 4 bolts that secures the lower handle cover to the handle assembly, and remove the cover from the handle; refer to Figure 82.
5. Remove the wire harness from bottom controls cover (item 26 in Figure 84).
6. Remove the 2 flange nuts (7) and 2 bolts (33) that secure the bottom controls cover (26) to the upper receiver weldment (8).
7. Remove the 2 screw and washer assemblies (Item 33 in Figure 84) that secure the bottom controls cover (26) to the upper receiver weldment (8), and remove the cover from the receiver.
8. Remove the throttle cable (27 in Figure 85).
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 6–10).
12. Remove the brake latch shaft; refer to Disassembling the Brake Latch Shaft (page 6–12).
13. Remove the flange nut (7) and bolt (21)—which function as a throttle arm stop bolt—from the upper receiver weldment; refer to Figure 85.
14. Remove the nut (Item 20 in Figure 84), washer (2) and bolt (30) that secure the throttle arm (1) to the handle assembly (3), and remove the arm from the handle.
15. If necessary, remove the bolt (32) that secures the throttle lever (34) to the throttle arm (1), and remove the lever from the arm.
16. If necessary, remove the flange bushings (Item 31 in Figure 84) from the throttle arm (1).
17. Remove the 4 screws (item 1 in Figure 85) that secure 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 84, and shoulder screw (4) that secure the brake lever (6) to the upper receiver weldment (8), and remove the brake lever from the receiver.
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 secure the lift assist handle (27) to the upper receiver weldment (8).
22. Remove the nut (Item 9 in Figure 84) and bolt (29) that secure the upper receiver weldment (8) to the lower handle (19).
23. Disconnect the wire harness from the potentiometer sensor (item 16 in Figure 85) and proximity sensor (18).
24. Remove the upper receiver weldment from the lower handle assembly.

25. If necessary, remove the cotter pin (item 18 in Figure 84), bearing spacer (15) and clevis pin (14) that secure the handle adjuster assembly (22) to the upper receiver weldment (8).
26. Remove the handle adjuster assembly (Item 22 in Figure 84) from the upper receiver weldment and separate handle torsion spring (23) and spring spacer (24) from the handle adjuster.

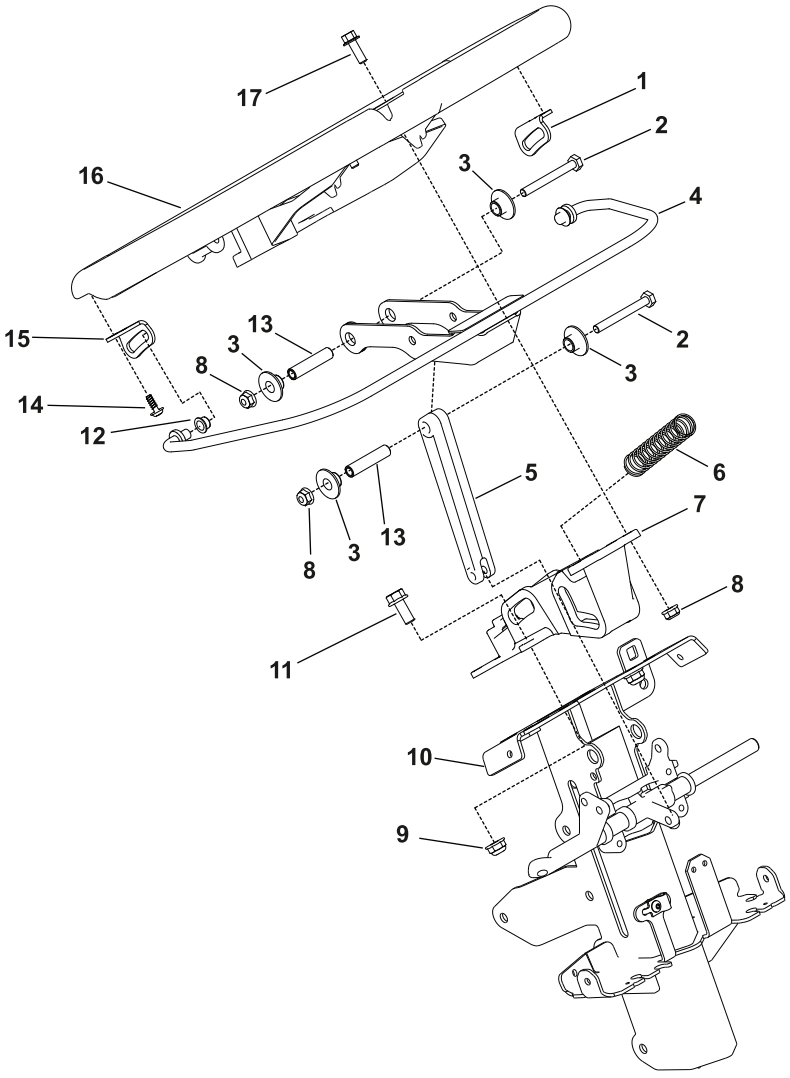

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Figure 86

1. Left bail bracket	7. Handle mount	13. Spacer (2 each)
2. Bolt (2 each)	8. Flange nut (4 each)	14. Torques-head screw (2 each)
3. Flange bushing (4 each)	9. Nut (2 each)	15. Right 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)	

27. Remove the 2 nuts (item 8 in Figure 86) and 2 bolts (17) that secure handle (16) to handle mount (7), and remove the handle from the clutch bail assembly and the handle mount.
28. If necessary, remove the 2 screws (14) that secure the left and right bail brackets (1 and 15) to the handle (16).

Disassembling the Handle Assembly (continued)

29. 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.
30. 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.
31. Remove the 2 nuts (item 9 in Figure 86) and 2 bolts (11) that secure the handle mount (7) to the upper receiver weldment (15). Remove the handle mount from the upper receiver weldment.

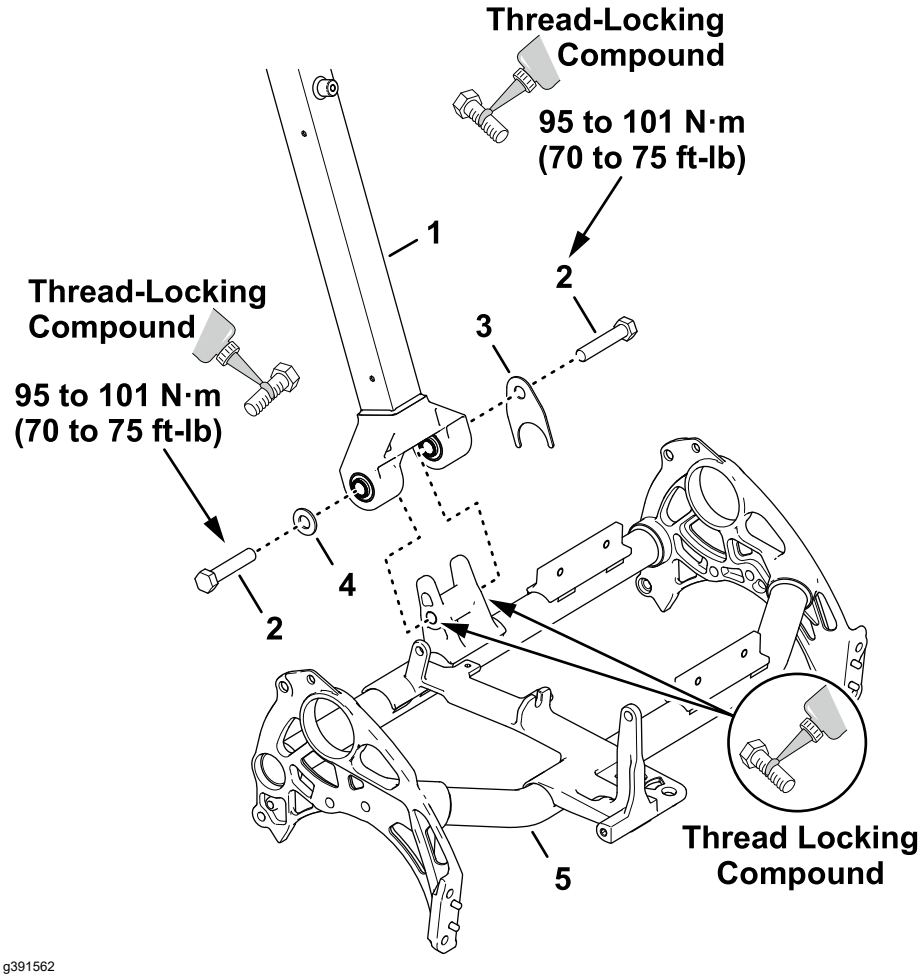

Figure 87

1. Lower handle assembly
2. Bolt (2 each)
3. Anti-rotation washer
4. Washer
5. Frame assembly

32. If necessary, remove the 2 bolts (item 2 in Figure 87), anti-rotation washer (3),and washer (4) that secure the lower handle assembly (1) to the frame assembly (5).

Assembling the Handle Assembly

1. If removed, clean the threads of the frame assembly and the 2 bolts (2), and apply a coat to medium strength thread-locking compound as shown in Figure 87.

2. If removed, install the lower handle assembly (1) onto the frame assembly (5) and secure with the 2 bolts (2), anti-rotation washer (3),and washer (4).

3. Lift the lower handle assembly until it contacts the stop, and torque the 2 bolts (Item 2 in Figure 87) to **95 to 101 N·m (70 to 75 ft-lb)**.

4. Install the handle mount (item 7 in Figure 86) to the upper receiver weldment (10) and secure with 2 bolts (11) and 2 nuts (9).
5. 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).
6. 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).
7. If removed, install the left and right bail brackets (1 and 19) to the handle (20) with the 2 torques-head screws (18).
8. Install the clutch bail assembly (item 4 Figure 86) to the handle (16). Secure the handle to the handle mount (7) with the 2 bolts (17) and 2 nuts (8).
9. Position the spring spacer (Item 24 in Figure 84) 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).
10. If removed, install the lift assist handle (27) to the upper receiver weldment (8) and secure with the bolts (11 and 16).
11. Slide the upper receiver weldment (item 8 in Figure 84) into 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.
12. Reposition the wire harness.
13. If removed, install the flange bushings (5), bolt (12) and flange nut (13) into the brake lever (6).
14. Position the brake lever (item 6 in Figure 84) to the upper receiver weldment (8) and secure with the shoulder screw (4) and flange nut (7).
15. Install the InfoCenter mount (item 4 in Figure 85) onto the handle and secure with the 4 screws (1).
16. Install the wire harness.
17. If removed, install the flange bushings (item 31 in Figure 84) inside the throttle arm (1).
18. If removed, slide the throttle lever (34) onto the throttle arm (1) and secure with bolt (32).

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

20. Install the throttle arm (1) to the handle assembly (3) and secure with bolt (30), washer (2) and flange nut (20).
21. Install the bolt (item 21 in Figure 84) and 2 flange nuts (7) to the upper receiver weldment (8). Ensure that the head of the bolt is resting the on throttle arm (1).
22. Install the brake latch shaft; refer to Assembling the Brake Latch Shaft (page 6–13).

23. Install the clutch and reel drive lever assembly; refer to Assembling the Cutting Unit Drive Lever Assembly (page 6–11).
24. Install the reel cable; refer to Installing the Reel Cable (page 6–8).
25. Install the brake cable; refer to Installing the Brake Cable (page 6–5).
26. Install the throttle cable (item 27 in Figure 84).
27. Adjust the traction bail proximity sensor; refer to Adjusting the Traction Bail Proximity Sensor (page 5–20).
28. Reposition the wire harness to the bottom control cover (26 in Figure 84). Install the cover to the upper receiver weldment (8) with the 2 screw and washer assemblies (25), 2 bolts (33) and 2 flange nuts (7).
29. Install the lower handle cover to the handle assembly and secure with the 4 bolts; refer to Figure 82.
30. Install the control cover to the handle assembly and secure with the 4 bolts; refer to Figure 82.
31. Connect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

Kickstand

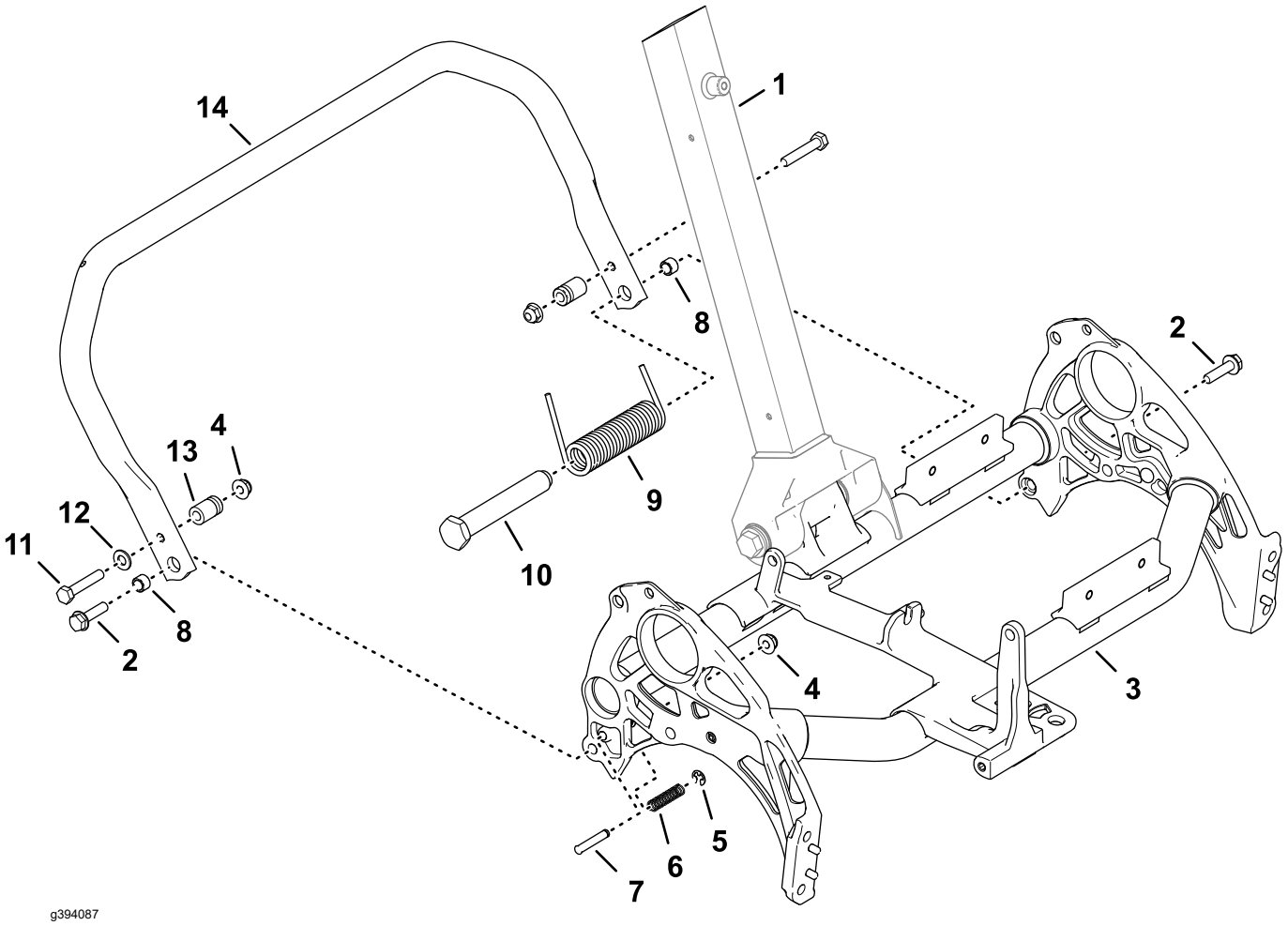

Figure 88

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

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.

1. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.

Removing the Kickstand (continued)

2. Disconnect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).
3. Pivot the kickstand up and hold against the frame stops.
4. Remove the bolt (item 2 in Figure 88) that secures the spring mount pin (10) and torsion spring (9) to the kickstand (16).
5. Remove the spring mount pin (10) and torsion spring (9) from the kickstand (14).
6. Remove the bolt (2), spacer (8) and nut (4) that secures the kickstand (14) to the frame (3).
7. Remove the kickstand (14) from the frame (3).
8. If necessary, remove the spring retainer (13) by removing the nut (4), washer (12) and bolt (11).
9. If necessary, remove the spacers (8) from the kickstand (14).

Installing the Kickstand

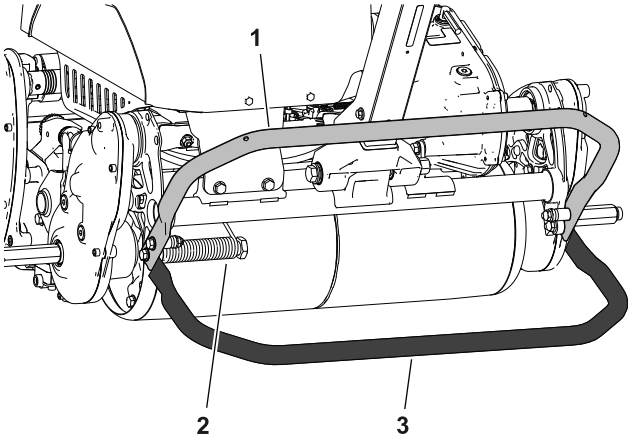

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Figure 89

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

1. If removed, install the spacers (8) to the kickstand (14).
2. If removed, secure the spring retainer (13) to kickstand with the bolt (11), washer (12) and nut (4).
3. Secure the kickstand (14) to the frame (3) with the torsion spring (9), spring mount pin (10) and bolt (2).
4. Secure the kickstand (14) to the frame (3) with spacer (8), bolt (2) and nut (4).
5. Connect the battery pack; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

Transport Wheels (Optional)

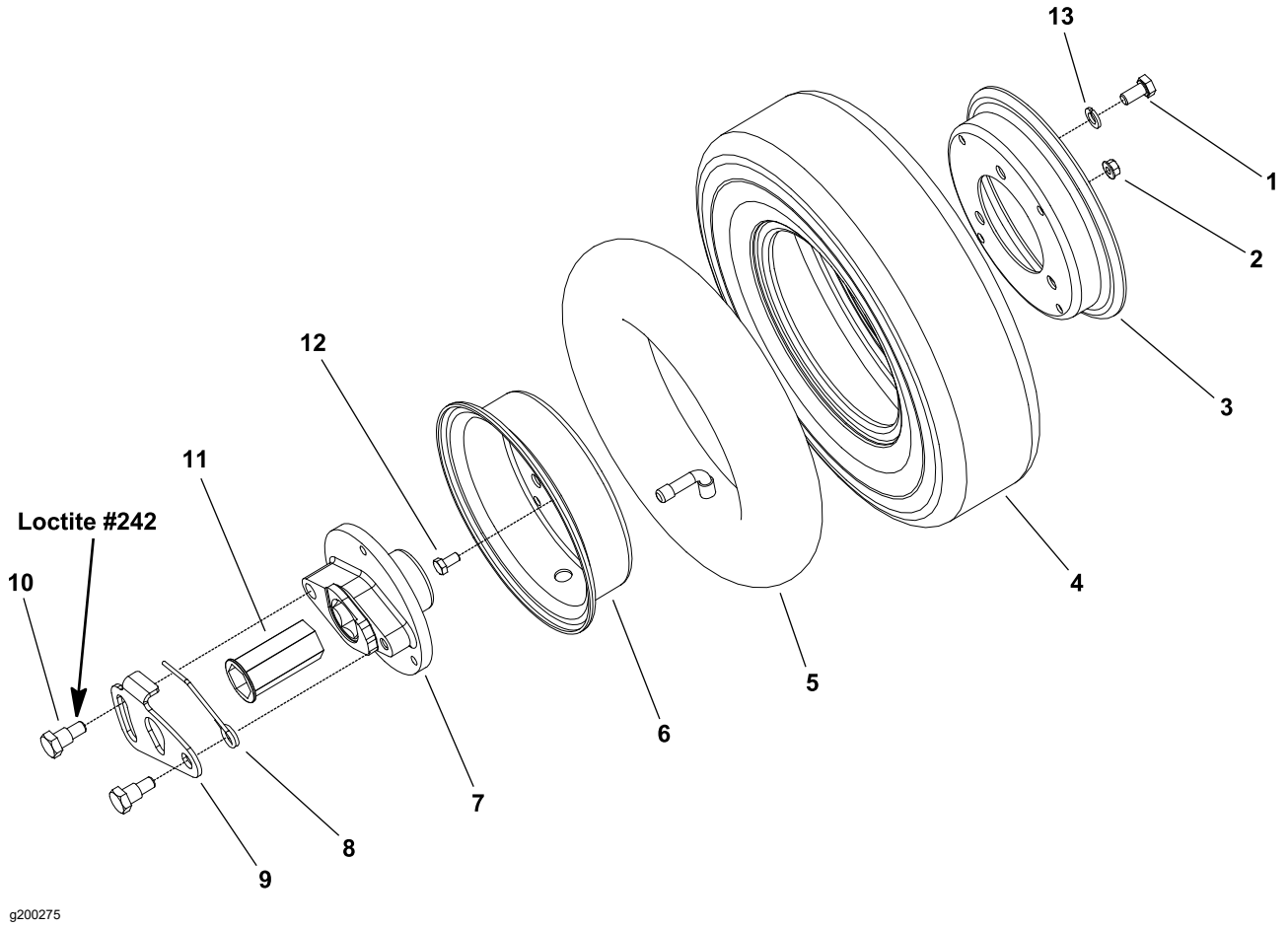

Figure 90

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

Removing the Transport Wheel

1. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Support the machine onto the machine onto the kickstand.

Removing the Transport Wheel (continued)

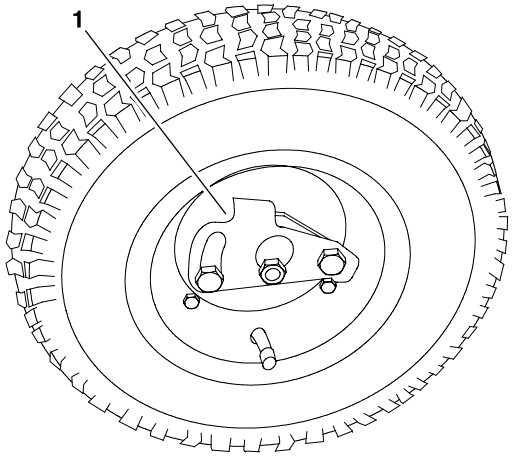

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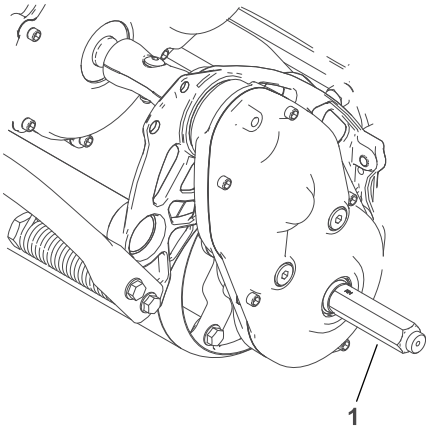
Figure 91

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 92

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)

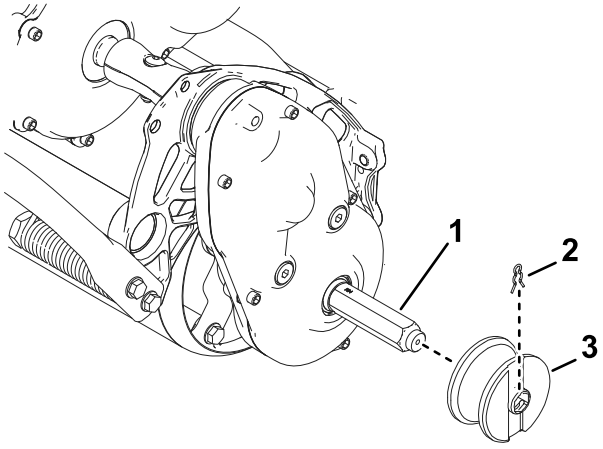


Figure 93

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

Removing the Rail Kit Wheel

1. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
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 6–25).

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 6–23).
4. Slide the rail kit wheel onto the wheel hex shaft and secure the wheel with a wheel clip.

Flex Frame Assembly

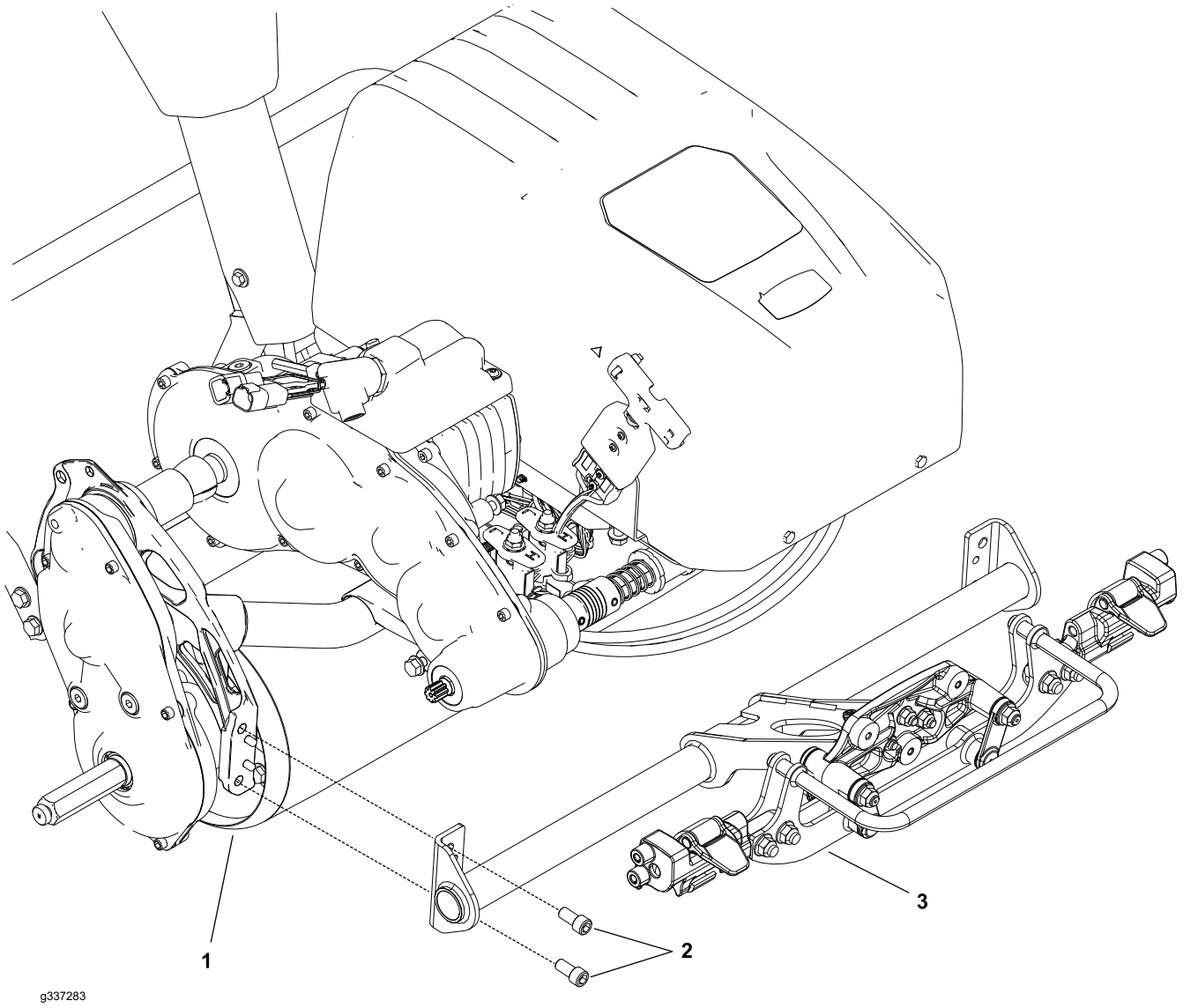


Figure 94

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

Removing the Flex Frame Assembly

1. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery pack; refer to Disconnecting and 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

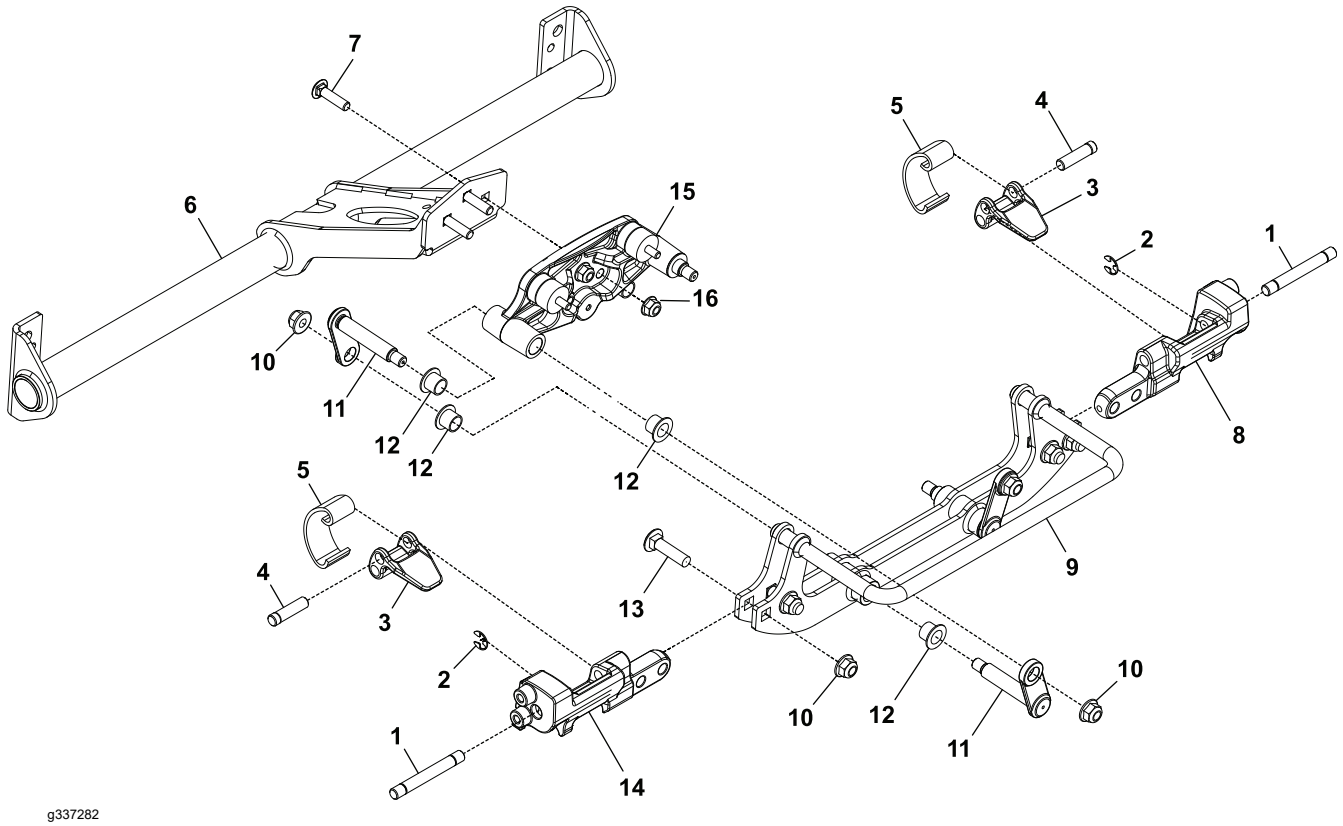


Figure 95

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

Disassemble the flex frame assembly using the Figure 95 as a guide.

Assembly of the Flex Frame Assembly

Assemble the flex frame assembly using the Figure 95 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 Disconnecting and Connecting the Lithium Battery Pack (page 5–3).

Chapter 7

DPA Cutting Units

Table of Contents

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

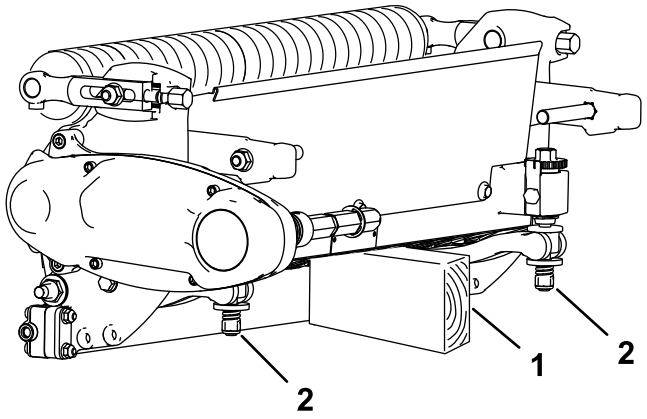


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Figure 96

1. Support
2. Bedbar adjuster screw nuts

Whenever the cutting unit is 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.

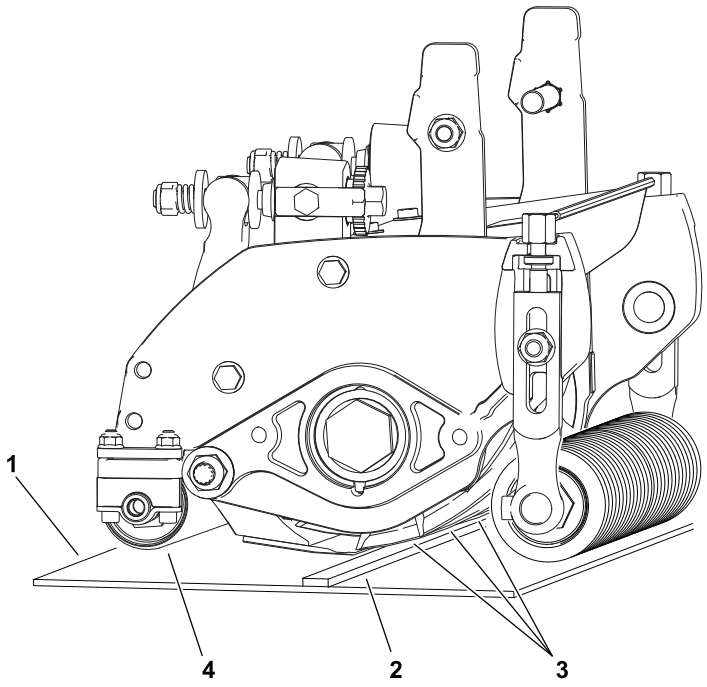

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Figure 97

1. Bench plate
2. Bench plate rib
3. Reel blade contacting 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 passes under the roller through the entire roller 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)

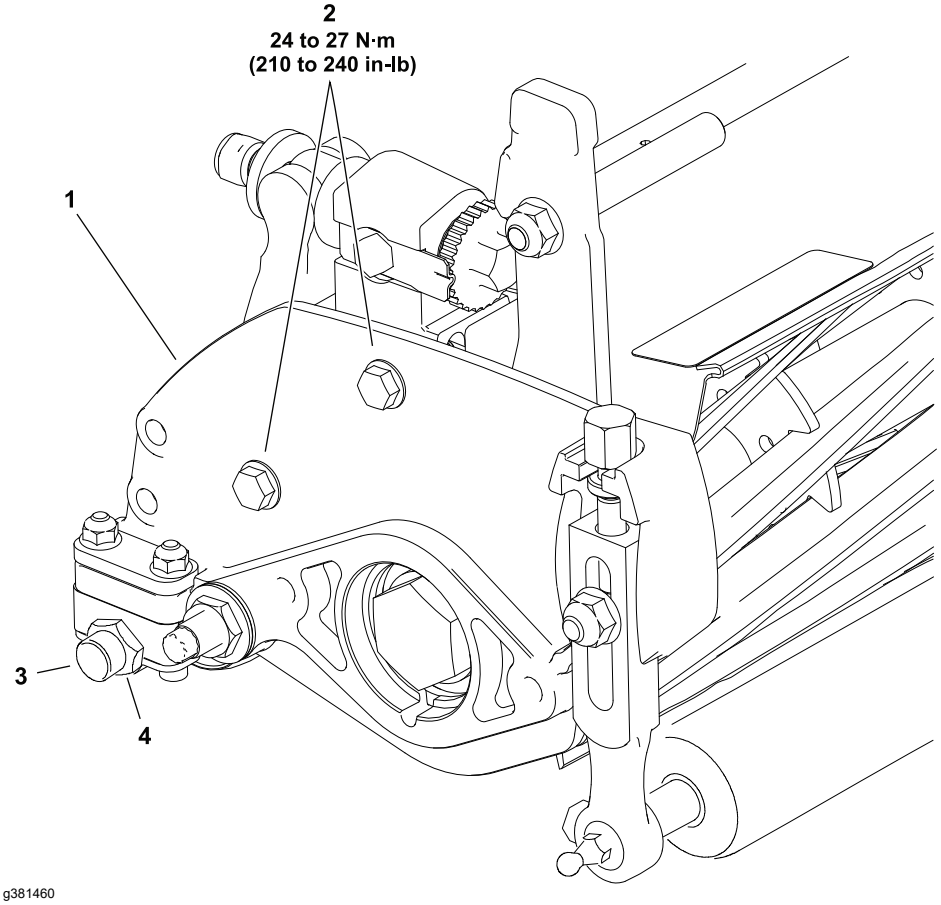

Figure 98

1. Side plate
2. Shoulder bolt (2 each)
3. Rear roller
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.

Service and Repairs

Bedbar Assembly

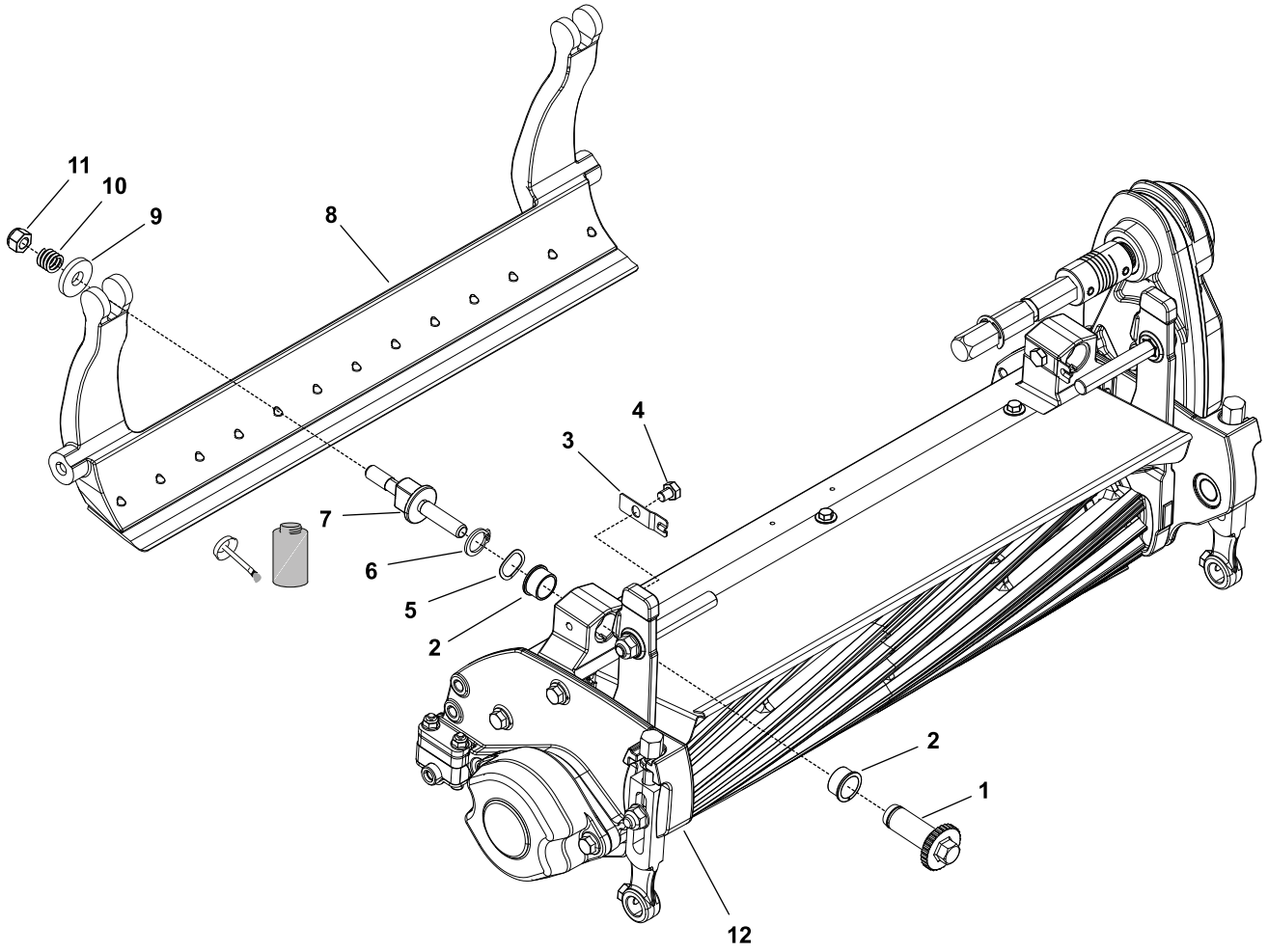

Figure 99

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

Removing the Bedbar

Note: Refer to Figure 99 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).

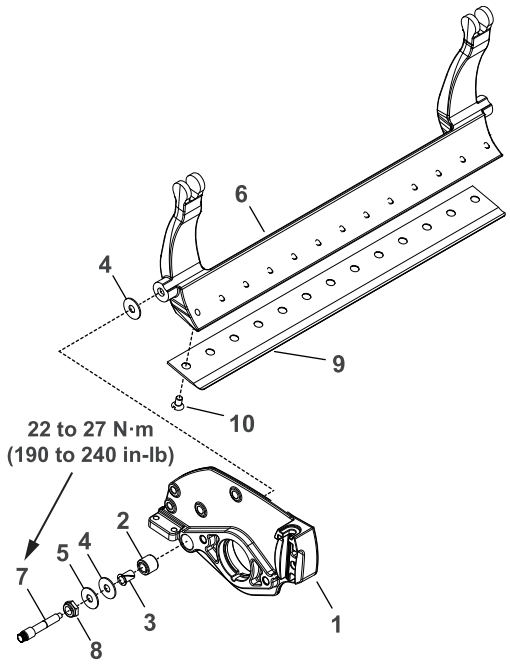

Figure 100

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

4. Loosen the lock nuts (item 8 in Figure 100) on each bedbar bolt (7).
5. Remove the two bedbar bolts (item 7 in Figure 100), 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 100) and rubber bushings (4) in the side plates for wear or damage. Replace the bushings if necessary.

Installing the Bedbar

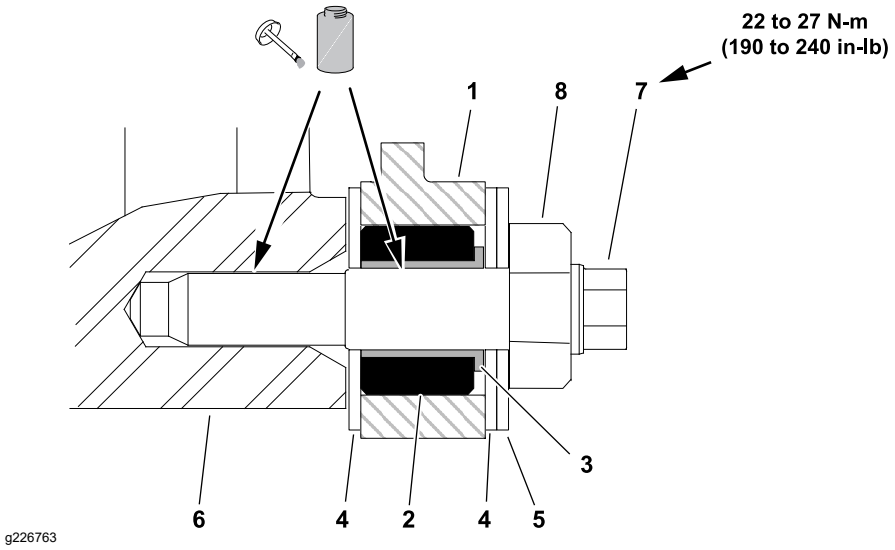

Figure 101

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

1. If rubber bushing (item 2 in Figure 101) 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 101.
2. If removed, install the nylon bushings (4) with flange facing outward; refer to Figure 101.
3. Apply anti-seize lubricant to the threads and shank of each bedbar bolt (7); refer to Figure 101.

⚠ 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 101) between the bedbar (16) and each side plate (1).
6. Slide a metal washer (item 5 in Figure 101) onto the bedbar bolt (7).

7. Install the bedbar bolt assemblies (item 7 in Figure 101). 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 101) until outside metal washers do not have any end play, but it can rotate.
9. Tighten the nut (item 11 in Figure 99) 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

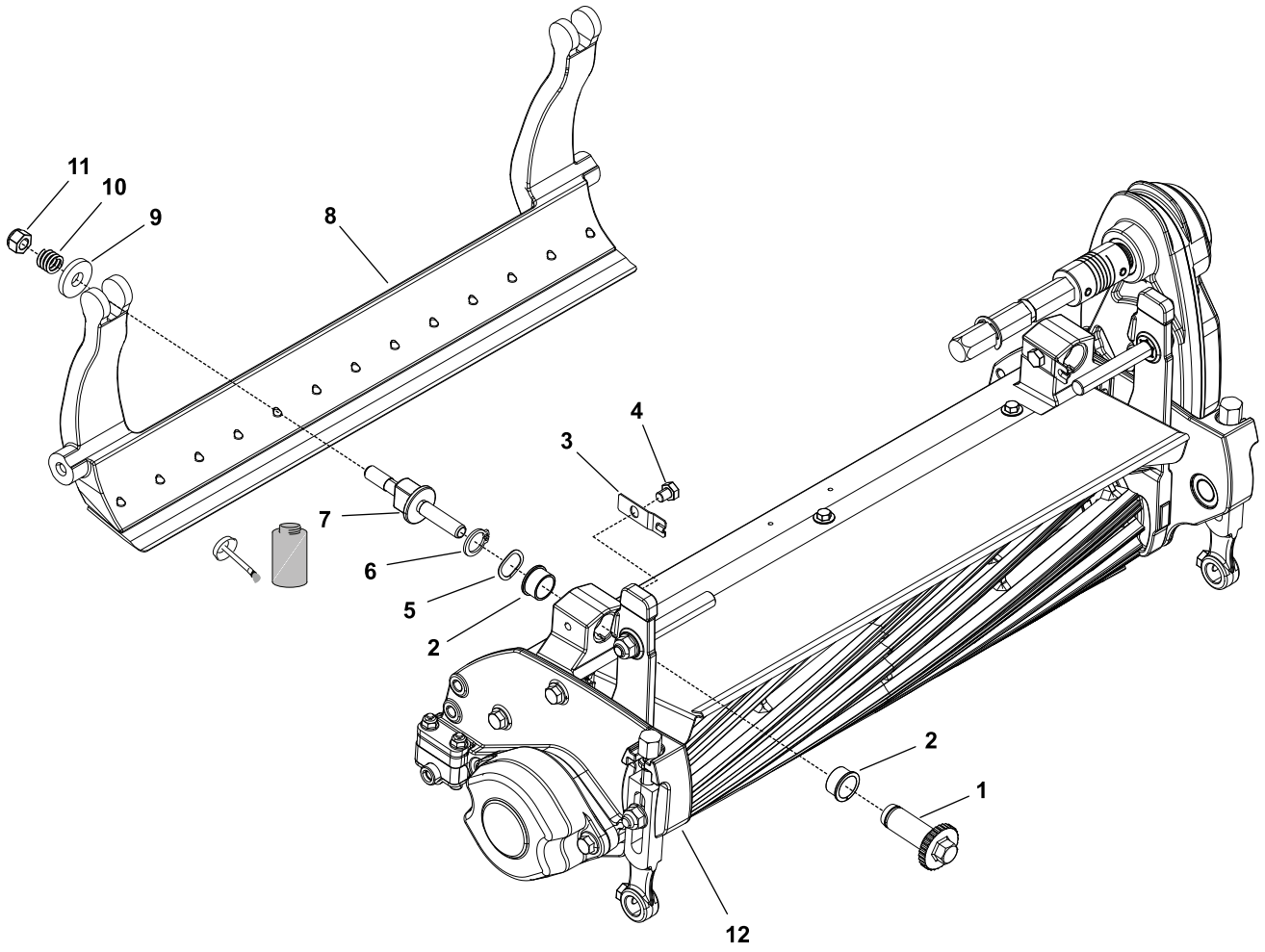

Figure 102

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

Note: Refer to Figure 102 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

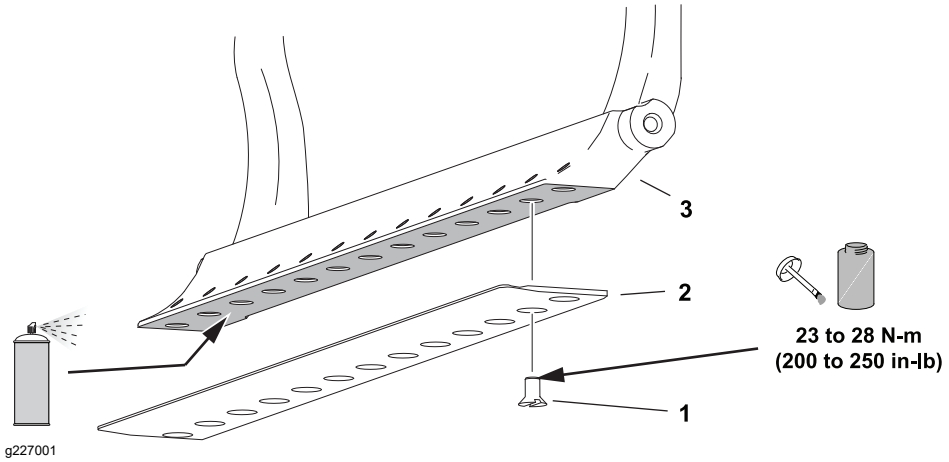

Figure 103

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. Using a socket wrench and the bedknife screw tool, remove screws that secure the bedknife to the bedbar, and remove the bedknife; refer to Special Tools (page 2–13).

IMPORTANT

Discard the old bedknife screws.

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.

IMPORTANT

Use new bedknife screws when installing the bedknife.

3. Assemble the bedknife to bedbar using new bedknife screws. Apply anti-seize lubricant to the threads of new screws. Do not apply anti-seize lubricant to the taper of the screw heads
4. Install all screws but do not tighten.

IMPORTANT

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

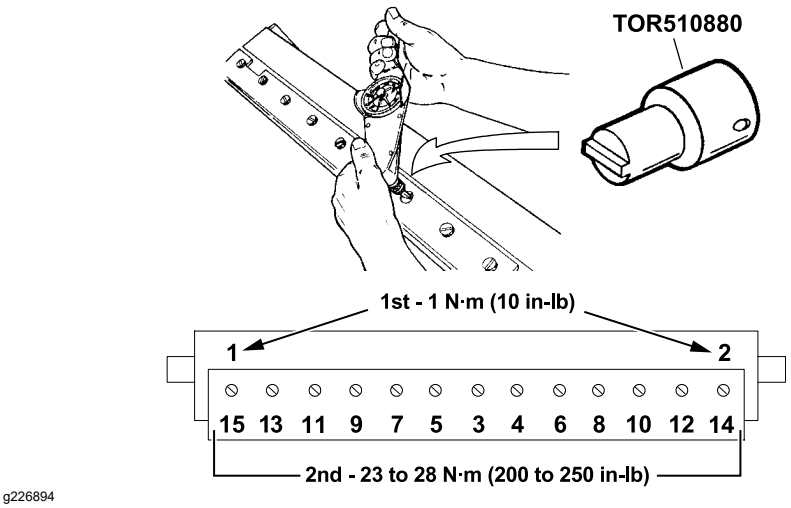

Figure 104

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.

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°

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 material so that the top surface of the bedknife is true; refer to Figure 105.

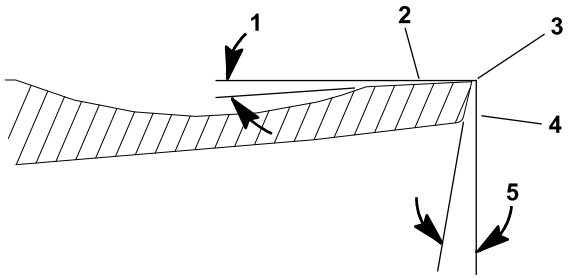

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Figure 105

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

IMPORTANT

Do not grind the bedknife below the service limit; refer to Figure 106. 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.

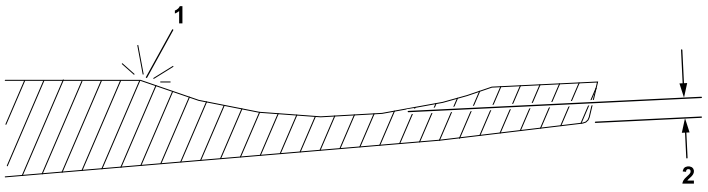

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Figure 106

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

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 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 the 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.

Troubleshooting Bedknife Grinding

Perform this troubleshooting procedure is a newly ground bedknife does not cut test paper at the center of the knife.

1. Place a .002 inch shim (Part No. 140-5531) between the outer most left and right magnets and the bedbar-bedknife assembly when placing it in the grinder (Figure 107).

   Note: If a bedknife does not cut paper more than 2 inches from each end, place the shims on the inner magnets instead of the outer magnets.

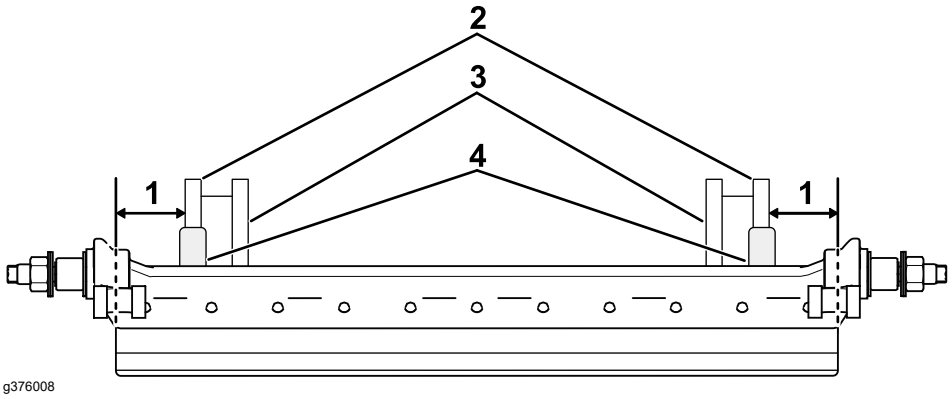


Figure 107

1.	1 inch between the outer edge of the bedknife and the outer magnet	3.	Inner magnets
2.	Outer magnets	4.	.002 inch shim (Part No. 140-5531)

2. Ensure that you are following the grinder manufacturer instructions and grind the bedknife.
3. In most cases the outside of each outer magnet should be 1 inch (25 mm) from the outside edge of the bedknife.
4. Remove the bedbar-bedknife assembly from the grinder.
5. If you have a precision flat granite surface plate, check the bedbar-bedknife; refer to Checking the Bedknife on a Granite Surface Plate (page 7–17).
6. Install the bedbar-bedknife assembly to the cutting unit and adjust the cutting unit; refer to your Cutting Unit Operator's Manual.
7. Test the cut across the entire length of the bedknife, if the paper does not cut across the entire length, complete this procedure again with an additional shim installed on each magnet (maximum of 4 shims total).

   Note: If a properly adjusted cutting unit does not cut the test paper cleanly across the entire length of the bedbar-bedknife after grinding, check the grind angle to be sure it is ground to the bedknife grinding specification; refer to Bedknife Grinding Specifications (page 7–14).

   Note: If there are still gaps after grinding with 2 shims at either the outer or inner magnets (maximum of 4 shims total), there may be a separate issue; contact the Technical Assistance Center.

Checking the Bedknife on a Granite Surface Plate

1. Place bedbar-bedknife assembly on a precision flat granite surface plate with the cutting-edge down. Look for visible light between the granite and the bedknife, or use a shim to test for .002 inch or greater gaps (Figure 108).

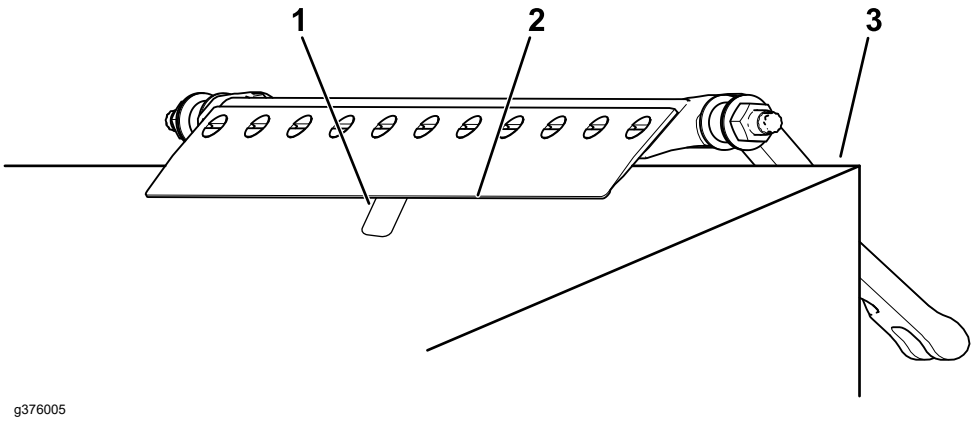


Figure 108

1. Shim (.002 inch) to test for gaps
2. Inspect the surface between the bedknife and granite for light
3. Granite surface plate

2. If there is a gap that the shim fits through, or light shows between the granite and the cutting edge after grinding with 1 shim, regrind the bedknife with an additional shim installed (maximum of 4 shims total, 2 per magnet); refer to Troubleshooting Bedknife Grinding (page 7–16).

Reel Assembly

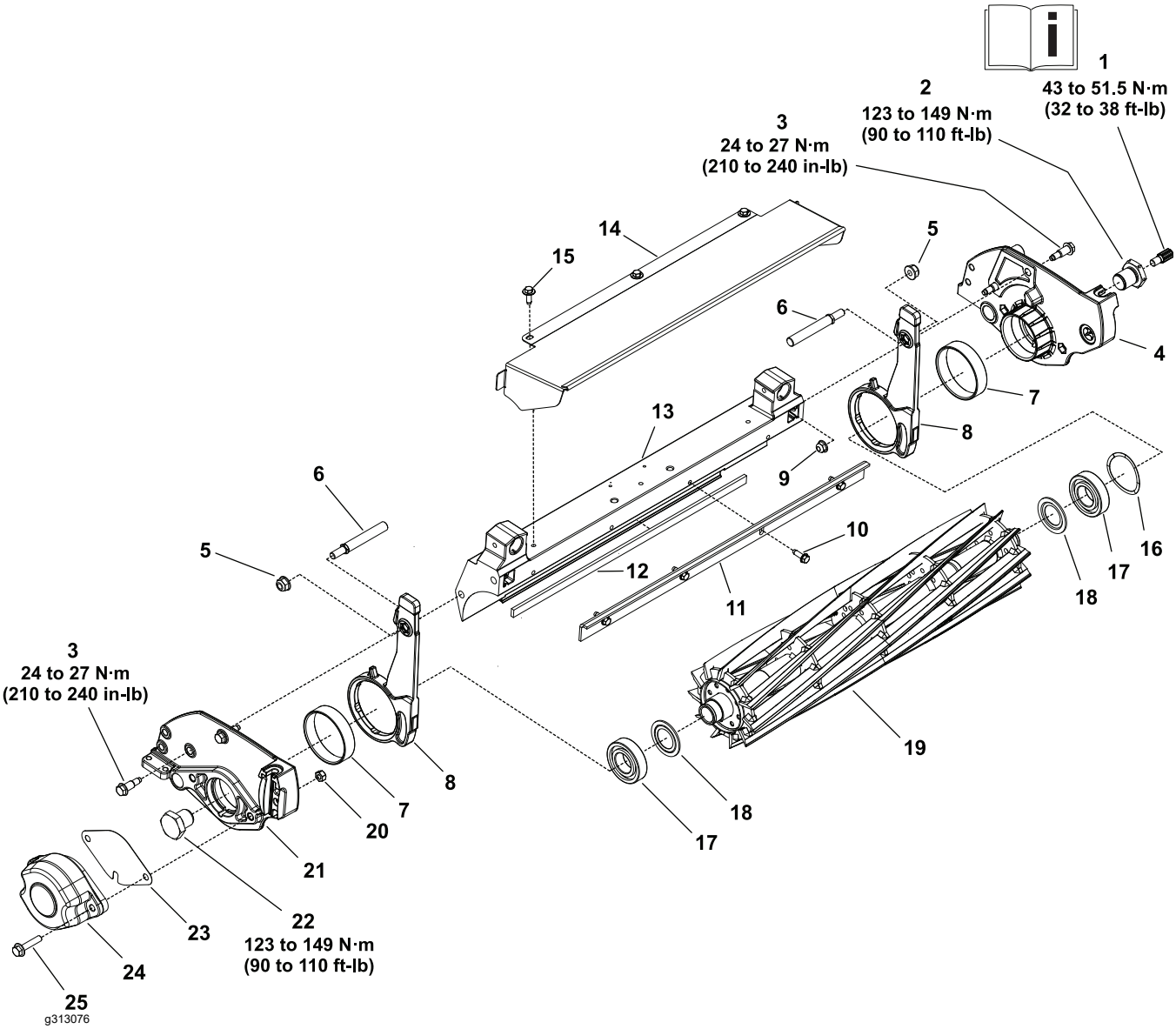


Figure 109

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

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 109 during this procedure.

1. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and

parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.

2. Disconnect the battery pack; refer to Disconnecting and 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 Gearbox 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.

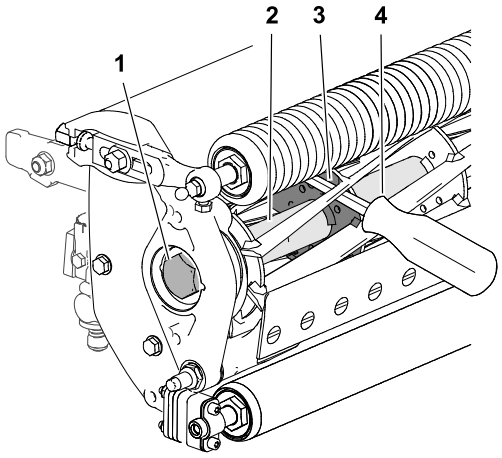
⚠ CAUTION ⚠

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 roller.

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



g381385

Figure 110

1. Reel nut – RH
2. Reel shaft
3. Support plate, weld side
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 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.

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 roller.

8. Remove the bedbar; refer to Removing the Bedbar (page 7–7).
9. Remove the front roller; refer to Removing the Front Roller (page 7–27).
10. Remove the rear roller; refer to Removing the Rear Roller (page 7–28).
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

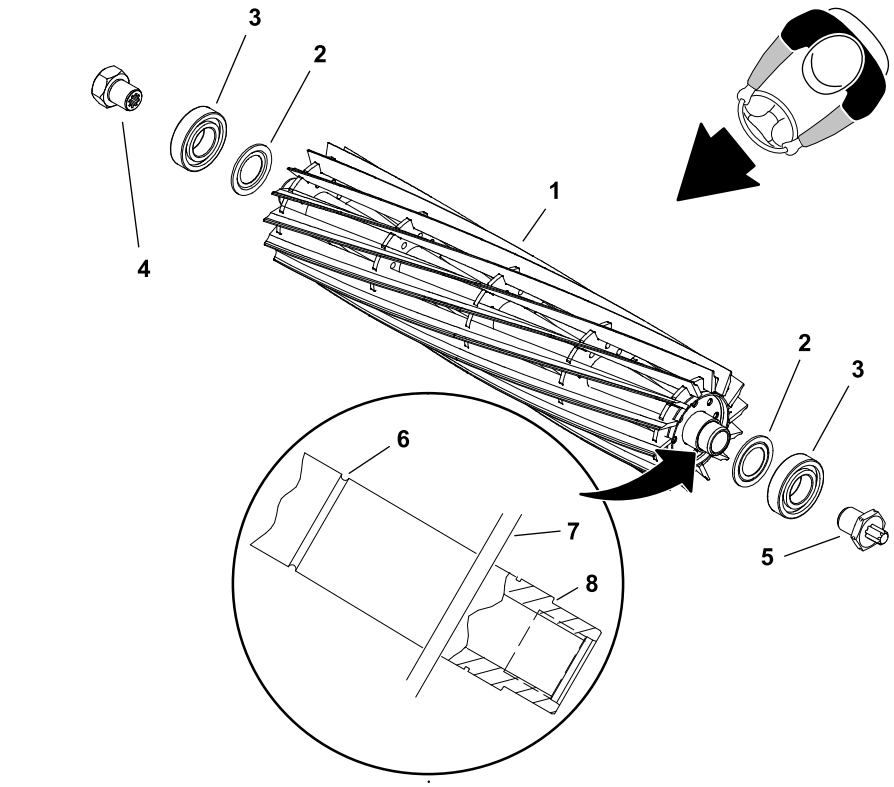


Figure 111

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

1. Remove the reel nuts from the cutting reel.
2. Slide the bearings and seals from the reel shaft. Discard the seals and inspect the reel bearings to ensure 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 7–25).
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.

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).

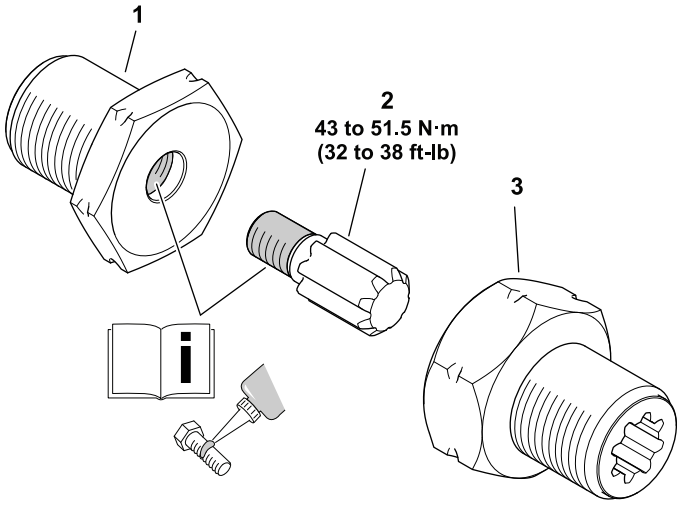


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Figure 112

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

   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

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 7–28).
7. Install the front roller; refer to Installing the Front Roller (page 7–27).
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.

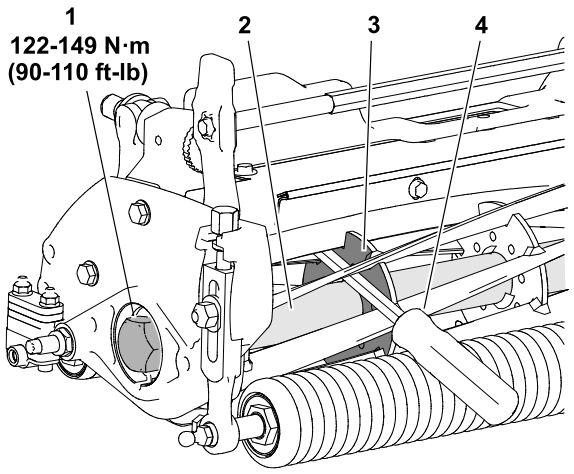

Figure 113

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

A. Insert a long- handled pry bar (3/8 x 12 inch with a screwdriver handle recommended) through the front of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move; refer to Figure 113.

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 other 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 4–10). 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 Gearbox Assembly (page 8–13).
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)

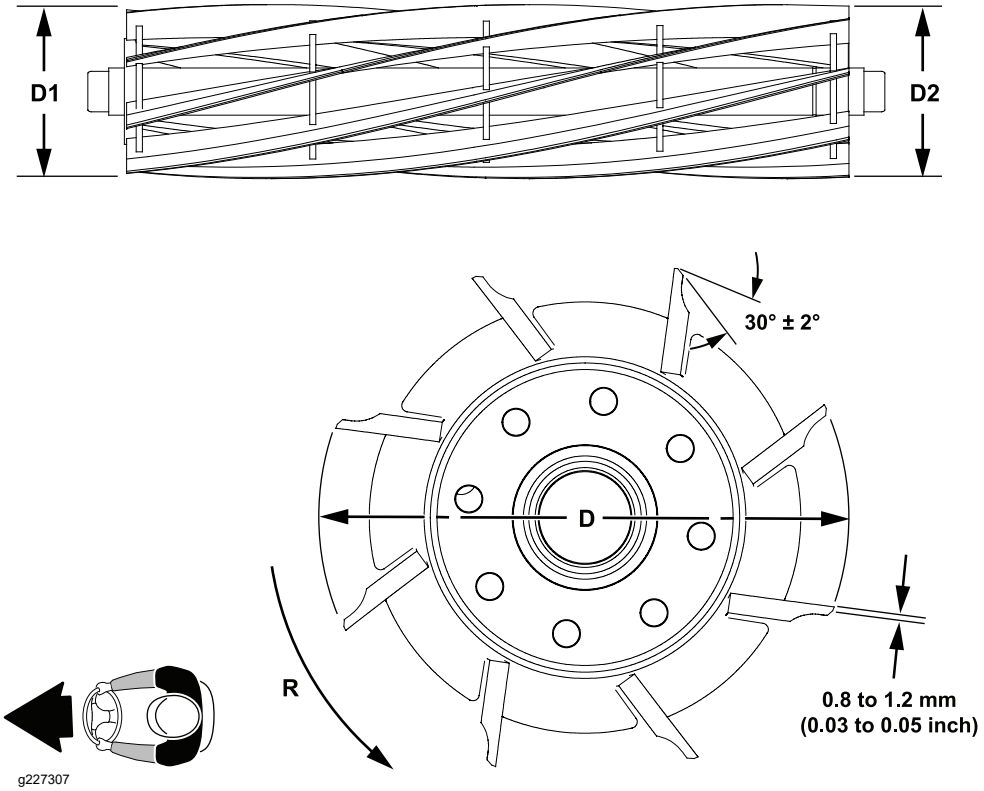

Figure 114
(R = Direction of Rotation)

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 7–25). 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.

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

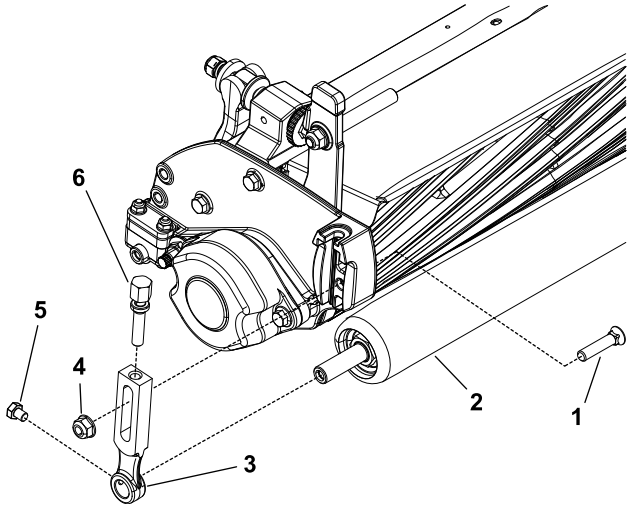

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Figure 115

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

Note: Refer to Figure 115 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 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 115 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 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.
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

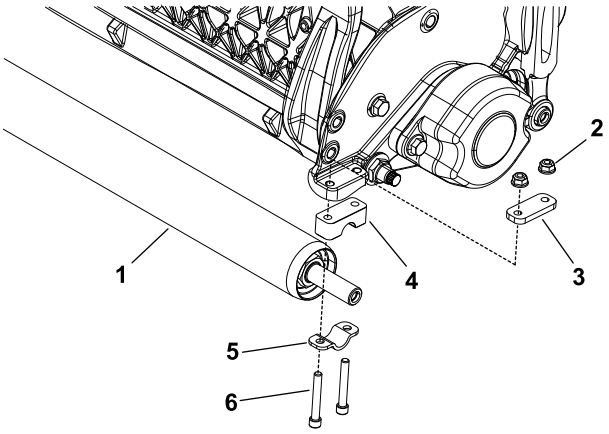

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Figure 116

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

Refer to Figure 116 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 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 116 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 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

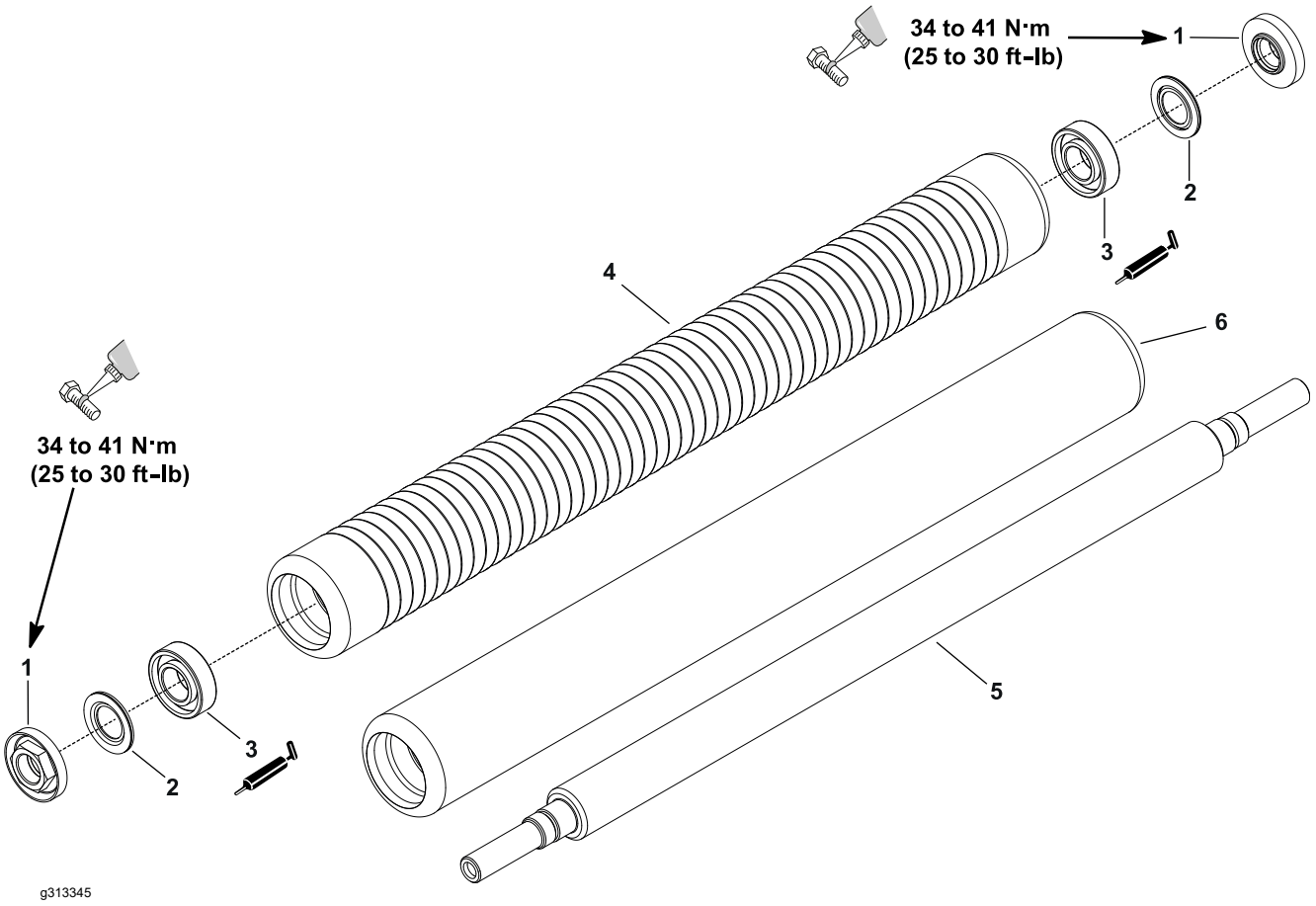

Figure 117

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

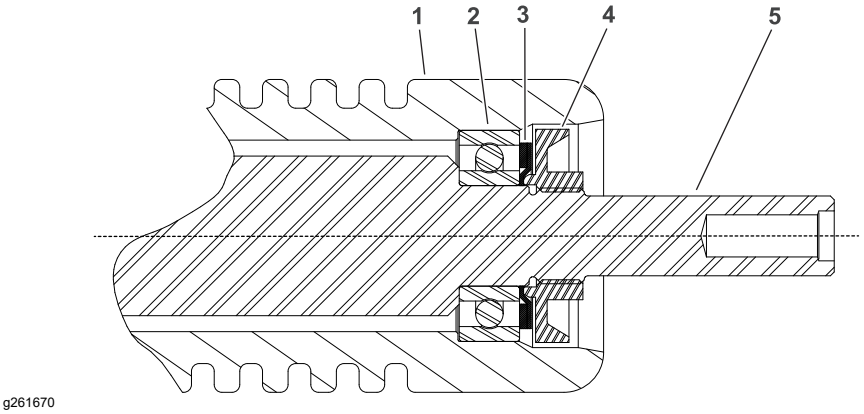

Figure 118

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

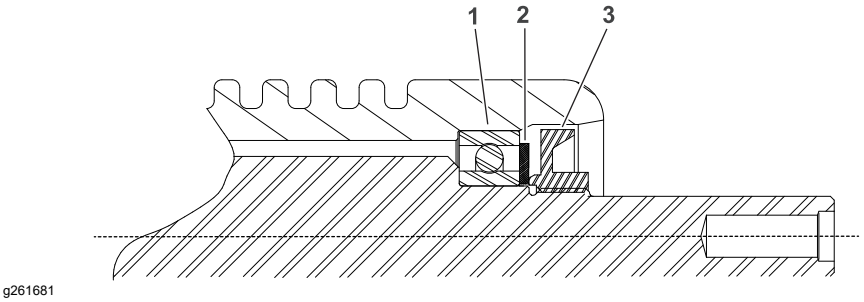

Figure 119

1. Bearing
2. Seal
3. Bearing lock nut

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 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*.

Chapter 8

Universal Groomer (Optional)

Table of Contents

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.

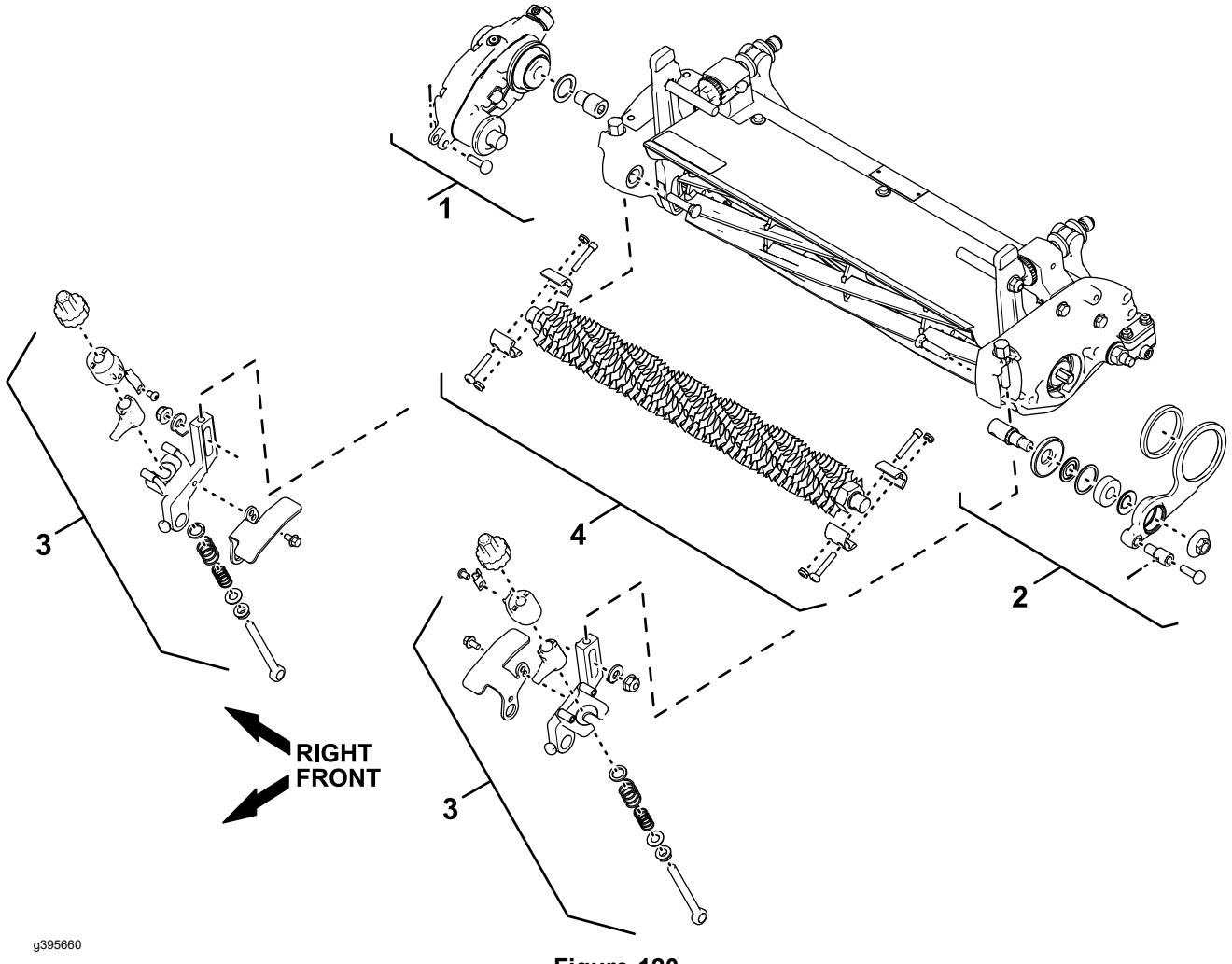

Figure 120

1. Gearbox assembly
2. Idler assembly
3. Height adjuster assembly (2 each)
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.

Groomer Drive Gearbox

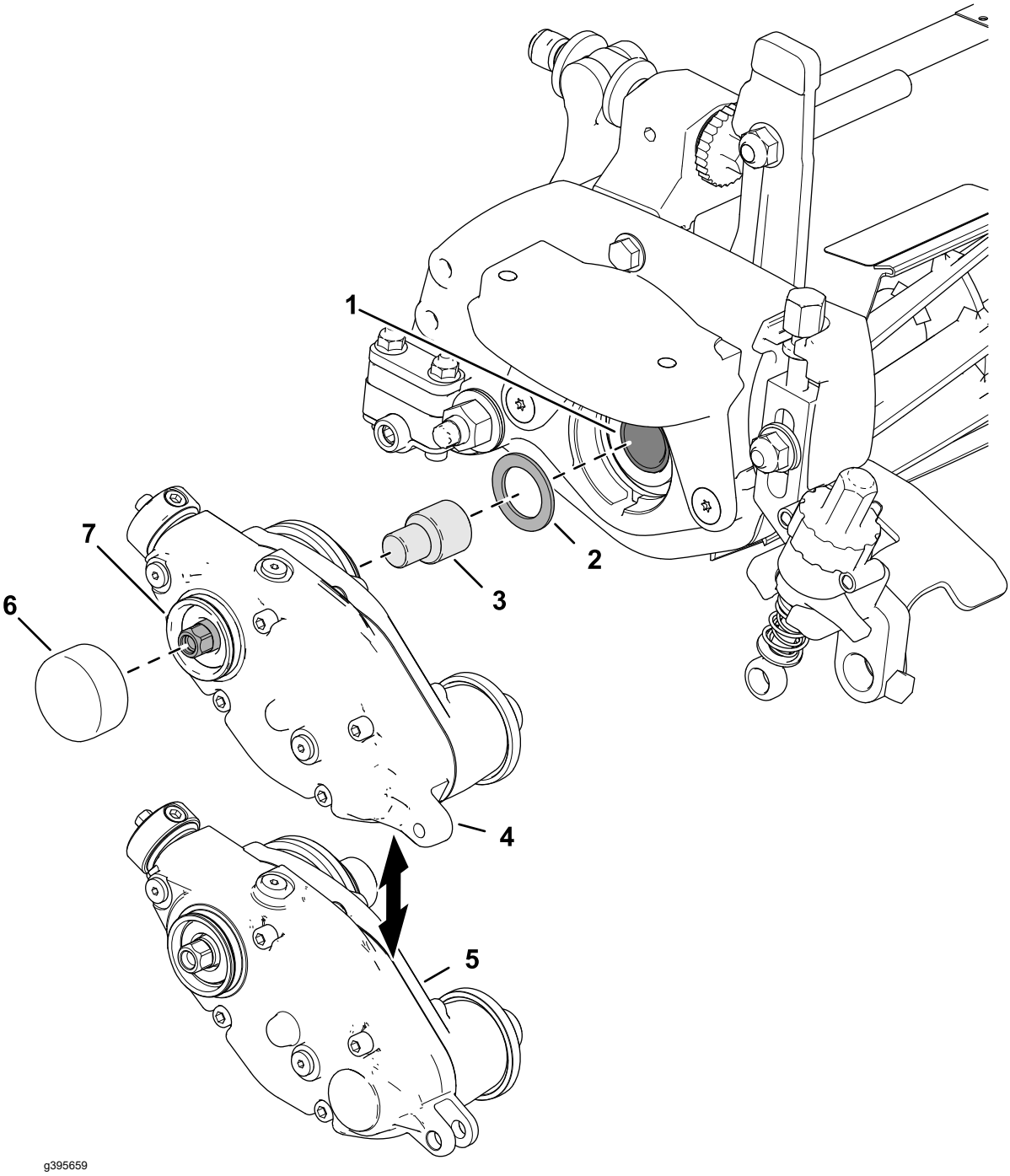

Figure 121

1. Reel shaft
2. Shim washer
3. Adapter
4. Single-lug groomer gearbox
5. 2-lug groomer gearbox
6. Cap
7. Gearbox cover lip

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

Removing the Gearbox Assembly

Refer to Figure 121 and Figure 122 for this procedure.

1. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).
3. Remove the cutting unit from the machine and place it on a level work surface; refer to *Operator's Manual*.
4. Remove the groomer reel assembly; refer to Removing the Groomer Reel (page 8–19).
5. Remove the cap from the lip of the groomer drive gearbox cover (Figure 121).
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 bottom 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 gearbox, and lift the pry bar until it contacts the front roller.

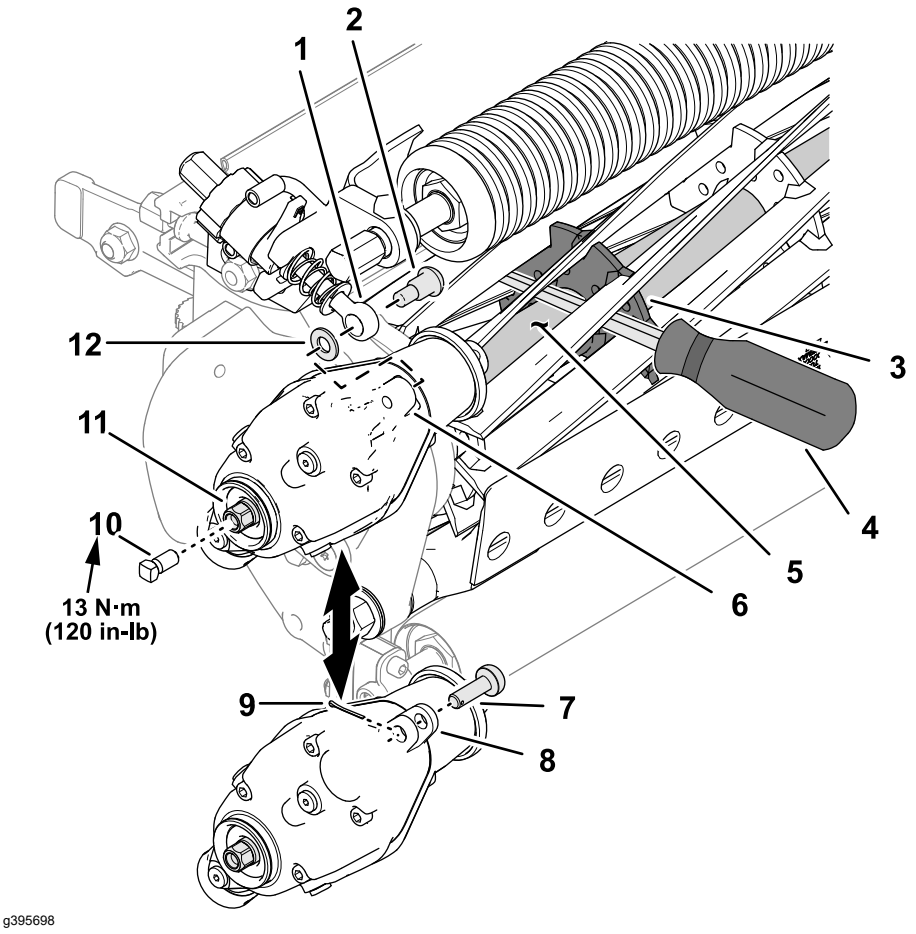

Figure 122

1. Eye bolt
2. Shoulder screw (with a single-lug groomer gearbox)
3. Weld side of reel support plate
4. Pry bar
5. Reel shaft
6. Single-lug groomer gearbox
7. Adjuster pin (with a 2-lug groomer gearbox)
8. 2-lug groomer gearbox
9. Cotter pin (with a 2-lug groomer gearbox)
10. Square head set screw (Toro Part No.1-803022)
11. Drive shaft (groomer-drive gearbox)
12. Hardened washer

9. Install a 5/16-18 X 5/8 inch square head set screw (Toro Part No.1-803022) into the end of the drive shaft for the groomer drive gearbox, and tighten the set screw to **13 N·m (120 in-lb)**; refer to Figure 122.

IMPORTANT

The square head set screw is needed to reinforce the hex end of the drive shaft when you remove or install the gearbox. Do not apply thread-locking compound to the square head set screw.

10. Disassemble the eye bolt of the groomer adjuster from the gearbox cover:
    - **Machines with a Single-Lug Groomer Gearbox:** remove the shoulder screw and hardened washer from the eye bolt and gearbox-cover lug.

- **Machines with a 2-Lug Groomer Gearbox:** remove the cotter pin and adjuster pin from the eye bolt and gearbox-cover lugs. Discard the cotter pin.

IMPORTANT

You must use a 6-point socket with a heavy wall to remove the gearbox from the reel. Do not use an impact wrench. A groomer gearbox installed at the right side of the cutting unit use a right hand thread; turn the drive shaft counterclockwise to remove the gearbox.

11. Use a heavy wall, 6 point socket and breaker bar at the outboard end of the groomer gearbox drive shaft, and rotate the socket counterclockwise to loosen and remove the gearbox driveshaft from the reel shaft.
12. If the hex head on the end of the drive shaft is damaged during removal, perform the following steps:
    A. Rotate the cutting unit as shown in Figure 123.

Removing the Gearbox Assembly (continued)

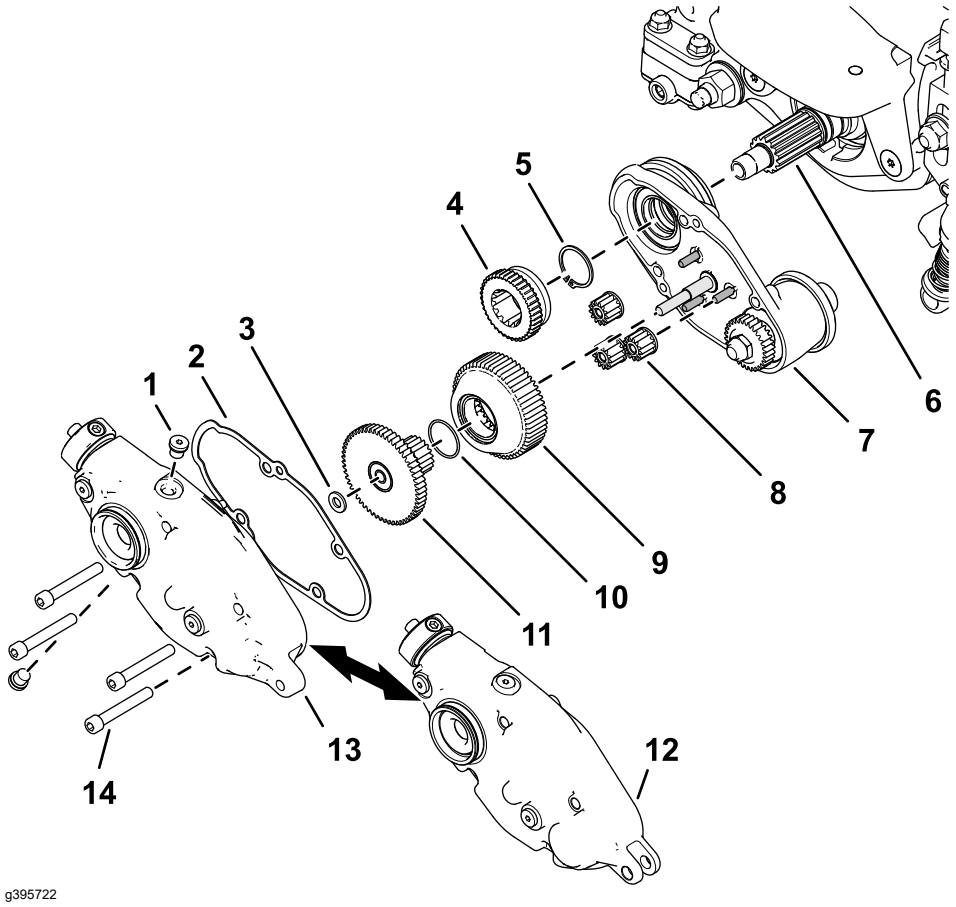

Figure 123

1. Fill/drain plug
2. Gasket
3. Thrust washer
4. Driver gear
5. Retaining ring
6. Damaged drive shaft
7. Gearbox housing
8. Planetary gear and bushing (3 each)
9. Ring gear
10. O-ring
11. Sun gear
12. 2-lug gearbox cover
13. Single lug gearbox cover
14. Socket head screw (4 each)

B. Remove the drain/fill plug from the bottom of the gearbox, and drain the oil.

C. Remove the 4 socket-head screws that secure the gearbox cover to the gearbox housing, and cover. Remove and discard the cover gasket.

D. Remove the thrust washer, sun gear, and ring gear from the gearbox housing.

E. Remove the driven gear from the drive shaft and planet gears from the pins on the gearbox housing.

F. Remove the retaining ring from the drive shaft.

G. Remove the gearbox housing assembly from the drive shaft.

H. Tip up the cutting unit to access the bottom of the reel.

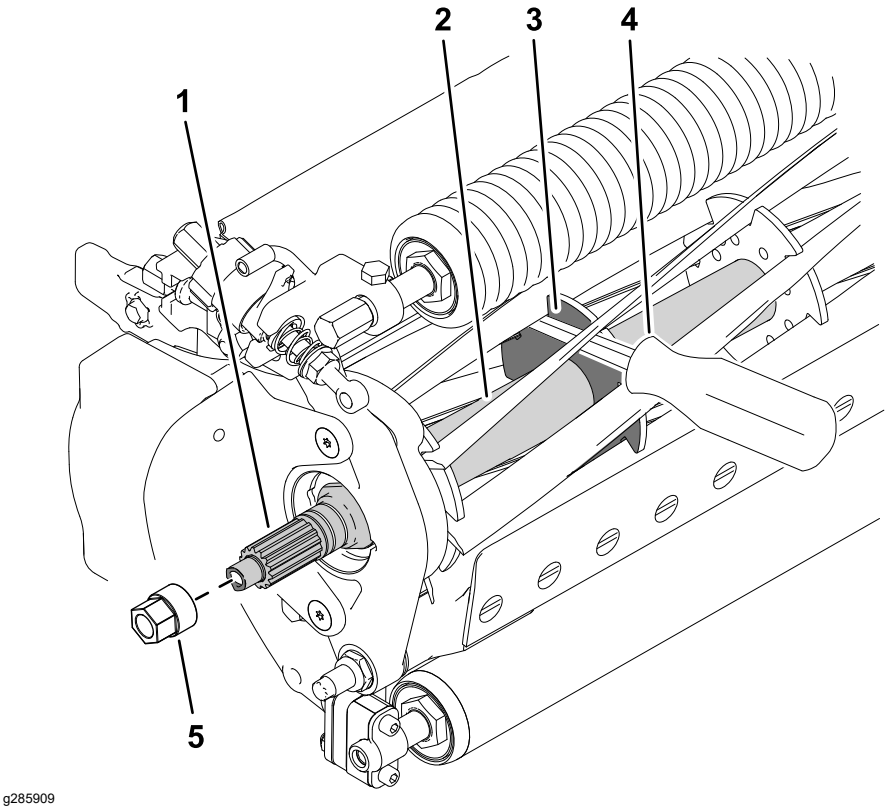

Figure 124

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

I. 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 bottom 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.

J. Move the pry bar against the weld side of the reel support plate closest to the groomer gearbox, and lift the pry bar so that it contacts the front roller.

K. Use the drive shaft removal tool on the large flats of the drive shaft assembly, and rotate the tool counterclockwise to loosen and remove the gearbox driveshaft from the reel shaft; refer to Drive Shaft Removal Tool (page 2–17).

13. Remove the pry bar, and tip the cutting unit back onto its rollers.
14. 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 Gearbox Assembly

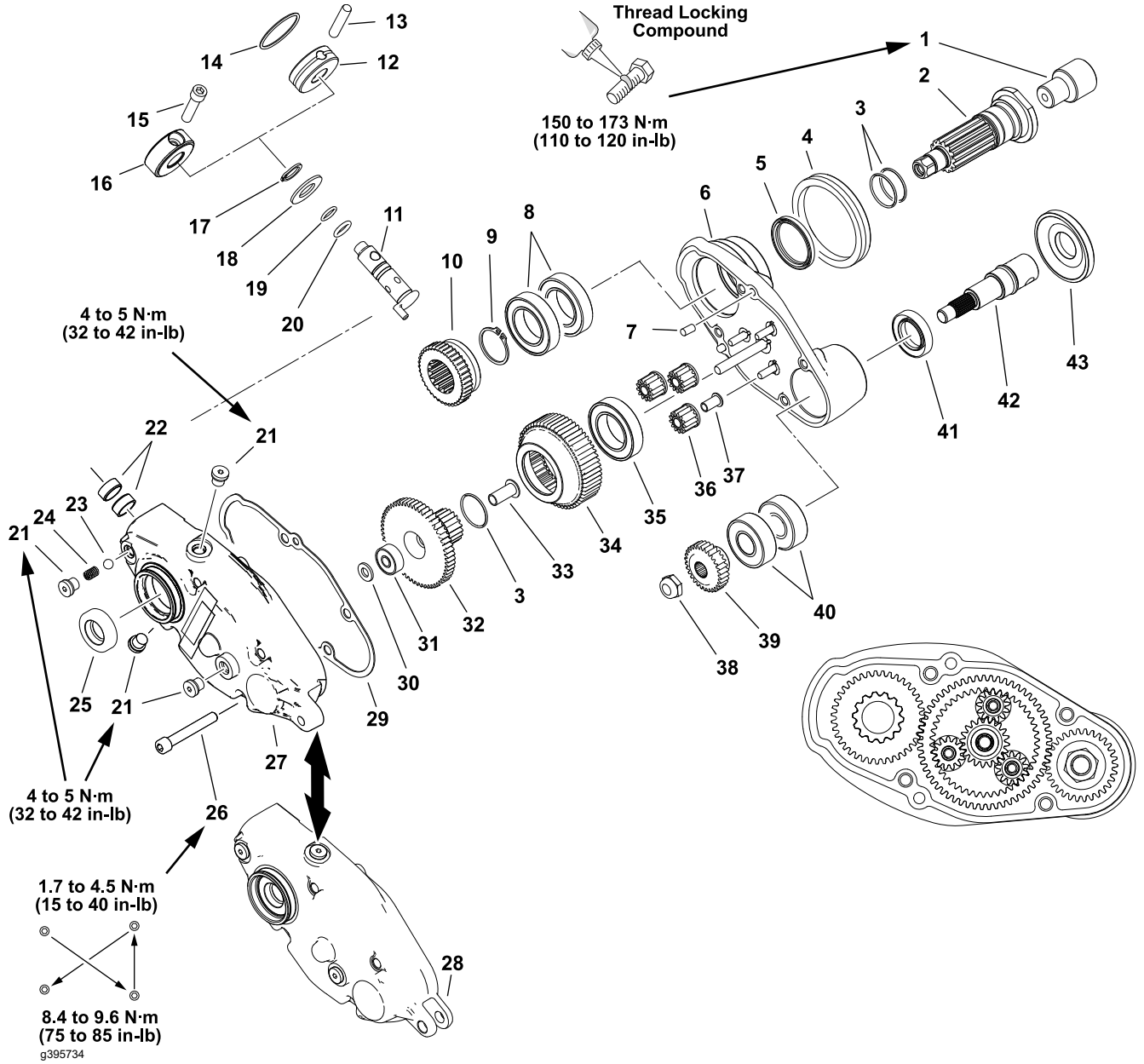

Figure 125

1.	Drive adapter	12.	Knob (2-lug gearbox)	23.	Detent ball	34.	Ring gear
2.	Input shaft	13.	Pin (2-lug gearbox)	24.	Detent spring	35.	Bearing
3.	O-ring (3 each)	14.	O-ring (2-lug gearbox)	25.	Oil seal	36.	Planet gear (3 each)
4.	V-ring	15.	Socket-head screw	26.	Socket-head screw(4 each)	37.	Flange bushing (3 each)
5.	Oil seal	16.	Knob (single-lug gearbox)	27.	Single-lug gearbox cover	38.	Lock nut
6.	Gearbox housing	17.	Retaining ring	28.	2-lug groomer gearbox cover	39.	Driver gear
7.	Dowel pin (2 each)	18.	Thrust washer	29.	Gasket	40.	Bearing (2 each)
8.	Ball bearing (2 each)	19.	O-ring	30.	Thrust washer	41.	Oil seal
9.	Retaining ring	20.	O-ring	31.	Ball bearing	42.	Driven shaft
10.	Driver gear	21.	Drain/fill plug (4 each)	32.	Sun gear	43.	Shield
11.	Actuator shaft	22.	Straight bushing (2 each)	33.	Flange bushing		

Note: Refer to Figure 125 during this procedure.

1. Remove the drain/fill plug and drain the oil from the gearbox, and drain the oil.
2. Remove the 4 socket-head screws and separate the gearbox cover and housing. Remove and discard the cover gasket.
3. Remove the thrust washer, sun gear, ring gear, and planet gears from the pins on the gearbox housing.
4. Continue to disassemble the gearbox as necessary.

⚠ CAUTION ⚠

Use the large 34.9 mm (1-3/8 inch) flats on the drive shaft to prevent it from rotating when removing or installing the drive adapter.

***Do Not* use the 12.7 mm (1/2 inch) hex head of the drive shaft when removing or installing the drive adapter—drive shaft damage may occur.**

---

5. If the drive adapter requires replacement, apply medium strength thread locking compound (Loctite 243 or equivalent) to the internal threads of the groomer gearbox drive shaft. Allow the thread locking compound to cure for 15 minutes before continuing this procedure.

   Note: A special tool is available to hold the drive shaft if necessary; refer to Special Tools (page 2–13).

6. Torque the drive adapter to **150 to 163 N·m (110 to 120 ft-lb)**. Allow the thread locking compound to cure for 15 minutes before continuing this procedure.
7. Carefully clean all the gasket material from the gearbox housing and cover.
8. Inspect the V-ring, seals, bearings, gears, and bushings in the gearbox assembly. Replace the damaged or worn components as necessary.
9. If the bearings for the sun gear, ring gear, or the gearbox housing are replaced, press the bearing all the way to shoulder of the bore.
10. If the flange bushings are replaced, ensure that the flange bushing is fully seated against the part.
11. Assembly the gearbox.
    - Ensure that all the retaining rings and O-rings are fully seated in the ring groove during assembly.
    - Lubricate the seal lips and O-rings before installing the shafts.
    - Lubricate the planet gear and sun gear pins in the gearbox housing with the gear oil prior to installing the gears.
12. Clean the gasket surface on the gearbox housing and cover with the solvent and install new gasket.
13. Ensure that the trust washer is assembled to the pin that supports the ring gear and sun gear, and the washer is located between the sun-gear bearing and the gearbox cover.

14. Fit the gearbox 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, torque the screws from 8.4 to 9.6 N·m (75 to 85 in-lb).

15. If removed, lubricate the O-rings for the drain/fill plug with Mobile XHP-222 or an equivalent grease.

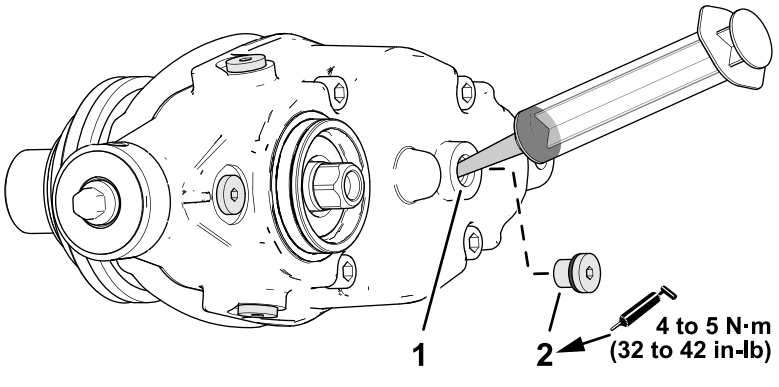

Figure 126

1. Gearbox cover
2. Drain/fill plug

16. Install all the plugs into the gearbox cover, except for the plug for the face of the cover (located between the 4 socket-head screws). Torque the plugs to **4 to 5 N·m (32 to 42 in-lb)**.

17. Add **50 ml (1.7 fluid ounces)** 80W-90 gear oil into the gearbox through the hole in the face of the cover.

18. Install drain/fill plug into the hole in the face of gearbox cover, and tighten the plug to **4 to 5 N·m (32 to 42 in-lb)**.

19. Operate the groomer gearbox by hand to check for proper operation prior to installation.

Installing the Gearbox Assembly

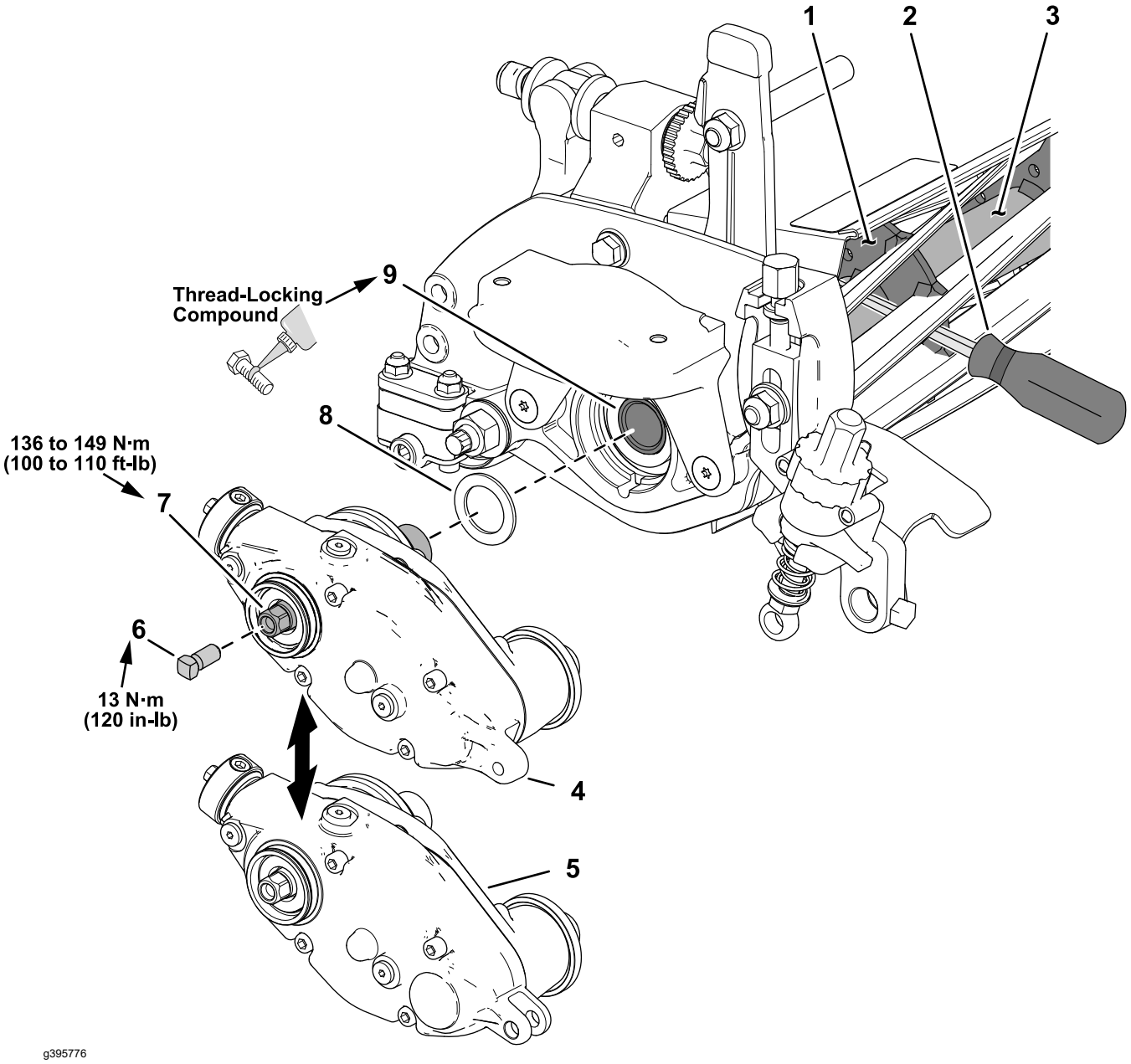

Figure 127

1. Weld side of reel support plate
2. Pry bar
3. Reel shaft
4. Single-lug groomer gearbox
5. 2-lug groomer gearbox
6. Square head set screw (Toro Part No.1-803022)
7. Input shaft assembly
8. Shim washer
9. Threads (reel shaft)

Refer to Figure 127 for this procedure.

1. Install a 5/16-18 X 5/8 inch square head set screw (Toro Part No.1-803022) into the end of the drive shaft for the groomer drive gearbox, and tighten the set screw to **13 N·m (120 in-lb)**; refer to Figure 127.

IMPORTANT

The square head set screw is needed to reinforce the hex end of the drive shaft when you remove or install the gearbox. Do not apply thread-locking compound to the square head set screw.

2. Clean the threads in the end of the reel shaft of any debris or grease.
3. Apply medium strength thread locking compound (Loctite 243 or equivalent) to the threads in the reel shaft.
4. 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.
5. Move the pry bar against the weld side of the reel support plate closest to the gearbox assembly and rest the handle of the pry bar against the front roller.
6. Position the groomer drive gearbox assembly against the cutting unit, and rotate the drive shaft assembly clockwise until it is seated against the reel shaft.

IMPORTANT

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

7. Torque the drive shaft assembly from **135 to 150 N·m (100 to 110 ft-lb)**. Allow the thread locking compound to cure for 15 minutes.
8. Remove the square head set screw from the end of the drive shaft.
9. Apply a retaining compound (Loctite 609 or equivalent) to the cap for the gearbox cover and install the cap to the lip of the cover.

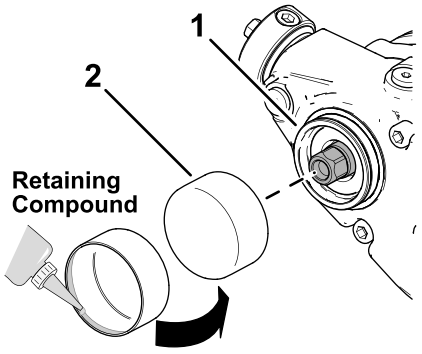

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Figure 128

1. Cap
2. Lip (gearbox cover)

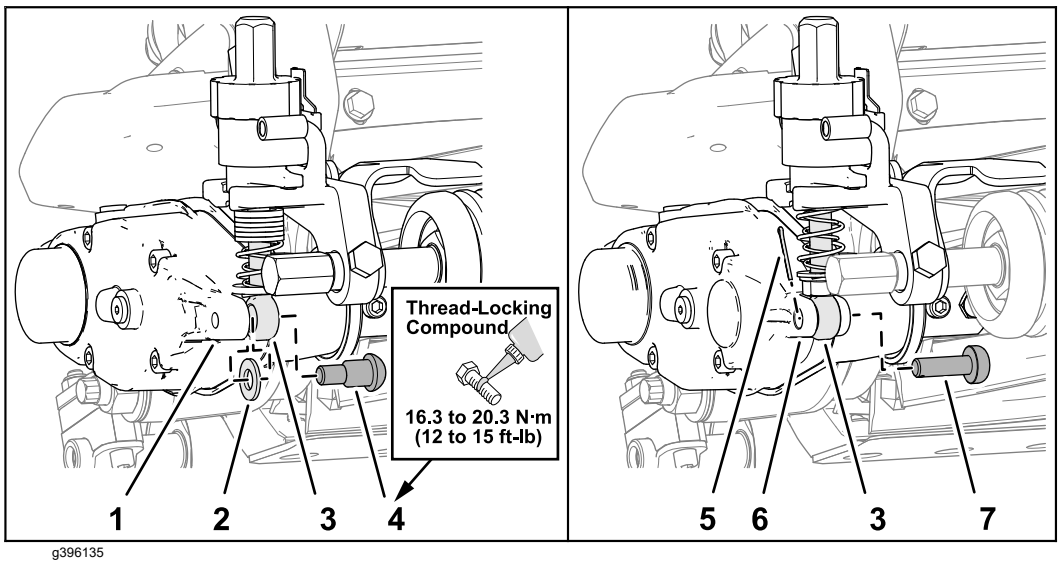

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Figure 129

1. Single-lug groomer gearbox
2. Hardened washer
3. Eye bolt
4. Shoulder screw
5. Cotter pin
6. 2-lug groomer gearbox
7. Adjuster pin

10. Assemble the eye bolt of the groomer adjuster to the gearbox cover (Figure 129).
    - **Cutting Units with a Single-Lug Groomer Gearbox**
        A. Apply a coat of medium-duty thread-locking compound to the shoulder screw.
        B. Align the hardened washer between the eye bolt and the gearbox-cover lug.
        C. Assemble the eye bolt and hardened washer to the gearbox lug with the shoulder screw. Torque the shoulder screw to **16.3 to 20.3 N·m (12 to 15 ft-lb)**.
    - **Cutting Units with a 2-Lug Groomer Gearbox**
        D. Align the eyebolt between the gearbox-cover lugs.
        E. Assemble the eye bolt to the lugs with the adjuster pin and cotter pin.
11. Install the groomer reel assembly; refer to Installing the Groomer Reel (page 8–21).

Idler Plate

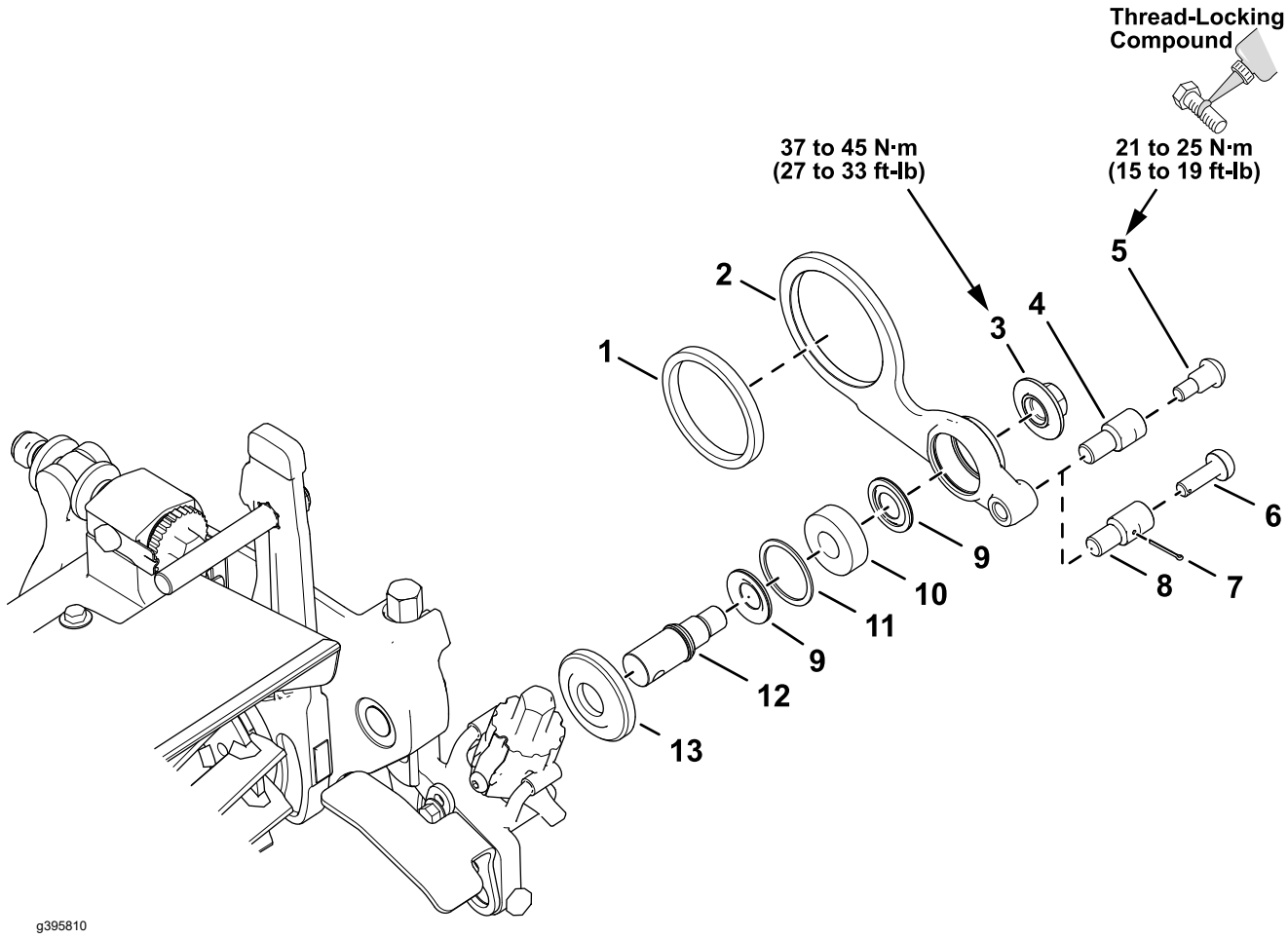

Figure 130

1.	Bushing	6.	Adjuster pin (with a 2-lug groomer gearbox)	11.	Retainer
2.	Idler plate	7.	Cotter pin (with a 2-lug groomer gearbox)	12.	Shaft
3.	Flange nut	8.	Spring pin (idler plate)—cross drilled (with a single-lug groomer gearbox)	13.	Shield
4.	Spring pin (idler plate)—threaded (with a 2-lug groomer gearbox)	9.	Bearing shield		
5.	Shoulder screw—threaded (with a single-lug groomer gearbox)	10.	Bearing		

Note: The groomer idler plate is located at the opposite side of the groomer gearbox.

Note: Early universal groomers used 2 non-adjustable compression springs on eye bolts for the 2-lug gearbox and idler plate. The single-lug gearbox and idler plate assemblies are the current groomer drive configuration, and use shim washers to preload the springs; refer to Figure 130.

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 8–19).
3. Remove the eye bolt of the groomer adjuster from the idler plate as follows:

Removing the Idler Assembly (continued)

- **Cutting units with a Single-Lug Groomer Gearbox:** remove the shoulder screw and hardened washer that secure the eye bolt to the spring pin of the idler plate.
- **Cutting units with a 2-Lug Groomer-Drive Gearbox:** remove the cotter pin and adjuster pin that secure the eye bolt to the spring pin of the idler plate.

  Note: Discard the cotter pin.

4. Remove the idler assembly.
5. If needed, remove the spring pin from the idler plate.
6. Inspect the shields, bearing, and bushing of the idler assembly. Replace worn or damaged components.

Installing the Idler Assembly

1. If the shields, bearing, or bushing were removed from the idler plate, install new components as follows:

   A. Press the bushing into the idler plate until the bushing is centered in the bore.

   B. Press the bearing into the idler plate so that the bearing contacts the shoulder in bore, and secure the bearing with the retaining ring.

   C. Assemble the 2 bearing shields to the idler plate with flocked side of shield toward the bearing.

   D. Check the idler plate orientation (left side of the cutting unit), and insert the stub shaft (item 12 in Figure 130) through shields and bearing. Use the through hole in the shaft to prevent it from rotating, and torque the flange nut to **37 to 45 N·m (27 to 33 ft-lb)**.

   E. If the spring pin was removed from the idler arm, install the spring pin, and torque it to **37 to 45 N·m (27 to 33 ft-lb)**.

2. Assemble the eye bolt of the groomer adjuster to the idler plate (Figure 131) as follows:

   - **Cutting Units with a Single-Lug Groomer Gearbox**

     A. Apply a coat of medium-duty thread-locking compound to the shoulder screw.

     B. Assemble the eye bolt to the spring pin of the idler plate with the shoulder screw. Torque the shoulder screw to **16.3 to 20.3 N·m (12 to 15 ft-lb)**.

   - **Cutting units with a 2-Lug Groomer-Drive Gearbox:** assemble the eye bolt to spring pin of the idler plate with the adjuster pin and cotter pin.

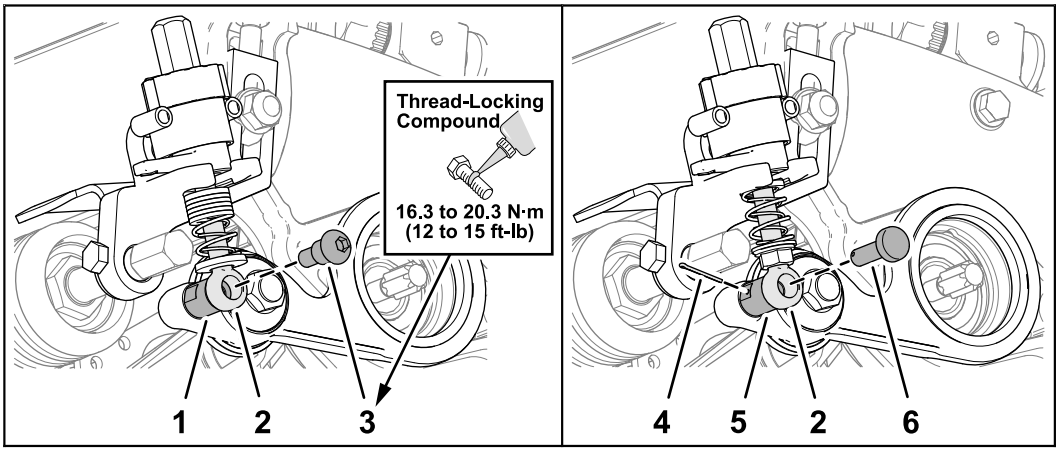

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Figure 131

1. Spring pin (idler plate)—threaded (with a single-lug groomer gearbox)
2. Eye bolt
3. Shoulder screw
4. Cotter pin
5. Spring pin (idler plate)—cross drilled (with a 2-lug groomer gearbox)
6. Adjuster pin

3. Install the reel drive; refer to Installing the Reel Drive Assembly (page 4–10).

Groomer Reel

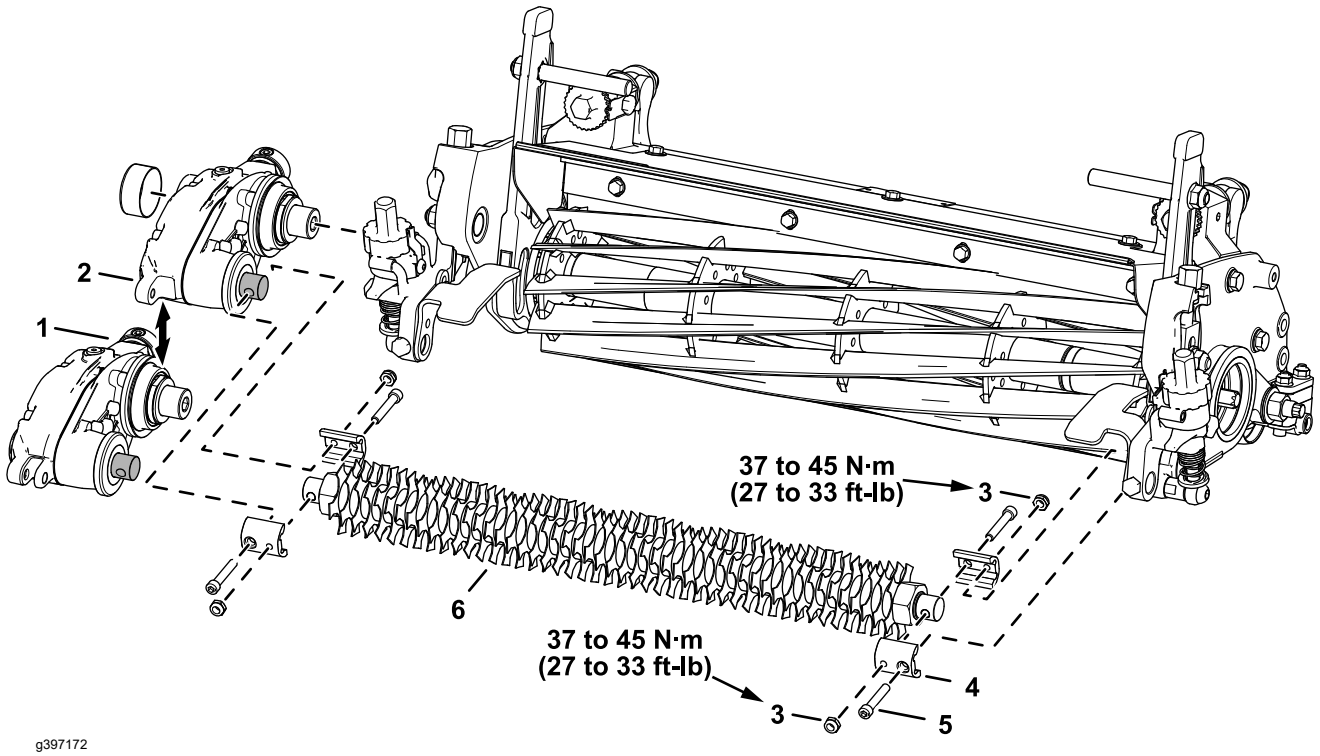

Figure 132

1. 2lug groomer gearbox
2. Single lug groomer gearbox
3. Jam nut (4 each)
4. Shaft clamp (4 each)
5. Bolt (4 each)
6. 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 Groomer Drive Gearbox (page 8–4) and Idler Plate (page 8–16).

Servicing the Groomer Reel

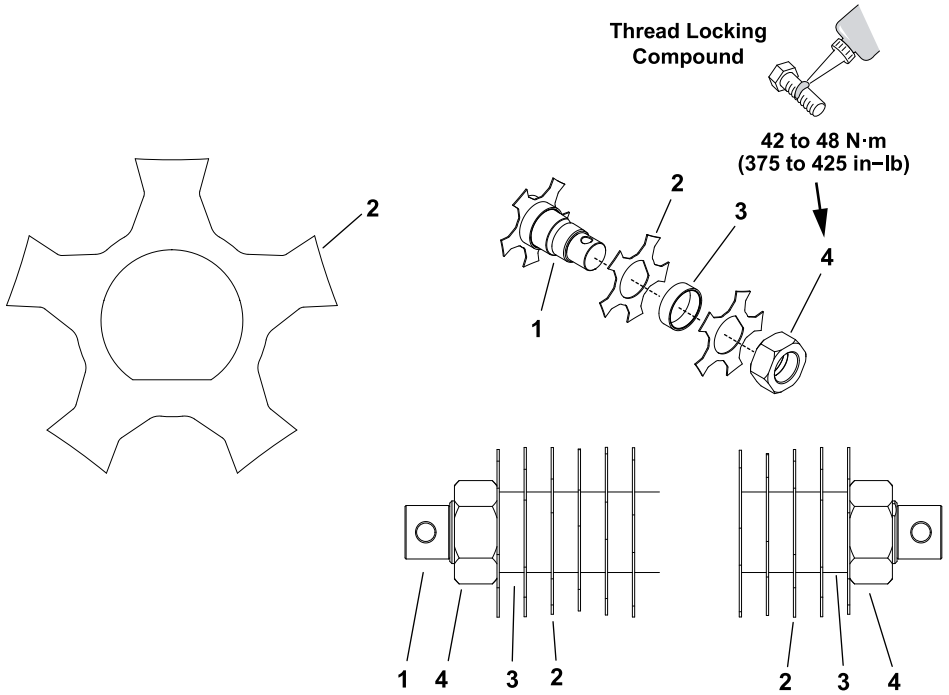

Figure 133

1. Groomer reel shaft
2. Groomer blade (51 each)
3. Spacer (50 each)
4. Lock nut (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 133.

1. Remove the groomer reel from the cutting unit; refer to Removing the Groomer Reel (page 8–19).
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, the 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 8–21).

Installing the Groomer Reel

1. Position the groomer reel between the gearbox driven shaft and stub shafts of the idler plate.

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.

Single-Lug Groomer Gearbox and Idler Plate

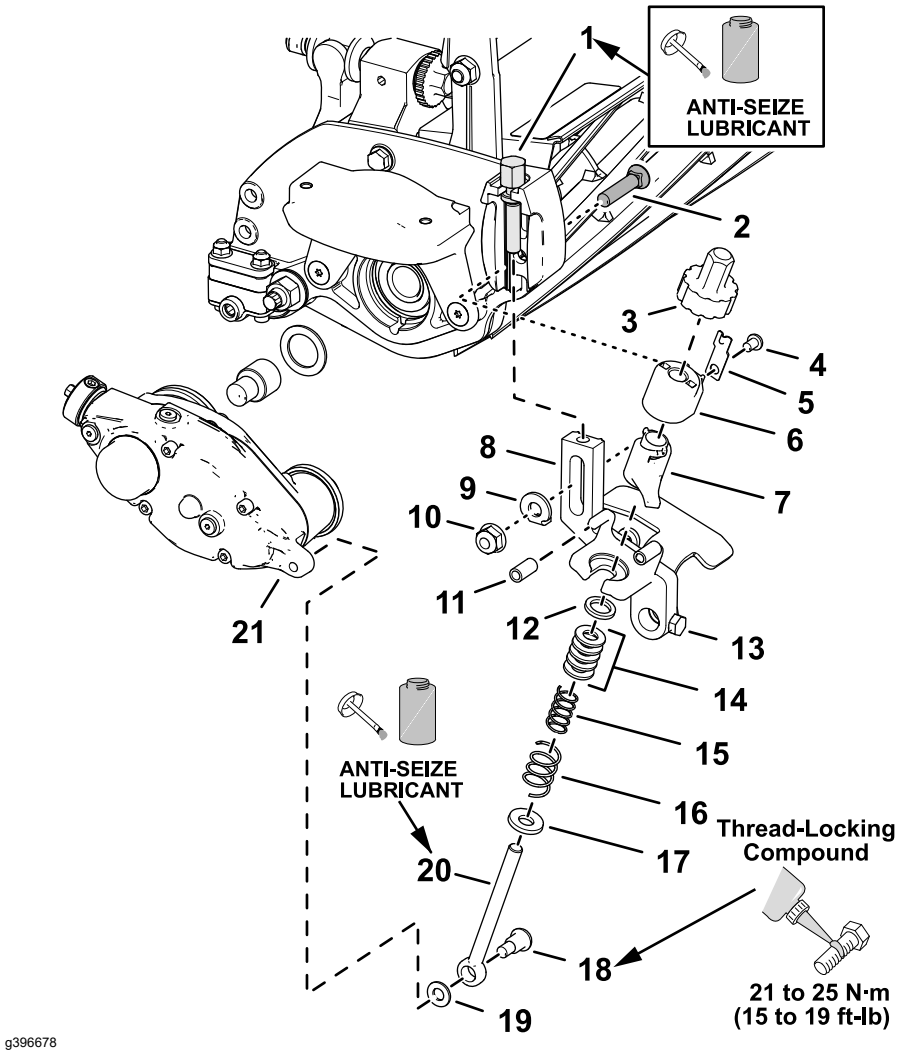

Figure 134

1. Height of cut screw
2. Plow bolt
3. Height adjuster knob
4. Screw
5. Detent spring
6. Quick up cover
7. Quick up handle
8. Groomer height of cut arm
9. Height of cut washer
10. Lock nut
11. Bumper
12. Washer 20.6 x 14.3 mm (0.813 x 0.563 inch)
13. Lock screw
14. Shim washers
15. Compression spring (inner)
16. Compression spring (outer)
17. Belleville washer
18. Eye bolt
19. Shoulder screw
20. Hardened washer
21. Single-lug groomer gearbox

Note: Early universal groomers used 2 non-adjustable compression springs on eye bolts for the 2-lug gearbox and idler plate. The single-lug gearbox and idler plate assemblies are the current groomer drive configuration, and use shim washers to preload the springs; refer to Figure 134.

Disassembling the Height Adjuster

Note: Refer to Figure 134 during this procedure.

1. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).
3. Remove the cutting unit from the machine; refer to the *Operator's Manual*.
4. Remove the shoulder screws and hardened washers that secure the eye bolts to the lugs of the groomer gearbox and the idler plate.
5. Loosen the lock screws that secure the front roller to the height-of-cut arms.
6. Remove the lock nuts, height of cut washers, and plow bolts that secure the height-of-cut arms to the cutting unit side plates, and remove the height adjusters and front roller from the cutting unit.
7. Remove the height-of-cut bolts from the groomer height of cut arms.
8. Disassemble the height adjuster assembly as necessary.
9. Clean all the components and inspect for wear or damage. Replace all the worn or damaged components.

Assembling the Height Adjuster

1. Apply anti-seize lubricant to the upper threads of the adjustment rod and lower threads of the height adjusters.
2. Assemble the height-of-cut bolts to the height-of-cut arms.
3. If both the height of cut arms are removed, align 1 height-of-cut arm and height-of-cut bolt to the cutting unit side plate.
4. Loosely assemble the height-of-cut arm to the side plate with the plow bolt, plow bolt, height of cut washer, and lock nut. Do not tighten the flange lock nut.
5. Loosely assemble the front roller shaft to the height-of-cut arm.
6. Assemble the other height of cut bracket to the front roller shaft. Assemble height-of-cut arm and height-of-cut bolt to the cutting unit side plate.
7. Assemble the height-of-cut arm to the side plate with the plow bolt, plow bolt, height of cut washer, and lock nut. Tighten the 2 lock nuts and 2 plow bolts finger tight.
8. Adjust the height-of-cut bolts so that the height-of-cut arm are the same.
9. Center the front roller between the height-of-cut arms, and tighten the lock screws in the height-of-cut arms.
10. Align the hardened washers between the eye bolts to the groomer gearbox and idler arm lugs, and loosely assemble the eye bolts and washers to the gearbox and idler plate lugs with the shoulder screws.
11. Adjust the cutting unit height-of-cut; refer to *Cutting Unit Operators Manual*.
12. Adjust the groomer reel height; refer to *Universal Groomer Drive Kit Installation Instructions*.
13. Ensure that both groomer quick up handles are in the OPERATING position.

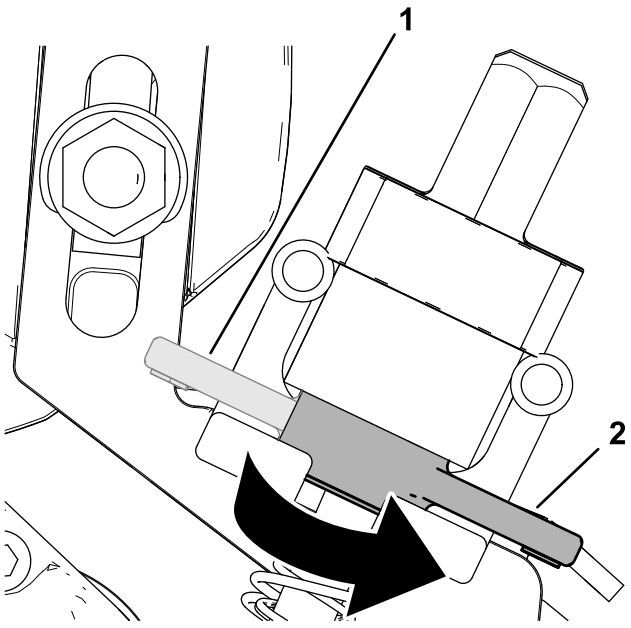

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Figure 135

1. Transport position
2. Operating position

14. Measure the distance between the washers (the current spring length) as shown in

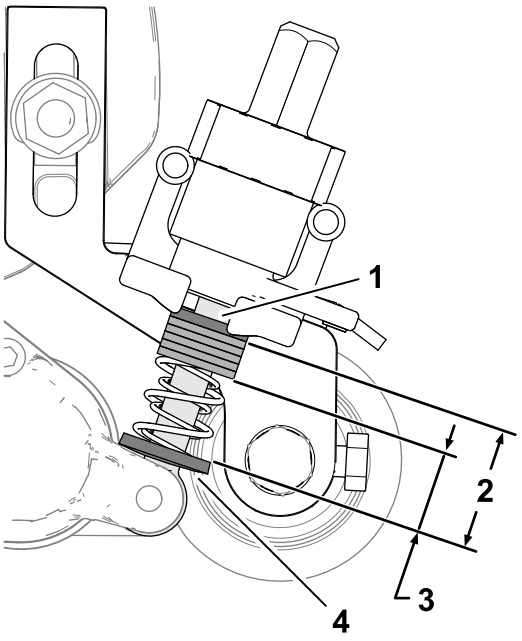

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Figure 136

1. Top washer
2. Original spring length (distance between top and bottom washers)
3. Desired spring length with optional washers—19 mm (0.75 inch)
4. Belleville washer

15. Subtract the desired (.75 inch or 19 mm) spring length from the current spring length, and divide this difference by 0.06 inches to determine how many shim washers you need to add to achieve the desired spring length.

Assembling the Height Adjuster (continued)

16. Repeat steps 14 and 15.
17. Remove the eye bolts and hardened washers from the groomer gearbox and idler arm lugs, and adjust the shim washers as you calculated in step 15.
18. Apply medium strength thread locking compound to the threads of the shoulder screws.
19. Align the hardened washers between the eye bolts to the groomer gearbox and idler arm lugs, and loosely assemble the eye bolts and washers to the gearbox and idler plate lugs with the shoulder screws.

2-Lug Groomer Gearbox and Idler Plate

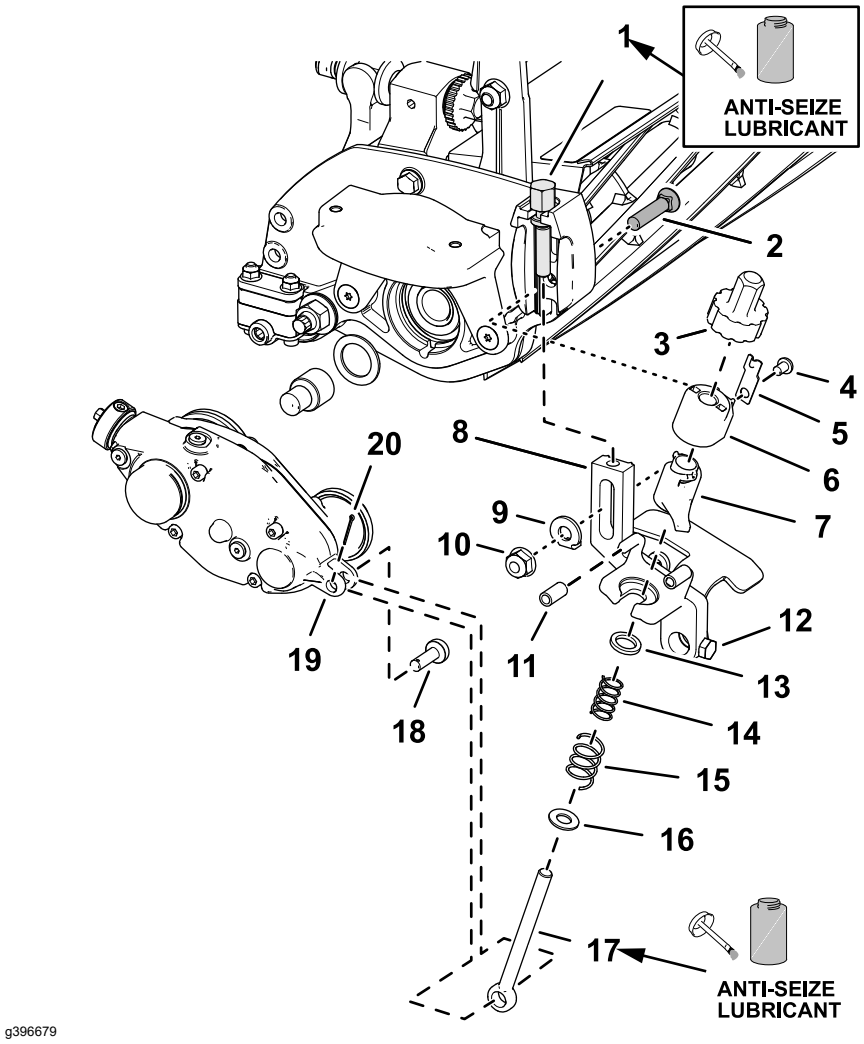

Figure 137

1.	Height of cut screw	7.	Quick up handle	13.	Washer 20.6 x 14.3 mm (0.813 x 0.563 inch)	19.	Adjuster pin
2.	Plow bolt	8.	Groomer height of cut arm	14.	Compression spring (inner)	20.	2-lug groomer-drive gearbox
3.	Height adjuster knob	9.	Height of cut washer	15.	Compression spring (outer)	21.	Cotter pin
4.	Screw	10.	Lock nut	16.	Washer 20.6 x 10.3 mm (0.813 x 0.406 inch)		
5.	Detent spring	11.	Bumper	17.	Serrated-flange nut		
6.	Quick up cover	12.	Lock screw	18.	Eye bolt		

Note: Early universal groomers used 2 non-adjustable compression springs on eye bolts for the 2-lug gearbox and idler plate. The single-lug gearbox and idler plate assemblies are the current groomer drive configuration, and use shim washers to preload the springs; refer to Figure 137.

Disassembling the Height Adjuster

1. Ensure that the cutting-unit-drive lever is in the DISENGAGE position, park the machine on a level surface, release the clutch bail, engage the service and parking brake, rotate the key switch to OFF, and remove the key; refer to the *Operator's Manual*.
2. Disconnect the battery; refer to Disconnecting and Connecting the Lithium Battery Pack (page 5–3).
3. Remove the cutting unit from the machine; refer to the *Operator's Manual*.
4. Remove the cotter pin and adjuster pin that secure the eye bolts to the lugs of the groomer gearbox and the idler plate.
5. Loosen the lock screws that secure the front roller to the height-of-cut arms.
6. Remove the lock nuts, height of cut washers, and plow bolts that secure the height-of-cut arms to the cutting unit side plates, and remove the arms from the cutting unit.
7. If needed, remove the height-of-cut bolts from the groomer height of cut arms.
8. Disassemble the height adjuster assembly as necessary.
9. Clean all the components and inspect for wear or damage. Replace all the worn or damaged components.

IMPORTANT

If the cutting unit is equipped with an eyebolt and flange nut used to adjust the spring pretension for the height of groom adjuster, replace the flange nut with washers to eliminate premature hardware wear.

Assembling the Height Adjuster

1. Apply anti-seize lubricant to the upper threads of the eye bolts and lower threads of the height-of-cut bolts.
2. Assemble an eye bolt to each of the height-of-cut arms with a serrated-flange nut, washer 20.6 x 10.3 mm (0.813 x 0.406 inch), inner and outer springs, and washer 20.6 x 14.3 mm (0.813 x 0.563 inch) washer below the slot in the arms, and the quick up handle, quick up cover, and height adjuster knob above the slots.
3. Apply anti-seize lubricant to the upper threads of the adjustment rod and lower threads of the height adjusters. Assemble the height adjuster assembly.
4. Assemble the height-of-cut bolts to the height-of-cut arms.
5. If both the height of cut arms are removed, align 1 height-of-cut arm and height-of-cut bolt to the cutting unit side plate.
6. Loosely assemble the height-of-cut arm to the side plate with the plow bolt, plow bolt, height of cut washer, and lock nut. Do not tighten the flange lock nut.
7. Loosely assemble the front roller shaft to the height-of-cut arm.
8. Assemble the other height of cut bracket to the front roller shaft. Assemble height-of-cut arm and height-of-cut bolt to the cutting unit side plate.
9. Assemble the height-of-cut arm to the side plate with the plow bolt, plow bolt, height of cut washer, and lock nut. Tighten the 2 lock nuts and 2 plow bolts finger tight.
10. Adjust the height-of-cut bolts so that the height-of-cut arm are the same.
11. Center the front roller between the height-of-cut arms, and tighten the lock screws in the height-of-cut arms.

Assembling the Height Adjuster (continued)

12. Secure the eye bolts to the groomer gearbox and idler arm lugs with the adjuster pin and cotter pin.
13. Adjust the cutting unit height-of-cut; refer to *Cutting Unit Operators Manual*.
14. Adjust the groomer reel height; refer to *Universal Groomer Drive Kit Installation Instructions*.
15. Ensure that both groomer quick up handles are in the OPERATING position.

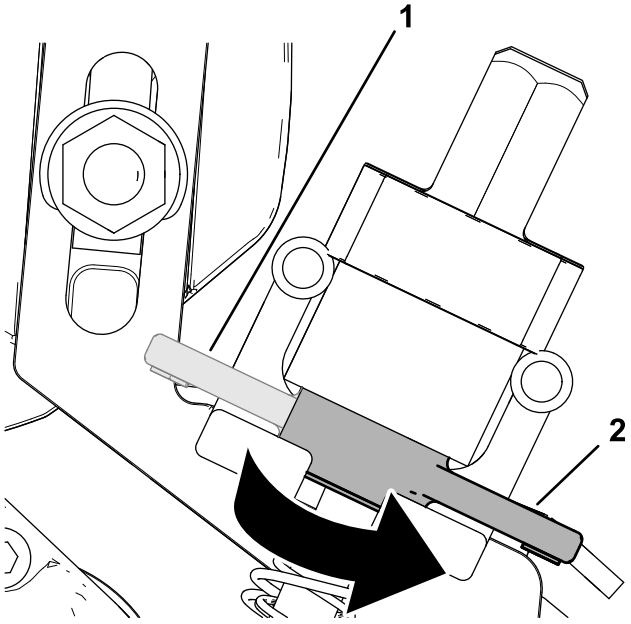

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Figure 138

1. Transport position
2. Operating position

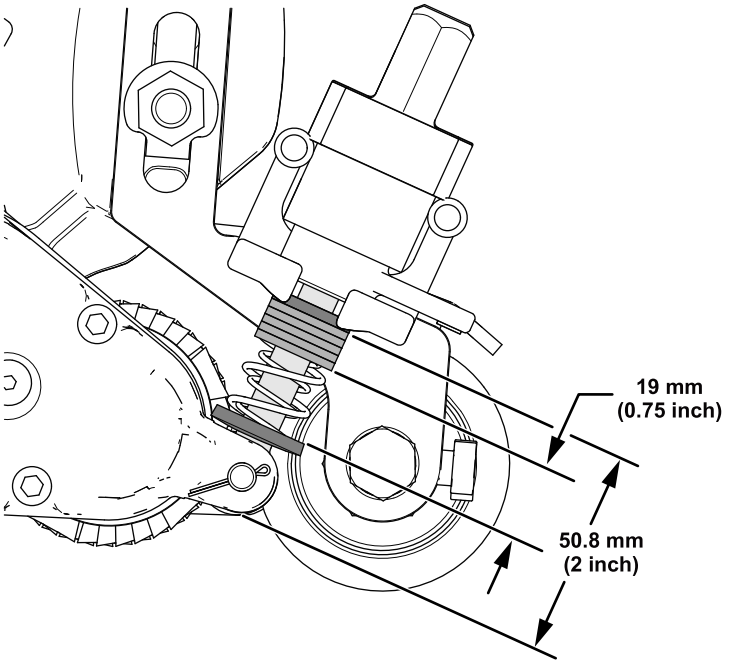

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Figure 139

16. Add or remove washers on the groomer eye bolts until the springs are compressed to **19 mm (0.75 inch)**.

The Grooming Brush (Optional)

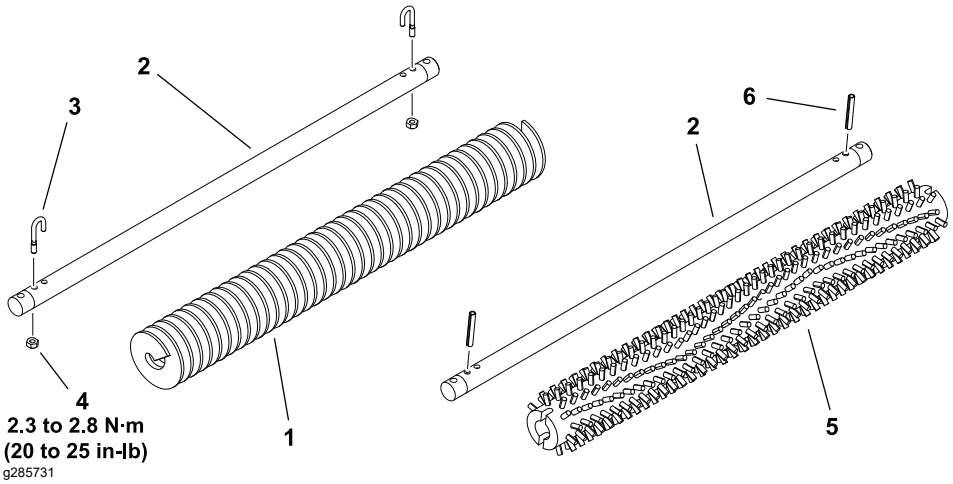


Figure 140

1. Spiral brush
2. Brush shaft
3. J-bolt (2 each)
4. Lock nut (2 each)
5. Grooming brush
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 8–19).

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)**.

Appendix A

Foldout Drawings

Table of Contents

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

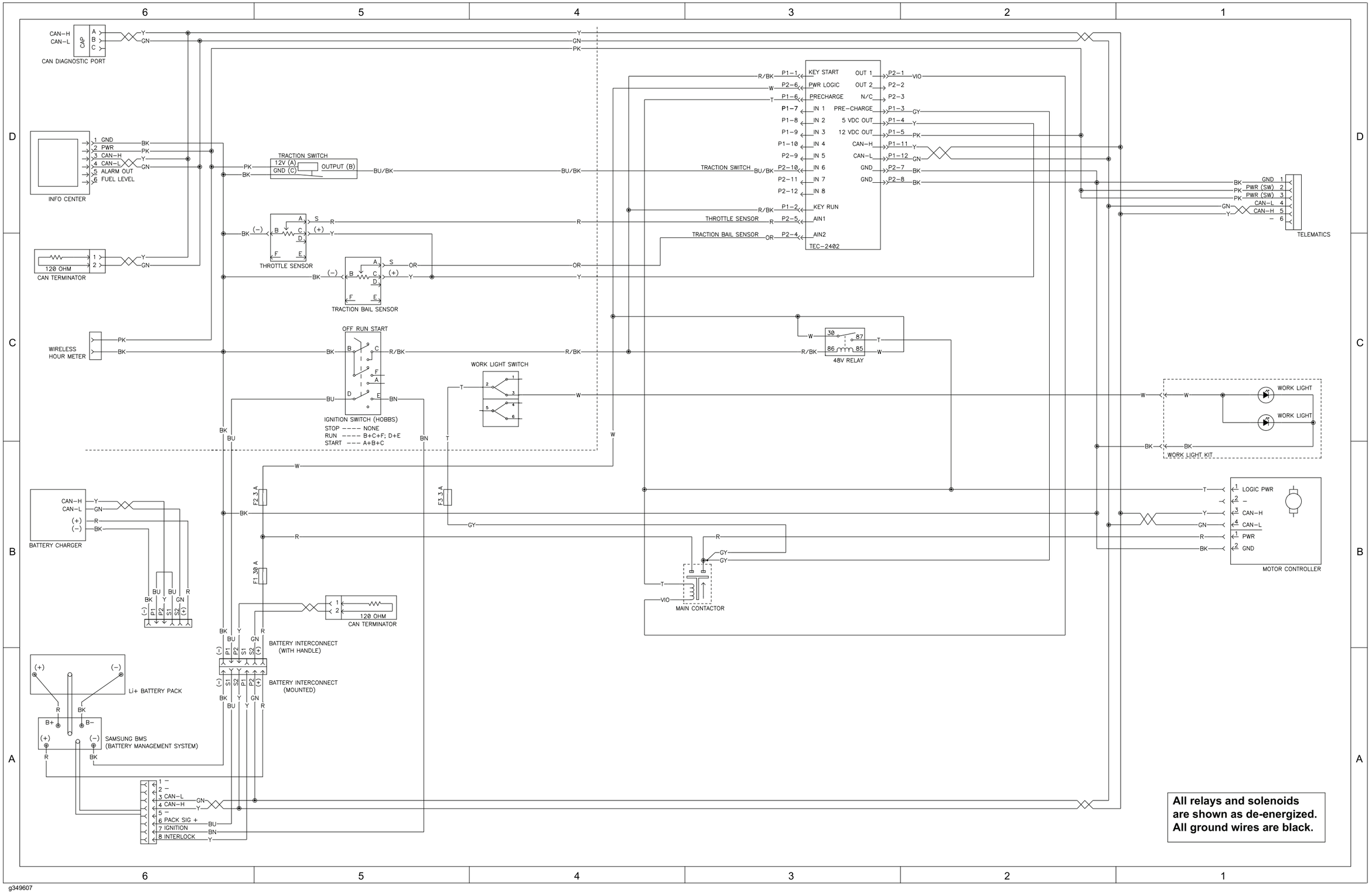
The individual wires of the electrical harness diagrams in this chapter identify both the wire color and the wire size.

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



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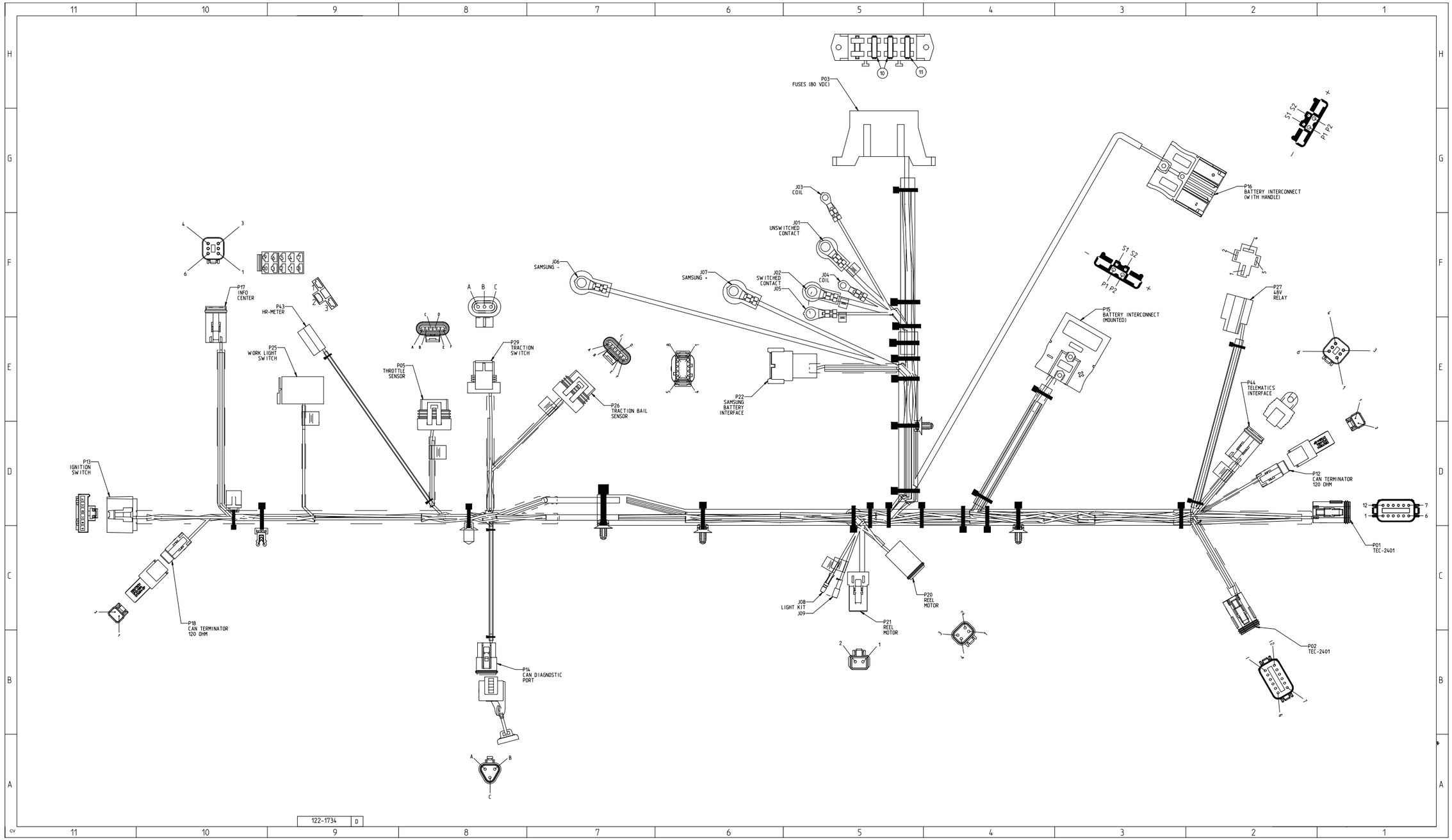
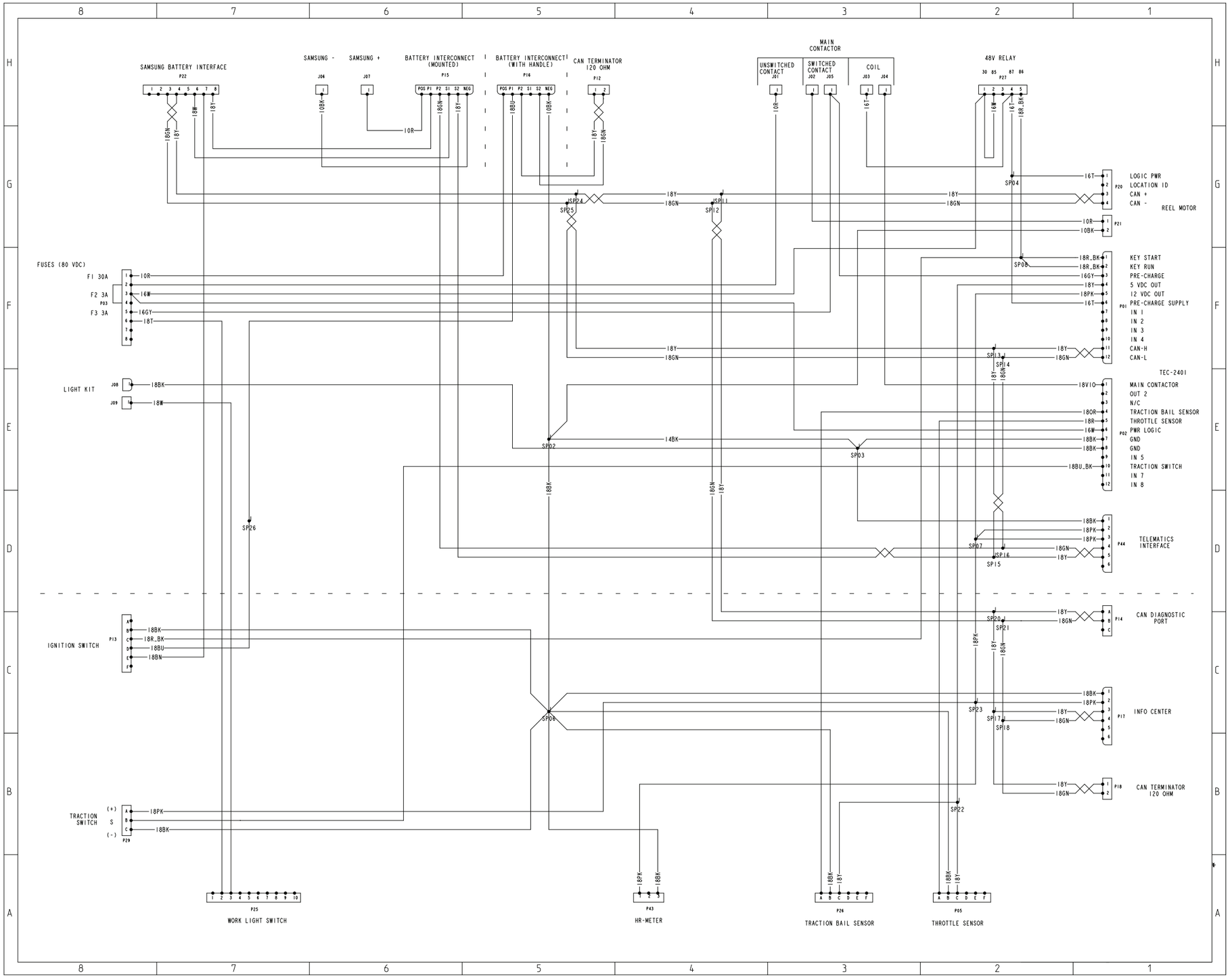
Wire Harness Drawing



Wire Harness Drawing



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Count on it.