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Count on it.

Service Manual

ProLine H800

(Models 31050, 31050TE and 31051)

8111 Lyndale Avenue South
Bloomington, MN 55420

Original Instructions (EN)
Contact us at www.Toro.com.

Revision History

Revision	Date	Description
A	06/2020	Initial issue.
B	7/2021	Add model 31051 and optional slope sensor information.

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.

or Mail to:

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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 ProLine H800.

Refer to the *Operator's Manuals* for operating, maintenance, and adjustment instructions. Space is provided in Chapter 2 (page 2–1) of this book to insert the *Operator's Manuals* and *Parts Catalog* for your machine. Additional copies of the *Operator's Manuals* 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.

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 2–7).

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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Additional Reference Materials

Yanmar 3TNV76 Service Manual
Yanmar 3TNV80F Service Manual
Danfoss DDC20 Axial Piston Pump Service Manual
Parker Torqmotor Service Procedure (TF, TG, TH, and TL Series)
Grammer Seats Repair Manual

Chapter 1

Safety

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Safety Instructions

The ProLine H800 machines are 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, hazard control and accident prevention are also dependent upon the awareness, concern and proper training of the personnel involved in the operation, transport, maintenance and storage of the machine. Improper use or maintenance of the machine can result in injury or death. To reduce the potential for injury or death, comply with the following safety instructions.

WARNING

To reduce the potential of injury or death, comply with the following safety instructions as well as information found in the *Operator's Manuals*.

Supervisor's Responsibilities

1. Ensure that the operators are fully trained and familiar with the *Operator's Manual*, all of the operating and safety decals on the machine and any operation information found in the *Installation Instructions* for accessories that are installed on the machine.
2. Establish your own special procedures and work rules for unusual operating conditions (e.g., slopes too steep for machine operation). Survey the mowing site completely to determine hills on which you can operate safely. When performing this site survey, always understand and take into consideration the turf condition and rollover risk.

Before Operating the Machine

- Review and understand the content of the *Operator's Manuals* before starting and operating the machine. Become familiar with the controls and know how to stop the machine and engine quickly. Additional copies of the *Operator's Manuals* are available at www.toro.com.
- Never allow children to operate the machine. Never allow adults to operate the machine without proper instructions.
- Become familiar with the controls and know how to stop the machine and engine quickly.
- Keep all the shields, safety devices, and decals in place. If a shield, safety device, or decal is illegible or damaged, repair or replace it before operating the machine.
- Always wear substantial shoes. Do not operate the machine while wearing sandals, tennis shoes or sneakers. Do not wear loose fitting clothing which could get caught in moving parts and cause personal injury.
- Wearing safety glasses, safety shoes, long pants and a helmet is advisable and required by some local safety and insurance regulations.
- Make sure work area is clear of objects which might be picked up and thrown by the attachments.
- Keep everyone, especially children and pets, away from the area of operation.
- Ensure the safety interlocks are functioning properly. Adjust or replace any malfunctioning switches or interlock mechanisms before operating the machine. Refer to Checking the Operation of the Interlock Switches (page 6–5) for additional information.
- Diesel fuel is highly flammable; handle it carefully.
  - Store fuel in containers specifically designed for storing fuel.
  - Do not remove the fuel tank cap of the machine while the engine is hot or running.
  - Do not smoke while handling the fuel.
  - Fill the fuel tank outdoors and only to a level within an inch of the top of the tank, not the filler neck. Do not overfill the fuel tank.
  - After refueling the machine, install the fuel tank and fuel container caps.
  - If you spill fuel, do not attempt to start the engine but move the machine away from the spill. Avoid creating any source of ignition until fuel vapors have dissipated. Wipe up any spilled fuel.

While Operating the Machine

- Sit on the seat when starting and operating the machine.
- Anytime you park the machine (short or long term), lower the cutting deck to the ground.

IMPORTANT

When you lower the cutting deck to the ground, the pressure from the hydraulic lift circuit releases and prevents the cutting deck from accidentally lowering.

- If you park the machine on a slope, block or chock the wheels.
- Keep hands, feet and clothing away from moving parts and the discharge area of an attachment.
- Do not touch the engine, muffler or exhaust pipe while the engine is running or soon after it is stopped because these areas could be hot enough to cause burns.

Before starting the machine

DANGER

The exhaust fumes are hazardous and have the potential of injury or death.

Do not run the engine in a confined area without adequate ventilation.

1. Set the parking brake.
2. Ensure that the traction pedal is in the NEUTRAL position and the PTO switch is in the OFF (disengaged) position.
3. After you start the engine, release the parking brake and keep foot off the traction pedal. Ensure that the machine does not move.

   Note: If machine movement is evident, the traction pedal linkage is adjusted incorrectly; therefore, shut off the engine and adjust the traction pedal linkage until the machine does not move when you release the traction pedal; refer to the *Operator's Manual*.

CAUTION

Running the engine causes the engine, radiator, and exhaust system to become hot. Touching a hot engine, radiator, or exhaust system can burn you.

Do not touch the engine, radiator, or exhaust system while the engine is running or soon after you stop it.

Before stopping the machine

1. Ensure that the traction pedal is in the NEUTRAL position.
2. Lower and disengage the cutting deck and wait for all moving parts to stop.
3. Set the parking brake.
4. Shut off the engine and remove the key from the key switch.

Maintenance and Service

- Before servicing or making any adjustments to the machine, lower the cutting deck, set the parking brake, shut off the engine, and remove the key from the key switch.
- Ensure that the machine is in safe operating condition by keeping all the nuts, bolts, and screws tight.
- Do not store the machine or a fuel container inside where there is an open flame, such as near a water heater or furnace.
- Ensure that all of the hydraulic line connectors are tight and that all the hydraulic hoses and lines are in good condition before applying pressure to the hydraulic system.
- Keep your body and hands away from pin-hole leaks in the hydraulic lines that eject hydraulic fluid under high pressure. Use cardboard or paper to find hydraulic leaks. The hydraulic fluid escaping under pressure can penetrate the skin and cause injury. If hydraulic fluid is accidentally injected into the skin, you must have it surgically removed within a few hours by a doctor familiar with this type of injury. Otherwise, gangrene may result.
- Before disconnecting or performing any work on the hydraulic system, release all the pressure in the system by parking the machine on a level surface, lowering the cutting deck completely, shutting off the engine, and then using all of the hydraulic controls (pressing the traction pedal, turning the steering wheel, and pressing the lift switch to both raise and lower).
- Use care when checking or servicing the cutting deck. Wear gloves and use caution when servicing the deck.
- To reduce potential fire hazards, keep the engine area free of excessive grease, grass, leaves, and dirt. Clean the protective screen on the machine frequently.
- If you must run the engine to perform maintenance or to make an adjustment, keep your hands, feet, clothing, and other parts of the body away from the cutting deck and other moving parts. Keep bystanders away.
- Do not overspeed the engine by changing the engine governor setting. To ensure safety and accuracy, check the maximum engine speed with a phototac.
- Shut off the engine before checking or adding oil to the engine crankcase.
- Disconnect the battery before servicing the machine. Disconnect the battery negative cable and then the positive cable. If battery voltage is necessary for troubleshooting or test procedures, temporarily connect the battery. Connect the positive battery cable and then the negative cable.
- Battery acid is poisonous and can cause burns. Avoid acid contact with skin, eyes, and clothing. Protect your face, eyes, and clothing when working with a battery.
- Battery gases can explode. Keep cigarettes, sparks, and flames away from the battery.
- When changing the attachments, tires, or performing other service, use correct blocks, hoists, and jacks to raise and support the machine. Ensure that the machine is parked on a solid level surface, such as a concrete floor. Before you lift the machine, remove all the attachments that may interfere with the safe and correct lift of the machine. Always block the wheels with chocks. Use appropriate jack stands to support the raised machine. Failing to properly support the machine with appropriate jack stands can cause the machine to move or fall and can result in personal injury; refer to Jacking Instructions (page 1–7).
- If major repairs are necessary, contact your Authorized Toro Distributor.

Maintenance and Service (continued)

- If welding on the machine is necessary, disconnect the battery negative cable to prevent electrical system damage.
- Ensure to dispose of potentially harmful waste (e.g., fuel, oil, engine coolant, filters, battery) in an environmentally safe manner. Follow all local codes and regulations when recycling or disposing of waste.
- At the time of manufacture, the machine conformed to the safety standards for riding mowers. To ensure the optimum performance and continued safety certification of the machine, use genuine Toro replacement parts and accessories. The replacement parts and accessories of other manufacturers can result in non-conformance with the safety standards and can void the warranty.

Jacking Instructions

⚠ CAUTION ⚠

Failing to properly support the machine with appropriate jack stands can cause the machine to move or fall and can result in personal injury.

When changing the attachments, tires, or performing other services, do the following steps:

- **Use correct blocks, hoists, and jacks to raise and support the machine.**
- **Park the machine on a solid level surface, such as a concrete floor.**
- **Before you lift the machine, remove all the attachments that may interfere with the safe and correct lift of the machine.**
- **Always block the wheels with chocks.**
- **Use appropriate jack stands to support the raised machine.**
- **Do not use the cutting deck as a jacking point.**

Raising the Front of the Machine

1. Set the parking brake and block the 2 rear wheels with chocks to prevent the machine from moving.

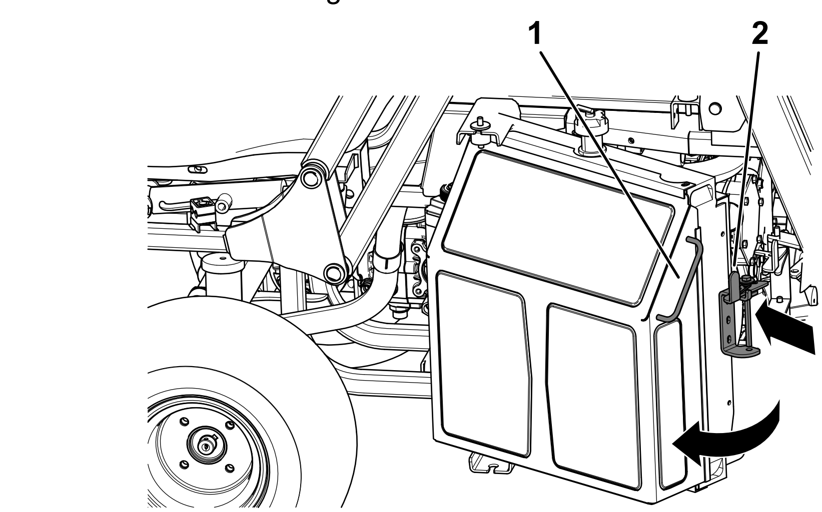

Figure 1

1. Handle
2. Latch

2. Access right side of the engine as follows:

   A. Push the latch on the radiator inward toward the radiator (Figure 1).

   B. Using the handle on the side of the radiator, rotate the radiator to access right side of the engine (Figure 1).

Raising the Front of the Machine (continued)

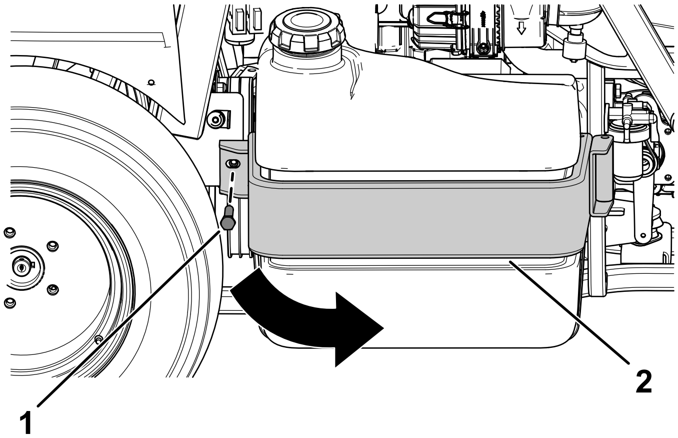

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Figure 2

1. Bolt
2. Fuel-tank bracket

3. Access left side of the engine as follows:
   A. Remove the bolt from the left side of the fuel-tank bracket (Figure 2).
   B. Rotate the fuel tank to access the left side of the engine (Figure 2).

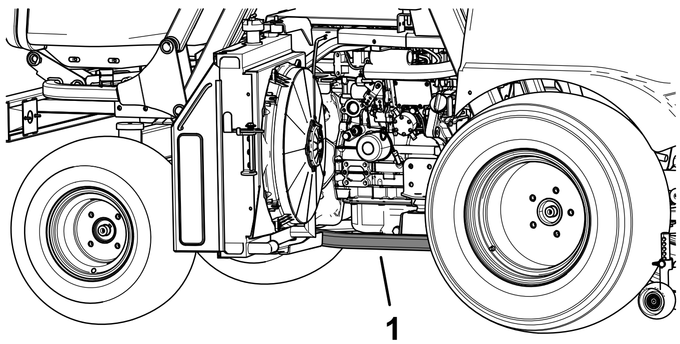

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Figure 3

1. Frame tube on the right side of the machine

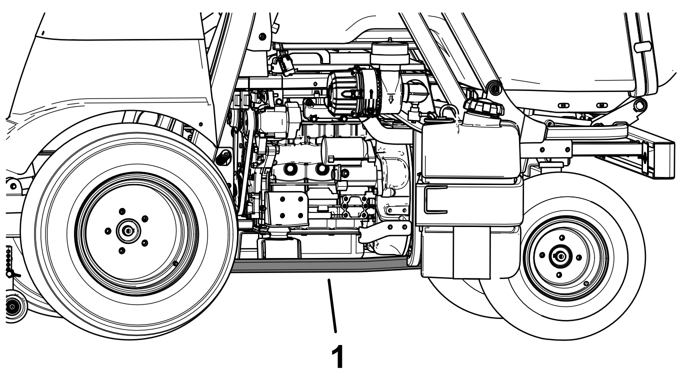

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Figure 4

1. Frame tube on the left side of the machine

4. Position the jack securely under the frame tube directly under the ROPS tube or as close as possible (Figure 3 and Figure 4).

Raising the Rear of the Machine

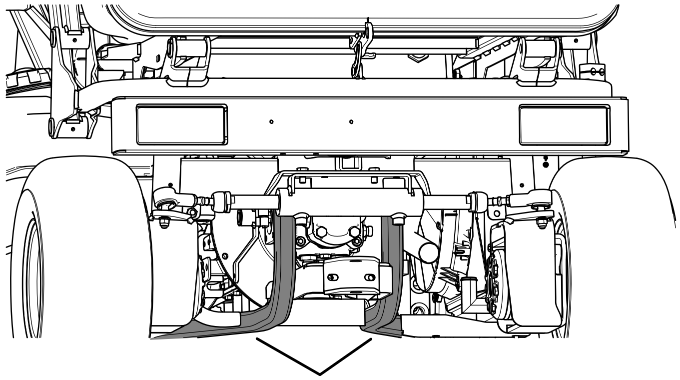

Figure 5

1. Rear jacking points

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1. Set the parking brake and block the 2 front wheels with chocks to prevent the machine from moving.
2. Position the jack securely under the frame (Figure 5).

Safety and Instructional Decals

Numerous safety and instruction decals are affixed to the traction unit and cutting deck of your ProLine H800. 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

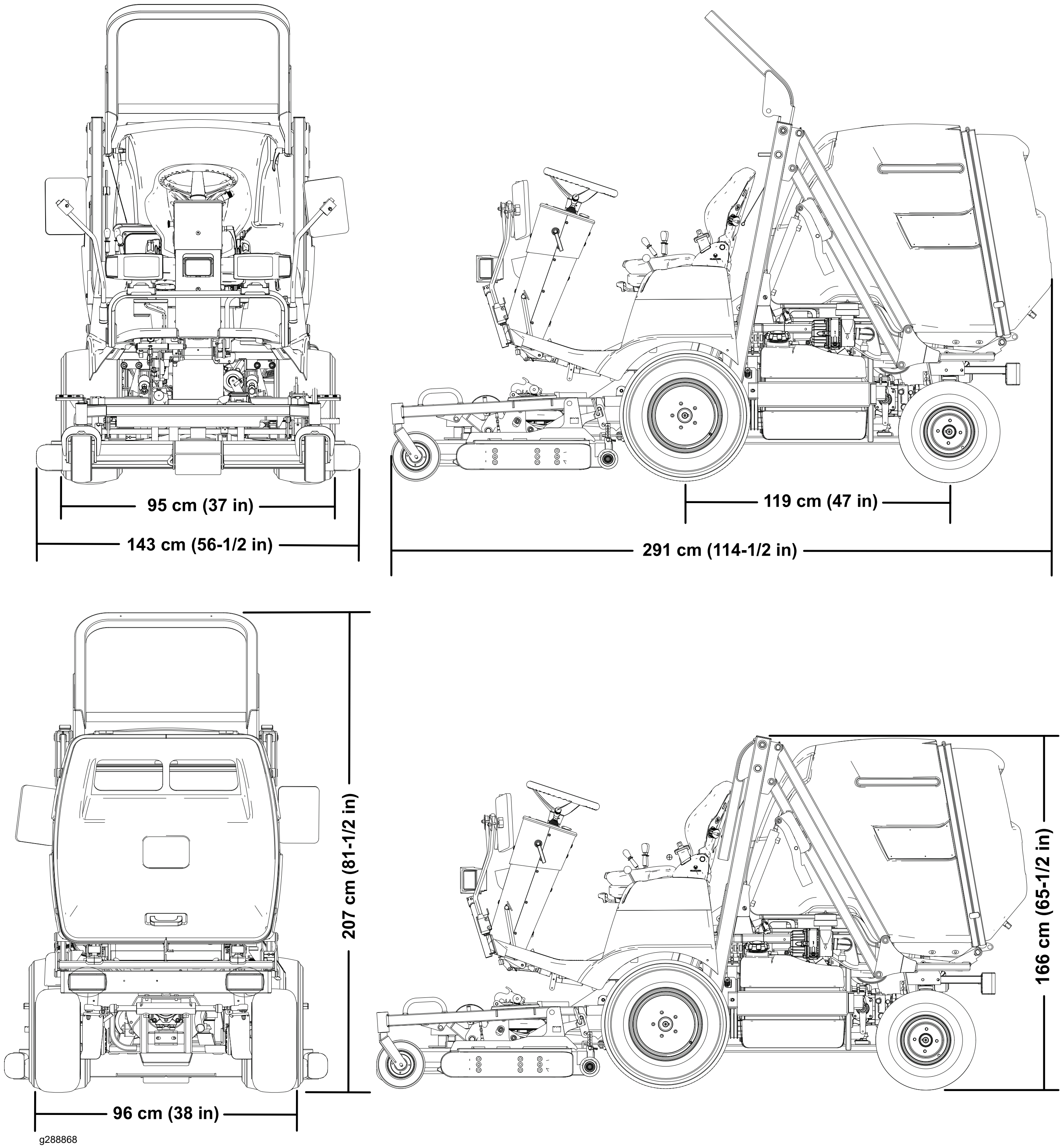

Figure 6

Engine - ProLine H800 (for Model 31050)

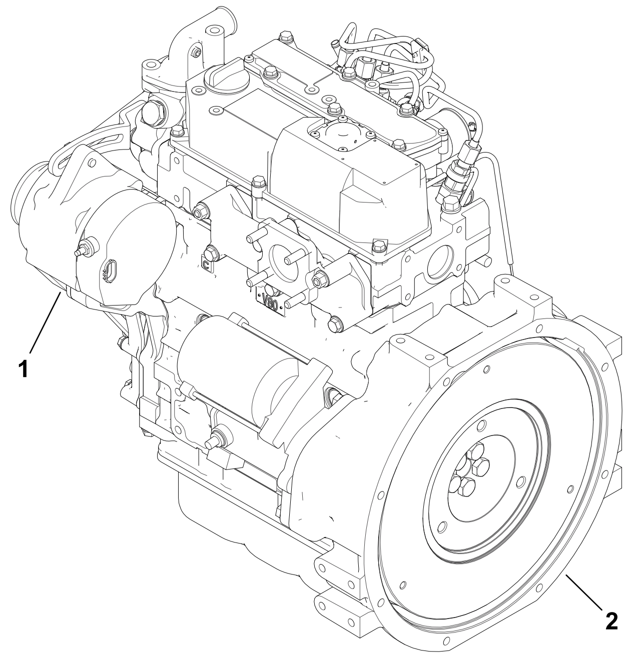

Figure 7
(Yanmar 3TNV80F - Shown)

1. Alternator
2. Flywheel

Item	Description
Make/Designation	Yanmar 3TNV76-XGZ: 4-cycle, 3 cylinder water cooled diesel. EPA Tier 3 compliant.
Bore	76 mm (3 inches)
Stroke	82 mm (3.2 inches)
Total displacement	1,116 cm^3 (68.1 in^3)
Fuel	Diesel or Biodiesel fuel (up to B7)
Fuel tank capacity	41 L (10.8 US gallons)
Fuel injection pump	Yanmar Supply Pump
Governor	Centrifugal-all speed governor
Low idle (no load)	1,000 rpm
High idle (no load)	3,210 rpm
Engine oil	API CJ-4 or higher; refer to the *Operator's Manual* for additional engine oil information
Engine-oil viscosity	Refer to the *Operator's Manual*
Crankcase-oil capacity	3.4 L (3.6 qt)
Oil pump	Gear driven trochoid type
Coolant capacity	7.5 L (8 qt)
Alternator	12 VDC, 55 A
Engine weight (dry)	112 kg (247 lb)

Engine - ProLine H800 (for Model 31050TE and 31051)

Item	Description
Make/Designation	Yanmar 3TNV80-NXDGZ: 4-cycle, 3 cylinder water cooled diesel. EPA Tier 4 compliant.
Bore	80 mm (3.15 inches)
Stroke	84 mm (3.31 inches)
Total displacement	1,267 cm^3 (77.31 in^3)
Firing order	1 (flywheel end) - 3 (fan end) - 2
Compression Ratio	19:1
Fuel	Diesel or Biodiesel fuel (up to B7)
Fuel tank capacity	41 L (10.8 US gallons)
Fuel injection pump	Yanmar Supply Pump
Fuel injector nozzle	Throttle type
Governor	Centrifugal-all speed governor
Low idle (no load)	1,500 to 1,650 rpm
High idle (no load)	3,100 to 3,250 rpm
Engine oil	API CJ-4 or higher; refer to the *Operator's Manual* for additional engine oil information
Engine-oil viscosity	Refer to the *Operator's Manual*
Crankcase-oil capacity	3.4 L (3.6 qt)
Oil pump	Gear driven trochoid type
Coolant capacity	7.5 L (8 qt)
Alternator/Regulator	12 VDC, 40 A
Engine weight (dry)	135 kg (298 lb)

Hydraulic System

Item	Description
Piston Pump	Danfoss DDC20
Displacement (per revolution)	20 cm^3 (1.22 in^3)
Relief Pressure	280 bar (4060 psi)
Charge Pressure	7 bar (101.5 psi)
Front Wheel Motors	Parker TL
Displacement (per revolution)	238 cm^3 (14.5 in^3)
Rear Wheel Motors	Parker TL
Displacement (per revolution)	169 cm^3 (10.3 in^3)
Steering Control Valve	Ognibene (Italian)
Relief Pressure	120 bar (1740 psi)
Lift/Lower Circuit Relief Pressure	120 bar (1740 psi)
Hydraulic Tank	5 L (5.3 qt)
Hydraulic Oil	See *Operator's Manual*

Chassis

Item	Description
Blades screws torque	50 N·m (37 ft-lb)
Blades disc torque	53 N·m (40 ft-lb)
Electro-magnetic clutch mid-screw torque	50 N·m (37 ft-lb)
Wheels bolts torque	85 N·m (63 ft-lb)
Engine-hydrostat bolt troque	350 N·m (258 ft-lb)

Torque Specifications

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

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

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

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

Identifying the Fastener

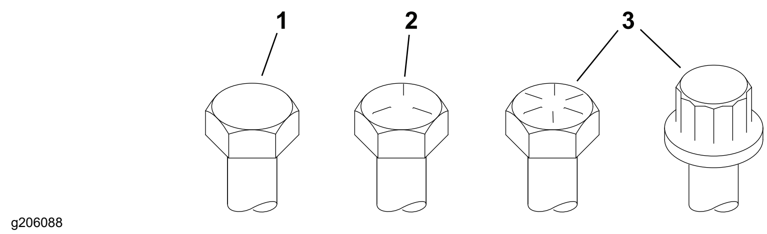

Figure 8

Inch Series Bolts and Screws

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

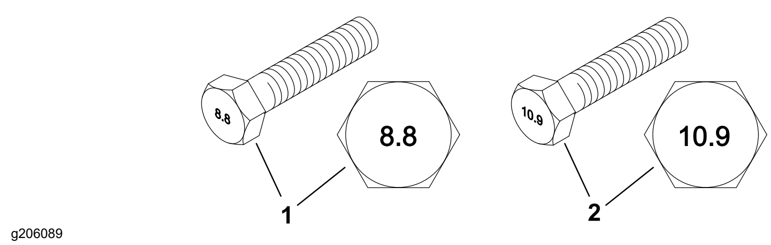

Figure 9

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*.

Calculating the Torque Values When Using a Drive-Adapter Wrench

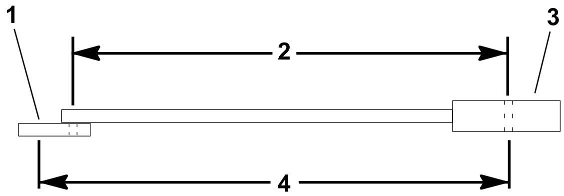

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Figure 10

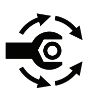
1. Drive-adapter wrench
2. Effective length of torque wrench
3. Torque wrench
4. Effective length of torque wrench + drive-adapter wrench

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 10) 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)**.

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

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

N·cm X 0.08851 = in-lb

ft-lb X 1.3558 = N·m

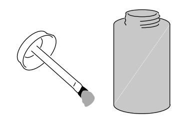
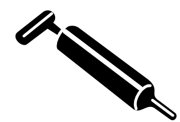
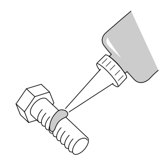
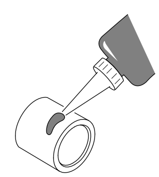
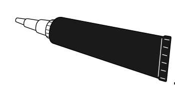
N·m X 0.7376 = ft-lb

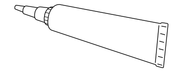
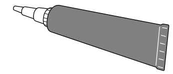
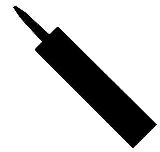
Shop Supplies

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 before assembly, ease installation of components during assembly, or fill cavities between moving parts through grease fittings after assembly. Unless otherwise noted, refer to the machine *Operator's Manual* or *Installation Instructions* for grease specifications.	
Thread locking compound (Threadlocker) 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 before 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, mouldings, 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 before 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 -51°F to 232°C (-60°F to 400°F), while high temperature variants can preform in temperatures up to 343°C (650°F).	

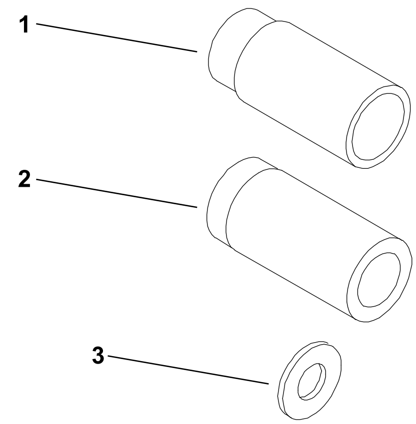
Special Tools

You can order these special tools from your Toro Distributor. Some tools may also be available from a local tool supplier.

Hydraulic Pressure Testing Kit

K-Line Part No. TOR47009

Use this kit to take various pressure readings for diagnostic tests. Quick disconnect fittings are provided to attach directly to the mating fittings on the machine test ports without the tools. A high-pressure hose is given for remote readings. Contains 1 each: 6,900 kPa (1,000 psi), 34,500 kPa (5,000 psi), and 69,000 kPa (10,000 psi) gauges.



57 LPM (15 GPM) Hydraulic Tester Kit

K-Line Part No. TOR214678

Use this tester to test the hydraulic circuits and components for flow and pressure capacities. The tester flow measurement maximum is 57 LPM (15 GPM). This tester includes the following:

Inlet Hose – This hose connects the system circuit to the inlet side of the hydraulic tester.

Load Valve – Turn the valve to restrict the flow to create a simulated working load in the circuit.

Pressure Gauge – A glycerine filled pressure gauge 0 to 34,500 kPa (0 to 5,000 psi) to provide operating circuit pressure.

Flow Meter – This meter measures the actual fluid flow in the operating circuit with a gauge rated at 5 to 55 LPM (1 to 15 GPM).

Outlet Hose – A hose from the outlet side of the hydraulic tester that connects to the hydraulic system circuit.

Fittings – An assortment of hydraulic fittings are included with this kit.

150 LPM (40 GPM) Hydraulic Tester

K-Line Part No. AT40002

Use this tester to test the hydraulic circuits and components for flow and pressure capacities. The tester flow measurement maximum is 151 LPM (40 GPM). This tester includes the following:

Load Valve – Turn the valve to restrict the flow to create a simulated working load in the circuit.

Pressure Gauge – A glycerine filled pressure gauge 0 to 34,500 kPa (0 to 5,000 psi) to provide operating circuit pressure.

Flow Meter – This meter measures the actual fluid flow in the operating circuit with a gauge rated at 20 to 150 LPM (4 to 40 GPM).

Note: This tester does not include any hydraulic hoses or fittings; refer to Hydraulic Hose Kit Toro Part No. TOR6007 and Hydraulic Test Fitting Kit Tor Part No. TOR4079.

Hydraulic O-Ring Kit

Toro Part No. 117-2727

This kit includes O-rings in a variety of sizes for the face seal and port seal hydraulic connections. To help prevent a hydraulic leak, replace the O-rings when you open the hydraulic connection.

Hydraulic Hose Kit

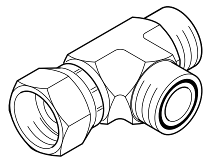
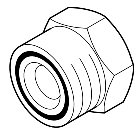
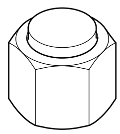
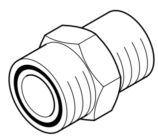
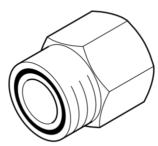
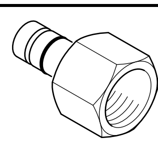
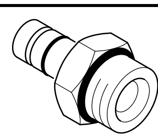
K-Line Part No. TOR6007

This kit includes the fittings and hoses that are used to connect high flow hydraulic filter kit (TOR6011) to the machine hydraulic traction system components.

Hydraulic Test Fitting Kit

K-Line Part No. TOR4079

This kit includes a variety of O-ring face seal fittings to let you connect the test gauges into the system.

FITTING TYPE	SIZE	K-Line Part Number
 SWIVEL NUT RUN TEE (2 each)	4 ORFS (9/16–18) 6 ORFS (11/16–16) 8 ORFS (13–16–16) 10 ORFS (1–14)	TOR4079–3 TOR4079–12 TOR4079–4 TOR4079–5
 PLUG (2 each)	4 ORFS (9/16–18) 6 ORFS (11/16–16) 8 ORFS (13–16–16) 10 ORFS (1–14)	TOR4079–13 TOR4079–14 TOR4079–15 TOR4079–16
 CAP (2 each)	4 ORFS (9/16–18) 6 ORFS (11/16–16) 8 ORFS (13–16–16) 10 ORFS (1–14)	TOR4079–17 TOR4079–18 TOR4079–19 TOR4079–20
 UNION (1 each)	6 ORFS (11/16–16) to 8 SAE-ORB (3/4–16) 8 ORFS (13–16–16) to 8 SAE-ORB (3/4–16) 10 ORFS (1–14) to 8 SAE-ORB (3/4–16)	TOR4079–8 TOR4079–9 TOR4079–2
 REDUCER (1 each)	10 ORFS (1–14) to 8 SAE-ORB (3/4–16) 12 ORFS (1 3/16–12) to 8 SAE-ORB (3/4–16)	TOR4079–7 TOR4079–6
 TEST CONNECTOR – FEMALE THREAD (2 each)	4 ORFS (9/16–18) 6 ORFS (11/16–16) 8 ORFS (13/16–16) 10 ORFS (1–14)	TOR4079–10 TOR4079–11 TOR4079–21 TOR4079–1
 TEST CONNECTOR – MALE THREAD (2 each)	4 SAE-ORB (7/16–20) 1/8 NPTF	TOR4079–22 TOR4079–23

High Flow Hydraulic Filter Kit

K-Line Part No: TOR6011

The high flow hydraulic filter kit is designed with large flow (150 LPM or 40 GPM) and high pressure (34,500 kPa or 5,000 psi) capabilities. This kit provides for bi-directional filtration which prevents filtered unwanted material from entering into the circuit regardless of the flow direction.

If a component failure occurs in the closed loop traction circuit, contamination from the damaged part will remain in the circuit until you remove it. Install a high flow hydraulic-fluid filter into the circuit when you connect the hydraulic test gauges in order to test the traction circuit components or after you replace a failed traction circuit component (e.g., piston pump or wheel motor). This filter removes contamination from the hydraulic fluid in the traction circuit, thereby preventing additional component damage.

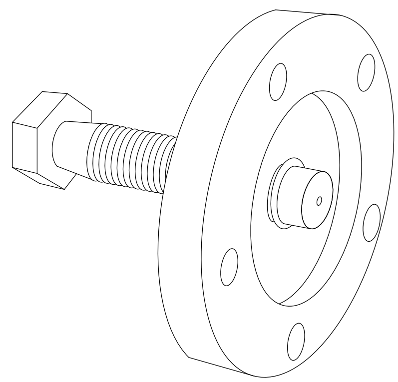
Note: This kit does not include the hydraulic hoses; refer to Hydraulic Hose Kit (page 2–16).

Note: The replacement filter element is Toro Part No. TOR6012. The filter element canister tightening torque is **34 N·m (25 ft-lb)**.

Wheel Hub Puller

K-Line Part No: TOR6004

The wheel hub puller allows you to safely remove the wheel hub from the wheel motor shaft.



Note: The replacement filter element is Toro Part No. TOR6012. The filter element canister tightening torque is **34 N·m (25 ft-lb)**.

Remote Starter Switch

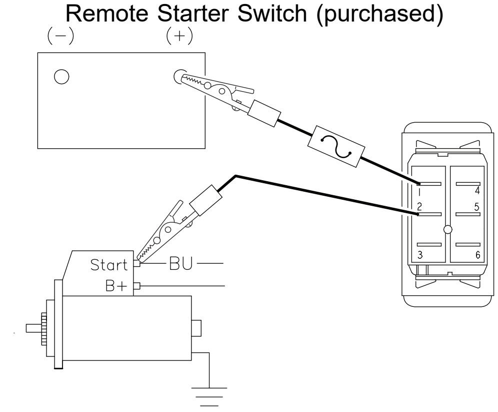
After flushing the hydraulic system or replacing a hydraulic component (e.g. gear pump, piston pump, drive motor), it is necessary to prime the hydraulic pumps. A remote starter switch can be used for this purpose. A remote starter switch can be purchased locally or fabricated as follows:

IMPORTANT: When using a remote starter switch, it is highly recommended to include a 20 amp in−line fuse between the battery and switch connector for circuit protection.

A remote stater switch can also be constructed using Toro switch #106−2027, a length of 14 gauge wire, a 20 amp in−line fuse, two (2) alligator clips and necessary connectors. Connecting the wire to switch terminals 1 and 2 will allow the momentary switch contacts to be used for the remote starter switch.

Note: For information on using the remote starter switch to prime the hydraulic pumps.

Remote Starter Switch (purchased)



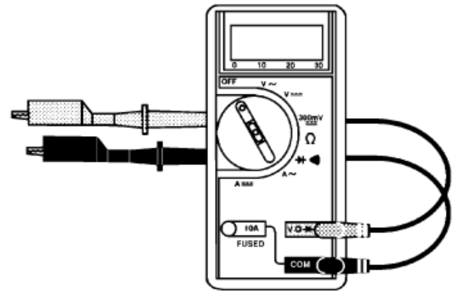
Remote Starter Switch (fabricated)

Multimeter

Obtain this tool locally

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

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



Battery Terminal Protector

Toro Part No. 107-0392

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

Battery Hydrometer

Use the battery hydrometer when measuring the specific gravity of the battery electrolyte. You can get this tool locally.

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.

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

General Hydraulic System Problems

Problem	Possible Cause	Corrective Action
Hydraulic fluid is leaking from the system.	The fitting(s), hose(s), or tube(s) are loose or damaged.	Secure or replace loose or damaged hydraulic connections.
	The O-ring(s) or seal(s) are missing or damaged.	Install a new O-ring(s) or seal(s).
The hydraulic fluid foams excessively causing fluid leakage from the hydraulic tank breather.	The hydraulic fluid level in the hydraulic tank is low.	Adjust the hydraulic fluid level.
	The hydraulic system has a wrong type of fluid. **Note:** Refer to the traction unit Operator's Manual for hydraulic fluid specifications.	Replace the hydraulic fluid.
	The incompatible hydraulic fluids are mixed in the system.	Replace the hydraulic fluid.
	There is water in the hydraulic system.	Replace the hydraulic fluid.
	The pump suction line has an air leak.	Replace the pump suction line.
The hydraulic system operates hot.	The traction system pressure is high due to load.	Check and adjust the load.
	The hydraulic fluid level in the tank is low.	Adjust the hydraulic fluid level.
	The hydraulic fluid is contaminated or the fluid viscosity is too light.	Replace the hydraulic fluid.
	The oil cooler is damaged or plugged.	Repair or replace the hydraulic fluid cooler.
	The oil cooler air flow is obstructed.	Verify cooling fan operation and remove debris from in and around the fluid cooler.
	The oil filter is plugged.	Replace the oil filter.
	The hydraulic pump bypass valve is open or damaged.	Close or replace the traction pump bypass valve(s).
	The hydrostat/hydraulic pump check valve is not seating or is damaged.	Check and replace the check valve.
	The charge pressure is low.	Verify the charge pressure.
	The hydrostat/hydraulic pump is worn or damaged.	Verify the traction pump operation and replace if necessary.
	Engine RPM is too low.	Increase the engine RPM.

General Hydraulic System Problems (continued)

Problem	Possible Cause	Corrective Action
The traction response is sluggish.	The hydraulic fluid is very cold.	Allow the hydraulic fluid to warm by safely operating the machine at rest.
	The hydraulic fluid level in the hydraulic tank is low.	Adjust the hydraulic fluid level.
	The traction pump bypass valve is open or damaged.	Close or replace the traction pump bypass valve(s).
	Engine RPM is too low.	Increase the engine RPM.
	The brakes are dragging or binding.	Check and replace the brake pads.
	The hydrostat/hydraulic pump check valve is not seating or is damaged.	Check and replace the check valve.
	The charge pressure is low.	Verify the charge pressure.
	The hydrostat/hydraulic pump is worn or damaged.	Verify the traction pump operation and replace if necessary.
Traction jerky when starting.	The traction control linkage is incorrectly adjusted, disconnected, binding or damaged.	Check an adjust the traction control linkage.
	The hydrostat/hydraulic pump check valve is not seating or is damaged.	Check and replace the check valve.
Neutral is difficult to find or unit operates in one direction only.	The traction control linkage is incorrectly adjusted, disconnected, binding or damaged.	Check an adjust the traction control linkage.
	The hydrostat/hydraulic pump check valve is not seating or is damaged.	Check and replace the check valve.
	The hydrostat/hydraulic pump is worn or damaged.	Verify the traction pump operation and replace if necessary.
No traction exists in either direction and the engine speed remains constant.	The brakes are dragging or binding.	Check and replace the brake pads.
	The hydraulic fluid level in the hydraulic tank is low.	Adjust the hydraulic fluid level.
	The hydrostat/hydraulic pump check valve is not seating or is damaged.	Check and replace the check valve.
	The traction pump bypass valve is open or damaged.	Close or replace the traction pump bypass valve(s).
	The charge pressure is low.	Verify the charge pressure.
	The hydrostat/hydraulic pump is worn or damaged.	Verify the traction pump operation and replace if necessary.
	The hydrostat/hydraulic pump driveshaft or key damaged.	Check and repair the hydraulic pump.
The differential lock will not engage.	An electrical problem exists in the solenoid valve circuit.	Test and replace the valve solenoid if necessary.
	Solenoid valve in the differential valve is leaking or faulty.	Clean the solenoid valve and replace the seals. Replace solenoid valve if necessary.

Steering Circuit Problems

Problem	Possible Cause	Corrective Action
The steering is inoperative or sluggish.	Engine RPM is too low.	Increase the engine RPM.
	The hydraulic fluid level in the hydraulic tank is low.	Adjust the hydraulic fluid level.
	The steering components (e.g., tie rods, steering cylinder ends) are worn or binding.	Repair or replace the components.
	The steering cylinder is binding.	Check and clear the binding of the steering cylinder.
	The steering relief valve in the steering control valve is stuck or damaged.	Clean the relief valve and replace the seals.
	The steering cylinder leaks internally.	Repair or replace the steering cylinder.
	The charge pressure is low.	Verify the charge pressure.

The Height Of Cut Circuit Problems

Problem	Possible Cause	Corrective Action
The height of cut will not lift or lift slowly.	Engine RPM is too low.	Increase the engine RPM.
	The hydraulic fluid level in the hydraulic tank is low.	Adjust the hydraulic fluid level.
	The height of cut cylinder is binding.	Check and clear the binding of the height of cut cylinder.
	The height of cut cylinder leaks internally.	Repair or replace the height of cut cylinder.
	Solenoid valve in the height of cut valve is leaking or faulty.	Clean the solenoid valve and replace the seals. Replace solenoid valve if necessary.
	The height of cut control valve is worn or damaged.	Repair or replace the height of cut control valve.
	The charge pressure is low.	Verify the charge pressure.

The Cutting Deck Lift Circuit Problems

Problem	Possible Cause	Corrective Action
The cutting deck lift circuit will not lift or lift slowly.	Engine RPM is too low.	Increase the engine RPM.
	The hydraulic fluid level in the hydraulic tank is low.	Adjust the hydraulic fluid level.
	The cutting deck lift cylinders is binding.	Check and clear the binding of the cutting deck lift cylinder.
	The cutting deck lift cylinders leaks internally.	Repair or replace the cutting deck lift cylinders.
	The cutting deck lift control valve (auxiliary control valve) is worn or damaged.	Repair or replace the cutting deck lift control valve.
	The charge pressure is low.	Verify the charge pressure.

The Hopper Lift Circuit

Problem	Possible Cause	Corrective Action
The hopper will not lift or lift slowly.	Engine RPM is too low.	Increase the engine RPM.
	The hydraulic fluid level in the hydraulic tank is low.	Adjust the hydraulic fluid level.
	The hopper lift cylinders is binding.	Check and clear the binding of the hopper lift cylinder.
	The hopper lift cylinders leaks internally.	Repair or replace the hopper lift cylinders.
	The hopper lift control valve (auxiliary control valve) is worn or damaged.	Repair or replace the hopper lift control valve.
	The charge pressure is low.	Verify the charge pressure.

The Hopper Tilt Circuit

Problem	Possible Cause	Corrective Action
The hopper will not tilt or tilts slowly.	Engine RPM is too low.	Increase the engine RPM.
	The hydraulic fluid level in the hydraulic tank is low.	Adjust the hydraulic fluid level.
	The hopper tilt cylinders is binding.	Check and clear the binding of the hopper tilt cylinder.
	The hopper tilt cylinders leaks internally.	Repair or replace the hopper tilt cylinders.
	The hopper tilt control valve (auxiliary control valve) is worn or damaged.	Repair or replace the hopper tilt control valve.
	The charge pressure is low.	Verify the charge pressure.

Chapter 4

Engine

Table of Contents

Additional Reference Materials

Yanmar 3TNV76 Service Manual
Yanmar 3TNV80F Service Manual

General Information

This chapter gives information about the repair of the Yanmar diesel engines used in the ProLine H800 machine. The general maintenance procedures are described in the *Operator's Manual*. Detailed information on engine troubleshooting, testing, disassembly, and assembly are identified in the *Yanmar 3TNV76 Service Manual* and *Yanmar 3TNV80F Service Manual*.

Additionally, some engine repair procedures are described in this manual. The described adjustments and repairs require tools which are commonly available in many service shops. Special tools are described in the *Yanmar 3TNV76 Service Manual* and *Yanmar 3TNV80F Service Manual*. The use of some specialized test equipment is explained. However, the cost of the test equipment and the specialized nature of some repairs may dictate that the work be done at an engine repair facility.

Service and repair parts for the Yanmar engines are supplied through your Authorized Toro Distributor. If the parts list is not available, provide your distributor with the Toro model and serial number of your machine as well as the Yanmar engine model and serial numbers.

Traction Unit Operator's Manual

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

Yanmar Service Manuals

The ProLine H800 model 31050 is powered by a Yanmar 3TNV76–XGZ (Tier 3 compliant) engine. The ProLine H800 model 31050TE and 31051 is powered by a Yanmar 3TNV80-NXDGZ (Tier 4 compliant) engines.*Yanmar 3TNV76 Service Manual* and *Yanmar 3TNV80F Service Manual* are available for these engines. Ensure that the correct engine manual is used when servicing the engine on your machine.

Service and Repairs

Air Cleaner Assembly

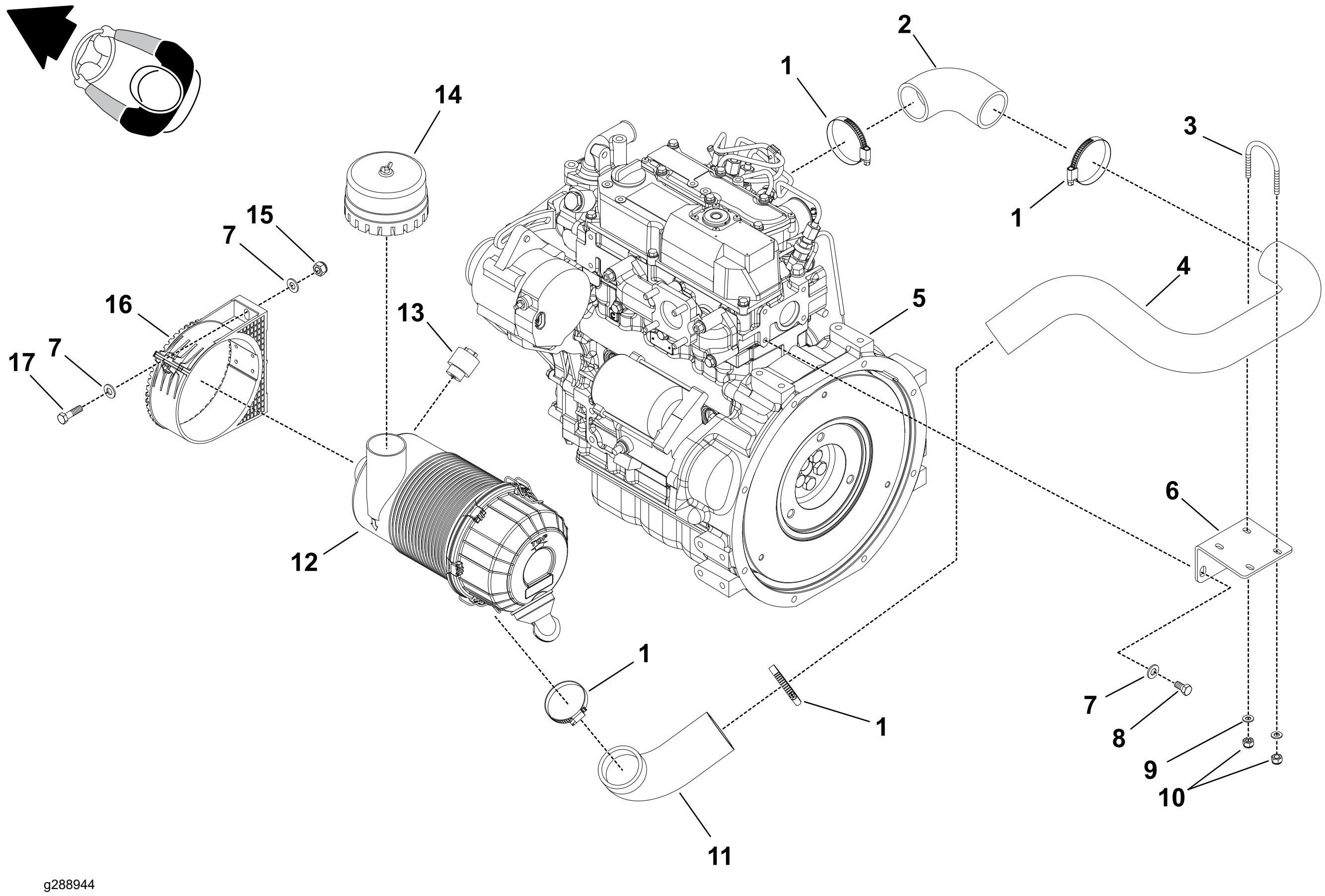


Figure 11

1.	Clamp	7.	Washer	13.	Air cleaner indicator
2.	90º Hose	8.	Bolt	14.	Prefilter
3.	U-Bolt	9.	Washer	15.	Nut
4.	Air cleaner hose	10.	Nut	16.	Clamp
5.	Engine	11.	Hose	17.	Bolt
6.	Bracket	12.	Air cleaner		

Removing the Air Cleaner Assembly

1. Park the machine on a level surface, lower the cutting deck, stop the engine, engage the parking brake and remove the key from the key switch.
2. Raise and lock the hopper assembly; refer to *Operator's Manual*.
3. Get the access to air cleaner components.
4. Remove the air cleaner components as necessary (Figure 11).
5. Refer to *Operator's Manual* for air cleaner service and maintenance procedures.
6. Examine the air cleaner assembly (item 12 in Figure 11) for wear and damage that could cause possible air leaks.
7. Examine the air hoses for wear or damage and replace the hoses if necessary.

Installing the Air Cleaner Assembly

IMPORTANT

Any leaks in the air cleaner system will allow the dirt into the engine and will cause serious engine damage. Ensure that all air cleaner components are in good condition and are properly secured during installation.

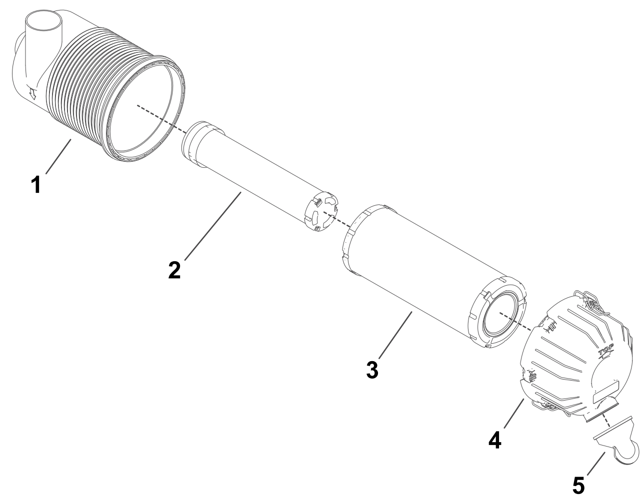


Figure 12

1. Air cleaner body
2. Safety filter
3. Primary filter
4. Air cleaner cover
5. Dust cap

1. Assemble the air cleaner (Figure 12).
   A. Ensure that the dust cap is pointed down after installation.
   B. If the air cleaner indicator was removed from the air cleaner, install the air cleaner indicator onto the air cleaner.
2. After air cleaner has been properly installed, install and secure the engine covers.
3. Unlock and lower the hopper assembly; refer to *Operator's Manual*.

Exhaust System

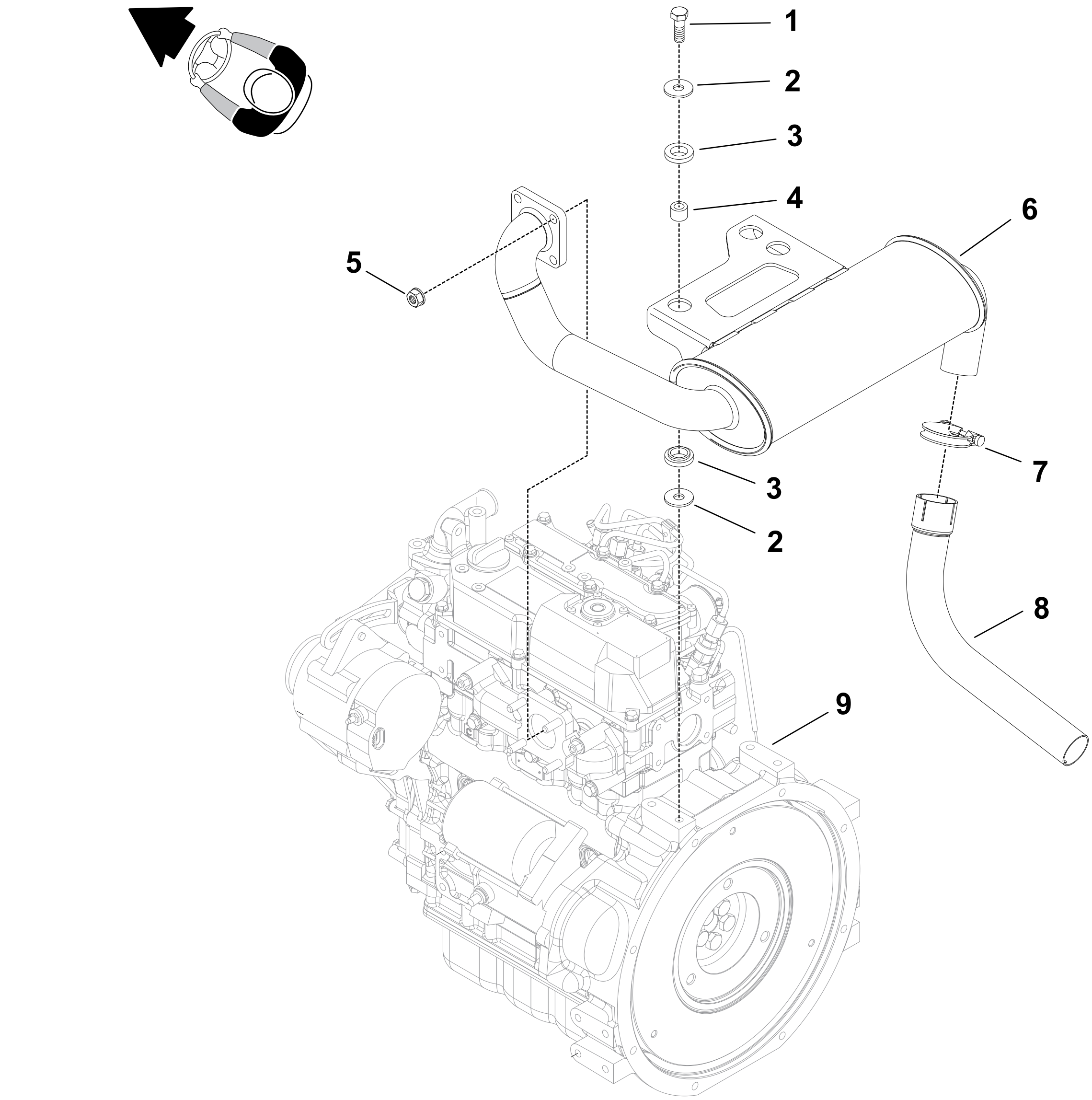


Figure 13

1.	Bolt	4.	Spacer	7.	Clamp
2.	Washer	5.	Nut	8.	Exhaust pipe
3.	Shock absorber	6.	Muffler	9.	Engine

Removing the Exhaust System

CAUTION

A hot engine and exhaust system can cause burns.

Allow the engine and the exhaust system to cool before working on or near them.

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Block the wheels with chocks to prevent the machine from moving.

Removing the Exhaust System (continued)

3. Allow engine and exhaust system to cool before doing any disassembly of exhaust system components. Get the access to exhaust system components.
4. Raise and lock the hopper assembly; refer to *Operator's Manual*.
5. Remove the top engine cover and rear engine cover assemblies (refer to Frame Assembly (page 7–19)) and get access to exhaust pipe.
6. Remove the exhaust pipe as shown in Figure 13.

Installing the Exhaust System

Note: Ensure that all exhaust system flanges and sealing surfaces are free of debris or damage that may prevent a tight seal.

1. Ensure to install new gaskets in place of all gaskets that were removed. Do not use any type of gasket sealant on gasket or flange surfaces.

IMPORTANT

Finger tighten all fasteners before securing the muffler to the engine so there is no preload on the exhaust system.

2. Assemble the exhaust pipe as shown in Figure 13.
3. After exhaust system components are properly installed, install and secure the top engine cover and rear engine cover assemblies (refer to Frame Assembly (page 7–19)).
4. Unlock and lower the hopper assembly; refer to *Operator's Manual*.

Radiator

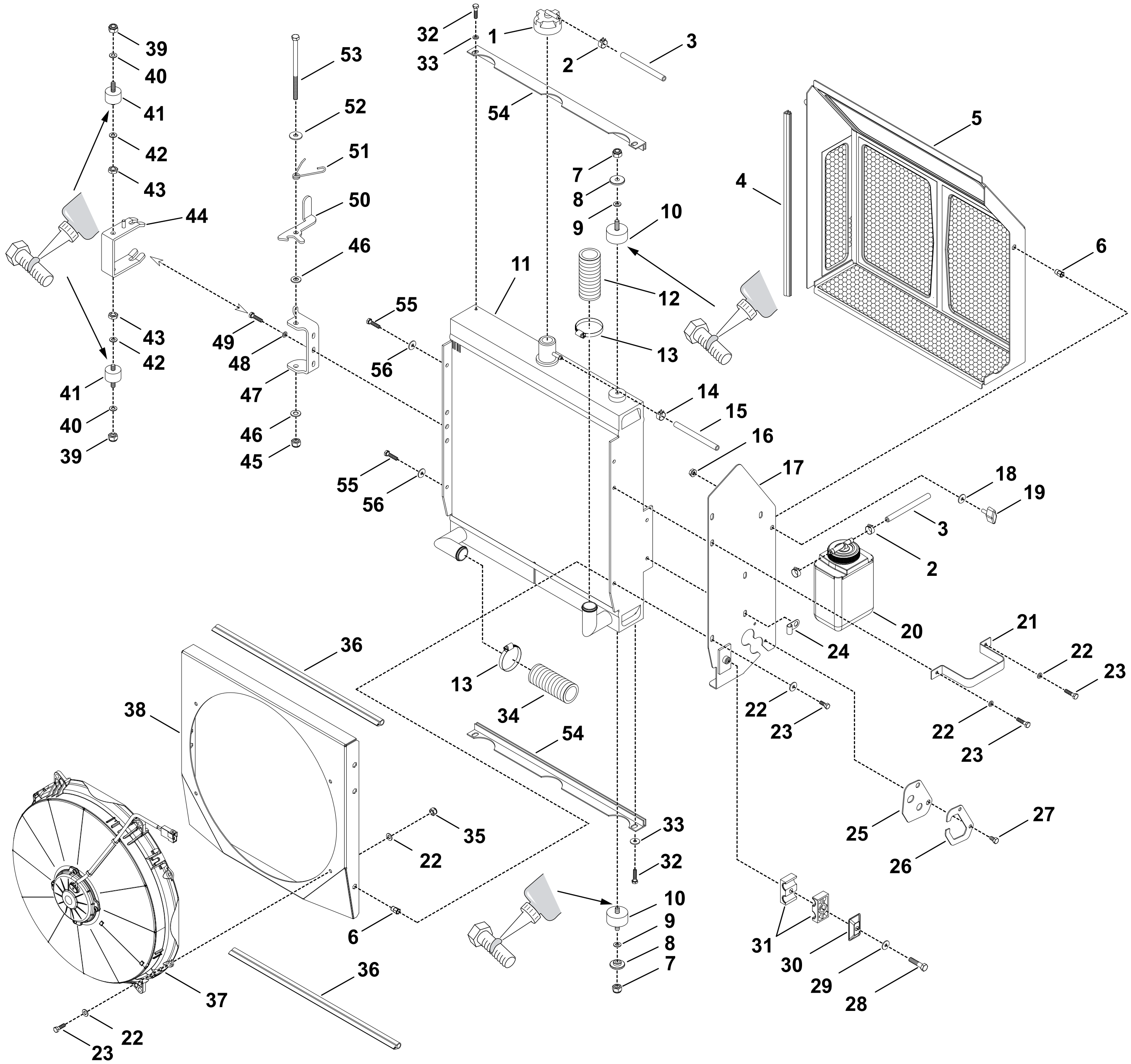


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Figure 14

1.	Cap	15.	Hose	29.	Washer	43.	Nut
2.	Clamp	16.	Nut	30.	Plate	44.	Bracket
3.	Hose	17.	Cable guard	31.	Collar	45.	Nut
4.	Gasket	18.	Washer	32.	Bolt	46.	Washer
5.	Debris screen	19.	Knob	33.	Washer	47.	Bracket
6.	Thread insert	20.	Tank	34.	Hose	48.	Washer
7.	Nut	21.	Clamp	35.	Nut	49.	Bolt
8.	Bushing	22.	Washer	36.	Gasket	50.	Bracket
9.	Washer	23.	Bolt	37.	Blower	51.	Spring
10.	Shock absorber	24.	Grommet	38.	Fan shroud	52.	Washer
11.	Radiator	25.	Gasket	39.	Nut	53.	Bolt
12.	Hose	26.	Frame	40.	Washer	54.	Bracket
13.	Clamp	27.	Bolt	41.	Shock absorber	55.	Bolt
14.	Clamp	28.	Bolt	42.	Washer	56.	Washer

Removing the Radiator

1. Park machine on a level surface, lower cutting deck, shut off the engine, engage parking brake, and remove key from the key switch.
2. Raise and lock the hopper assembly; refer to *Operator's Manual*.

DANGER

If the radiator or engine is hot, pressurized hot coolant can escape and cause burns.

Do not open the radiator cap or drain the radiator when the coolant is hot.

WARNING

Ethylene-glycol antifreeze is poisonous.

Keep the coolant away from children and pets.

Keep the coolant in a labelled container.

Discard the coolant in accordance with local hazardous waste ordinances.

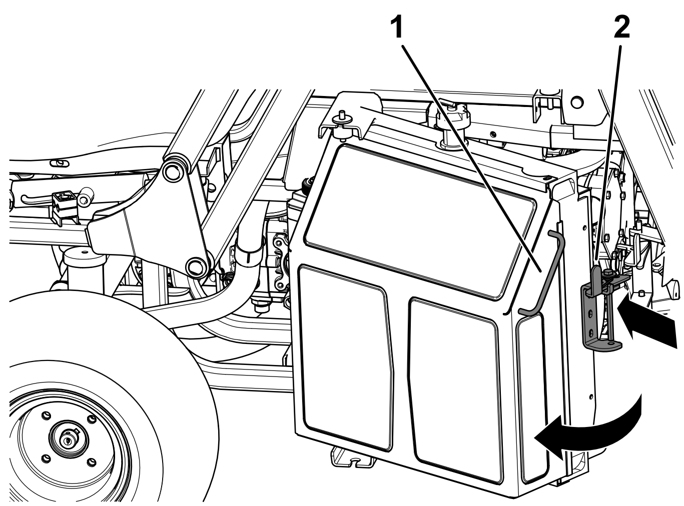

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Figure 15

1. Handle
2. Latch

3. Push the latch on the radiator inward toward the radiator (Figure 15).
4. Using the handle on the side of the radiator, rotate the radiator (Figure 15).
5. Drain coolant from the radiator; refer to the *Operator's Manual*.

IMPORTANT

Follow all local codes and regulations when recycling or disposing engine coolant.

6. Remove the screen from machine; refer to the *Operator's Manual*.

Removing the Radiator (continued)

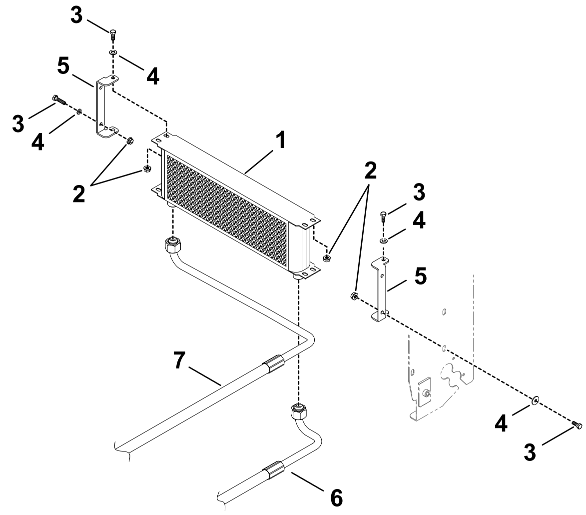

Figure 16

1. Oil cooler
2. Nut
3. Bolt
4. Washer
5. Bracket
6. Hydraulic hose
7. Hydraulic hose

⚠ CAUTION ⚠

Before opening the hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic fluid.

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7. Read the General Precautions for Removing and Installing the Hydraulic System Components (page 5–63).
8. Clean the hydraulic tube ends and oil cooler fittings to prevent hydraulic contamination.
9. Disconnect the hydraulic hoses from the radiator. Position hoses away from the radiator.
10. Cover or plug the hydraulic hoses to prevent contamination.
11. Disconnect the radiator hoses (upper and lower) from the radiator.
12. Loosen the hose clamp and remove overflow hose from the radiator fill opening.
13. Remove coolant reservoir from bracket on the cable guard.
14. Disconnect the electrical power connector of the blower. Remove the 4 nuts and 4 bolts that secures the blower to the radiator.
15. Remove the blower from the radiator.
16. Support the radiator assembly before loosening mounting fasteners.
17. Remove the 2 nuts and 2 bushings that secure the radiator to the radiator support.
18. Carefully pull the radiator assembly from the machine. Plug the radiator and hose opening to prevent contamination.
19. If necessary, disassemble the radiator (Figure 14).

Removing the Radiator (continued)

20. If necessary, separate the oil cooler from the radiator as follows (Figure 16):
    A. Remove the 4 nuts, bolts and washers that attach the oil cooler to the radiator.
    B. Separate the oil cooler from the radiator.
    C. If the hydraulic fittings are to be removed from the oil cooler, mark the fitting orientation for assembly.
    D. Remove the 2 straight fittings from the oil cooler and discard the O-rings from the fittings.
21. Inspect all gaskets on the radiator and radiator frame. Replace any foam seals that are damaged.

Installing the Radiator

1. If disassembled, assemble the radiator (Figure 14).
2. If separated, assemble the oil cooler to the radiator as follows:
    A. If the straight fittings were removed from the oil cooler, lubricate and install the new O-rings onto the fittings. Install the fittings into the oil cooler port openings and tighten the fittings; refer to Installing the Hydraulic Fittings (page 5–10).
    B. Attach the oil cooler to the radiator with 4 bolts, washers and nuts (Figure 16).
3. Remove any plugs installed during the removal procedure.
4. Properly locate the radiator in position and install the 2 mount bushings and nuts.
5. Install the fan assembly to the radiator with the 4 bolts, washers and nuts.
6. Connect the electrical plug to the blower.
7. Apply sealant to the threads, and then connect the hydraulic fittings to the radiator.
8. Install the upper and lower radiator hoses. Secure them with the proper hose clamps.
9. Install coolant reservoir to bracket onto the mount bracket and secure with 2 bolts, washers and nuts.
10. Connect the overflow hose to the radiator filler neck and secure with the hose clamp.
11. Ensure that the radiator drain plug is tight. Fill the radiator with coolant; refer to the *Operator's Manual*.
12. Install the debris screen to the radiator; refer to the *Operator's Manual*.
13. Rotate the radiator and secure it in place with the latch.
14. Check and add the hydraulic fluid as necessary to raise the fluid level to the operating range; refer to the *Operator's Manual*.
15. Unlock and lower the hopper assembly; refer to *Operator's Manual*.
16. Start the engine and check for coolant and hydraulic fluid leaks. Repair any leaks before returning the machine to service.
17. Continue to run the engine to obtain the operating temperature. Check the coolant and hydraulic fluid levels and adjust as necessary.

Fuel System

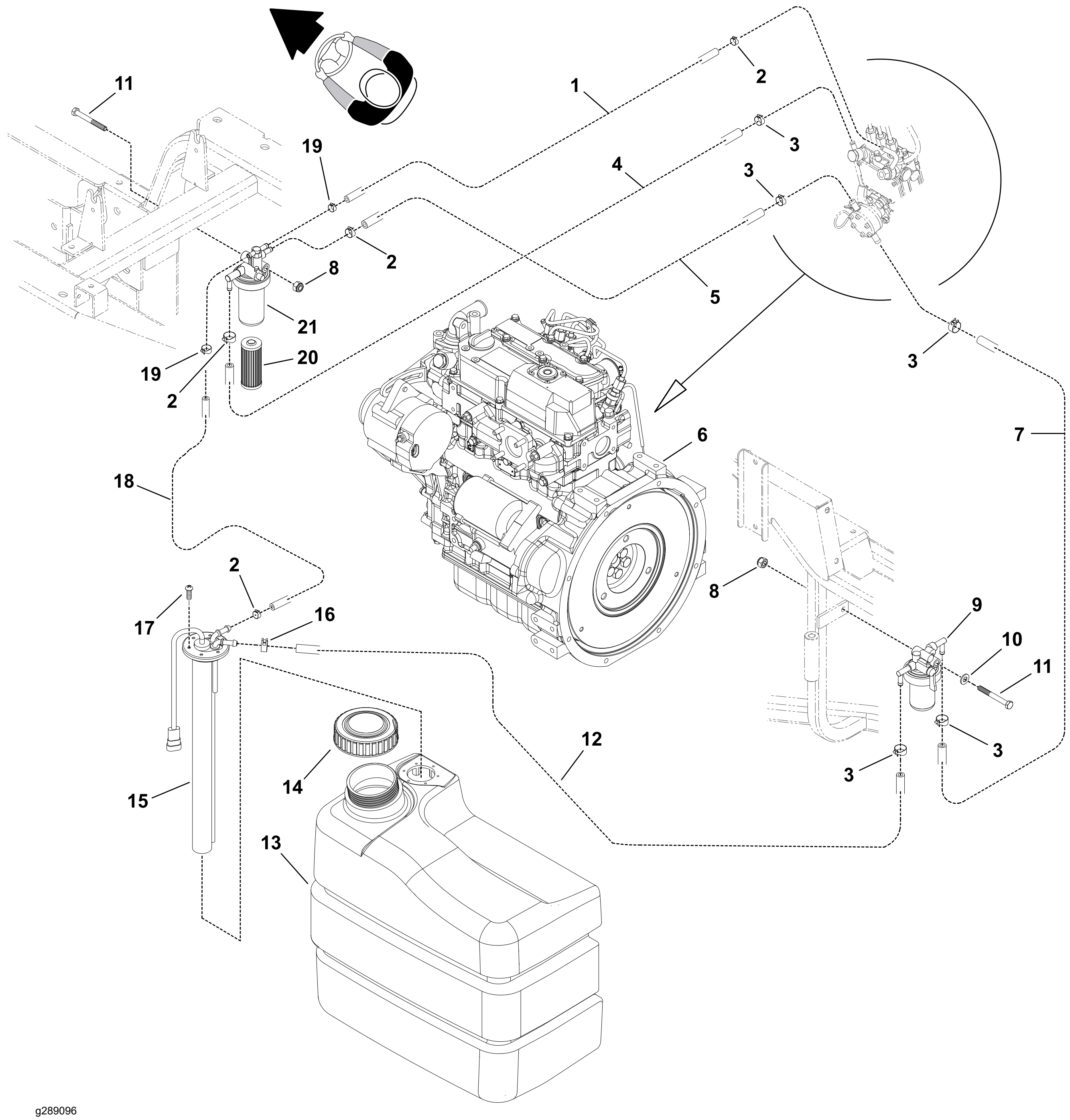

Figure 17

1. Hose
2. Clamp
3. Clamp
4. Hose
5. Hose
6. Engine
7. Hose
8. Nut
9. Water separator assembly
10. Washer
11. Bolt
12. Hose
13. Fuel tank
14. Fuel tank cap
15. Float
16. Clamp
17. Screw
18. Hose
19. Clamp
20. Fuel filter element
21. Fuel filter assembly

DANGER

Diesel fuel is highly flammable and explosive. A fire or a explosion from the fuel can burn you, burn other people, and damage property.

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

Checking the Fuel Lines and Connections

Check the fuel lines and connections at the scheduled maintenance intervals recommended in the *Operator's Manual*. Check the lines for deterioration, damage, leaks or loose connections. Replace the hoses, clamps and fittings as necessary.

Draining and Cleaning the Fuel Tank

Drain and clean the fuel tank at the maintenance intervals recommended in the *Operator's Manual*. If the fuel system becomes dirty or if the machine is stored for an extended period, drain and clean the fuel tank.

To clean the fuel tank, flush the tank out with clean diesel fuel. Ensure that the fuel tank is free of contamination and debris.

Priming the Fuel System

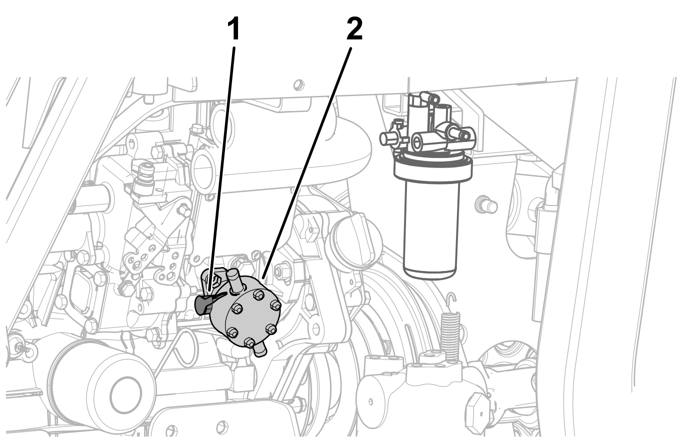

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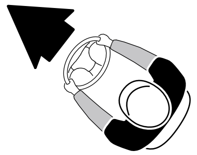
Figure 18

1. Lever
2. Fuel pump

The fuel system needs to be primed before starting the engine for the first time, after running out of fuel, or after fuel system maintenance (e.g., draining the fuel/water separator, replacing the fuel filter or a fuel hose). To prime the fuel system, ensure that the fuel tank has fuel in it.

At the left side of the engine, operate the lever of the fuel pump until you fill the fuel-filter bowl.

Removing the Fuel Tank



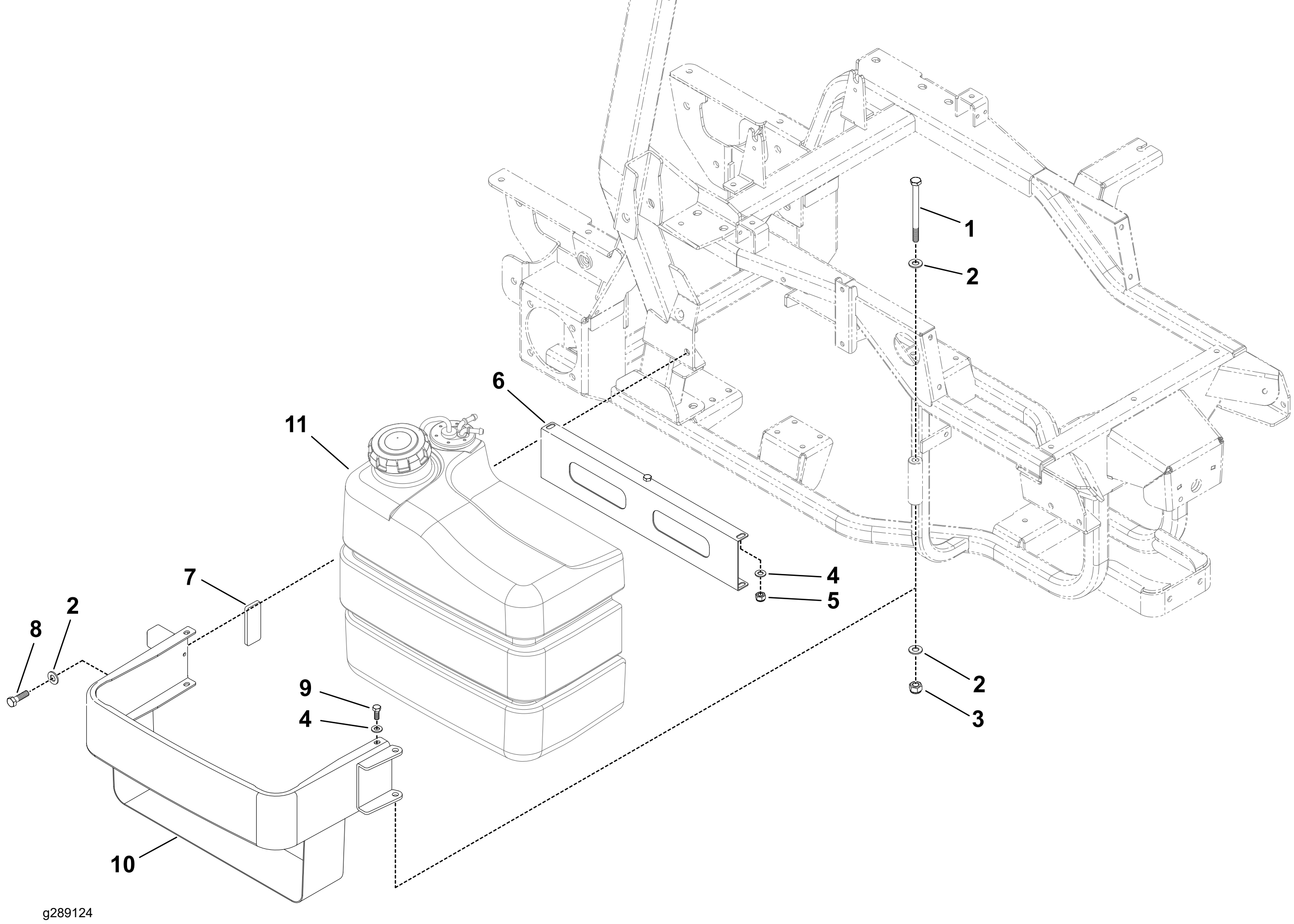


Figure 19

1. Bolt
2. Washer
3. Nut
4. Washer
5. Nut
6. Cross rail
7. Rubber grommet
8. Bolt
9. Bolt
10. Fuel tank support
11. Fuel tank

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Raise and lock the hopper assembly; refer to *Operator's Manual*.
3. Remove the battery negative cable from the negative post of the battery.
4. Allow the engine to completely cool.
5. Unplug the wire harness connections of fuel tank float.
6. Use a fuel transfer pump to remove the fuel from the fuel tank and into a certified fuel storage.
7. Loosen the hose clamps and carefully disconnect the fuel hoses from the fuel tank float on top of the fuel tank.

   Note: Before removing the fuel hoses from the fuel tank, label the hoses for assembly purposes.

Removing the Fuel Tank (continued)

8. Cover or plug the fuel hoses or fitting openings to prevent contamination from entering the fuel system.
9. Remove the fuel tank as shown in Figure 19.

Installing the Fuel Tank

1. Install the fuel tank to the frame as shown in Figure 19.
2. Remove the plugs from the fuel hoses or fitting openings.
3. Connect the fuel hoses to the fuel tank float on top of the fuel tank. Secure the fuel hoses with the hose clamps.
4. Connect the wire harness connectors to the fuel tank float.
5. Connect the battery negative cable to the negative battery post.
6. Fill the fuel tank with clean fuel; refer to the *Operator's Manual*.
7. Prime the fuel system; refer to Priming the Fuel System (page 4–12).
8. Check the fuel hoses and fittings for leaks.

   Note: Repair all fuel leaks before returning the machine to service.
9. Unlock and lower the hopper assembly; refer to *Operator's Manual*.

Engine

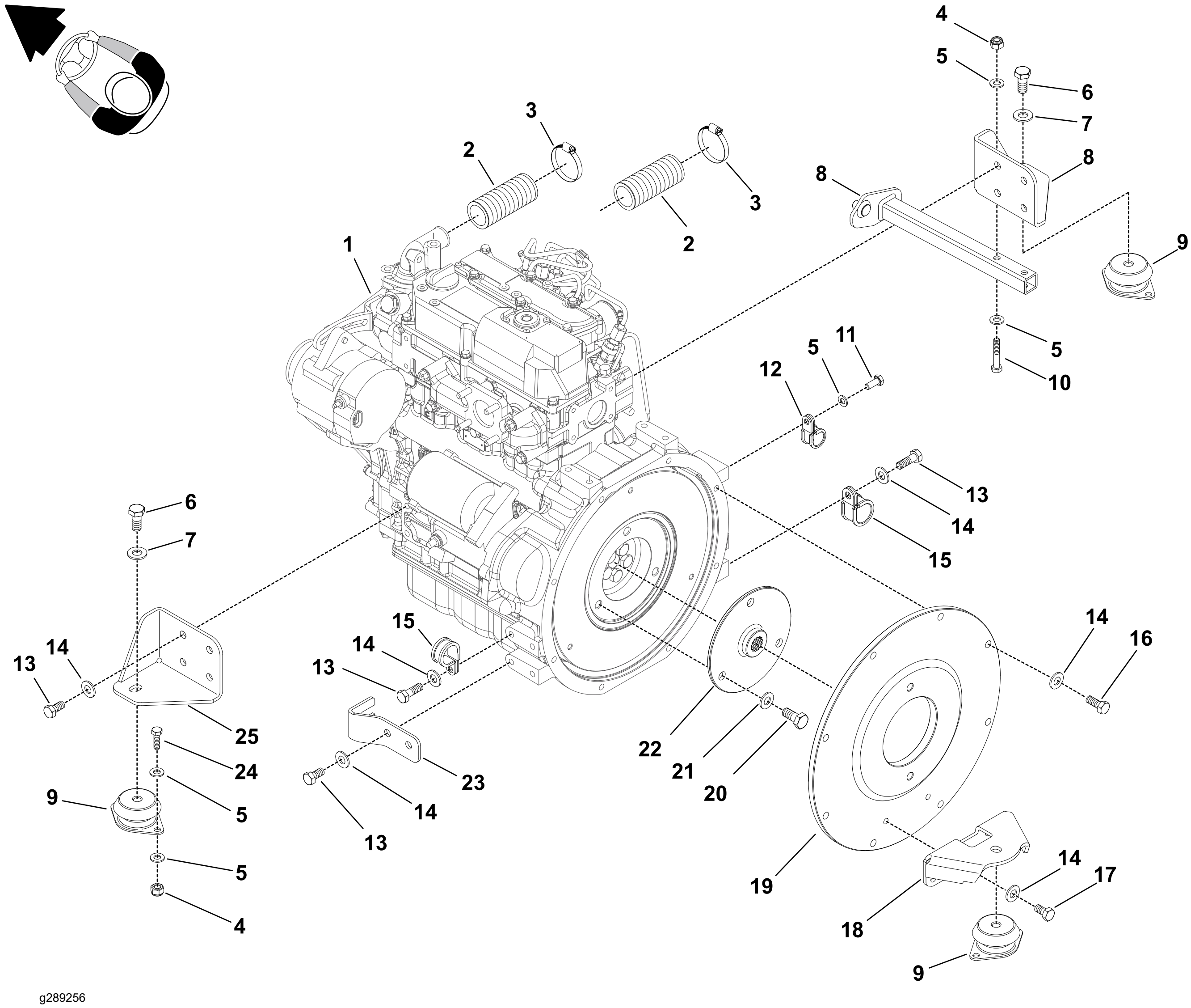


Figure 20

1.	Engine	10.	Bolt	19.	Flange
2.	Hose	11.	Bolt	20.	Bolt
3.	Clamp	12.	Clamp	21.	Washer
4.	Nut	13.	Bolt	22.	Joint
5.	Washer	14.	Washer	23.	Support
6.	Bolt	15.	Clamp	24.	Bolt
7.	Washer	16.	Bolt	25.	Engine support
8.	Engine support	17.	Bolt		
9.	Shock absorber	18.	Engine support		

Removing the Engine

1. Park machine on a level surface, lower cutting deck, stop engine, apply parking brake and remove key from the key switch.
2. Disconnect the battery negative cable from the battery terminal and then disconnect the positive cable from the battery; refer to Servicing the Battery (page 6–51).

Removing the Engine (continued)

3. Remove the hopper assembly from the machine; refer to Removing the Hopper Assembly (page 9–3).
4. Remove the chute assembly from the machine; refer to *Operator's Manual*.

CAUTION

Do not open radiator cap or drain coolant if the radiator or engine is hot. Pressurized, hot coolant can escape and cause burns.

Ethylene−glycol antifreeze is poisonous. Dispose of coolant properly or store it in a properly labeled container away from children and pets.

5. Drain coolant from the radiator into a suitable container. Remove the radiator from the machine (see Removing the Radiator (page 4–8)).

DANGER

Diesel fuel is highly flammable and explosive. A fire or an explosion from the fuel can burn you, burn other people, and damage property.

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

6. Drain the fuel from the fuel tank into a suitable container. Remove the fuel tank from the machine; refer to Removing the Fuel Tank (page 4–13).
7. Remove the engine front, top and rear covers; refer to Frame Assembly (page 7–19).
8. Remove the air cleaner assembly from the engine; refer to Removing the Air Cleaner Assembly (page 4–3).
9. Remove the exhaust pipe from the engine; refer to Removing the Exhaust System (page 4–5).
10. Remove the PTO driveshaft from the machine; refer to Removing the PTO Driveshaft (page 8–18).
11. Remove the electric clutch from the engine; refer to Removing the Electric Clutch (page 8–15).
12. Remove the hydraulic piston pump and gear pump from the engine; refer to Removing the Hydraulic Pump Assembly (page 5–83).

    Note: To prevent damage to the electrical wire harness, numerous cable ties are used to secure the wire harness to the machine components. Record the location of all cable ties that are removed from the machine during the engine removal so that they can be properly replaced during the engine installation.

Removing the Engine (continued)

13. Disconnect the wires and/or electrical connections from the following engine electrical components:
    A. Alternator connector and stud.
    B. Oil pressure switch located near the engine oil filter.
    C. Connector and positive battery cable from the starter motor.
    D. High temperature shut down switch and temperature sender located on the water pump housing.
    E. Fuel stop solenoid on the injector pump.
    F. Battery negative cable from the injector pump.
    G. Glow plug strip.
    H. PTO clutch wire connector.

CAUTION

The engine is very heavy, and a hoist not rated for the weight of the engine may fail, causing possible injury and damage to the engine.

Use hoist equipment rated to lift the engine, which is approximately 135 kg (298 lb).

14. Attach a suitable lift or hoist to lift the engine from the frame. Support the engine with the lift or hoist to prevent the engine from shifting or moving.
15. Remove the fasteners that secure the engine (with brackets) to the engine shock mounts and the engine mount brackets (Figure 20).

CAUTION

Use 1 person to operate the lift or hoist while another person guides the engine from the machine.

IMPORTANT

When removing the engine ensure that you do not damage the engine, fuel hoses, hydraulic lines, electrical harness or other parts.

16. Carefully raise the engine and remove from the machine.
17. If necessary, remove the engine brackets from the engine (Figure 20).

Installing the Engine

IMPORTANT

Ensure that all parts removed from the engine during maintenance or overhaul are correctly installed on the engine.

1. Park the machine on a level surface and remove the key from the key switch. Block the wheels with chocks to prevent the machine from moving.
2. If the engine brackets were removed from the engine, install the brackets to the engine (Figure 20).

CAUTION

The engine is very heavy, and a hoist not rated for the weight of the engine may fail, causing possible injury and damage to the engine.

Use hoist equipment rated to lift the engine, which is approximately 135 kg (298 lb).

3. Attach a suitable lift or hoist to the lift tabs on the front and rear of the engine. Support the engine with lift or hoist to prevent the engine from shifting or moving.

CAUTION

Use 1 person to operate the lift or hoist while the other person guides the engine into the machine.

IMPORTANT

When installing the engine ensure that you do not damage the engine, fuel hoses, hydraulic lines, electrical harness, radiator or other parts.

4. Carefully lower the engine to the machine frame. Ensure that the fastener holes of the engine brackets are aligned with the holes in the engine shock mount.
5. Secure the engine to the engine mount brackets (Figure 20).
6. Install the hydraulic piston pump and gear pump onto the engine; refer to Installing the Hydraulic Pump Assembly (page 5–84).
7. Connect all the wire harness connectors to the following engine components:
   A. Alternator connector and stud.
   B. Oil pressure switch located near the engine oil filter.
   C. Connector and positive battery cable to the starter motor.
   D. High temperature shut down switch and temperature sender located on the water pump housing.
   E. Fuel stop solenoid on the injector pump.
   F. Battery negative cable to the injector pump.
   G. Glow plug strip.

Installing the Engine (continued)

H. PTO clutch wire connector.

8. Using the notes that you recorded during removal, secure the wires with cable ties in proper locations.
9. Install the electric clutch onto the engine; refer to Installing the Electric Clutch (page 8–16).
10. Install the PTO driveshaft onto the machine; refer to Installing the PTO Driveshaft (page 8–19).
11. Install the exhaust pipe onto the engine; refer to Installing the Exhaust System (page 4–6).
12. Install the air cleaner assembly onto the engine; refer to Installing the Air Cleaner Assembly (page 4–4).
13. Install the engine front, top and rear covers; refer to Frame Assembly (page 7–19).
14. Install the radiator onto the machine; refer to Installing the Radiator (page 4–10).
15. Service the cooling system; refer to the *Operator's Manual*.
16. Install the fuel tank onto the machine; refer to Installing the Fuel Tank (page 4–14)).
17. Add fuel to the fuel tank; refer to the *Operator's Manual*.
18. Install the chute assembly onto the machine; refer to *Operator's Manual*.
19. Install the hopper assembly onto the machine; refer to Installing the Hopper Assembly (page 9–4).
20. Connect both the battery cables to the battery. Connect the positive battery cable and then the battery negative cable.
21. Ensure that all the wires, fuel lines, hydraulic hoses, and cables are clear of moving parts and secured to their original locations.
22. Check the engine oil level and adjust as necessary; refer to the *Operator's Manual*.
23. Prime the fuel system; refer to Priming the Fuel System (page 4–12).
24. Start the engine and operate the hydraulic controls to properly fill the hydraulic and engine coolant systems; refer to Charging the Hydraulic System (page 5–72) and refer to proper coolant fill procedure.

Chapter 5

Hydraulic System

Table of Contents

Additional Reference Materials

Danfoss DDC20 Axial Piston Pump Service Manual

Parker Torqmotor Service Procedure (TF, TG, TH, and TL Series)

General Information

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

Checking the Hydraulic Fluid

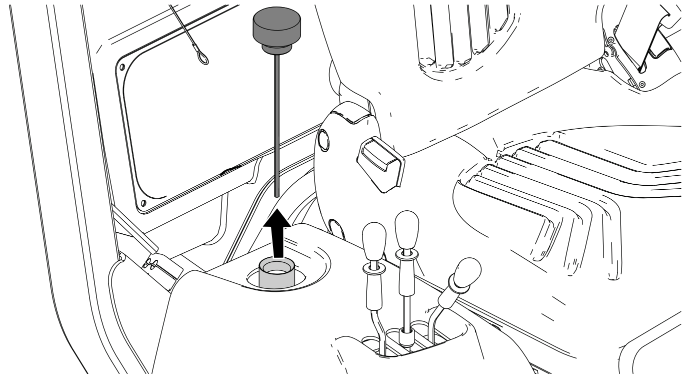


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Figure 21

The hydraulic system on your machine is designed to operate on high quality hydraulic fluid. The hydraulic system tank is located under the right console and holds approximately 5.0 L (5.3 qt) of hydraulic fluid (Figure 21). Refer to the *Operator's Manual* for the procedure on checking the hydraulic-fluid level and hydraulic fluid recommendations.

IMPORTANT

Check the hydraulic-fluid level daily.

Pushing or Towing the Traction Unit

IMPORTANT

If towing limits are exceeded, severe damage to the hydraulic pump may occur.

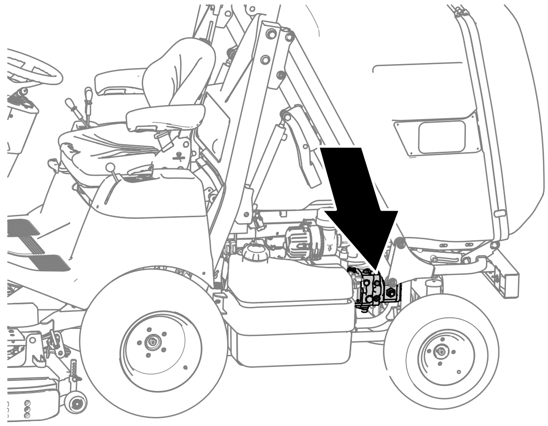

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Figure 22

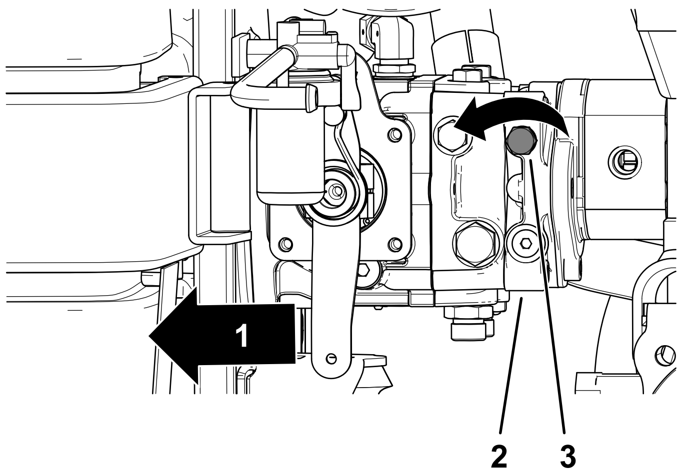

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Figure 23

1. Front of the machine
2. Hydraulic pump
3. Control knob (bypass valve)

If it becomes necessary to tow or push the machine, tow or push at a speed of 3 to 5 km/h (2 to 3 mph), and for a very short distance. If you must move the machine a considerable distance (more than a few feet), transport it on a truck or trailer. Whenever you push or tow the machine, open the bypass valve on the hydraulic pump.

Locate the control knob for the bypass valve at the left side of the hydraulic pump (Figure 22). Using a socket wrench with a 17 mm socket, rotate the control knob 3 turns counterclockwise (Figure 23). Refer to *Operator's Manual* for pushing or towing procedures.

IMPORTANT

Do not rotate the control knob more that 3 turns.

Releasing Pressure from the Hydraulic System

Follow the steps below to release all pressure in the hydraulic system prior to starting any service procedures. There must be no pressure in the hydraulic system.

Releasing the Hydraulic Pressure from the Traction Circuit

Note: If you park the machine on an inclined or sloped surface, the pressure in the traction circuit will not release.

1. Park the machine on a level surface.
2. Lower the cutting deck.
3. Turn the key switch to the OFF position and allow the engine to stop.
4. Move the traction pedal in both the forward and reverse direction for 5 to 10 times.

Releasing the Hydraulic Pressure from the Lift Circuit

1. Turn the key switch to the ON position (do not start the engine) and fully lower the cutting deck to the ground.
2. Turn the key switch to the OFF position.
3. After lowering the cutting deck, ensure that the lift cylinders do not support the cutting deck.

Releasing the Hydraulic Pressure from the Steering Circuit

1. Park the machine on a level surface.
2. Lower the cutting deck.
3. Turn the key switch to the OFF position and allow the engine to stop.
4. After the engine has come to a complete stop, rotate the steering wheel to full left and back to full right for 3 times to dissipate the hydraulic pressure in the system.

Releasing the Hydraulic Pressure from the Hopper Lift and Tilt Circuit

1. Park the machine on a level surface.
2. Turn the key switch to the ON position (do not start the engine). If the hopper is in raised position, fully lower the hopper assembly.
3. Turn the key switch to the OFF position.
4. After lowering the hopper assembly, ensure that the lift and tilt hydraulic cylinders do not support the hopper assembly. Operate the hopper lift and tilt control levers in both directions for 5 to 10 times.

Releasing the Hydraulic Pressure from the Height Of Cut Circuit

1. Park the machine on a level surface.
2. Turn the key switch to the ON position (do not start the engine) and fully lower the cutting deck to the ground.
3. Operate the height of cut switch in both directions for 5 to 10 times.
4. Turn the key switch to the OFF position.

Traction Circuit Component Failure

The traction circuit of the ProLine H800 is a closed loop system that includes the hydraulic pump and hydraulic motor. If a component failure occurs in the traction circuit, unwanted material and contamination from the damaged component will circulate throughout the traction circuit. This contamination can damage other components in the circuit, so remove the contamination to prevent additional component failure.

The recommended method to remove contamination from the traction circuit is to temporarily install a Toro high flow hydraulic-fluid filter into the circuit; refer to Special Tools (page 2–15). Use a high flow hydraulic-fluid filter when you connect hydraulic test gauges in order to test the traction circuit components or after you replace a failed traction circuit component (e.g., hydraulic pump or hydraulic motor). Using a high flow hydraulic-fluid filter will remove contaminants from the hydraulic fluid in the traction circuit, thereby preventing additional component damage.

After you have installed the Toro high flow hydraulic-fluid filter in the traction circuit, raise and support the machine with all the drive wheels off the ground. Then, operate the traction circuit to allow the hydraulic fluid to flow through the circuit. The filter removes contamination from the traction circuit during the circuit operation. Because the Toro high flow filter is bi-directional, the traction circuit can be operated in both the forward and reverse directions. When you are certain that the filter has removed the contaminants from the hydraulic fluid of the traction circuit, remove the filter. Refer to Filtering the Closed-Loop Traction Circuit (page 5–68) for additional information on using the Toro high flow hydraulic-fluid filter.

The alternative method to remove contamination from the traction circuit is to disassemble the entire traction circuit, drain the hydraulic fluid, and clean all the components, tubes, and hoses. Operating the machine with contaminants in the traction circuit could cause additional damage to components of the traction circuit.

Hydraulic Hoses

The hydraulic hoses are subject to extreme conditions such as pressure differentials during operation and exposure to weather, sun, chemicals, very warm storage conditions, in addition to mishandling during operation and maintenance. These conditions can cause damage to the hose or deterioration to the hose material. Some hoses are more susceptible to these conditions than others. Examine all of the hydraulic hoses of the machine frequently and repair or replace them as necessary. Hoses that move during normal machine operation should be replaced every 2 years. Check hydraulic hoses for the following signs of deterioration or damage:

- A hose that is hard, cracked, cut, abraded, charred, leaking, or otherwise damaged.
- A hose that is kinked, crushed, flattened, or twisted.
- A hose cover that is blistered, soft, degraded, or loose.
- Hose fittings that are cracked, damaged, or badly corroded.

WARNING

Before disconnecting or performing any work on the hydraulic system, shut off the engine and press the motion control pedals to release the pressure in the system.

- **Keep your body and hands away from pin-hole leaks or nozzles that eject hydraulic fluid under high pressure.**
- **Do not use your hands to search for leaks; use a piece of paper or cardboard.**
- **Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and cause serious injury.**
- **If hydraulic fluid is injected into your skin, the fluid damage to your body must be surgically removed within a few hours by a doctor familiar with this form of injury or gangrene may result.**

When you replace a hydraulic hose, ensure that the hose is straight (not twisted) before you tighten the fittings. Observe the imprint (layline) on the hose to do this. Using 2 wrenches, hold the hose straight with 1 wrench and tighten the hose swivel nut onto the fitting with the other wrench; refer to Installing the Hydraulic Hoses and Tubes (page 5–8).

Note: If the hose has an elbow at 1 end, tighten the swivel nut on the elbow end before you tighten the nut on the straight end of the hose.

For more hydraulic hose information; refer to *Hydraulic Hose Servicing* of the Toro Basics Series Training Books (Part No. 94813SL) found on the Service Reference Set available from your Authorized Toro Distributor.

Installing the Hydraulic Hoses and Tubes

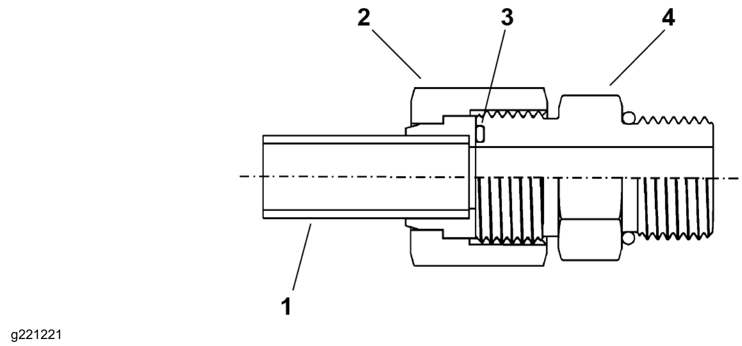


Figure 24

1. Tube or hose 2. Swivel nut 3. O-ring 4. Fitting body

1. Ensure that all the threads, the sealing surfaces of the hose/tube, and the fitting are free of burrs, nicks, scratches, or unwanted material.
2. Align the hose/tube against the body of the fitting so that the face of the hose/tube sleeve fully touches the face of the fitting.

   Note: It may be necessary to use a drive-adapter wrench (e.g., crowfoot wrench) to install a hydraulic fitting; refer to Calculating the Torque Values When Using a Drive-Adapter Wrench (page 2–9).
3. Use your hand to thread the swivel nut onto the fitting. While you hold the hose/tube in alignment with a wrench, use a torque wrench to tighten the swivel nut to the recommended torque value within the specified range of torque values; refer to the Hose/Tube Installation Torque Table (page 5–8).

IMPORTANT

The hydraulic hoses used on this machine have BSPP (British Standard Parallel Pipe) threads. The hydraulic hoses used on this machine have ORFS (O-Ring Face Seal) threads. If the hoses are replaced, ensure that the replacement has the correct type of threads, or component damage and leakage will occur.

Hose/Tube Installation Torque Table

Size	Hose/Tube Thread Size	Installation Torque
3/8 BSPP	19	30 to 35 N·m (22 to 26 ft-lb)
6 ORFS	11/16–16	37 to 44 N·m (27 to 33 ft-lb)
8 ORFS	13/16–16	51 to 63 N·m (37 to 47 ft-lb)
10 ORFS	1–14	82 to 100 N·m (60 to 74 ft-lb)
12 ORFS	1-3/16–12	116 to 142 N·m (85 to 105 ft-lb)
16 ORFS	1-7/16–12	150 to 184 N·m (110 to 136 ft-lb)

Installing the Hydraulic Hoses and Tubes (continued)

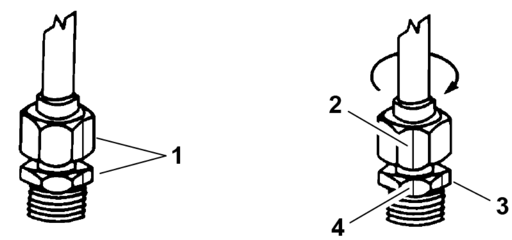
4. If a torque wrench is not available or if space at the swivel nut prevents the use of a torque wrench, use the alternative procedure Flats From Wrench Resistance (FFWR) given below:

Flats From Wrench Resistance Table

Size	FFWR
3/8 BSPP	1/2 to 3/4
6 ORFS	1/2 to 3/4
8 ORFS	1/2 to 3/4
10 ORFS	1/2 to 3/4
12 ORFS	1/3 to 1/2
16 ORFS	1/3 to 1/2

A. Use a wrench to tighten the swivel nut onto the fitting until you feel light resistance with the wrench-approximately **3.39 N·m (30 in-lb)**.

B. Put a mark on the swivel nut and body of the fitting. Hold the hose/tube in alignment with a wrench to prevent the hose/tube from turning (Figure 25).



g221222

Figure 25

1. Mark nut and fitting body
2. Final position
3. Initial position
4. Extend line

Note: The markings on the nut and body of the fitting show that the connection is correctly tightened.

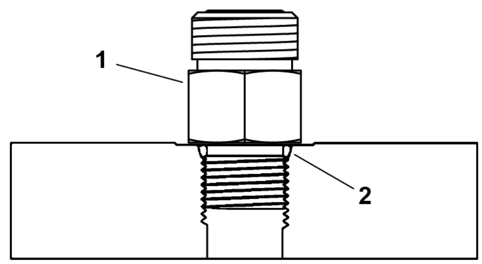
C. Use a second wrench to tighten the nut to the correct Flats From Wrench Resistance (FFWR); refer to the Flats From Wrench Resistance Table (page 5–9).

Installing the Hydraulic Fittings

IMPORTANT

The hydraulic fittings used in this machine may have BSPP (British Standard Parallel Pipe) threads or ORFS (O-Ring Face Seal) threads for the hose connections, and SAE or BSPP threads for the component connections. Pay close attention to the fitting thread type and the type of seal used when replacing the hydraulic tank fittings and seals, or component damage and leakage may occur.

Installing the Non-Adjustable Fittings



g221223

Figure 26

1. Fitting
2. O-ring or dowty seal

1. Ensure that all the threads, the sealing surfaces of fitting, and the component port are free of burrs, nicks, scratches, or unwanted material.
2. To help prevent a hydraulic leak, replace the O-ring when you open the connection.
3. Lightly lubricate the O-ring with clean hydraulic fluid. Ensure that the threads of the fitting are clean with no lubricant applied.

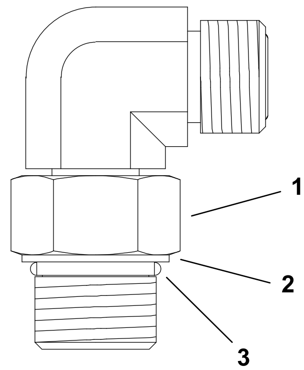
IMPORTANT

Before tightening the fitting, determine the material used for the port the fitting is being installed in. Installing a fitting into an aluminum port requires reducing the installation torque.

4. Install the fitting into the port, then use a torque wrench and socket to tighten the fitting to the recommended torque value within the specified range of torque values; refer to the Fitting Installation Torque Table (page 5–12).

   Note: It may be necessary to use a drive-adapter wrench (e.g., crowfoot wrench) to install a hydraulic fitting; refer to Calculating the Torque Values When Using a Drive-Adapter Wrench (page 2–9).
5. If a torque wrench is not available or if space at the port prevents the use of a torque wrench, use the Flats From Finger Tight (FFFT) procedure given below:
   A. Install the fitting into the port and tighten the fitting down full length until finger-tight.
   B. If the port material is steel, tighten the fitting to the listed value; refer to the Flat From Finger Tight (FFFT) Table (page 5–12).
   C. If the port material is aluminum, tighten the fitting to 60% of the listed value; refer to the Flat From Finger Tight (FFFT) Table (page 5–12).

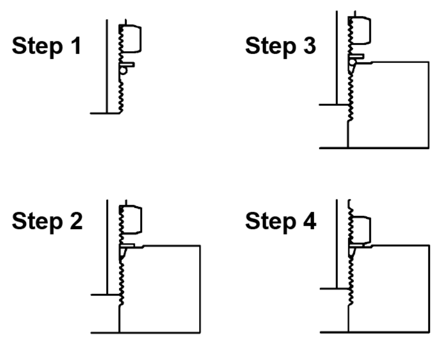
Installing an Adjustable Fitting



g221224

Figure 27

1. Locknut
2. Back-up washer
3. O-ring



g221225

Figure 28

1. Step 1: clearance the lock nut
2. Step 2: seat the back-up washer
3. Step 3: align the fitting
4. Step 4: tighten the lock nut

1. Ensure that all the threads, the sealing surfaces of fitting, and the component port are free of burrs, nicks, scratches, or unwanted material.
2. To help prevent a hydraulic leak, replace the O-ring when you open the connection.
3. Lightly lubricate the O-ring with clean hydraulic fluid. Ensure that the threads of the fitting are clean with no lubricant applied.
4. Turn back the locknut as far as possible. Ensure that the back-up washer is not loose and it is pushed up as far as possible (Step 1 in Figure 28).
5. Install the adjustable fitting into the port by hand until the washer contacts the face of the port (Step 2 in Figure 28).
6. If the adjustable fitting needs to align with another component, rotate the fitting counterclockwise until it is aligned to the desired position (Step 3 in Figure 28). Do not rotate the adjustable fitting more than 1 turn counterclockwise.

IMPORTANT

Before tightening the fitting, determine the material used for the port the fitting is being installed in. Installing a fitting into an aluminum port requires reducing the installation torque.

Installing an Adjustable Fitting (continued)

7. Tighten the fitting lock nut (Step 4 in Figure 28):

   A. Hold the fitting in the correct alignment with a wrench and use a torque wrench and tighten the fitting to the recommended torque value within the specified range of torque values; refer to the Fitting Installation Torque Table (page 5–12). This tightening procedure requires a drive-adapter wrench (e.g., crowfoot wrench); refer to Calculating the Torque Values When Using a Drive-Adapter Wrench (page 2–9).

   B. If a torque wrench is not available or if space at the port prevents the use of a torque wrench, hold the fitting in the correct alignment with a wrench and tighten the lock nut with a second wrench.

   C. If the port material is steel, tighten the fitting to the listed Flats From Finger Tight (FFFT) value; refer to the Flat From Finger Tight (FFFT) Table (page 5–12).

   D. If the port material is aluminum, tighten the fitting to 60% of the listed FFFT; refer to the Flat From Finger Tight (FFFT) Table (page 5–12).

Fitting Installation Torque Table

Fitting Size	Fitting Thread Size	Installation Torque Into Steel Port	Installation Torque Into Aluminum Port
1/4 BSPP	13.5 mm (0.52 inch)–19	45 to 55 N·m (33 to 41 ft-lb)	27 to 34 N·m (20 to 25 ft-lb)
3/8 BSPP	16.7 mm (0.66 inch)–19	51 to 62 N·m (38 to 46 ft-lb)	33 to 38 N·m (24 to 28 ft-lb)
6 SAE	9/16—18	47 to 56 N·m (34 to 42 ft-lb)	28 to 35 N·m (20 to 26 ft-lb)
8 SAE	3/4—16	79 to 97 N·m (58 to 72 ft-lb)	48 to 58 N·m (35 to 43 ft-lb)
10 SAE	7/8—14	135 to 164 N·m (99 to 121 ft-lb)	82 to 100 N·m (60 to 74 ft-lb)
12 SAE	1–1/16—12	182 to 222 N·m (134 to 164 ft-lb)	110 to 134 N·m (81 to 99 ft-lb)
14 SAE	1–3/16—12	217 to 265 N·m (160 to 196 ft-lb)	131 to 160 N·m (96 to 118 ft-lb)
16 SAE	1–5/16—12	274 to 336 N·m (202 to 248 ft-lb)	165 to 202 N·m (121 to 149 ft-lb)
20 SAE	1–5/8—12	335 to 410 N·m (247 to 303 ft-lb)	202 to 248 N·m (149 to 183 ft-lb)

Flat From Finger Tight (FFFT) Table

Size	FFFT
1/4 BSPP	1.00 ± 0.25
3/8 BSPP	1.50 ± 0.25
6 SAE	1.50 ± 0.25
8 SAE	1.50 ± 0.25
10 SAE	1.50 ± 0.25
12 SAE	1.50 ± 0.25
16 SAE	1.50 ± 0.25

Hydraulic Schematic

The hydraulic schematic for the PLH800 machine is located in Appendix A (page A–1).

Hydraulic Flow Diagrams

Traction Circuit

Hydraulic system pressure is generated by a piston-driven pump coupled to the engine flywheel. This variable-displacement pump provides hydraulic flow under regulated pressure to the front and rear wheel motors, and changes its fluid flow rate with an internal swash plate. The swash plate angle is controlled by the traction pedal through a linkage system. The angle of the swash plate determines the pump flow, and ultimately the speed of the machine. When the traction pedal is moved to its fullest extension, the pump swash plate rotates fully to provide maximum pump output flow and peak machine speed. With the engine running and the traction pedal in the NEUTRAL position, the swash plate within the hydraulic pump are held in the vertical position, providing no fluid flow to wheel motors, and the machine remains stationary.

The closed loop traction circuit includes 2 rear wheel motors, 2 front wheel motors, and a differential valve.

Forward Direction

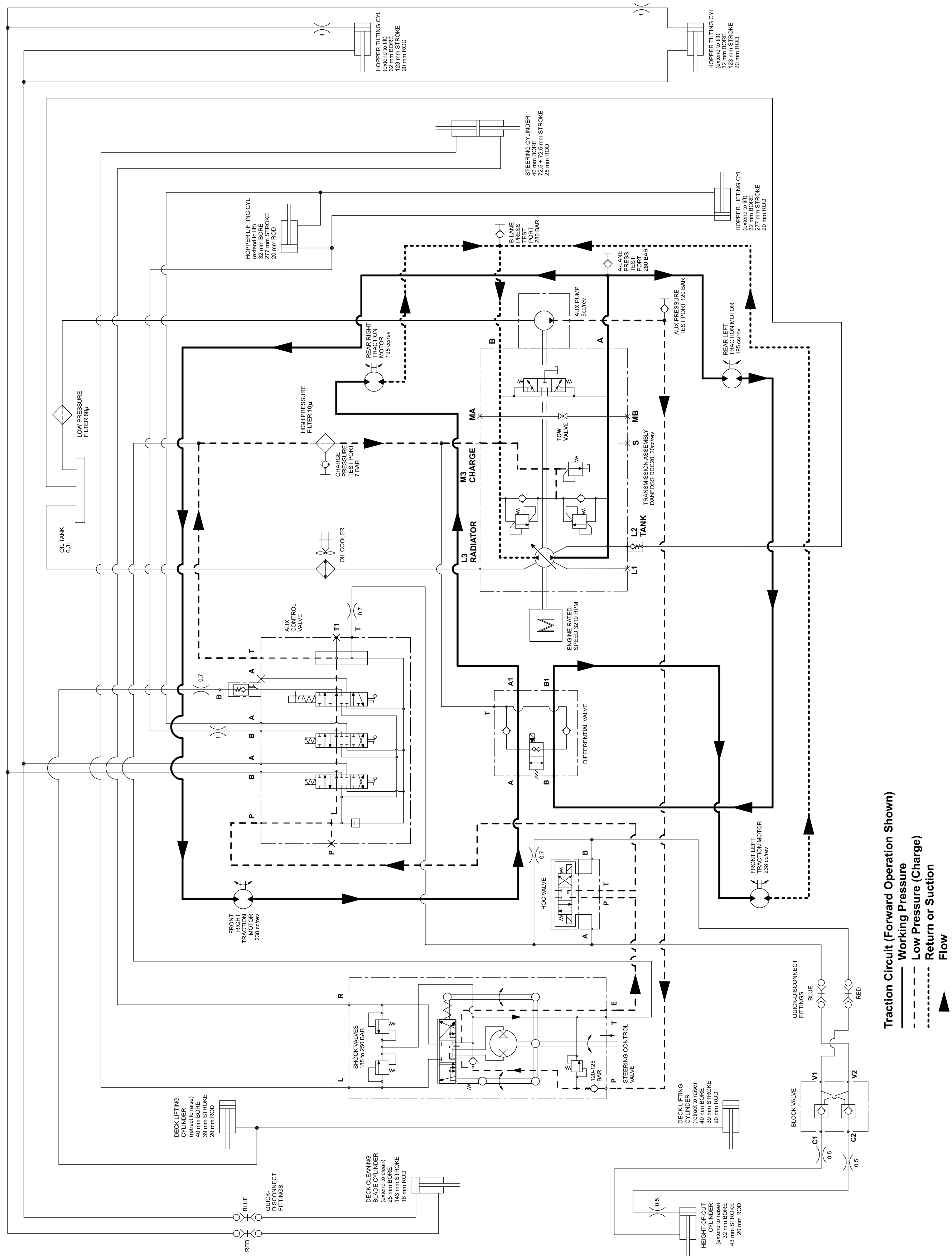


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Figure 29

Forward Direction (continued)

The forward traction pressure is limited to **280 bar (4,061 psi)**. The fluid flowing from the motor returns to the variable displacement pump and is continuously pumped through the closed loop circuit as long as the traction pedal is pressed.

The piston pump is equipped with a case drain to allow normal internal leakage to be removed.

The hydraulic pump also includes a gerotor charge pump. The charge pump provides a constant supply of pressurized fluid to the closed loop traction circuit for lubrication and to make up for fluid that is lost due to internal leakage in the system. The charge pump is fed through a filter from the hydraulic tank. The charge pump flow is directed to the low pressure side of the closed loop traction circuit. The charge pressure is limited to **7 bar (101 psi)** by a dedicated pressure relief valve in the hydraulic pump.

Reverse Direction

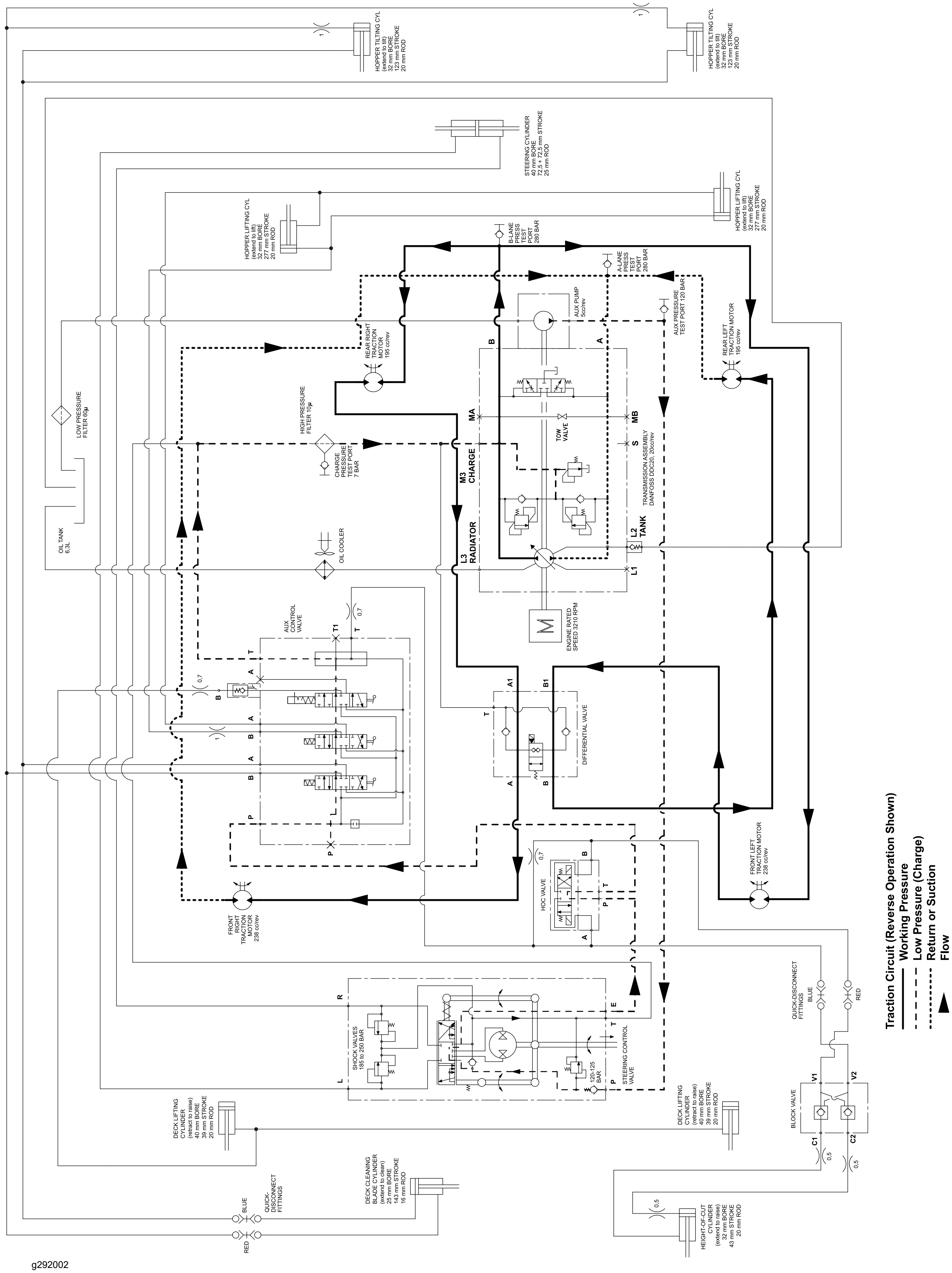

Figure 30

Reverse Direction (continued)

The traction circuit operates essentially the same in reverse as it does when moving forward. The primary difference is that the direction of fluid flow through the circuit is reversed when the bottom of the traction pedal is pushed. The reverse traction pressure is likewise limited to **280 bar (4,061 psi)**. Again, the fluid flowing from the wheel motors will return to the variable displacement pump and is continuously pumped through the closed loop traction circuit as long as the traction pedal is pushed. The charge circuit functions the same in reverse as it does in the forward direction.

Steering Circuit

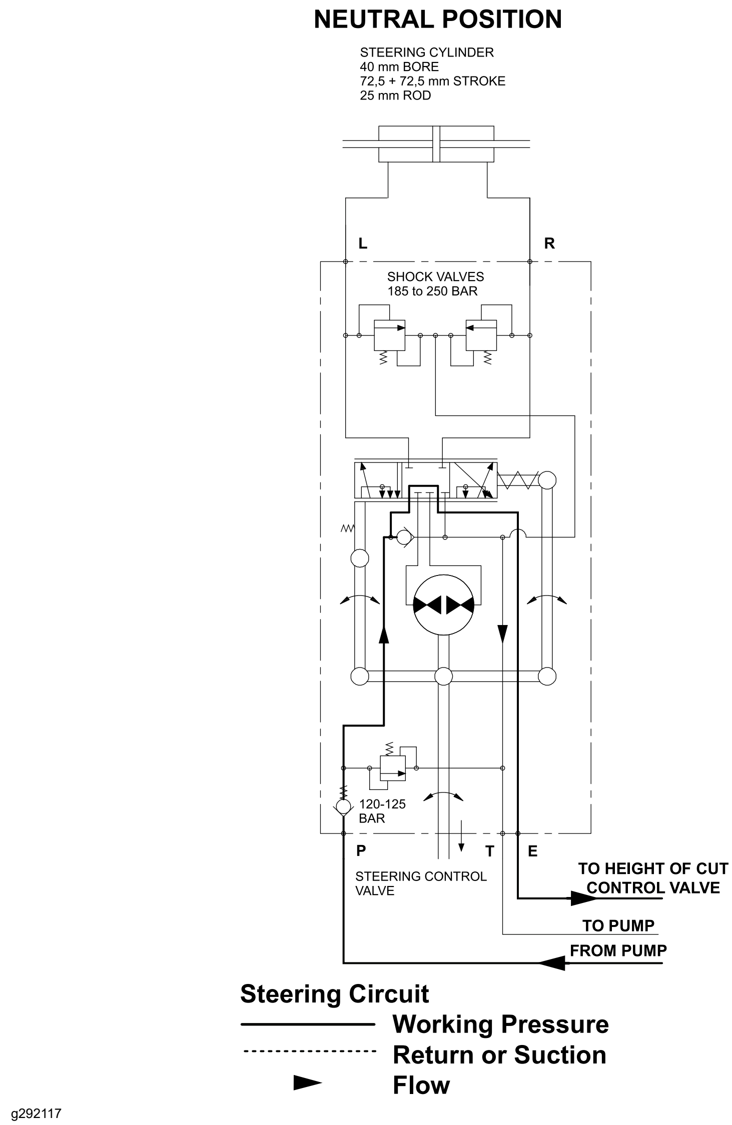

Figure 31

The charge pump supplies the fluid flow for the steering circuit, height of cut control, and the auxiliary control circuit. The pump output flows first to the steering control valve before reaching the height of cut valve, so that the steering circuit has priority. The steering circuit pressure is limited to a **120-125 bar (1,740-1,813 psi)** by a relief valve located inside the steering control. When the steering wheel is not being turned and the engine is running (hydraulic pressure is present), charge pump flow enters the steering control valve at the P port and bypasses both the rotary meter and steering cylinder. Flow leaves the steering control valve through the E port, and is directed to the height of cut control valve.

Right Turn

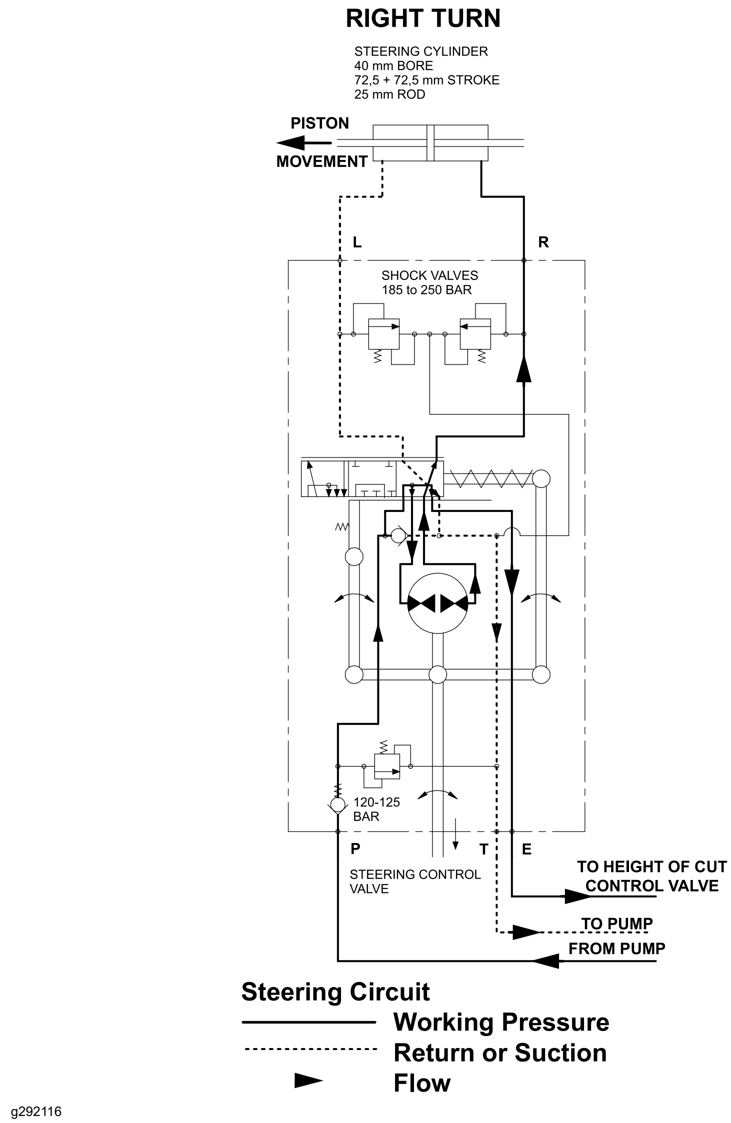

Figure 32

When a right turn is made with the engine running, the turning of the wheel positions the steering control spool valve so flow passes through the top of the spool. The fluid flow entering the steering control valve at the P port passes through the rotary meter, and is directed out through the R port. Pressure then extends the steering cylinder for a right turn.

The rotary meter ensures that the fluid flow to the cylinder remains proportional to the amount of steering wheel rotation. The fluid leaving the steering cylinder flows back through the spool valve, then out the T port and returns to the pump.

Left Turn

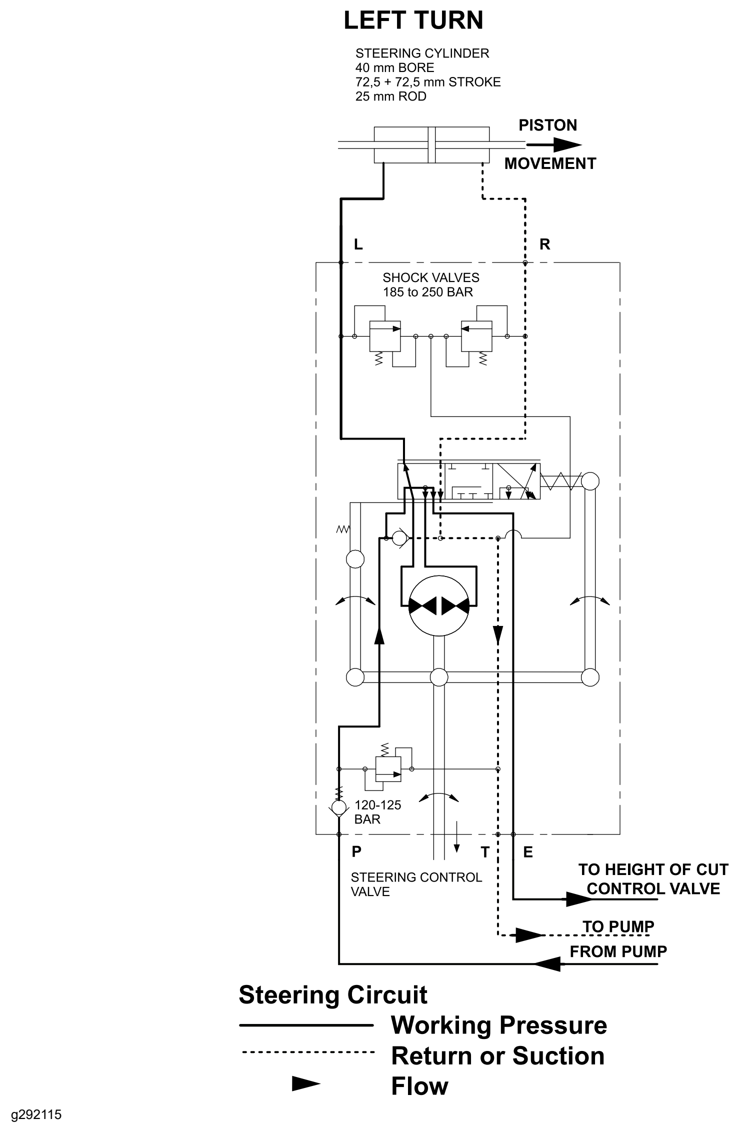

Figure 33

When a left turn is made with the engine running, the turning of the wheel positions the steering control spool valve so that the flow passes through the bottom of the spool. The fluid flow entering the steering control valve at the P port passes through the rotary meter, and is directed out the L port. Pressure extends the steering cylinder for a left turn.

The rotary meter ensures that the fluid flow to the cylinder is proportional to amount of steering wheel rotation. The fluid leaving the steering cylinder flows back through the spool valve, then out the T port and returns to the pump.

Height Of Cut Circuit

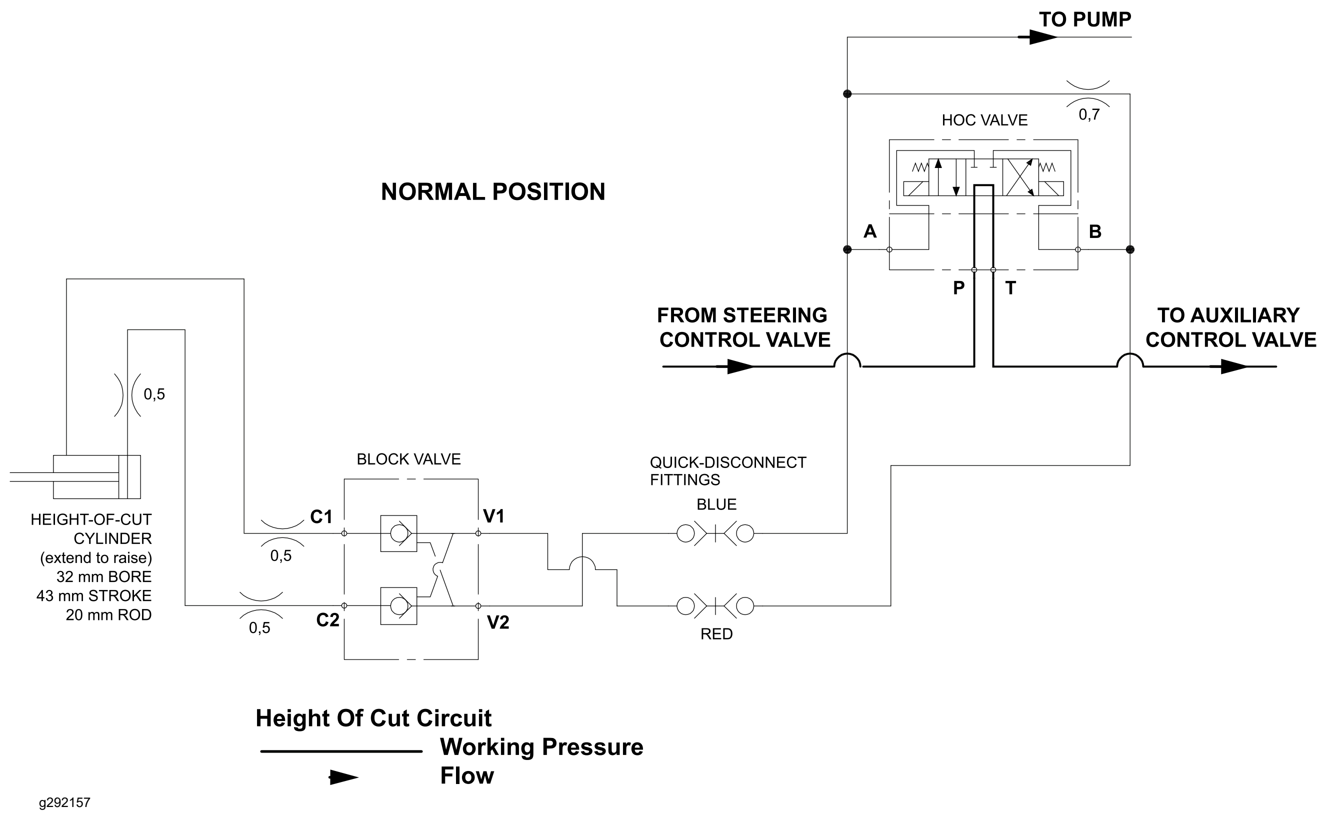

Figure 34

The charge pump supplies fluid pressure to the steering circuit, height of cut circuit and auxiliary circuit. The charge pump is fed through a filter from the hydraulic tank. The pump output flows to the steering control valve first before reaching the height of cut circuit. When the height of cut is not being adjusted higher or lower, fluid flow enters the height of cut control valve manifold at the P port and exits from the T port.

Raising the Height Of Cut

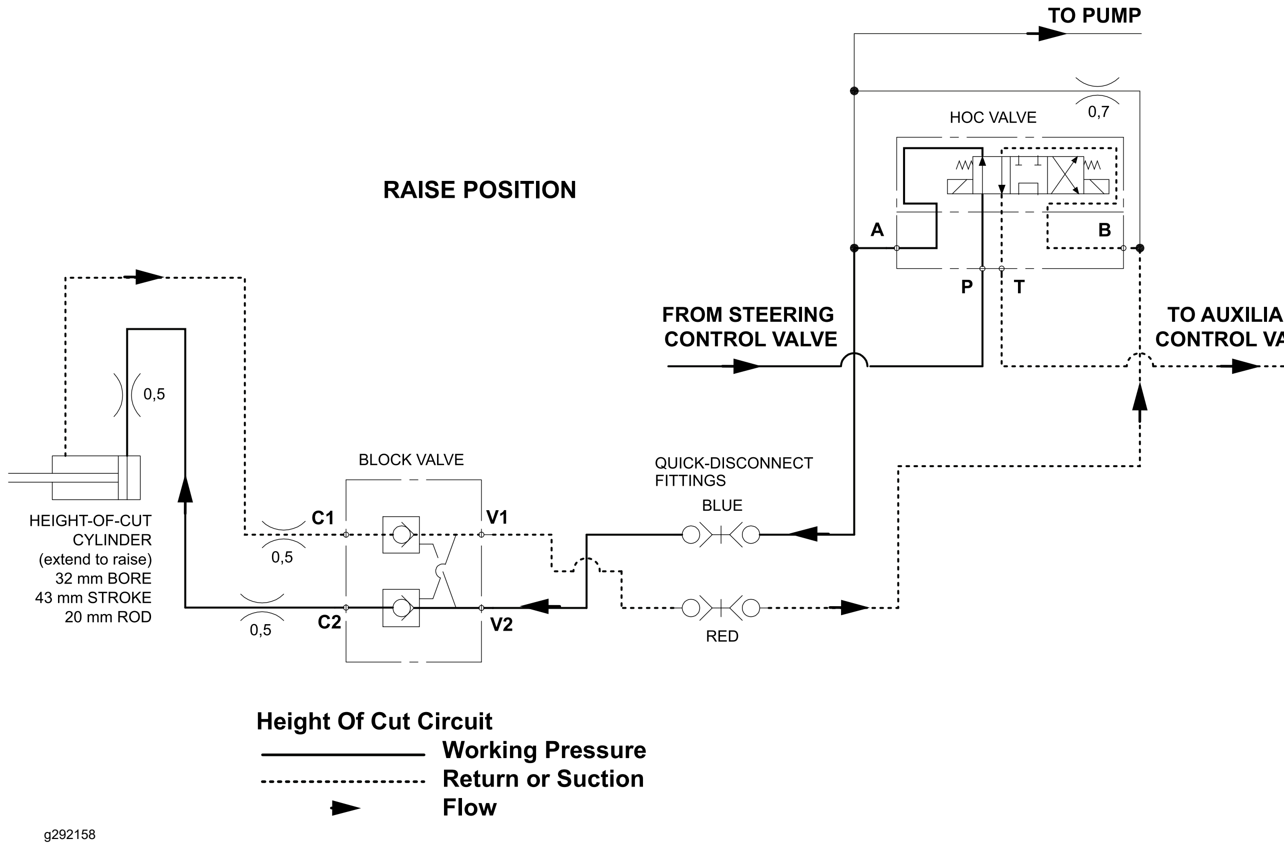

Figure 35

When the height of cut switch is moved to the RAISE position, the solenoid valve inside the control valve is energized to cause the valve to shift, allowing fluid flow from the P port to the A port. This extends the piston, causing the height of cut to raise. The fluid displaced from the rod end of the height of cut cylinder is routed to the T port. The block valve (located between the height of cut control valve and the cylinder) holds the fluid pressure in the height of cut cylinder to maintain the correct level of cut until the next adjustment.

Lowering the Height Of Cut

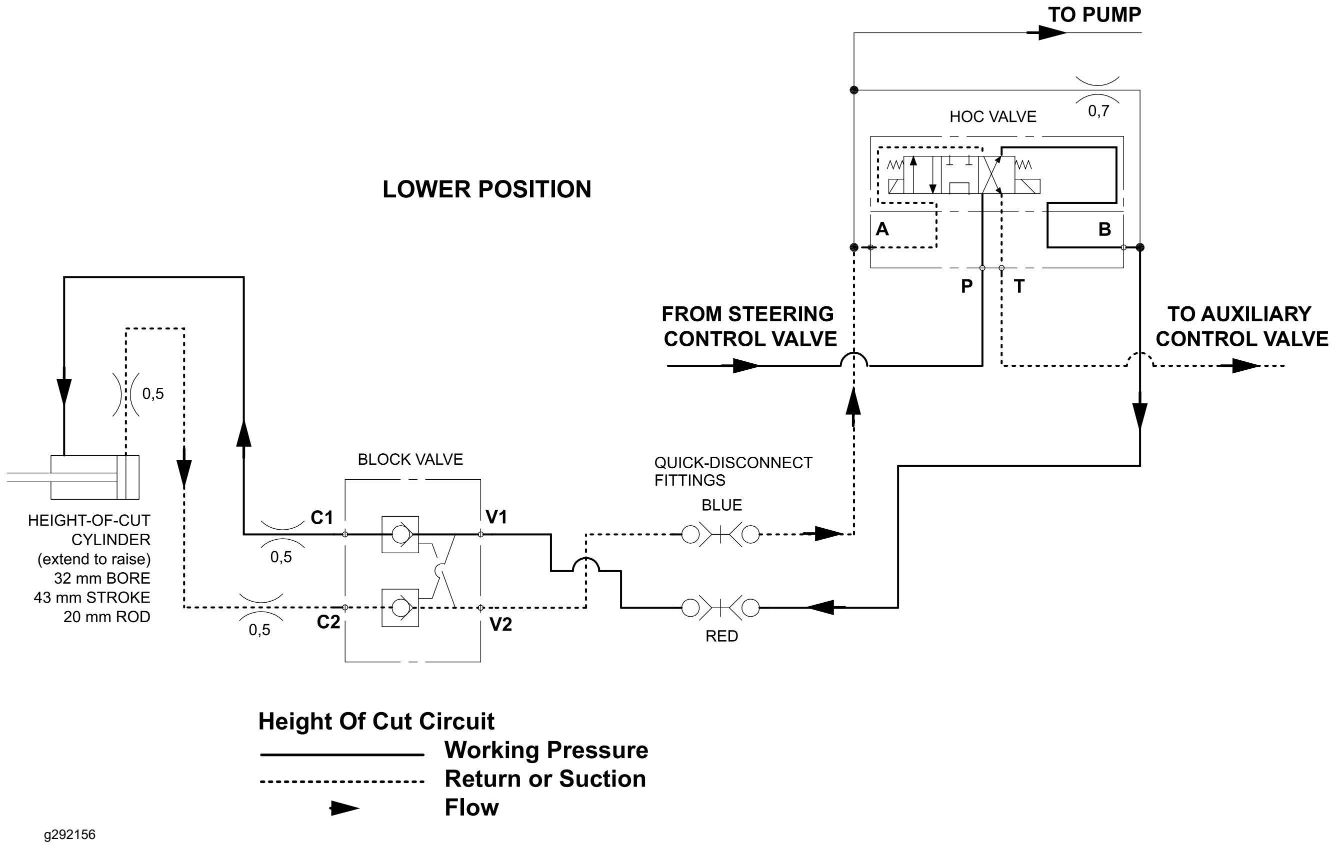

Figure 36

When the height of cut switch is moved to the LOW position, the solenoid valve inside the control valve is energized to cause the valve to shift, allowing fluid flow from the P port to the B port. This retracts the piston, causing the height of cut to lower. The fluid displaced from the barrel end of the height of cut cylinder is routed to the T port. The block valve (located between the height of cut control valve and cylinder) holds the fluid pressure in the height of cut cylinder to maintain correct level of cut until the next adjustment.

Auxiliary Control Circuit

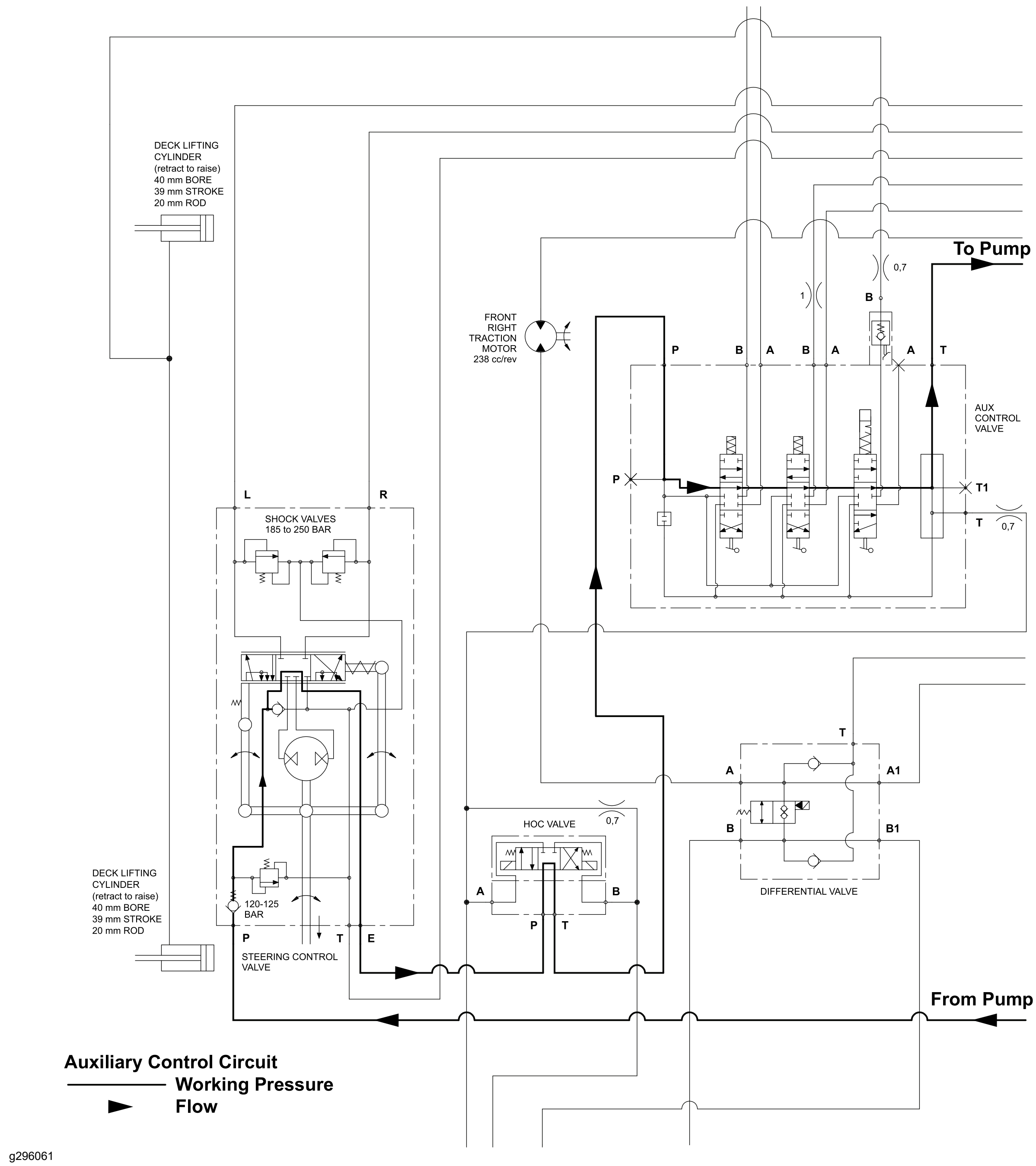

Figure 37

The charge pump supplies fluid pressure to the steering circuit, the height of cut circuit, and the auxiliary control valve. The charge pump takes its suction through a filter from the hydraulic tank. The pump output flows to the steering control valve and height of cut valve before reaching the auxiliary control valve. When the auxiliary controls are being adjusted to raise or lower, fluid flow enters the auxiliary control valve manifold at the P port and exits from the T port.

Raising the Cutting Deck

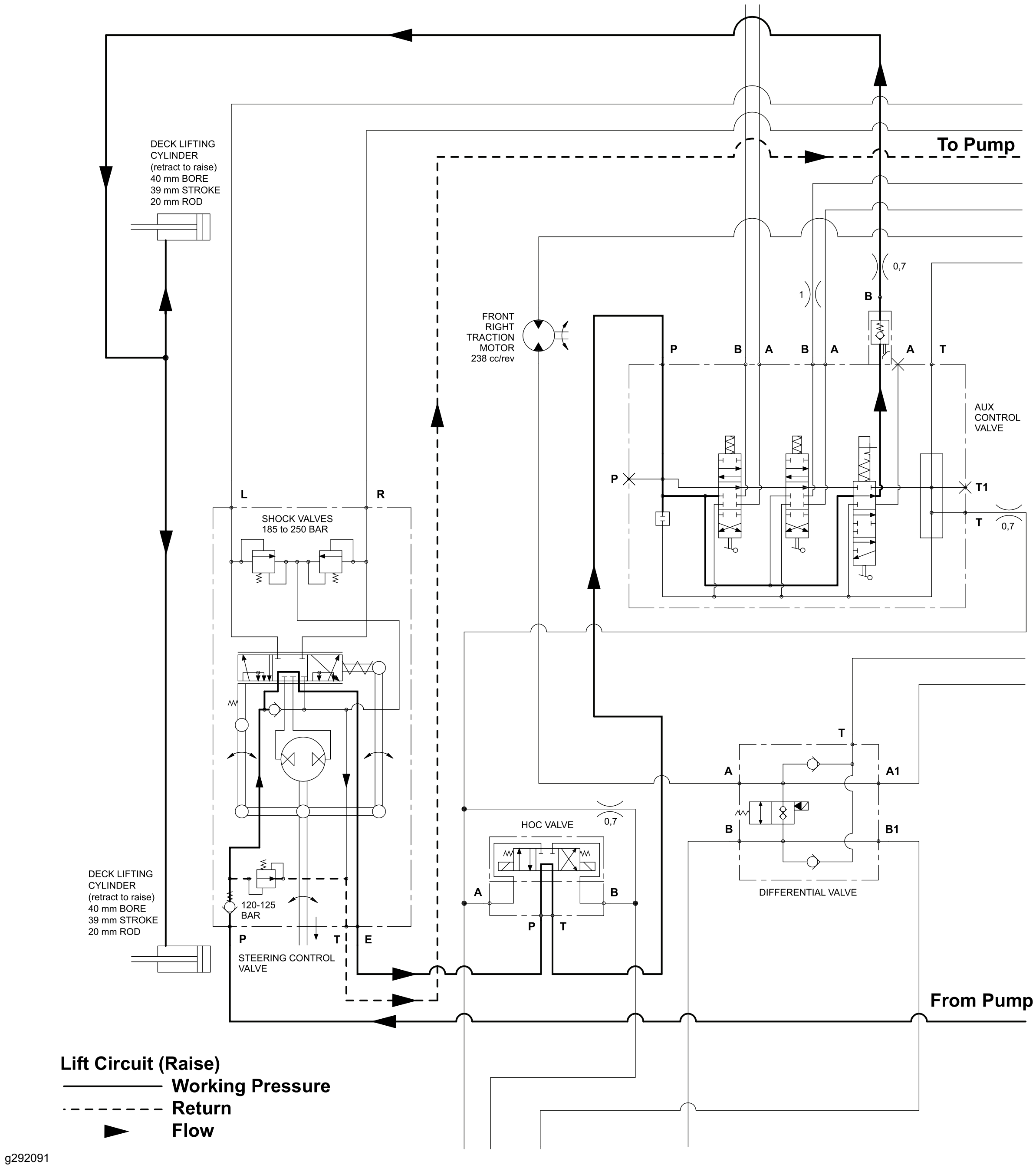

Figure 38

When the cutting deck lift lever is moved to the RAISE position, hydraulic fluid flow is directed to the deck lift cylinders. The hydraulic pressure against the cylinder pistons retracts the lift cylinders, lifting the cutting deck. When the deck lift cylinders reach the end of their stroke (or if the lift arms are prevented from raising any further), the relief valve in the steering control valve opens and directs the hydraulic flow back to the pump until the lift lever is returned to the neutral position. The pressure relief valve opens at **120-125 bar (1,740-1,813 psi)**.

Note: If the cutting deck lift lever is moved to the RAISE position while the steering wheel is being turned, the cutting deck lift speed will be reduced.

Lower the Cutting Deck

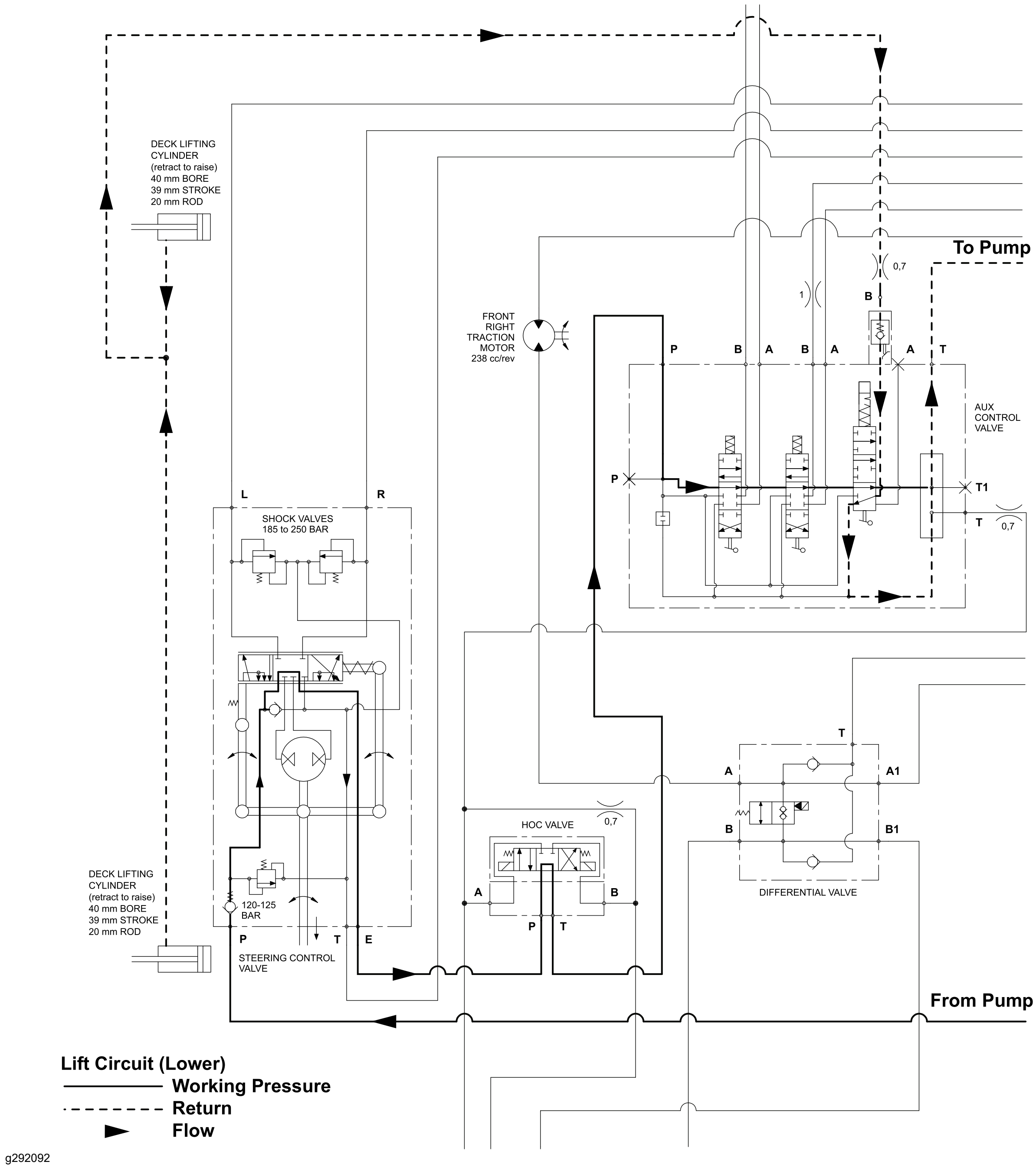

Figure 39

When the cutting deck lift lever is moved to the LOWER position, hydraulic fluid flows through the auxiliary control valve manifold and opens a path for fluid trapped in the lift cylinder piston to escape through the open port in the auxiliary control valve. The weight of the cutting deck causes the cylinders to extend and the cutting deck lowers.

Raising the Hopper

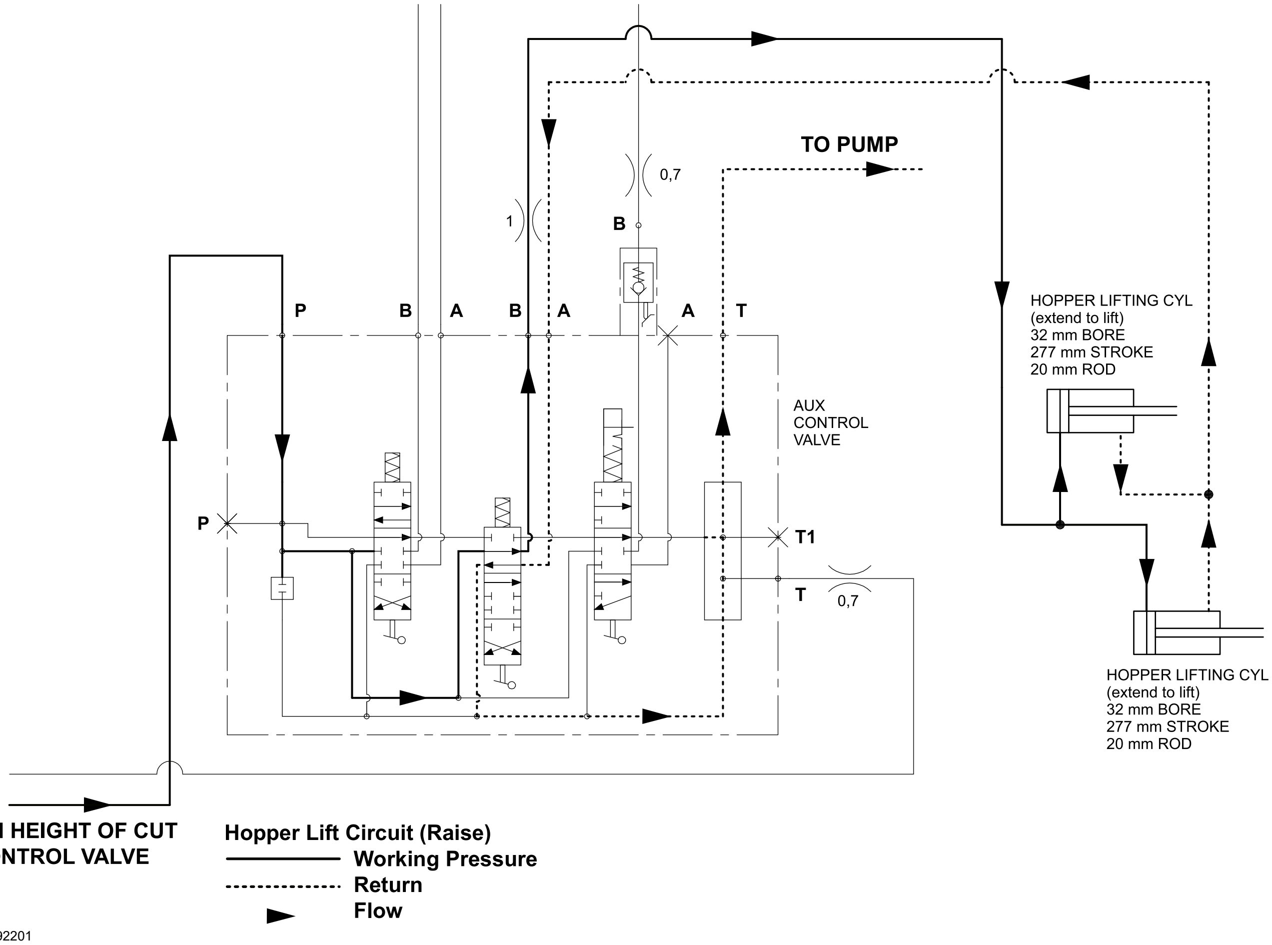

Figure 40

When the hopper lift lever is moved to the RAISE position, hydraulic fluid flow is directed to the hopper lift cylinders. The hydraulic pressure extends the lift cylinders and the hopper goes up. When the hopper lift cylinders reach the end of their stroke, the relief valve in the steering control valve opens and directs the hydraulic flow to the pump until the lift lever is returned to the neutral position.

Lowering the Hopper

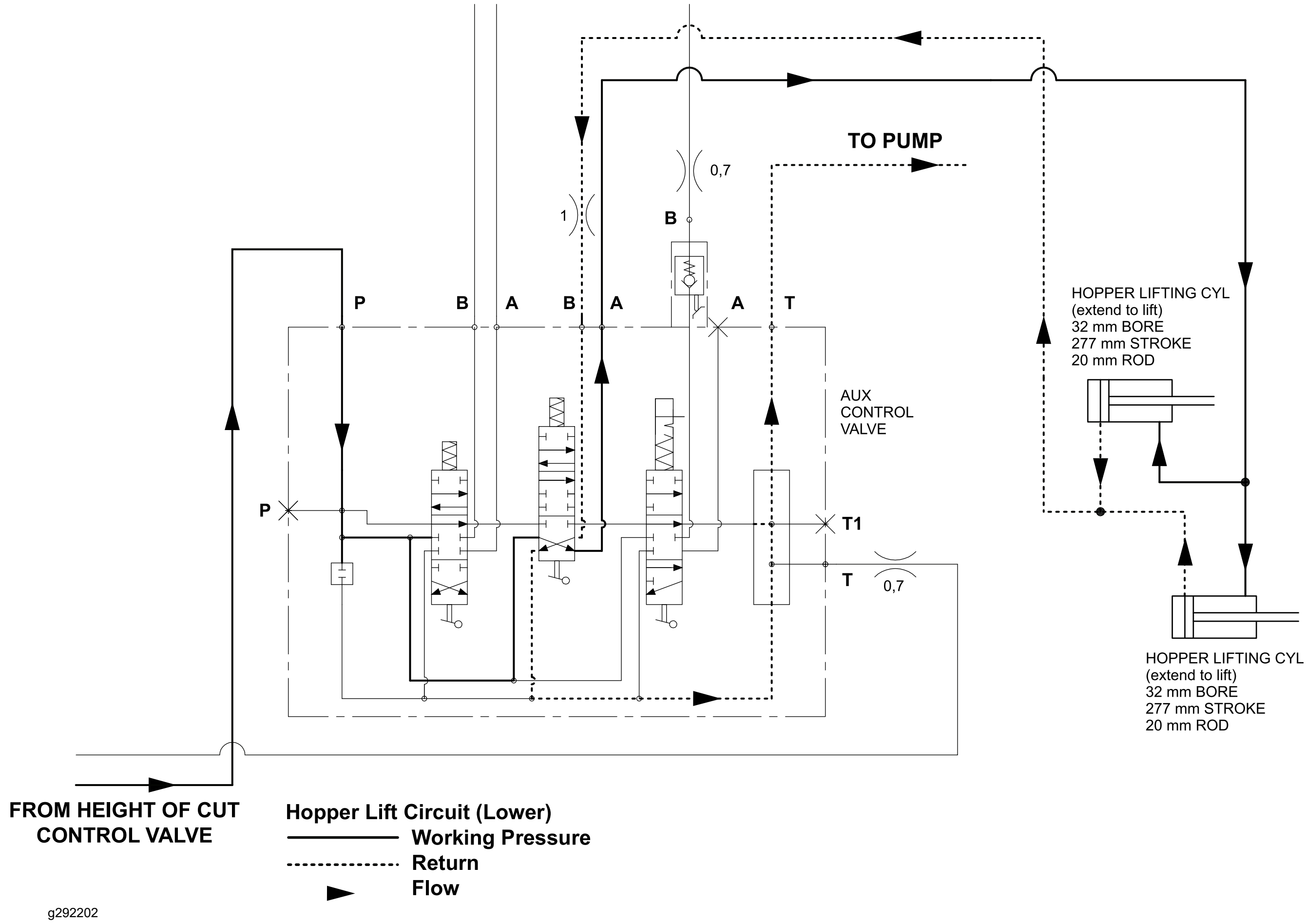

Figure 41

When the hopper lift lever is moved to the LOWER position, hydraulic fluid flow is directed to the hopper lift cylinders. The hydraulic pressure in the rod side of the cylinder causes the piston to retract and lowers the hopper. When the lift cylinders reach the end of their stroke, the relief valve in the steering control valve opens and directs the hydraulic flow to the pump until the lift lever is returned to the neutral position.

Tilting the Hopper

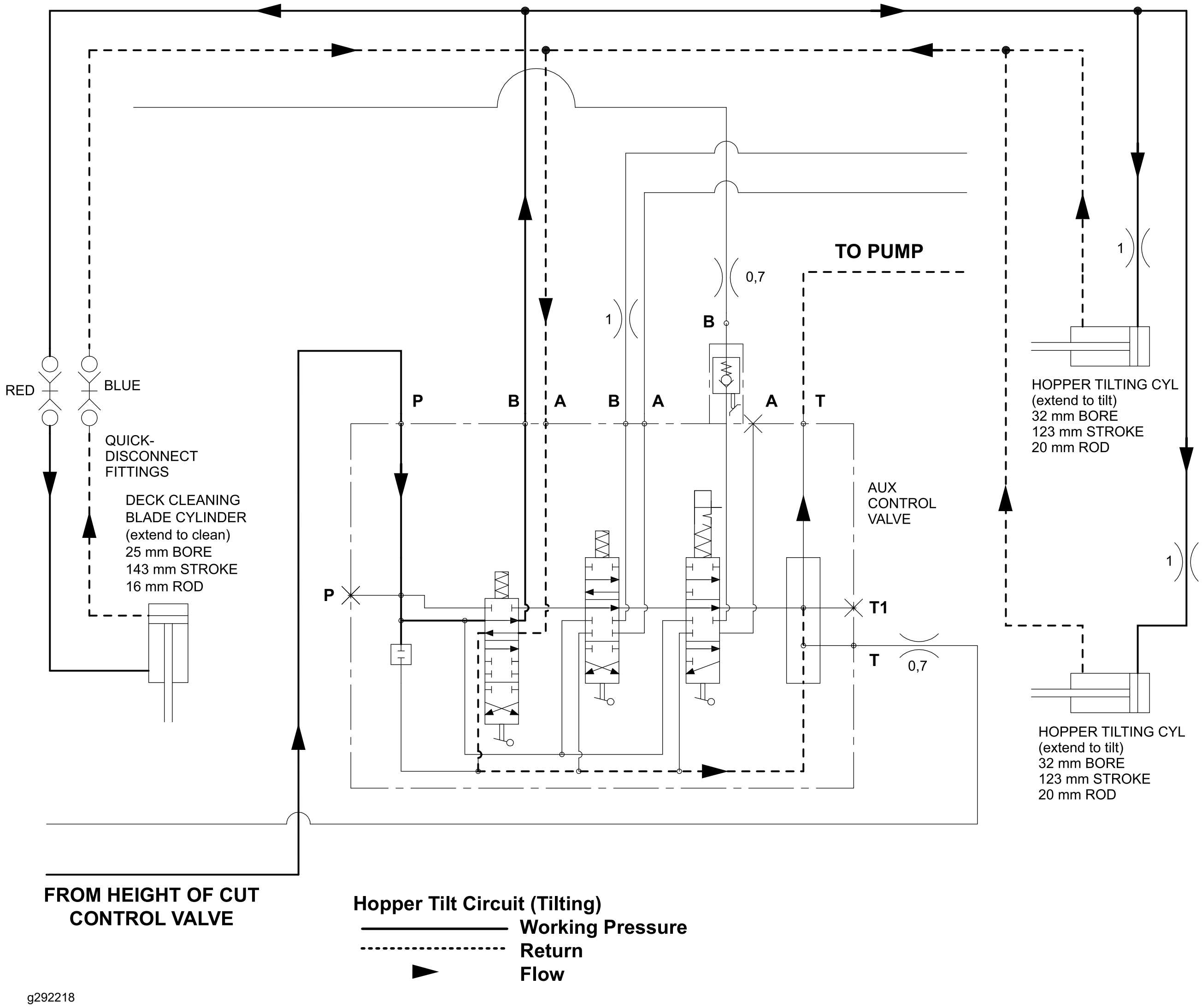

Figure 42

When the hopper tilt lever is moved to the TILT position, hydraulic fluid flow is directed to the hopper tilt cylinders. The hydraulic pressure extends the cylinders and tilts the hopper. When the tilt cylinders reach the end of their stroke, the relief valve in the steering control valve opens and directs the hydraulic flow to the pump until the tilt lever is returned to the neutral position.

The deck cleaning blade is controlled by the deck cleaning cylinder. The purpose of the blade is to swipe across the opening of the grass chute when the hopper is tilted. This aids in keeping the chute clear of grass cuttings and other debris.

When the hopper tilt lever is moved to the TILT position, hydraulic fluid flow is also directed to the cutting deck cleaning cylinder. Pressure in the rod side of the cylinder causes the piston to retract the deck cleaning cylinder and operate the blade assembly simultaneously.

Leveling the Hopper

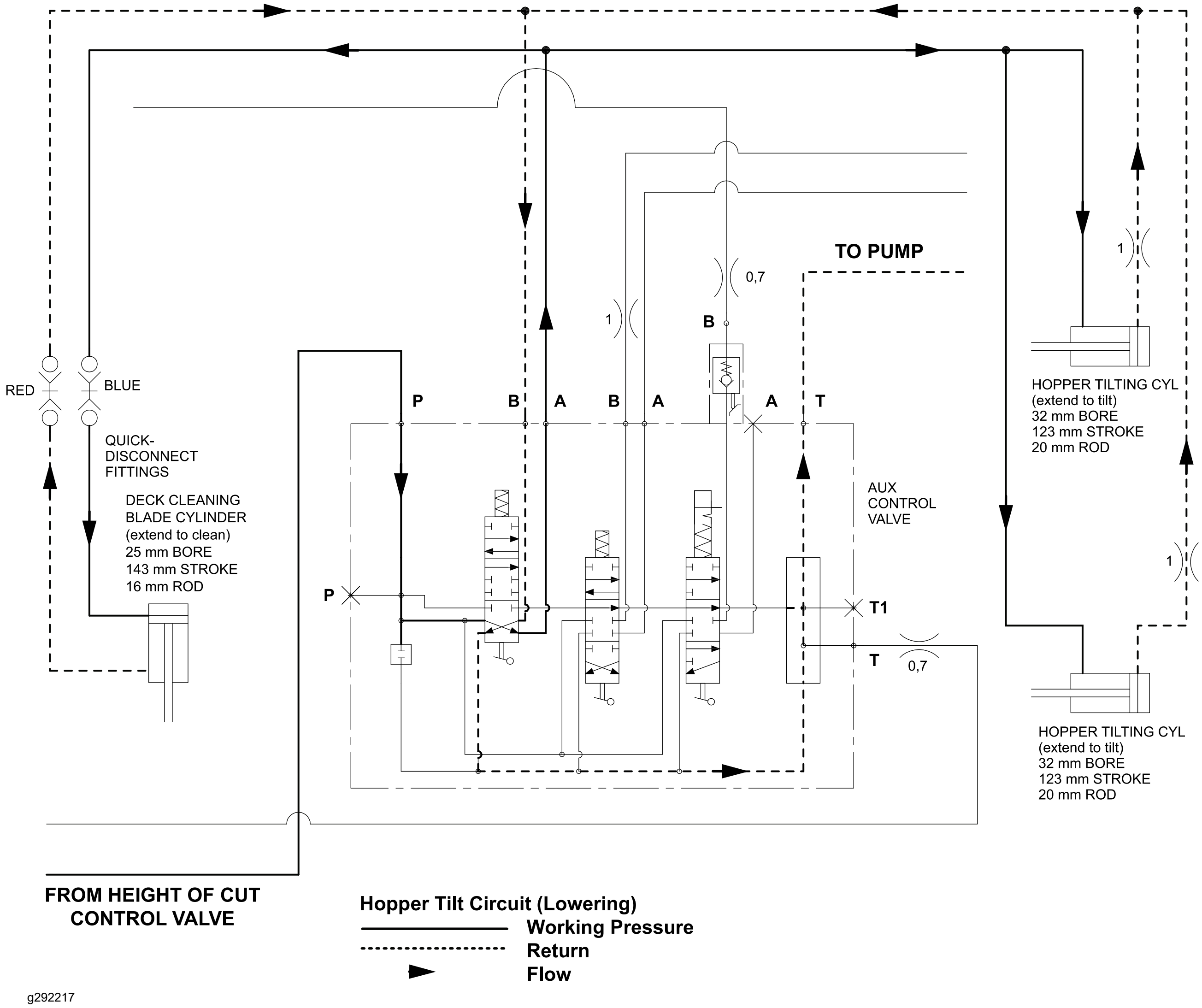

Figure 43

When the hopper lift lever is moved to the LOWER position, hydraulic fluid flow is directed to the hopper lift cylinders. The hydraulic pressure in the rod side of the cylinder causes the piston to retract and lowers the hopper. When the lift cylinders reach the end of their stroke, the relief valve in the steering control valve opens and directs the hydraulic flow to the pump until the lift lever is returned to the neutral position.

The deck cleaning blade is controlled by the deck cleaning cylinder. The purpose of the blade is to swipe across the opening of the grass chute when the hopper is tilted. This aids in keeping the chute clear of grass cuttings and other debris.

When the hopper tilt lever is moved to the LOWER position, hydraulic fluid flow is also directed to the cutting deck cleaning cylinder. Pressure in the rod side of the cylinder causes the piston to retract the deck cleaning cylinder and operate the blade assembly simultaneously.

Testing the Hydraulic System

The most effective procedure to isolate the problems in the hydraulic system is to use hydraulic test equipment, such as pressure gauges and flow meters in the circuits during different operational checks; refer to Special Tools (page 2–15).

WARNING

Opening the hydraulic system without releasing pressure from the system will cause the hydraulic fluid to escape, causing possible injury.

Before you disconnect the hydraulic components or work on the hydraulic system, release the pressure in the system; refer to Releasing Pressure from the Hydraulic System (page 5–5).

WARNING

Hydraulic fluid escaping under pressure can penetrate skin and cause injury.

- **Keep your body and hands away from pin-hole leaks or nozzles that eject hydraulic fluid under high pressure.**
- **Do not use your hands to search for leaks; use a piece of paper or cardboard.**
- **Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and cause serious injury.**
- **If hydraulic fluid is injected into your skin, the fluid damage to your body must be surgically removed within a few hours by a doctor familiar with this form of injury or gangrene may result.**

CAUTION

Failing to use gauges having the recommended pressure (kPa/psi) rating could damage the gauge and cause personal injury from contact with hot, leaking hydraulic fluid.

Use gauges with the recommended pressure rating as listed in the test procedures.

IMPORTANT

Before performing the hydraulic tests, check all obvious areas, such as fluid supply, filter, binding linkages, loose fasteners, or improper adjustments before you assume that a hydraulic component is the source of the problem.

IMPORTANT

Use 2 people to perform all the tests, with 1 person in the seat and the other to read and record the test results.

1. Use the following resources to assist with hydraulic system troubleshooting:
   - The Hydraulic Schematic in Appendix A (page A–1).
   - Hydraulic Flow Diagrams (page 5–14).
   - General and system specific troubleshooting tables in Chapter 3: Troubleshooting.
2. Clean the machine fully before you disconnect or disassemble any hydraulic components.
3. When you perform tests on the hydraulic system, wear eye protection.
4. Before you perform any test, inspect the traction control lever linkages for improper adjustment, binding, or broken parts.
5. Perform all the hydraulic tests with the fluid at normal operating temperature.
6. Install clean metal caps or plugs on the hydraulic lines that are left open or exposed during the testing or component removal.
7. The engine must be in good operating condition. Use a non-contact tachometer (phototach) to verify and monitor engine RPM when performing a hydraulic test. Engine speed can affect the accuracy of the test readings. Use the information below when performing hydraulic system tests. If engine RPM is above or below the specified speed during a test, you will need to adjust the expected hydraulic performance parameters.
8. When you use a hydraulic tester (pressure and flow), ensure that the inlet and outlet hoses are properly connected and not reversed to prevent damaging the hydraulic tester or components.
9. Install the hydraulic fittings by hand and ensure that they are not cross-threaded before you tighten them with a wrench.
10. Position any test hoses away from parts that may move during the test procedure.
11. After you connect the test equipment, check the hydraulic fluid level in the hydraulic tank and ensure that the fluid level is correct.
12. When you use a hydraulic tester (pressure and flow), open the tester load valve fully before you start the engine to reduce the possibility of damaging the components.
13. Record the results of all hydraulic tests performed.
14. After a hydraulic test procedure has been completed, check the hydraulic fluid level in the hydraulic tank before returning the machine to service.

Testing the Traction Circuit - Charge Pressure

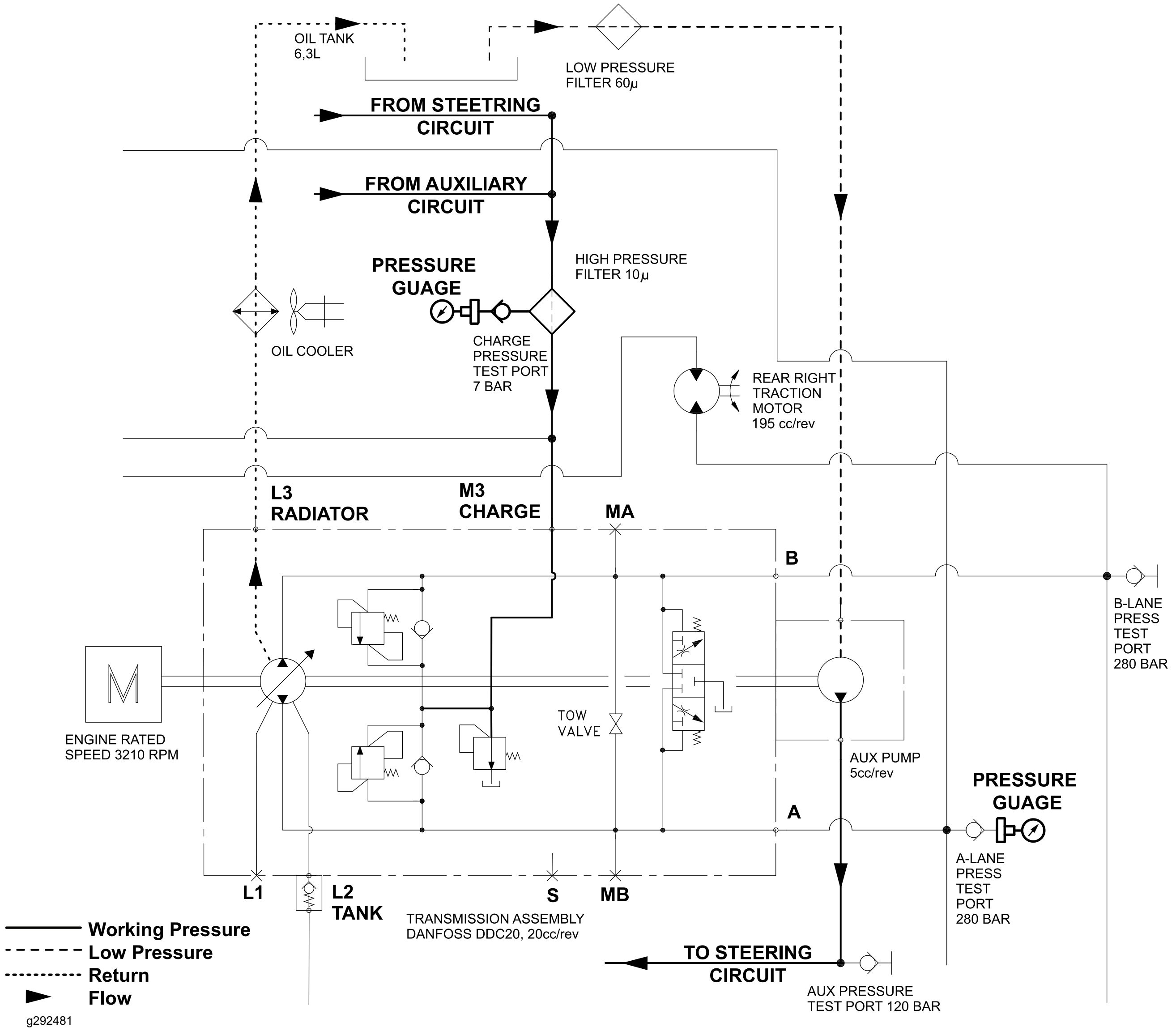

Figure 44

The charge pressure test is the first in a series of tests recommended to determine traction circuit performance. A charge pressure drop of more than 20% indicates an internal leak in the hydraulic pump. Continued unit operation can generate excessive heat, cause damage to seals and other components in the hydraulic system, and affect overall machine performance.

Special Equipment Required:

- Pressure gauge (accurate below 300 psi) with hose and quick disconnect coupling.
- Pressure gauge (accurate below 2000 psi) with hose and quick disconnect coupling.
- Phototach (non−contact tachometer).

1. Once the test equipment is properly connected, you can run the engine and pump to warm the hydraulic fluid to operating temperature.

   Any test procedure that requires an open or uncapped line (like a case drain leak check) would not apply. In those rare situations, the hydraulic fluid should be warmed before disconnecting the lines.

Testing the Traction Circuit - Charge Pressure (continued)

CAUTION

Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to Releasing Pressure from the Hydraulic System (page 5–5).

2. Park the machine on a level surface with the PTO switch off, lower the cutting deck, shut off the engine, and set the parking brake.
3. Read all Warnings, Cautions, and precautions listed at the beginning of this section.
4. Ensure that the traction pedal is in NEUTRAL position, the steering wheel is stationary and parking brake is set.

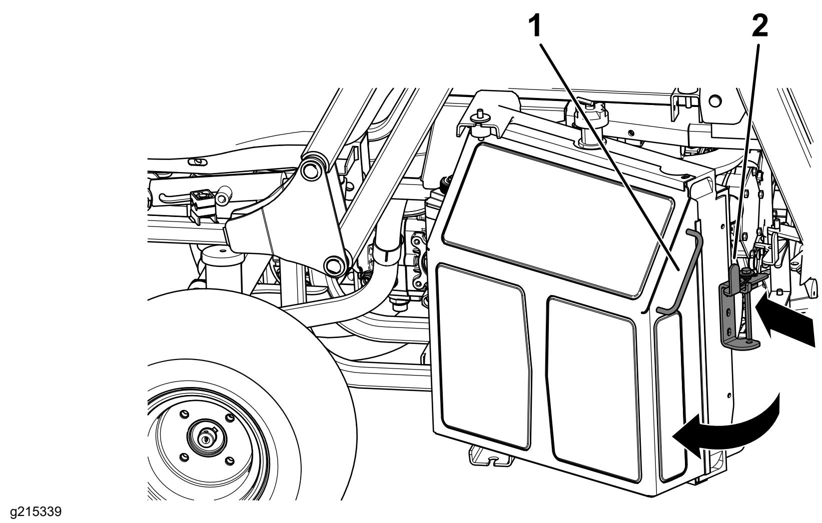

Figure 45

1. Handle
2. Latch

5. Push the latch (item 2) inward toward the radiator (Figure 45).
6. Using the handle (item 1), rotate the radiator to access the hydraulic fluid filter (Figure 45).

Testing the Traction Circuit - Charge Pressure (continued)

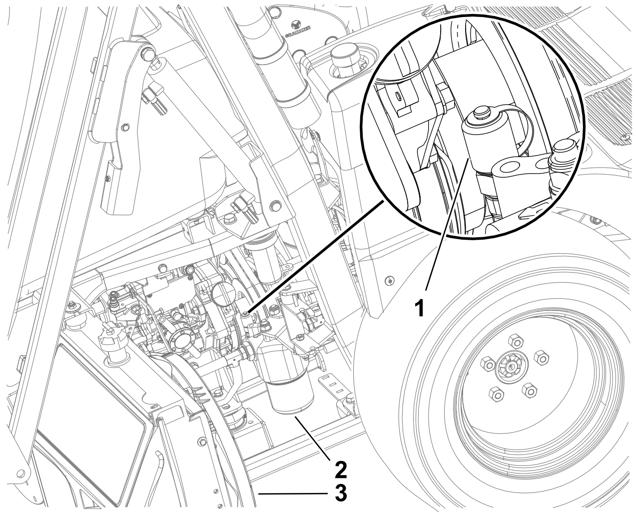

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Figure 46

1. Hydraulic pressure test port
2. Hydraulic fluid filter
3. Radiator

---

7. Gain access to the charge pressure test port (Figure 46).
8. Clean the charge pressure test port. Loosen and remove the cap from the test port.
9. Install a pressure gauge (below 300 psi) to the test port.
10. Install a pressure gauge (below 2000 psi) to the traction pump “A” port.
11. Attach a heavy chain to the rear of the machine frame and an immovable object to prevent the machine from moving during testing.
12. Block the wheels with chocks to prevent the wheels rotation during testing.
13. Start the engine and move the throttle to full speed (3,210 rpm) position. Use a phototac to check that the engine speed is correct.
14. Record the reading on the charge test port pressure gauge. The charge pressure without load should read **5.6 to 7 bar (81 to 101.5 psi)**. If the charge pressure specification is not met, the hydraulic pump charge relief valve may be damaged. Repair or replace the hydraulic pump charge relief valve; refer to Servicing the Hydraulic Piston Pump (page 5–86).
15. Sit in the operator’s seat, release the parking brake, and slowly press the traction pedal forward until the pressure reached to **100 to 115 bar (1450 to 1668 psi)** on the traction circuit pressure gauge and then to reverse while monitoring the charge test port pressure gauge.
16. Record the reading on the charge test port pressure gauge (under load). The charge pressure (under load) should not drop more than 20% when compared to the charge pressure (without load) recorded in para 14.

    If the specifications are not met, perform the hydraulic pump flow and traction relief pressure test; refer to Testing the Traction Circuit - Hydraulic Pump Flow and Relief Pressure (page 5–44).
17. Release the traction pedal, move the throttle to low speed position, and shut off the engine.

Testing the Traction Circuit - Charge Pressure (continued)

18. After you complete the charge pressure testing, release hydraulic system pressure; refer to Releasing Pressure from the Hydraulic System (page 5–5). Remove the pressure gauges and install the hydraulic pressure test ports.
19. Rotate and lock the radiator in correct position.
20. Start the engine, check for hydraulic fluid leaks, repair any leaks as required, and fill the hydraulic tank with the correct quantity of new hydraulic fluid before returning the machine to service.

Testing the Wheel Motors Efficiency

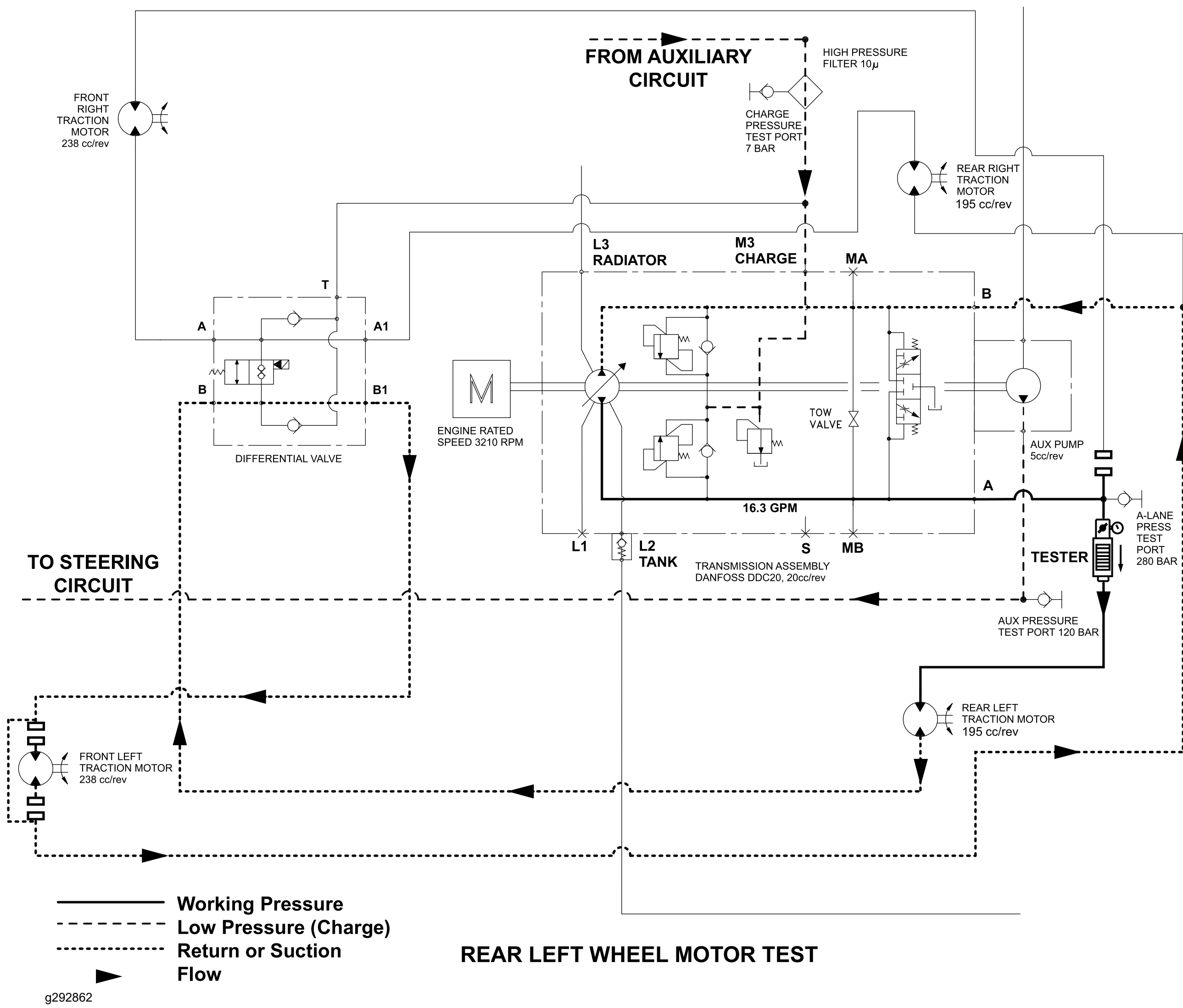

Figure 47

The wheel motor efficiency test evaluates the traction circuit performance. Hydraulic fluid flow of **2.8 LPM (0.74 GPM)** or more through a stationary rear wheel motor under load indicates an internal leak in the wheel motor. Fluid flow of **3.4 LPM (0.9 GPM)** or more through a stationary front wheel motor under load indicates an internal leak in the wheel motor. A worn wheel motor is less efficient. Too much internal fluid bypass will cause the wheel motor to stall under heavy load conditions. Continued use of a worn wheel motor will generate excessive heat, causing damage to seals and other components within the hydraulic system.

During the normal process of wheel motor operation, the rate of fluid flow through the motor varies based on the rotating position of the wheel. For this reason, the test procedure includes checking hydraulic flow through the motor after rotating the wheel to 3 different positions to get multiple readings.

Special equipment required:

- Flow meter with pressure gauge that has at least an 68 LPM (18 GPM) capacity.
- Phototach (non-contact tachometer).

Rear Left Wheel Motor Test Procedure

The hydraulic fluid flows through the rear left and bypasses all other motors by masking the hydraulic connections (Figure 47).

1. Once the test equipment is properly connected, you can run the engine and pump to warm the hydraulic fluid to operating temperature.

   Any test procedure that requires an open or uncapped line (like a case drain leak check) would not apply. In those rare situations, the hydraulic fluid should be warmed before disconnecting the lines.

CAUTION

Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to Releasing Pressure from the Hydraulic System (page 5–5).

2. Park the machine on a level surface, lower the cutting deck, shut off the engine, and set the parking brake.
3. Ensure that the traction pedal is in NEUTRAL position.
4. Read all Warning, Cautions, and precautions listed at the beginning of this section.
5. Attach a heavy chain to the rear of the machine frame and an immovable object to prevent the machine from moving during testing.
6. Clean the junction of the hydraulic hose and bottom left side of the traction pump. Disconnect the hydraulic hose from bottom left side of the traction pump fitting.

IMPORTANT

When capping hydraulic motor fitting and hydraulic hose end, use a steel cap and plug to ensure that the fluid leakage will not occur. Plastic plugs will not hold hydraulic pressure that will be developed during this test procedure.

7. Place a steel cap on T fitting to block the hydraulic fluid flow to front right and rear right wheel motors. Also install the steel plugs in the open end of the disconnected hose to prevent leakage or contamination.
8. Install the tester in series with the pump and hose (Figure 47). Make sure the tester is installed in the correct flow direction and the tester flow control valve is open.
9. Disconnect the hydraulic lines from the left front wheel motor that is not being tested (Figure 47). Connect the hydraulic lines each other that are removed from the left front wheel motor to complete the closed loop circuit. Cap the ports in the left front wheel motor to prevent contamination.

Rear Left Wheel Motor Test Procedure (continued)

10. Chock the rear left wheel being tested to prevent from rotation.

CAUTION

Use extreme caution when performing this test. The wheel motor being tested will be trying to move the machine forward.

---

11. Start the engine and run it at low idle speed. Check for the hydraulic fluid leaks from the test connections and correct before the continuing the test.
12. Set the engine speed to approximately 3,210 rpm. Use a phototac to check that the engine speed is correct.
13. While sitting in the operator seat, and with the brakes firmly applied to prevent the rear wheels from rotating, slowly press the traction pedal in the forward direction until the tester pressure displays 69 to 103 bar (1,000 to 1,500 psi).
14. Return the traction pedal to the NEUTRAL position. Release the brakes, shut off the engine, and record the test results.

    Note: Testing the wheel motor leakage in 3 different wheel positions will give the most accurate test results.
15. Rotate the wheel motor being tested to 90º and retest. Record the test results.
16. Rotate the wheel motor being tested to 180º and retest. Record the test results.
17. The flow meter reading should be less than **2.8 LPM (0.74 GPM)** for the tested wheel motor. If the specification is not met, repair or replace the wheel motor.
18. Release the hydraulic pressure from the hydraulic system; refer to Releasing Pressure from the Hydraulic System (page 5–5).
19. Disconnect the tester from the pump outlet fitting and hydraulic hose and connect the pump outlet to the hydraulic hoses.

Front Left Wheel Motor Test Procedure

If the front left wheel motor requires testing, repeat the steps 2 through 19; refer to Figure 48.

Note: The flow meter reading should be less than **3.4 LPM (0.9 GPM)** for the tested wheel motor. If the specification is not met, repair or replace the wheel motor.

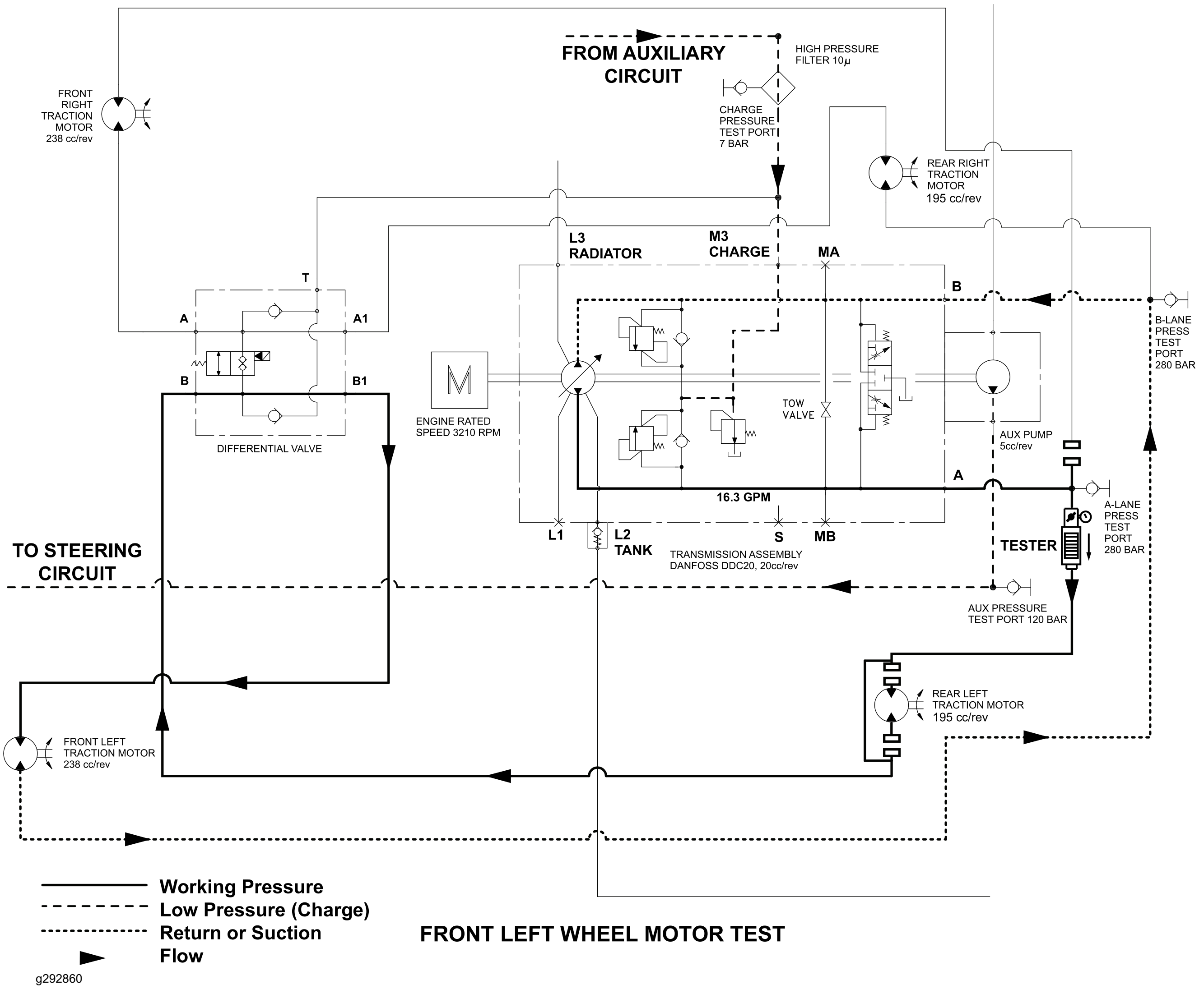

Figure 48

Front Right Wheel Motor Test Procedure

If the front right wheel motor requires testing, repeat steps 2through 19; refer toFigure 49.

Note: The flow meter reading should be less than **3.4 LPM (0.9 GPM)** for the tested wheel motor. If the specification is not met, repair or replace the wheel motor.

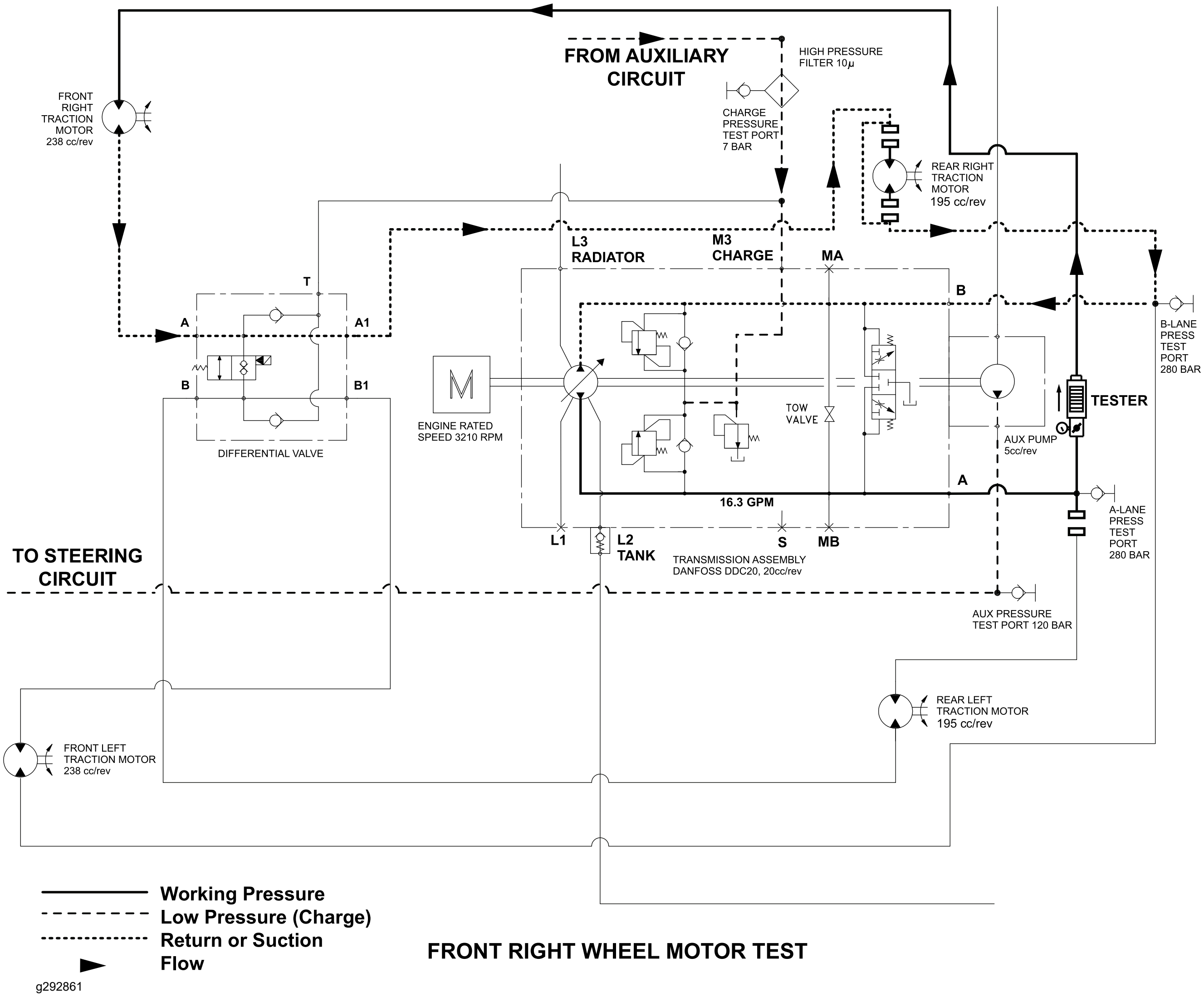

Figure 49

Rear Right Wheel Motor Test Procedure

If the rear right wheel motor requires testing, repeat the steps 2 through 19; refer toFigure 50.

Note: The flow meter reading should be less than **2.8 LPM (0.74 GPM)** for the tested wheel motor. If the specification is not met, repair or replace the wheel motor.

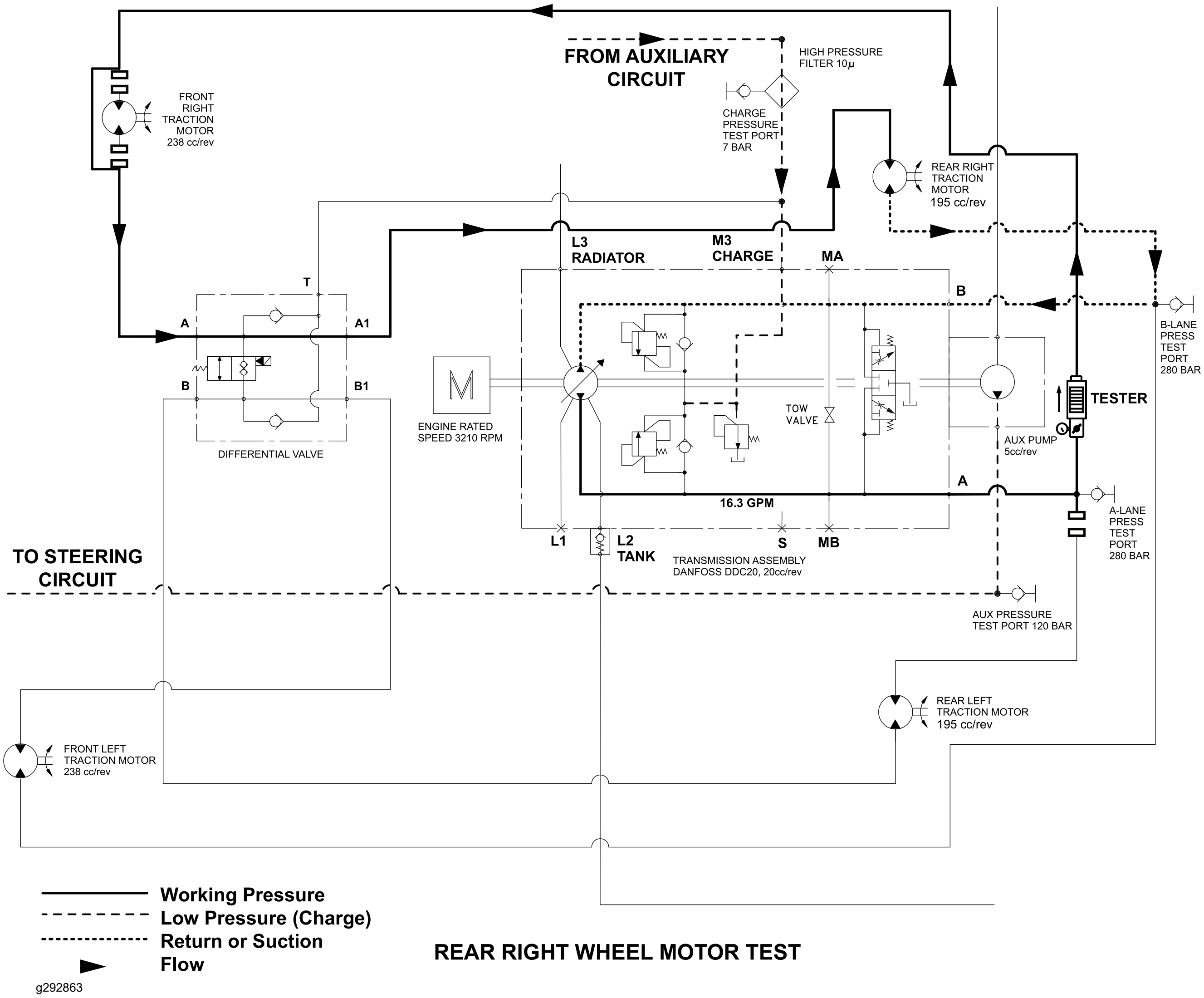

Figure 50

Testing the Traction Circuit - Hydraulic Pump Flow and Relief Pressure

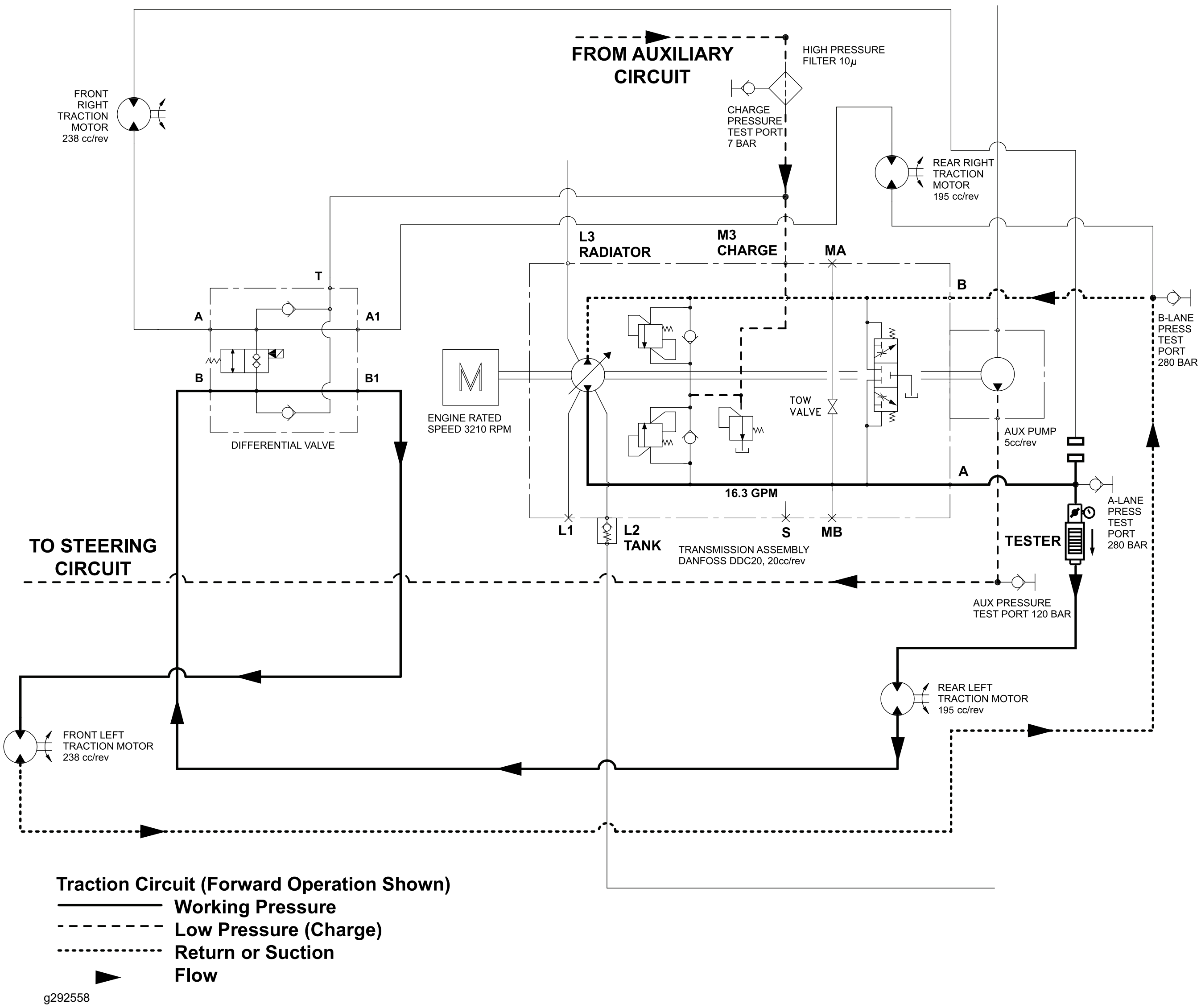

Figure 51

The hydraulic pump flow test is the third in a series of tests recommended to determine the traction circuit performance. This test compares fluid flow at no load with the fluid flow under load. A drop in flow under load of more than 12% indicates an internal leak or malfunctioning relief valve in the hydraulic pump.

The final traction circuit test is verifying the hydraulic pump relief valve operation. A worn hydraulic pump or malfunctioning relief valve is less efficient. Enough fluid bypass will cause the wheel motor to stall under heavy load conditions. Continued use of a worn wheel motor will generate excessive heat, causing damage to seals and other components within the hydraulic system.

Special Equipment Required:

- Flow meter with pressure gauge that has at least a 144 L/min (30 GPM) capacity.
- Phototach (non-contact tachometer).

Test Procedure

1. Once the test equipment is properly connected, you can run the engine and pump to warm the hydraulic fluid to operating temperature.

   Any test procedure that requires an open or uncapped line (like a case drain leak check) would not apply. In those rare situations, the hydraulic fluid should be warmed before disconnecting the lines.

CAUTION

Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to Releasing Pressure from the Hydraulic System (page 5–5).

2. Park the machine on a level surface, lower the cutting deck, shut off the engine, and set the parking brake.
3. Read all Warning, Cautions, and precautions listed at the beginning of this section.
4. Access the hydraulic pump from right side as below:

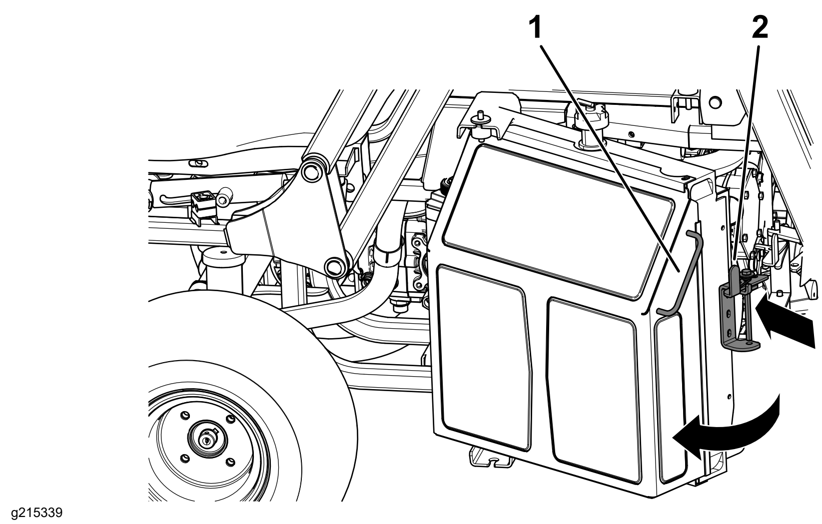

Figure 52

1. Handle
2. Latch

   A. Push the latch (item 2) inward toward the radiator (Figure 52).

   B. Using the handle (item 1), rotate the radiator to access the hydraulic pump (Figure 52).

Test Procedure (continued)

5. Access the hydraulic pump from left side. Remove the bolt (item 1) from the bracket (tem 2) and rotate the fuel tank to the right to access the hydraulic pump.

   Note: You must have the steering wheel rotated to the fully left locked position to rotate the fuel tank fully.

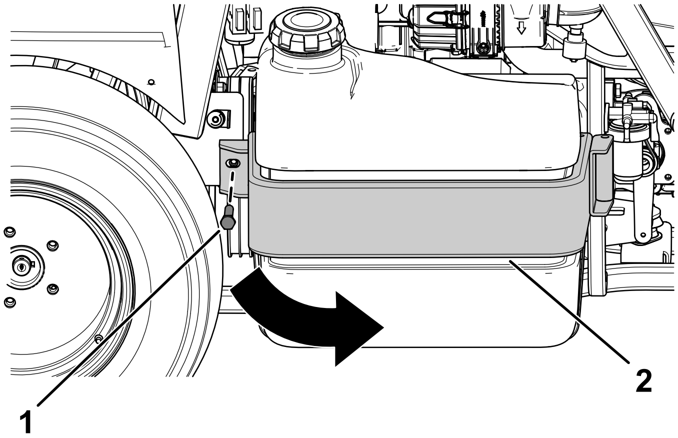

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Figure 53

1. Bolt
2. Fuel tank bracket

6. Ensure that the traction pedal is correctly adjusted for the NEUTRAL position. Also, ensure that the hydraulic pump is at full stroke when traction pedal is pressed fully in forward position.
7. Lift and support the machine so that all wheels are off the ground; refer to Jacking Instructions (page 1–7).

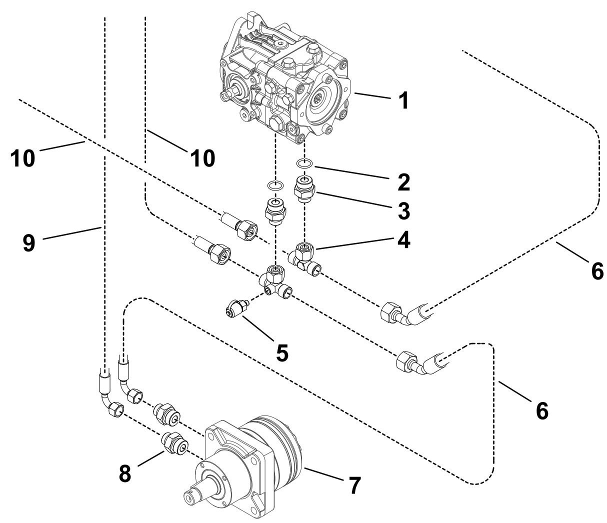

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Figure 54

1. Hydraulic pump
2. O-ring
3. Fitting
4. T fitting adaptor
5. Pressure port plug
6. Hose
7. Hydraulic motor
8. Fitting
9. Hose
10. Hose

8. Clean the junction of the hydraulic hose and left side of the fitting on bottom of the hydraulic pump (Figure 54), and disconnect the hose from the fitting.

IMPORTANT

Ensure that the fluid flow indicator arrow on the flow meter is showing that the fluid will flow from the pump, through the tester, and into the disconnected hydraulic hose.

9. Place a steel cap on T fitting to block the hydraulic fluid flow to front right and rear right wheel motors (Figure 54). Also install the steel plugs in the open end of the disconnected hose to prevent leakage or contamination.
10. Install the tester with pressure gauge in series with the pump and disconnected hose of rear left and front left motors (Figure 54). Make sure the tester is installed in the correct flow direction and the tester flow control valve is open.
11. Use the hydraulic hose kit to connect tester to the machine; refer to Special Tools (page 2–15). Ensure that the fitting and hose connections are properly tightened. Also, ensure that the flow control valve on the tester is fully open.

⚠ CAUTION ⚠

During this procedure, all the wheels will be off the ground and rotating. Ensure that the machine is well supported so it will not move and accidentally fall to prevent injuring anyone around the machine.

12. Start the engine and run it at low-idle speed. Check for hydraulic-fluid leaks from the test connections and correct before continuing the test.
13. With the engine running, move the throttle to full speed **(3,210 rpm)** position. Use a phototac to check that the engine speed is correct.
14. Verify the pump flow at no load as follows:
    A. Slowly press the traction pedal to fully forward position.
    B. Record the tester pressure and flow readings at no load. Unrestricted pump output should be approximately **63 LPM (16.7 GPM)**.
15. Verify the pump flow under load as follows:
    A. Slowly press the traction pedal to fully forward position, and keep the pedal pressed full forward.
    B. Apply an additional load of **150 to 170 bar (2,175 to 2,465 psi)** by slowly closing the flow meter.
    C. Record the tester pressure and flow readings under load.
16. Verify the traction relief valve operation as follows:
    A. Return the traction pedal to the NEUTRAL position.
    B. Fully close the flow meter flow control valve.
    C. Slowly set the traction pedal to full forward position.
    D. Record the tester pressure reading.

       The system pressure should reach **280 bar (4061 psi)** before the relief valve opens.

       Note: The relief valve setting is **285 bar (4133 psi)**. An additional **5 bar (70 psi)** is necessary to overcome system charge pressure before the relief valve opens.

Test Procedure (continued)

E. Release the traction pedal, open the flow control valve fully, move the throttle to low speed, and shut off the engine.

17. If the relief pressure can not be met or is greater than specified, the traction relief valve is damaged and should be replaced.
18. The under load test flow reading (step 15C) should not drop more than 12% when compared to the no load test flow reading (step 14B). A difference of more than 12% may indicate the hydraulic pump is worn and should be repaired or replaced.
19. After you complete the testing, disconnect the tester and connect the hose to the pump fitting.
20. Rotate and lock the radiator in correct position.
21. Rotate the fuel tank into position and secure it with the bolt.
22. Start the engine, check for hydraulic leaks, and make repairs as required. Properly service the system quantity before returning the machine to service.

Testing the Steering Circuit - Steering Control Valve, Relief Valve Pressure and Steering Cylinder

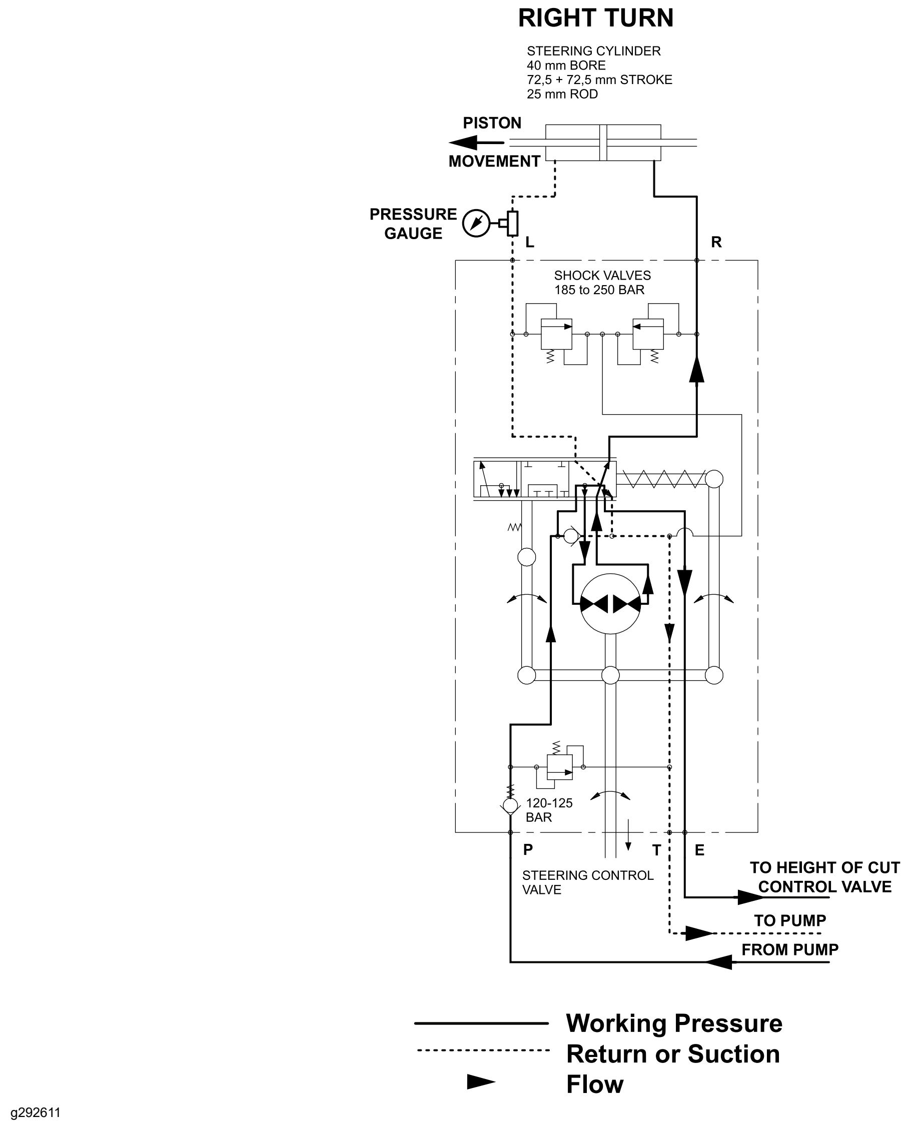

Figure 55

Steering unit performance will be impacted by incorrect rear tire pressure, binding in the hydraulic steering cylinder, extra weight on the vehicle, and/or binding of the steering spindle. Check for these conditions before proceeding with any steering system hydraulic testing.

Note: The relief valve for the steering circuit is integrated into the steering control valve.

Special Equipment Required:

- Pressure gauge accurate below 2500 psi.
- Phototach (non−contact tachometer).

Test Procedure

1. Ensure that the hydraulic fluid is at normal operating temperature by operating the machine for at least 10 minutes.
2. Drive the machine slowly in a figure eight on a flat level surface.

A. There should be no shaking or vibration in the steering wheel or rear wheels.

B. The steering wheel movements should be followed immediately by a corresponding rear wheel movement without the steering wheel continuing to turn.

3. Stop unit with the engine running. Turn the steering wheel with small quick movements in both directions. Let go of the steering wheel after each movement.

A. The steering control valve should respond to each steering wheel movement.

B. When steering wheel is released, steering control should return to the NEUTRAL position with no additional turning.

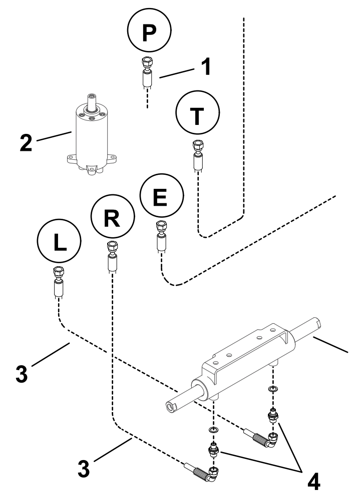

Figure 56

1. Hose
2. Steering control valve
3. Hose
4. Fitting
5. Steering cylinder

4. If either of these performance tests indicate a steering problem, determine if the steering cylinder is damaged using the following procedure:

A. Park the machine on a level surface with the PTO switch off, lower the cutting deck, and set the parking brake.

B. With the engine running, turn the steering wheel to the right (clockwise) until the steering cylinder rod is fully extended and shut off the engine.

C. Read all Warnings, Cautions, and precautions listed at the beginning of this section.

D. Clean the fitting and hose end on the right (piston extended) side of the steering cylinder. Then, disconnect the hose.

E. Use an elbow or a tee fitting with a hole plugged and install a pressure gauge at the end of the disconnected hose.

F. With the engine shut off, continue turning the steering wheel to the right (clockwise) with the steering cylinder fully extended. Monitor the open fitting on the steering cylinder as the wheel is turned. If the hydraulic fluid comes out of the fitting while turning the steering wheel to the left, the steering cylinder has internal leakage and should be repaired or replaced.

Test Procedure (continued)

5. The steering circuit relief valve located in the steering control valve can be tested with the pressure gauge installed in the same location as the steering cylinder test (step 4) as follows:
   A. Start the engine and run it at low-idle speed. Check for hydraulic-fluid leaks from the test connections and correct before continuing the test.
   B. Set the engine speed to approximately 2,000 rpm. Use a phototac to check that the engine speed is correct.

IMPORTANT

Hold the steering wheel at full lock only long enough to get a system pressure reading. Holding the steering wheel against the stop for an extended period may damage the steering control valve.

   C. Monitor the pressure gauge carefully when turning the steering wheel for a right hand turn (clockwise) and holding.
   D. The system pressure should be approximately 120 to 125 bar (1,740 to 1812 psi) as the relief valve lifts.
   E. Shut off the engine and record the test results.
6. If the specification is not met, replace the steering control valve; refer to Steering Control Valve (page 5–112).
7. After you complete the testing, shut off the engine, and then release hydraulic system pressure; refer to Releasing Pressure from the Hydraulic System (page 5–5). Disconnect the pressure gauge, and connect removed hydraulic hose to the steering cylinder.
8. Start the engine, check for hydraulic-fluid leaks, repair any leaks as required, and fill the hydraulic tank with the correct quantity of new hydraulic fluid before returning the machine to service.

Testing the Steering Circuit - Charge Pump Flow

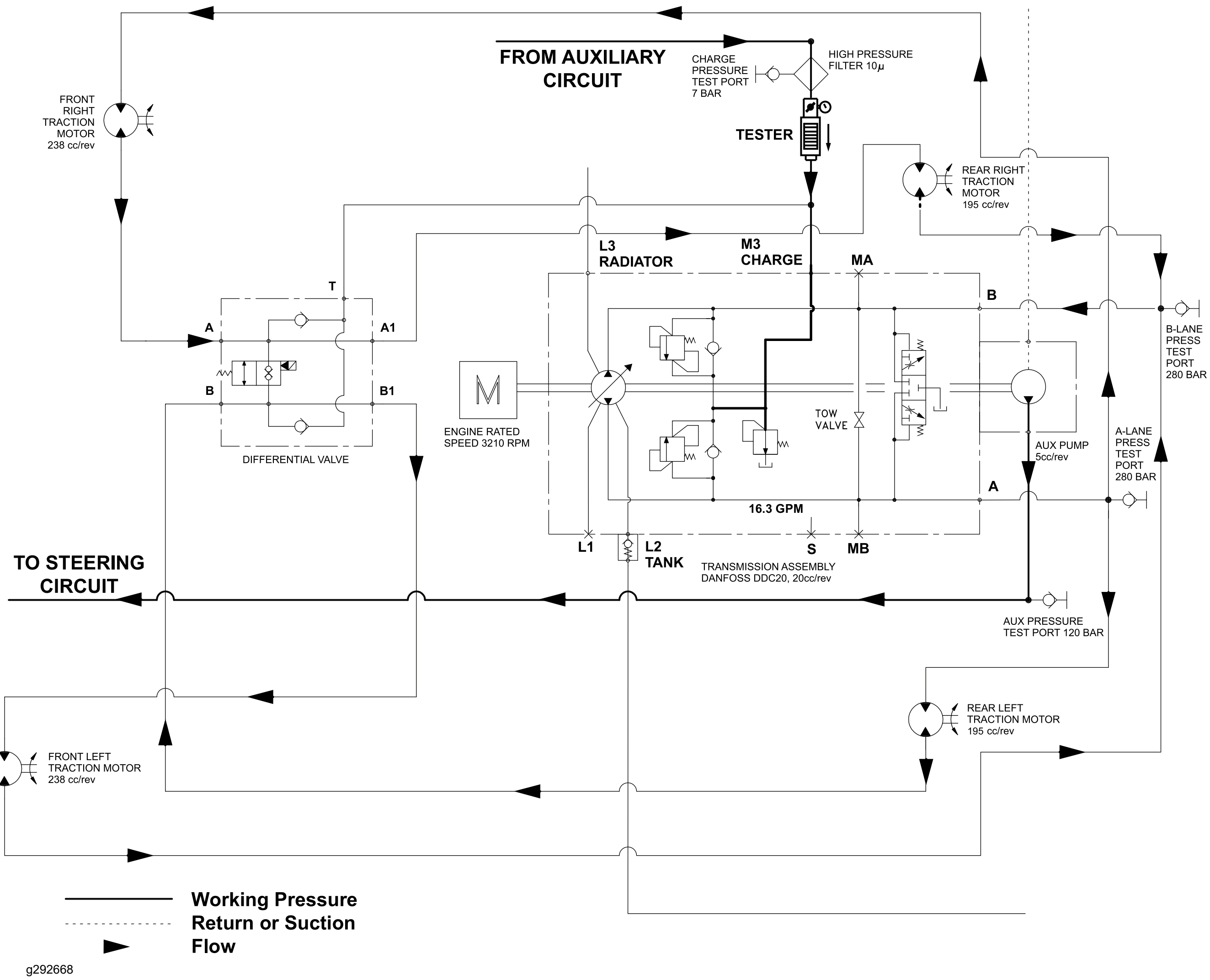

Figure 57

The charge pump is designed to satisfy the steering cylinder needs (at full speed). The charge pump flow test compares fluid flow at no load with fluid flow under load. A drop in flow under load of more than 15% indicates the gears and wear plates in the pump have worn. Continued operation with a worn pump can generate excessive heat and cause damage to the seals and other components in the hydraulic system.

Special Equipment Required:

- Flow meter with pressure gauge that has at least a 19 LPM (5 GPM) capacity.
- Phototach (non−contact tachometer).

Test Procedure

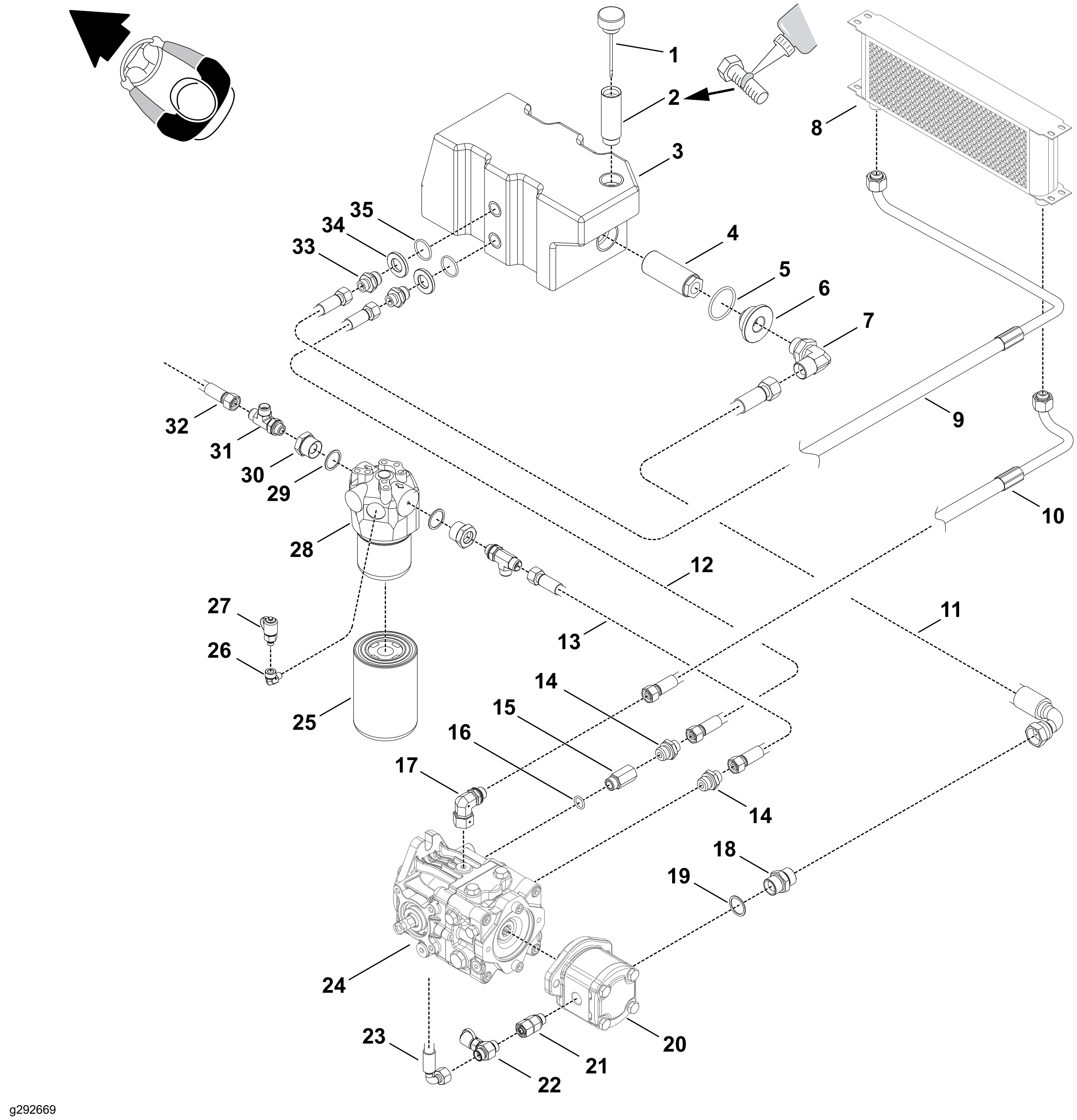

Figure 58

1.	Cap	13.	Hose	25.	Hydraulic filter
2.	Extension	14.	Fitting	26.	90º fitting
3.	Hydraulic tank	15.	One direction valve	27.	Plug
4.	Hydraulic tank filter	16.	O-ring	28.	Filter assembly
5.	O-ring	17.	90º adaptor	29.	Washer
6.	Filter support	18.	Fitting	30.	Reducer
7.	90º adaptor	19.	Washer	31.	Adaptor
8.	Oil cooler	20.	Charge pump	32.	Hose
9.	Hose	21.	Adaptor	33.	Fitting
10.	Hose	22.	T fitting	34.	Washer
11.	Hose	23.	Hose	35.	O-ring
12.	Hose	24.	Piston pump		

Test Procedure (continued)

1. Park the machine on a level surface with the PTO switch off, lower the cutting deck, shut off the engine, and set the parking brake.
2. Read all Warning, Cautions, and precautions listed at the beginning of this section.

⚠ CAUTION ⚠

Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to Releasing Pressure from the Hydraulic System (page 5–5).

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3. Raise and support the operator seat, remove the seat plate to get access to the hydraulic pump assembly.
4. Clean the junction of the hydraulic hose and right side fitting on the pump. Disconnect the hose (item 13 in Figure 57) from the right side of the pump fitting.

IMPORTANT

Ensure that the fluid flow indicator arrow on the flow meter is showing that the fluid will flow from the hydraulic tube, through the tester and into the pump.

---

5. Install a tester with the pressure gauge and flow meter in series between the pump fitting and the disconnected hose. Ensure that the flow control valve on the tester is fully open.
6. Ensure that the hydraulic fluid is at normal operating temperature by operating the machine for at least 10 minutes.
7. Ensure that the traction pedal is in the NEUTRAL position, steering wheel is stationary, and parking brake is set.
8. Start the engine and run it at low-idle speed (1,500 to 1,650 rpm). Check for hydraulic-fluid leaks from the test connections and correct before continuing the test.
9. With the engine running, move the throttle to full speed (3,210 rpm) position. Use a phototac to check that the engine speed is correct.
10. Verify the pump flow at no load as follows:
    A. Record the tester pressure and flow readings at no load.
    B. Unrestricted pump output should be approximately **15 LPM (4 GPM)**.

Test Procedure (continued)

11. Verify the pump flow under load as follows:

CAUTION

Do not close the tester valve fully when performing this test. In this test, the hydraulic tester is positioned in an unprotected part of the steering circuit.

Pump damage can occur if the fluid flow is fully restricted by fully closing the tester flow control valve.

    A. Monitor the tester pressure gauge carefully while you slowly close the flow control valve until you get 75 bar (1088 psi).

    B. Record the tester pressure and flow readings under load.

12. Move the throttle to low speed (1,500 to 1,650 rpm) position and shut off the engine.

13. The under load test flow reading (step 11B) should not drop more than 15% when compared to the no load test flow reading (step 10A). A difference in flow of more than 15%, or the inability to achieve specified pressure may indicate:

    A. A restriction in the pump inlet line.

    B. The charge pump is worn and should be repaired or replaced; refer to Servicing the Gear Pump (page 5–88).

14. After you complete the testing, shut off the engine, and then release pressure from the hydraulic system; refer to Releasing Pressure from the Hydraulic System (page 5–5).

15. Disconnect the tester, and connect the removed hydraulic tube.

16. Start the engine, check for hydraulic-fluid leaks, repair any leaks as required, and fill the hydraulic tank with the correct quantity of new hydraulic fluid before returning the machine to service.

Testing the Auxiliary Control Circuit - Cutting Deck Lift Cylinder Internal Leakage

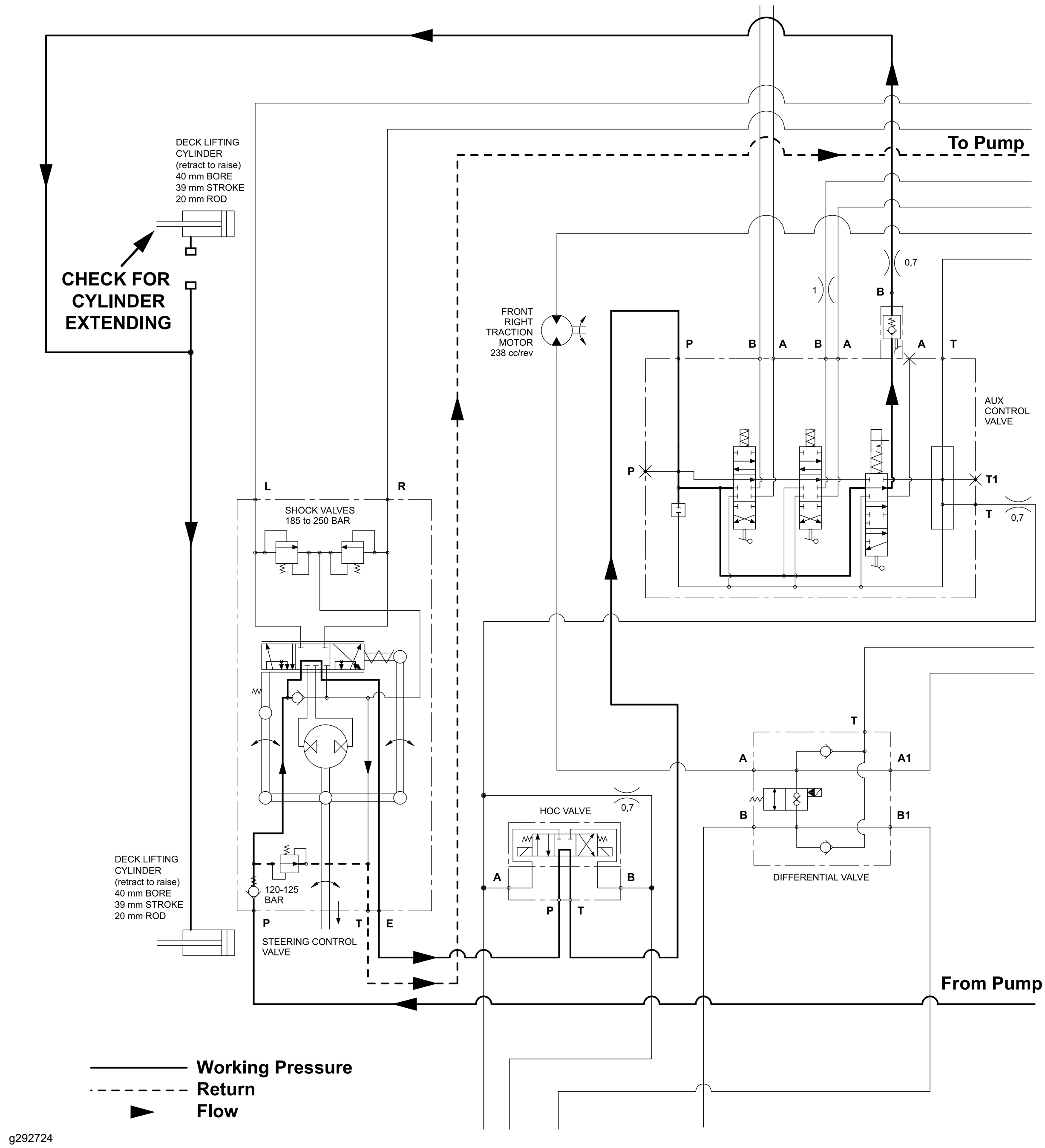

Figure 59

Perform a cutting deck lift cylinder internal leakage test if you identify a cutting deck raise and lower problem. This test determines if the lift cylinder being tested is damaged. The lift cylinders must be tested individually.

Note: The raise/lower circuit operation can be affected by several possible issues. The lift cylinder can potentially bind, there may be extra weight on the cutting deck, and/or the lift components can be hampered during operation. Inspect these components for proper function before continuing with the lift cylinder internal leakage test.

Test Procedure

Note: When performing the lift cylinder internal leakage test, the cutting deck should be attached to the lift arms and the cutting deck should be in raise position.

1. Park the machine on a level surface with the PTO switch off, shut off the engine, and set the parking brake.
2. Read all Warning, Cautions, and precautions listed at the beginning of this section.
3. If necessary, remove the front wheel to get access to the lift cylinder; refer to Removing the Wheels (page 7–3).
4. Use a jack to support the raised the lift arm under the lift cylinder that is to be tested. This will remove the load from the lift cylinder and relieve cylinder hydraulic pressure. Leave the jack under the lift arm for support and to prevent the arm from lowering.
5. Clean the area around the end of the hydraulic hose at the rod end of the lift cylinder for the supported lift arm. Disconnect the hydraulic hose from the lift cylinder rod end fitting.

IMPORTANT

When capping lift cylinder fitting and hydraulic hose end, use a steel cap and plug to ensure that the fluid leakage will not occur. Plastic plugs will not hold hydraulic pressure that will be developed during this test procedure.

6. Place a steel cap on the open lift cylinder fitting to seal the lift cylinder. Also, install a steel plug in the open end of the disconnected hose to prevent leakage or contamination.
7. Slowly lower the jack and remove it from under the lift arm. The cutting deck should settle slightly and then be supported by the capped lift cylinder.
8. The capped lift cylinder should be able to support the cutting deck long enough for the machine to move from one cutting area to another during operation.
9. If the lift cylinder allows the cutting deck to lower too quickly, replace the lift cylinder; refer to Lift Cylinder (page 5–109).
10. Once the condition of the lift cylinder is determined, use a jack to raise the lift arm slightly to remove the load from the cylinder.
11. Support the lift arm with jack stands to prevent it from lowering.
12. Remove the cap from the cylinder fitting and the plug from the hydraulic hose.
13. Connect the hydraulic hose to the lift cylinder fitting.
14. Carefully remove the jack from under the lift arm.
15. If removed, install the wheel onto the machine; refer to Installing the Wheels (page 7–4).
16. Start the engine and operate the lift cylinders through several up and down cycles. Shut off the engine and check for any leakage.
17. If necessary, repeat the steps 4 through 16 for other lift cylinders.
18. Check and fill the hydraulic tank with the correct quantity of new hydraulic fluid before returning the machine to service.

Testing the Auxiliary Control Circuit - Hopper Lift Cylinder Internal Leakage

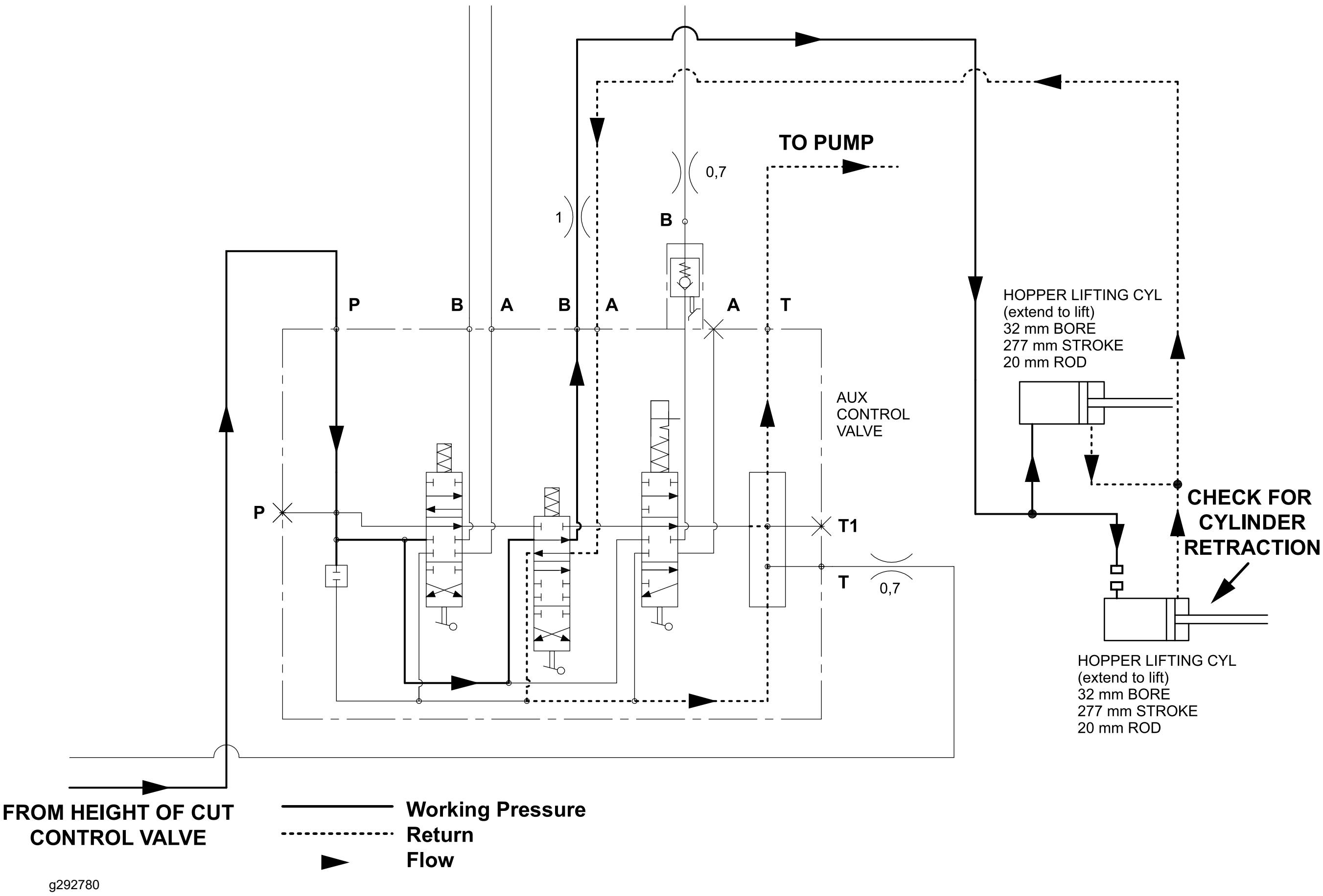

Figure 60

Perform a hopper lift cylinder internal leakage test if a raise/lower problem exists. This test determines if the lift cylinder is damaged. Each hopper lift cylinder must be tested individually.

Note: The raise/lower circuit operation can be affected by the hopper lift cylinder binding, extra weight on the hopper, and/or binding of the lift components. Ensure that these items are checked before continuing with the hopper lift cylinder internal leakage test.

Test Procedure

Note: When performing the lift cylinder internal leakage test, the hopper must be attached to the lift arms.

1. Park the machine on a level surface and raise the hopper; refer to *Operator's Manual*.
2. Switch of the PTO, shut off the engine, and set the parking brake.
3. Secure the hopper in raised position with hopper safety lock; refer to *Operator's Manual*.
4. Clean the area around the hydraulic hoses end at the barrel end of the hopper lift cylinder. Disconnect the hydraulic hoses from the hopper lift cylinder barrel end fitting.

Test Procedure (continued)

IMPORTANT

When capping the hopper lift cylinder fitting and hydraulic hose end, use a steel cap and plug to ensure that there is no fluid leakage. The plastic plugs cannot hold the hydraulic pressure that is developed during this test procedure.

5. Install a steel cap on the open hopper lift cylinder fitting to seal the lift cylinder. Also, install a steel plug in the open end of the disconnected hose to prevent leakage or contamination.
6. Remove the hopper safety lock and allow the hopper weight onto the hopper lift cylinder.
7. The capped hopper lift cylinder should be able to support the hopper long enough for the machine to tilt and clean the hopper.
8. If the hopper lift cylinder allows the hopper to lower too quickly, replace the hopper lift cylinder; refer to Hopper Lift Cylinder (page 5–118).
9. Once the hopper lift cylinder condition is determined, raise the hopper slightly which removes the load from the lift cylinder.
10. Lock the hopper lift cylinder with hopper safety lock to prevent it from lowering.
11. Remove the cap from the cylinder fitting and the plug from the hydraulic hose.
12. Connect the hydraulic hose to the hopper lift cylinder fitting.
13. Carefully remove the hopper safety lock. Start the engine and operate the hopper lift cylinders through several up and down cycles. Shut off the engine and check for any leakage.
14. If necessary, repeat the steps 3 through 13 for other hopper lift cylinder.
15. Check and fill the hydraulic tank with the correct quantity of new hydraulic fluid before returning the machine to service.

Testing the Auxiliary Control Circuit - Hopper Tilt Cylinder Internal Leakage

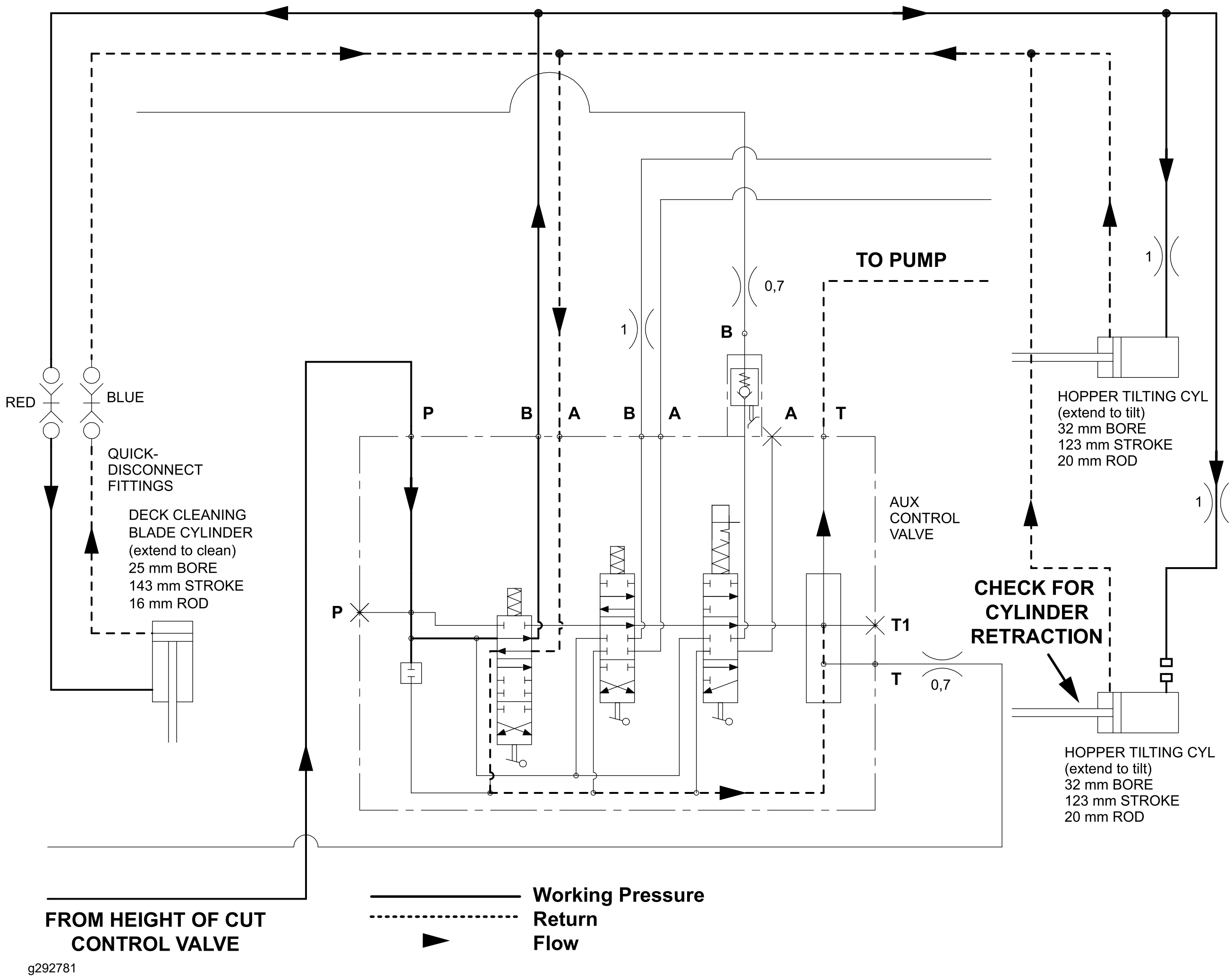

Figure 61

Perform a hopper tilt cylinder internal leakage test if you identify a hopper tilt and lower problem. This test determines if a hopper tilt cylinder being tested is damaged. The hopper tilt cylinders must be tested individually.

Note: The hopper tilt/lower circuit operation can be affected by the hopper tilt cylinder binding, extra weight on the hopper, and/or binding of the lift components. Ensure that these items are checked before continuing with the hopper tilt cylinder internal leakage test.

Test Procedure

Note: When performing the hopper tilt cylinder internal leakage test, the hopper should be attached to the hopper lift arms.

1. Park the machine on a level surface and tilt the hopper; refer to *Operator's Manual*.
2. Switch of the PTO, shut off the engine, and set the parking brake.
3. Secure the hopper in tilt position.
4. Clean the area around the hydraulic hoses end at the barrel end of the hopper tilt cylinder. Disconnect the hydraulic hoses from the hopper tilt cylinder barrel end fitting.

Test Procedure (continued)

IMPORTANT

When capping the hopper tilt cylinder fitting and hydraulic hose end, use a steel cap and plug to ensure that there is no fluid leakage. The plastic plugs cannot hold the hydraulic pressure that is developed during this test procedure.

5. Install a steel cap on the open hopper tilt cylinder fitting to seal the tilt cylinder. Also, install a steel plug in the open end of the disconnected hose to prevent leakage or contamination.
6. Allow the hopper weight onto the hopper tilt cylinder.
7. The capped hopper tilt cylinder should be able to support the hopper long enough for the machine to tilt and clean the hopper.
8. If the hopper tilt cylinder allows the hopper to lower too quickly, replace the hopper tilt cylinder; refer to Hopper Tilt Cylinder (page 5–121).
9. Once the hopper tilt cylinder condition is determined, tilt the hopper slightly which removes the load from the tilt cylinder.
10. Secure the hopper in tilt position.
11. Remove the cap from the cylinder fitting and the plug from the hydraulic hose.
12. Connect the hydraulic hose to the tilt cylinder fitting.
13. Start the engine and operate the hopper tilt cylinders through several tilt and lower cycles. Shut off the engine and check for any leakage.
14. If necessary, repeat the steps 3 through 13 for other hopper lift cylinder.
15. Check and fill the hydraulic tank with the correct quantity of new hydraulic fluid before returning the machine to service.

Testing the Height Of Cut Cylinder Internal Leakage

The block valve in the height of cut circuit should hold the cylinder piston in correct position all the time.

If the height of cut piston lowers the height of cut itself, replace the height of cut cylinder; refer to Height Of Cut Cylinder (page 5–124).

Service and Repairs

General Precautions for Removing and Installing the Hydraulic System Components

Before Repairing or Replacing the Components

1. Before removing any parts from the hydraulic system, park the machine on a level surface, lower the cutting deck, turn the engine OFF, set the parking brake, and remove the key from the key switch.
2. Clean the machine before you disconnect, remove, or disassemble the hydraulic components.

   Note: Cleanliness is necessary whenever you work on the hydraulic equipment. Ensure that you clean the hydraulic components, hoses, connections, and fittings.
3. Label all the disconnected hydraulic lines and hoses for proper installation after repairs are completed.
4. Note the position of the hydraulic fittings (especially elbow fittings) on the hydraulic components before removal.

   Note: Mark the parts, if necessary before removal and ensure that they are aligned properly when installing the hydraulic fittings, hoses, and tubes.

WARNING

Before disconnecting or doing any work on the hydraulic system, release all the pressure in the system; refer to **Releasing Pressure from the Hydraulic System (page 5–5)****.**

5. The hydraulic fluid may be hot. Be careful when you loosen and remove the hydraulic system components.
6. Install clean caps or plugs on the hydraulic lines, hydraulic fittings, and components that are left open or exposed to prevent hydraulic system contamination. Cap the opening as soon as the line or port is exposed.

After Repairing or Replacing the Components

1. Check the hydraulic-fluid level in the hydraulic tank and add correct quantity of fluid if necessary. Use the hydraulic fluids that are specified in the traction unit *Operator's Manual*.

IMPORTANT

Drain and fill the hydraulic-system tank and change the hydraulic fluid filters if the component failure is severe or the system is contaminated; refer to the traction unit *Operator's Manual*.

2. Lubricate the O-rings and seals with clean hydraulic fluid before installing the hydraulic components.
3. Remove all the caps or plugs from the hydraulic tubes, hydraulic fittings, and components before connecting them again.

After Repairing or Replacing the Components (continued)

4. Use proper tightening procedures when installing the hydraulic hoses and fittings; refer to Installing the Hydraulic Hoses and Tubes (page 5–8) and Installing the Hydraulic Fittings (page 5–10).
5. After you complete the repairs, check the control linkages or cables for proper adjustment, binding, or broken parts.
6. Whenever hydraulic fluid has been drained from the pumps (system drain, flush, or pump removal/installation) it is important to properly prime the hydraulic pumps, refer to Priming the Hydraulic Pump (page 5–70).
7. After you disconnect or replace any hydraulic component, operate the machine functions slowly until the air is out of the system; refer to Charging the Hydraulic System (page 5–72).
8. Check for hydraulic-fluid leaks. Shut off the engine and repair leaks if necessary.

Checking the Hydraulic Lines and Hoses

WARNING

Hydraulic fluid escaping under pressure can penetrate skin and cause injury.

- **Ensure that all hydraulic-fluid hoses and lines are in good condition and all hydraulic connections and fittings are tight before applying pressure to the hydraulic system.**
- **Keep your body and hands away from pinhole leaks or nozzles that eject high-pressure hydraulic fluid.**
- **Use a piece of cardboard or paper to find hydraulic leaks.**
- **Release all pressure in the hydraulic system before performing any work on the system.**
- **Seek immediate medical attention if hydraulic fluid is injected into your skin.**

IMPORTANT

Check the hydraulic lines and hoses daily for leaks, kinked lines, loose mounting supports, wear, loose fittings, weather deterioration, and chemical deterioration. Repair the damaged hydraulic equipment before operating the machine.

Flushing the Hydraulic System

IMPORTANT

Flush the hydraulic system whenever there is a severe component failure or the system is contaminated (for example, the fluid appears milky, black, or contains metal particles).

IMPORTANT

If a component failure occurs in the traction circuit; refer to the Traction Circuit Component Failure (page 5–6) for information regarding the importance of removing contamination from the traction circuit.

1. Ensure that the hydraulic fluid is at normal operating temperature by operating the machine for at least 10 minutes.

CAUTION

Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to Releasing Pressure from the Hydraulic System (page 5–5).

2. Park the machine on a level surface, engage the parking brake, lower the cutting deck and stop the engine. Remove key from the key switch.

   Note: Ensure that you clean all the hydraulic connections that are disconnected for draining.

3. Drain the hydraulic fluid from the hydraulic reservoir; refer to the *Operator's Manual*.
4. Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–63).

CAUTION

Flush the hydraulic system with the hydraulic fluid as warm as possible, but to prevent additional system damage, Do Not operate a machine with contaminated hydraulic fluid to warm the fluid before draining.

IMPORTANT

Follow all local codes and regulations when recycling or disposing the hydraulic fluid and filters.

5. Clean the area around the mounting area of the hydraulic-fluid filter. Remove and replace the hydraulic-fluid filter.

Flushing the Hydraulic System (continued)

6. Drain the complete hydraulic system. Drain all the hoses, tubes, and components while the system is warm. Flush the hoses and tubes to remove any contamination.
7. Ensure that the mounting surface of the hydraulic-fluid filter is clean. Apply clean hydraulic fluid to the gasket on new filter. Tighten the filter until the gasket contacts the mounting plate, then tighten the filter 3 quarters of a turn.

IMPORTANT

Using other hydraulic fluids could damage the hydraulic system. Use the hydraulic fluids that are specified in the *Operator's Manual*.

8. Fill the hydraulic reservoir with the correct quantity of new hydraulic fluid; refer to the *Operator's Manual*.
9. Disconnect the electrical connector to the fuel stop solenoid to prevent the engine from starting.
10. Prime the hydraulic pump; refer to Priming the Hydraulic Pump (page 5–70).
11. Connect the electrical connector to the fuel stop solenoid to allow the engine to start.
12. Start the engine and operate at low idle speed for minimum of 2 minutes. Increase the engine speed to high idle for a minimum of 1 minute under no load.
13. Raise and lower the cutting deck, hopper assembly server times. Turn the steering wheel fully left and right several times.
14. Shut off the engine and check for hydraulic fluid leaks.

    Note: Check the hydraulic-fluid level in the hydraulic tank and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
15. Operate the machine for 2 hours under normal operating conditions.
16. Check the condition of hydraulic fluid. If new fluid shows any signs of contamination, repeat steps 1 through 15 again until the fluid is clean.
17. When the hydraulic fluid is free from contamination, assume normal operation and follow the recommended maintenance intervals.

Filtering the Closed-Loop Traction Circuit

Filtering a closed-loop hydraulic system after a major component failure (e.g., hydraulic pump or hydraulic motor) is necessary to prevent unwanted material from transmitting throughout the system. If a closed-loop hydraulic system filtering tool is not used to ensure the system cleanliness, repeat failures, as well as subsequent damage to other hydraulic components in the affected system will occur. To effectively remove the contamination from the closed-loop circuit, use the Toro high flow hydraulic filter and hydraulic hose kits (refer to Special Tools (page 2–15)).

1. Park the machine on a level surface, shut of the engine, and remove the key from the key switch.

   Note: Before lifting the machine with a jack, review and follow the Jacking Instructions (page 1–7).

2. Lift and support the machine so that all 4 wheels are off the ground.

   Note: If the hydraulic motor was replaced, install a high-flow filter to the inlet of the new motor instead of to the hydraulic pump fitting. This will prevent system contamination from entering and damaging the new hydraulic motor.

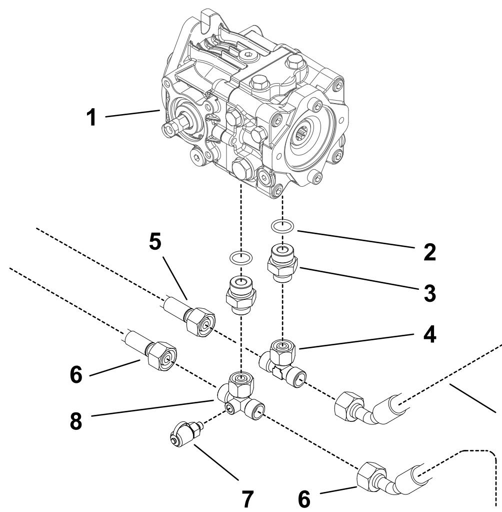

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Figure 62

1. Hydraulic pump
2. O-ring
3. Fitting
4. Right T fitting
5. Hydraulic hose (reverse)
6. Hydraulic hose (forward)
7. Plug
8. Left T fitting

3. Clean the junction of the hydraulic hose and left T fitting (item 8 in Figure 62) at the bottom of the hydraulic pump. Disconnect the left T fitting from the hydraulic pump.

4. Connect the Toro high flow hydraulic filter in series between the hydraulic pump and the left T fitting. Use the hydraulic hose kit (refer to Special Tools (page 2–15)) to connect the filter to the machine. Ensure that the fitting and hose connections are properly tightened.

IMPORTANT

Using other hydraulic fluids could damage the hydraulic system. Use the hydraulic fluids that are specified in the *Operator's Manual*.

Filtering the Closed-Loop Traction Circuit (continued)

5. After you install the high-flow filter to the machine, check and fill the hydraulic tank with the correct quantity of new hydraulic fluid.
6. Start the engine and run it at low-idle speed. Check for hydraulic-fluid leaks at the filter and hose connections. Correct any leaks before you proceed.

CAUTION

During this procedure, all the wheels will be off the ground and rotating.

Ensure that the machine is well supported so it will not move and accidentally fall to prevent injuring anyone around the machine.

IMPORTANT

While engaging the traction circuit, monitor the indicator on the high flow hydraulic filter. If the indicator shows red, either reduce the pressure on the traction pedal or reduce the engine speed to decrease the hydraulic flow through the filter.

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7. With the engine running at low-idle speed, slowly move the traction pedal to the forward direction to allow flow through the traction circuit and high-flow filter. Keep the traction circuit engaged in forward for 5 minutes while gradually increasing both forward pressure on the traction pedal and engine speed. Monitor the filter indicator to ensure that the green color is showing during operation.
8. With the engine running at high-idle speed and traction pedal moved to the forward direction, periodically apply brakes to increase pressure in the traction circuit. While monitoring the filter indicator, continue this process for 5 more minutes.

IMPORTANT

If you are using a filter that is not the Toro high flow filter that is bi-directional, do not press the traction pedal in the reverse direction. If the flow is reversed when using a filter that is not bi-directional, unwanted material from the filter will again enter the traction circuit.

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9. With the engine running at high-idle speed, alternately move the traction pedal from forward to reverse. While monitoring the filter indicator, continue this process for 5 more minutes.
10. Shut off the engine and remove the key from the key switch.
11. Remove the high flow hydraulic filter and hydraulic hose kit from the machine. Connect the left T fitting to the hydraulic pump. Ensure that you properly tighten the hoses; refer to Installing the Hydraulic Hoses and Tubes (page 5–8).
12. Lower the machine to the ground.
13. Check the hydraulic-fluid level in the hydraulic tank and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.

Priming the Hydraulic Pump

When the hydraulic system is flushed or charged or the hydraulic components are installed, it is important to properly prime the hydraulic pumps. The hydraulic pump priming ensures that the hydraulic pumps have sufficient fluid during initial start-up and running. The pump can be primed by using a remote starter switch (refer to Special Tools (page 2–15)) to crank the engine which allows the pump to prime.

Use the following procedure to prime the hydraulic pumps:

1. Ensure that the key switch is in the OFF position and the key is removed from the key switch.
2. Check the hydraulic-fluid level in the hydraulic tank and add correct quantity of fluid if necessary; refer to the *Operator’s Manual*.

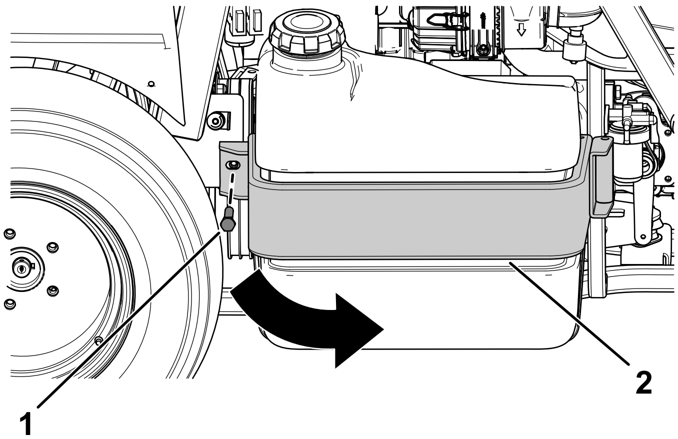


Figure 63

1. Bolt
2. Fuel tank bracket

3. Remove the bolt from the left side of the fuel tank bracket and rotate the fuel tank to the right to access the engine (Figure 63).

   Note: You must have the steering wheel rotated to the fully locked position to rotate the fuel tank out fully.

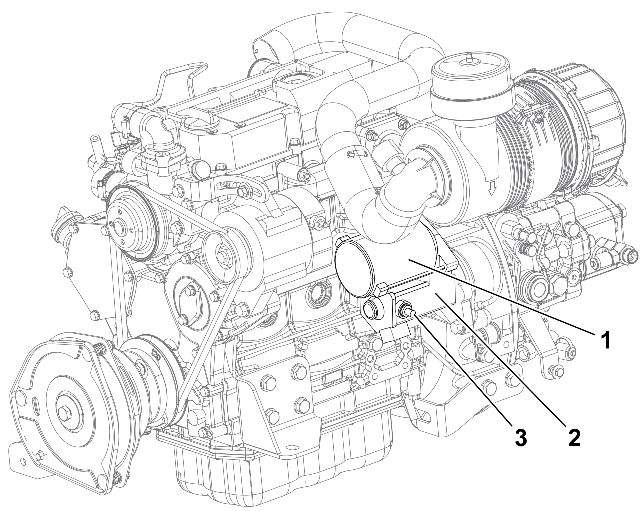


Figure 64

1. Starter motor
2. Starter solenoid
3. B+ terminal

Priming the Hydraulic Pump (continued)

Note: A blue wire connects to the starter motor solenoid B+ terminal (Figure 64). It is necessary to remove this blue wire from the solenoid terminal for hydraulic pump priming.

4. Connect the remote starter switch electrical leads to the starter motor solenoid B+ terminal and positive post of the battery.
5. Engage the remote starter switch and crank the starter for 30 seconds to prime the hydraulic pumps. Wait for 30 seconds to allow the starter motor and starter solenoid to cool. Repeat the cranking procedure for the second time.
6. Disconnect the remote starter switch leads from the starter motor solenoid terminal and positive post of the battery.
7. Connect the wire harness electrical connector to the fuel solenoid terminal.

Charging the Hydraulic System

Note: When initially starting the hydraulic system with new or rebuilt components such as hydraulic pump, hydraulic motor, or lift cylinders, it is important that the hydraulic system is charged properly. Remove the air from the system and its components to reduce the chance of damage.

IMPORTANT

Change the hydraulic fluid filter when you repair or replace the hydraulic components.

1. Park the machine on a level surface and shut off the engine.
2. After the hydraulic system components have been properly installed and if the hydraulic pump was rebuilt or replaced, ensure that the hydraulic pump housing is at least half full of clean hydraulic fluid.
3. Ensure that all of the hydraulic connections, lines, and components are secured tightly.

   Note: Flush and fill the hydraulic system and reservoir whenever there is a severe component failure or the system is contaminated; refer to Flushing the Hydraulic System (page 5–66).
4. Ensure that the hydraulic tank is full. Add correct quantity of hydraulic fluid if necessary; refer to the *Operator's Manual*.
5. Check the control linkage for proper adjustment, binding, or damaged parts.
6. Disconnect the electrical connector to the fuel stop solenoid to prevent engine from starting.
7. Prime the hydraulic pump; refer to Priming the Hydraulic Pump (page 5–70).
8. Connect the electrical connector to the fuel stop solenoid to allow the engine to start.
9. Ensure that the traction pedal is in NEUTRAL position and the PTO switch is in the OFF position. Start the engine and run it at low-idle speed.

   Note: The hydraulic pump must pick up the hydraulic fluid and fill the hydraulic system. If there is no indication of fill in 30 seconds, shut off the engine and find the cause.
10. After the hydraulic system starts to show the signs of fill, press the deck lift switch until the lift cylinder rod moves in and out several times.
11. If the lift cylinders does not move after 3 to 5 seconds or if the pump emits abnormal sounds, shut off the engine immediately, and find the cause or problem. Inspect for the following:
    A. The oil filter or suction lines that are loose.
    B. An incorrect hose routing.
    C. The suction line that is blocked.
    D. The charge relief valve in the hydraulic pump that is damaged.
12. After the lift cylinder moves normally, proceed to step 13.
13. Turn the steering wheel in both directions so that the steering cylinders move in and out several times.
14. Operate the traction pedal in the forward and reverse directions. The drive wheels should rotate in the proper direction. If the wheels rotate in the wrong direction, shut off the engine, inspect the hydraulic line placement at the hydraulic pump and hydraulic motor. Correct the hydraulic line installation before you proceed.

Charging the Hydraulic System (continued)

15. Ensure that the traction pedal returns to the NEUTRAL position when released from the forward or reverse direction and adjust if necessary; refer to the *Operator's Manual*.
16. Check the operation of the traction interlock switches; refer to Checking the Operation of the Interlock Switches (page 6–5).
17. If the hydraulic pump was replaced or rebuilt, operate the traction circuit so that all the wheels rotate slowly for 10 minutes.
18. Operate the machine by gradually increasing its work load to full over a 10 minute period.
19. Stop the machine. Check the hydraulic-fluid level in the hydraulic tank and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
20. Check the hydraulic components for leaks and tighten any loose connections.

Hydraulic Tank

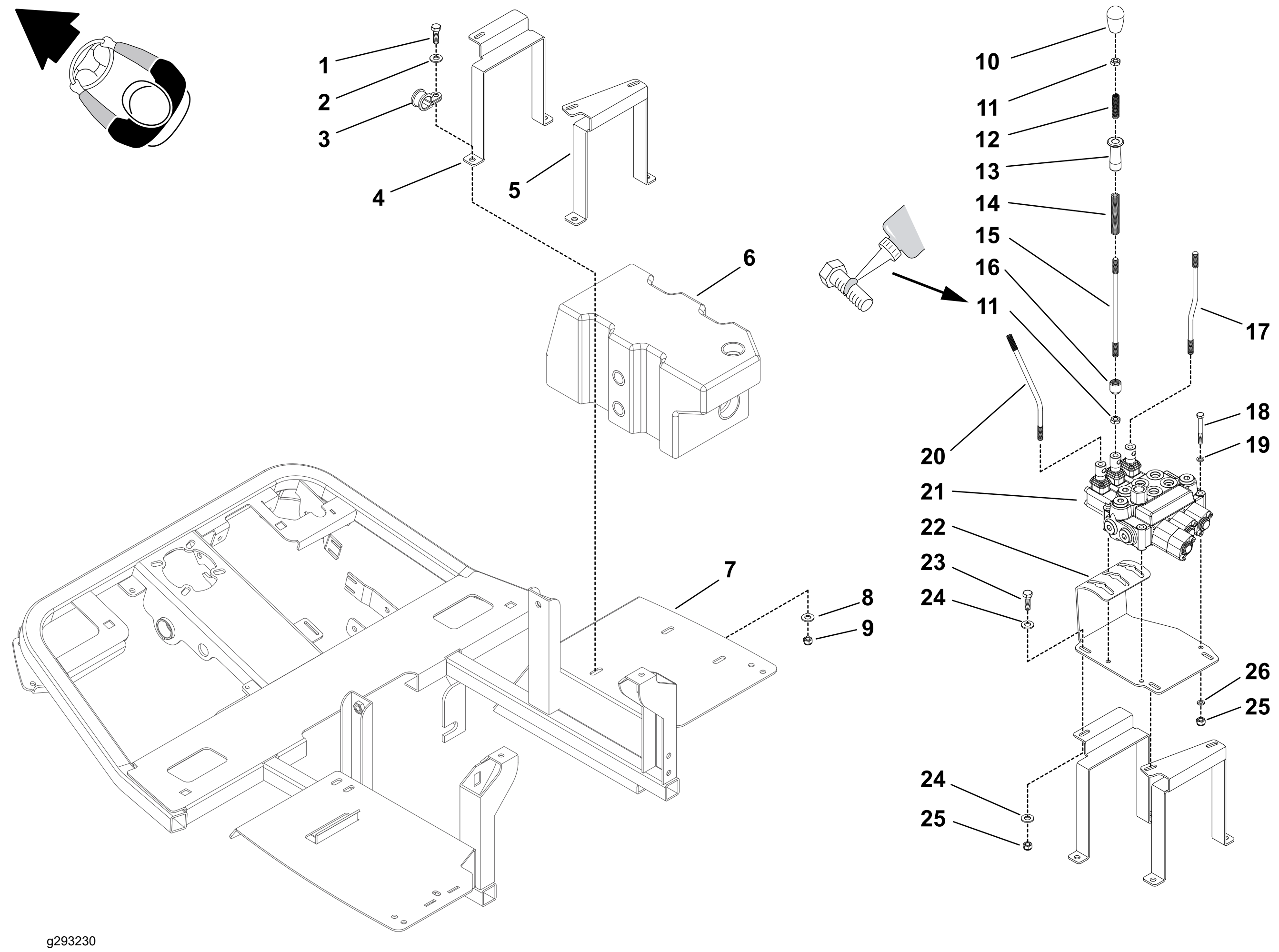


Figure 65

1. Bolt
2. Washer
3. Clamp
4. Band clamp
5. Band clamp
6. Hydraulic tank
7. Operator platform
8. Washer
9. Nut
10. Knob
11. Nut
12. Spring
13. Puller knob
14. Spring
15. Auxiliary valve lever
16. Connector
17. Auxiliary valve lever
18. Bolt
19. Washer
20. Auxiliary valve lever
21. Auxiliary control valve
22. Auxiliary control valve support
23. Bolt
24. Washer
25. Nut
26. Washer

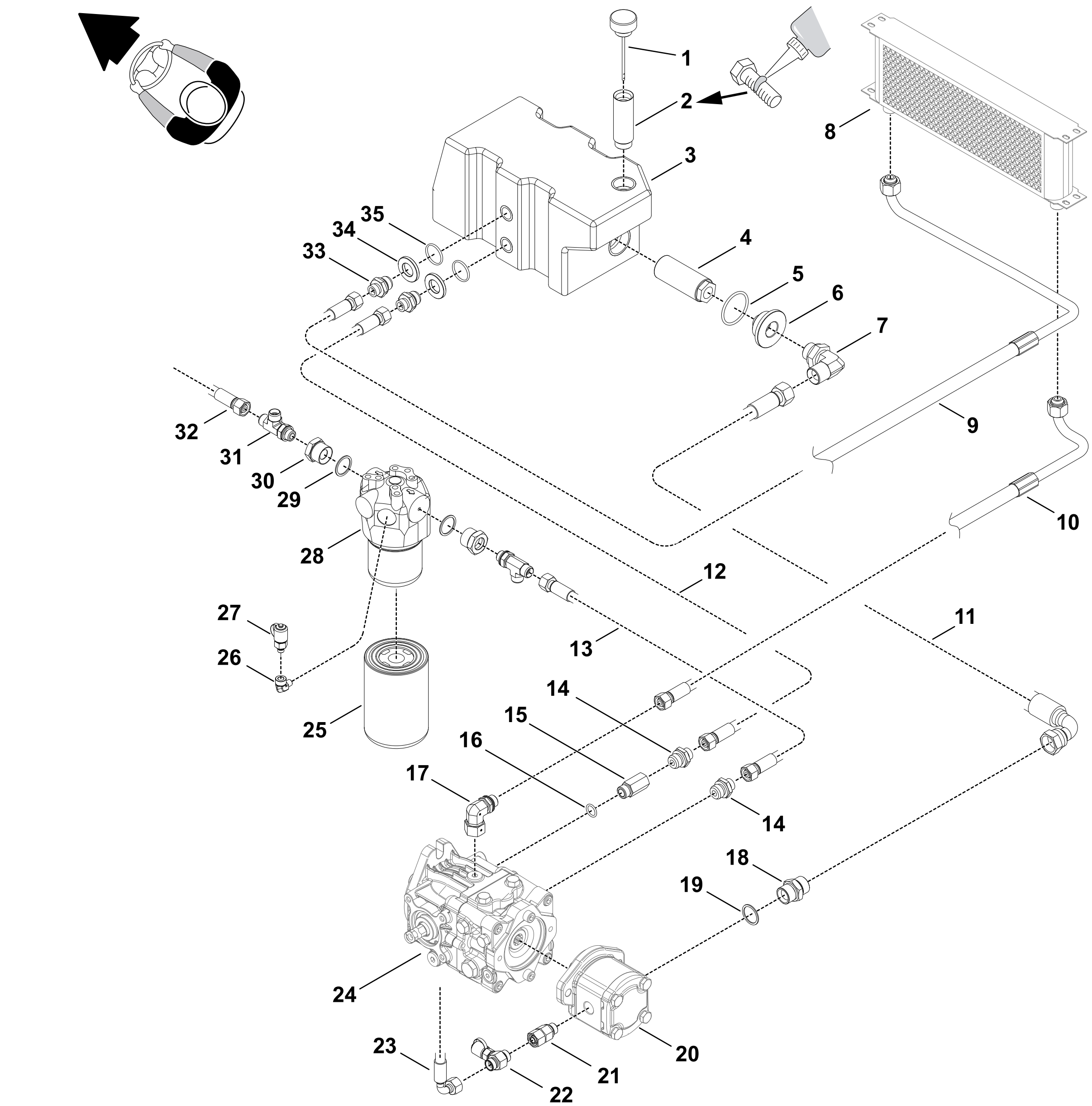


Figure 66

1.	Cap	13.	Hose	25.	Hydraulic filter
2.	Extension	14.	Fitting	26.	90º fitting
3.	Hydraulic tank	15.	One direction valve	27.	Plug
4.	Hydraulic tank filter	16.	O-ring	28.	Filter assembly
5.	O-ring	17.	90º adaptor	29.	Washer
6.	Filter support	18.	Fitting	30.	Reducer
7.	90º adaptor	19.	Washer	31.	Adaptor
8.	Oil cooler	20.	Charge pump	32.	Hose
9.	Hose	21.	Adaptor	33.	Fitting
10.	Hose	22.	T fitting	34.	Washer
11.	Hose	23.	Hose	35.	O-ring
12.	Hose	24.	Piston pump		

Remove the Hydraulic Tank

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Drain the hydraulic fluid from the tank into a suitable container; refer to *Operator's Manual*.
3. Remove the right console to get access to auxiliary control valve; refer to Disassembling the Body Assembly (page 7–6).
4. Clean the hydraulic hose ends and fittings on the hydraulic tank to prevent contaminants from entering into the hydraulic system.
5. For assembly purposes, label all the hydraulic hoses and fittings.
6. Remove the auxiliary control valve; refer to Remove the Auxiliary Control Valve (page 5–78).
7. Remove the remaining hydraulic connections from the fitting on the hydraulic tank and drain the hoses into a suitable container.
8. Install the clean caps or plugs on the hydraulic hoses and fittings to prevent system contamination.
9. Remove the bolts (item 1 in Figure 65), washers (2 and 8) and nuts (9) that secures the band clamps (4 and 5) to the operator platform (7).
10. Remove the band clamps and remove the hydraulic tank from the machine.
11. Remove the hydraulic tank filter from the hydraulic tank and discard the O-ring from the filter.
12. If the hydraulic fittings are to be removed from the hydraulic tank, mark the fitting orientation for assembly purposes. Remove the fittings from the tank and discard the O-rings from the fittings.

Inspecting the Hydraulic Tank

1. Clean the hydraulic tank and tank strainer with solvent.
2. Inspect the hydraulic tank for leaks, cracks, or other damage.

Installing the Hydraulic Tank

1. If the hydraulic fittings were removed from the hydraulic tank, lubricate and install the new O-rings to the fittings. To properly align and install the fittings into the tank openings, use the marks that you made during the removal process. Tighten the fittings; refer to Installing the Hydraulic Fittings (page 5–10).
2. Lubricate and install the new tank filter O-ring onto the filter. Thread the tank filter into the hydraulic tank with hand. Then, use a wrench, turn the filter into the tank port 1-1/2 to 2 full turns beyond finger tight.
3. Position the hydraulic tank onto the operator platform and secure with band clamps, bolts, washers and nuts (Figure 65).
4. Remove the caps or plugs that were installed to the hydraulic hoses and fittings during the removal process.
5. Install the auxiliary control valve onto the band clamps; refer to Installing the Auxiliary Control Valve (page 5–79).
6. Use the labels that you attached during tank removal to correctly connect the hydraulic hoses to the fittings on the hydraulic tank; refer to Installing the Hydraulic Fittings (page 5–10).
7. Fill the hydraulic tank with the correct quantity of new hydraulic fluid.
8. Operate the machine and check for the hydraulic leaks near the components and fittings. Tighten any loose connections.

Installing the Hydraulic Tank (continued)

9. Check the hydraulic fluid level and adjust if necessary; refer to *Operator's Manual*.
10. Install the right console onto the machine; refer to Assembling the Body Assembly (page 7–7).

Auxiliary Control Valve

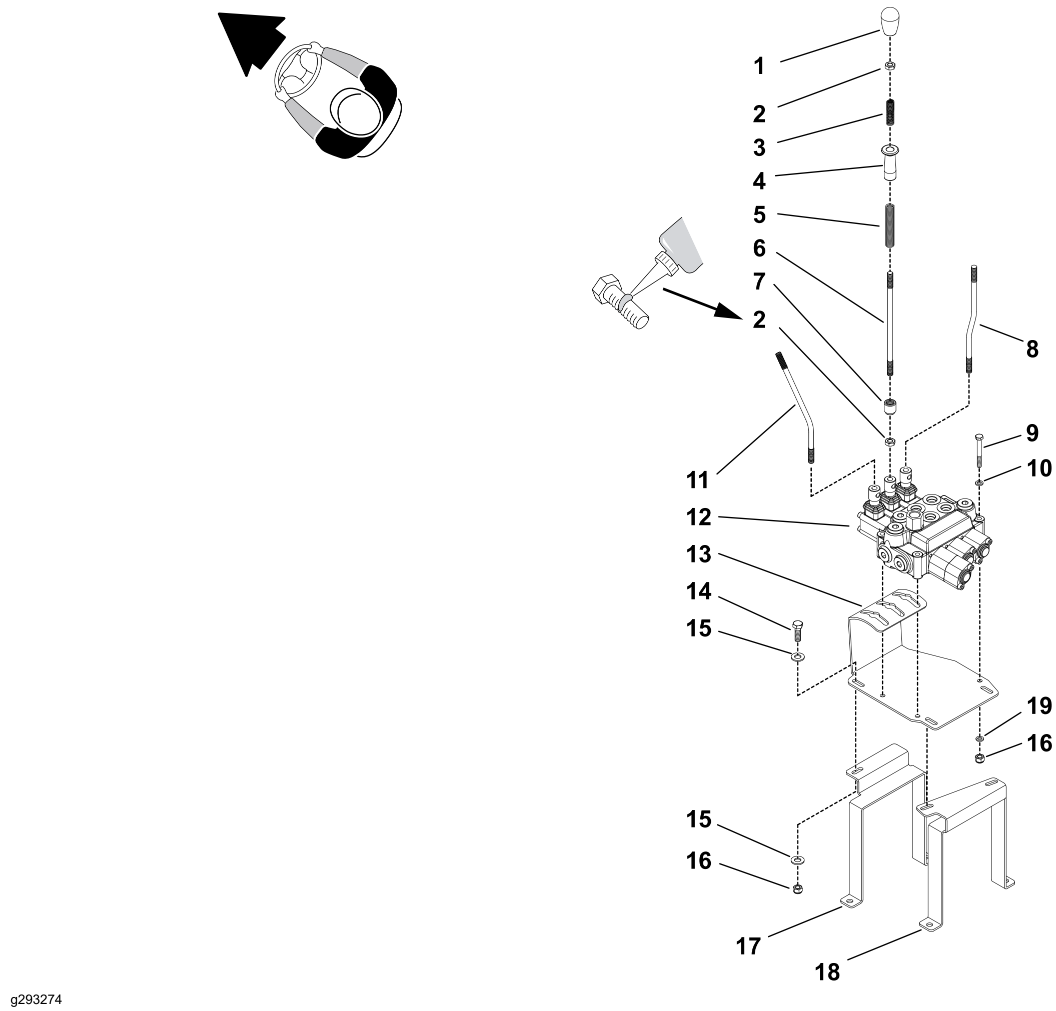


Figure 67

1.	Knob	8.	Auxiliary valve lever	15.	Washer
2.	Nut	9.	Bolt	16.	Nut
3.	Spring	10.	Washer	17.	Band clamp
4.	Puller knob	11.	Auxiliary valve lever	18.	Band clamp
5.	Spring	12.	Auxiliary control valve	19.	Washer
6.	Auxiliary valve lever	13.	Auxiliary control valve support		
7.	Connector	14.	Bolt		

Remove the Auxiliary Control Valve

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Drain the hydraulic fluid from the tank into a suitable container; refer to *Operator's Manual*.
3. Remove the right console to get access to auxiliary control valve; refer to Disassembling the Body Assembly (page 7–6).
4. Clean the hydraulic hose ends and fittings on the hydraulic tank to prevent contaminants from entering into the hydraulic system.
5. For assembly purposes, label all the hydraulic hoses and fittings.

Remove the Auxiliary Control Valve (continued)

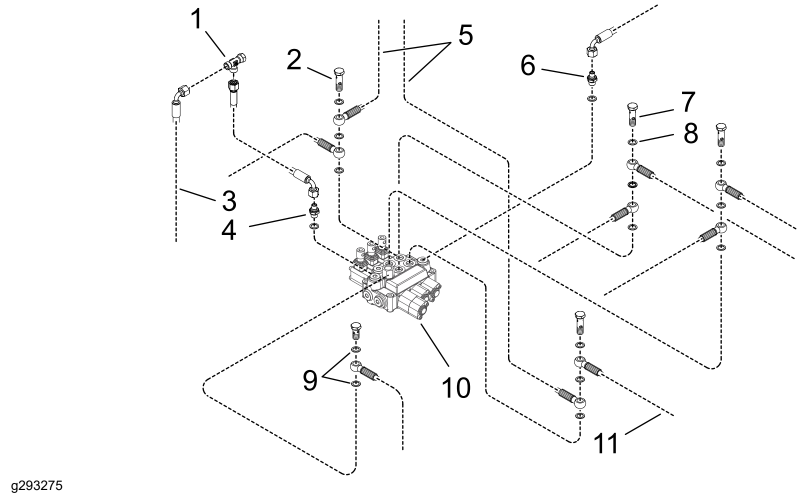


Figure 68

1. Adaptor
2. Bolt
3. Hose
4. Fitting nipple
5. Hose
6. Fitting nipple
7. Bolt
8. O-ring
9. O-ring
10. Auxiliary control valve
11. Hose

---

6. Remove the hydraulic connections from the auxiliary control valve and discard the O-rings from the fittings (Figure 68).
7. Install the clean caps or plugs on the hydraulic hoses and fittings to prevent system contamination.
8. Remove the bolts (item 9 in Figure 67), washers (10 and 19) and nuts (16) that secures the auxiliary control valve (12) to the auxiliary control valve support (13).
9. Remove the auxiliary control valve from the auxiliary control valve support.
10. If the hydraulic fittings to be removed from the auxiliary control valve, mark the fitting orientation for assembly purposes. Remove the fitting from the auxiliary control valve and discard the O-rings from the fittings.

Installing the Auxiliary Control Valve

1. If the hydraulic fittings were removed from the auxiliary control valve, lubricate and install the new O-rings to the fittings. To properly align and install the fittings into the auxiliary control valve openings, use the marks that you made during the removal process. Tighten the fittings; refer to Installing the Hydraulic Fittings (page 5–10).
2. Position the auxiliary control valve onto the auxiliary control valve support and secure with the bolts, washers and nuts (Figure 67).
3. Remove the caps or plugs that were installed to the hydraulic hoses and fittings during the removal process.
4. Use the labels that you attached during tank removal to correctly connect the hydraulic hoses to the fittings on the auxiliary control valve; refer to Installing the Hydraulic Hoses and Tubes (page 5–8).
5. Fill the hydraulic tank with the correct quantity of new hydraulic fluid; refer to *Operator's Manual*.

Installing the Auxiliary Control Valve (continued)

6. Operate the machine and check for the hydraulic leaks near the components and fittings. Tighten any loose connections.
7. Check the hydraulic fluid level and adjust if necessary; refer to *Operator's Manual*.
8. Install the right console onto the machine; refer to Assembling the Body Assembly (page 7–7).

Traction Neutral Arm Assembly

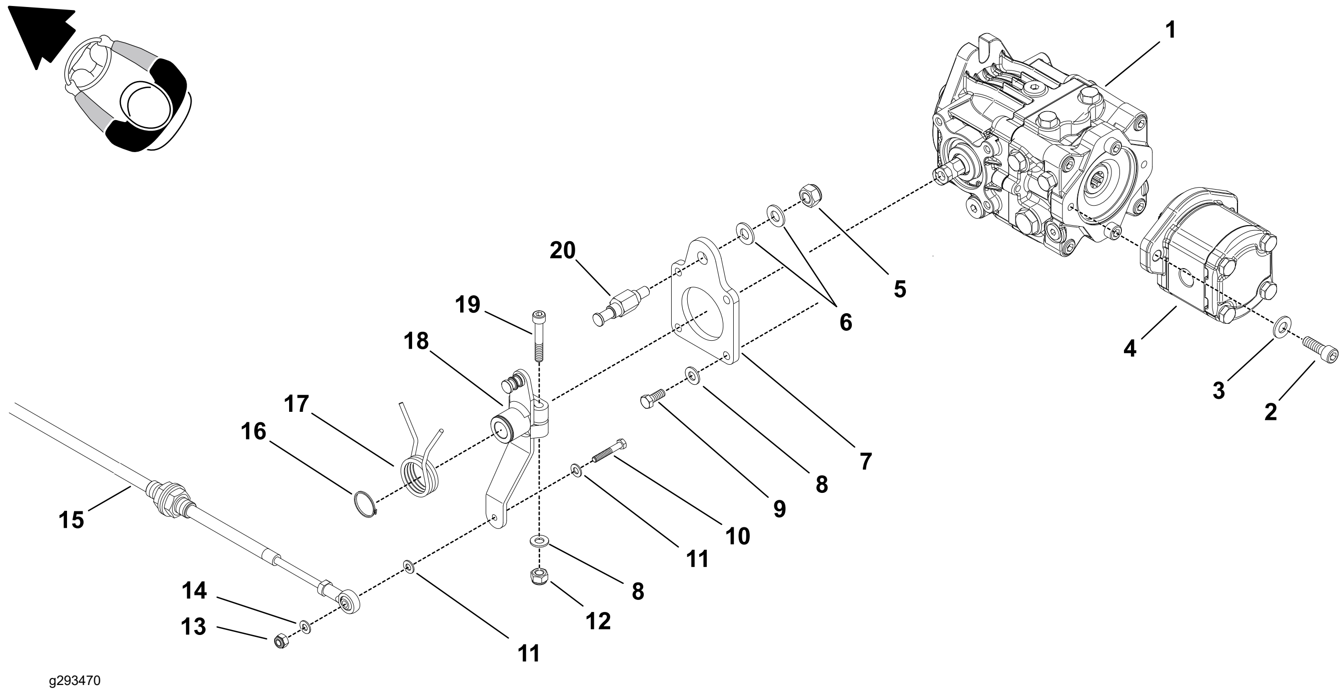


Figure 69

1.	Hydraulic pump	8.	Washer	15.	Traction cable
2.	Socket head screw	9.	Bolt	16.	Retaining ring
3.	Washer	10.	Bolt	17.	Return spring
4.	Gear pump	11.	Washer	18.	Traction neutral arm
5.	Nut	12.	Nut	19.	Socket head screw
6.	Washer	13.	Nut	20.	Hydrostat neutral shaft
7.	Bracket	14.	Washer		

Removing the Traction Neutral Arm Assembly

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Remove the traction neutral arm (item 17 in Figure 69) components on the hydraulic pump as necessary (Figure 69).

Installing the Traction Neutral Arm Assembly

1. Install the traction neutral arm components to the hydraulic pump (Figure 69).
2. Check and adjust the traction neutral position; refer to *Operator's Manual*.

Hydraulic Pump Assembly

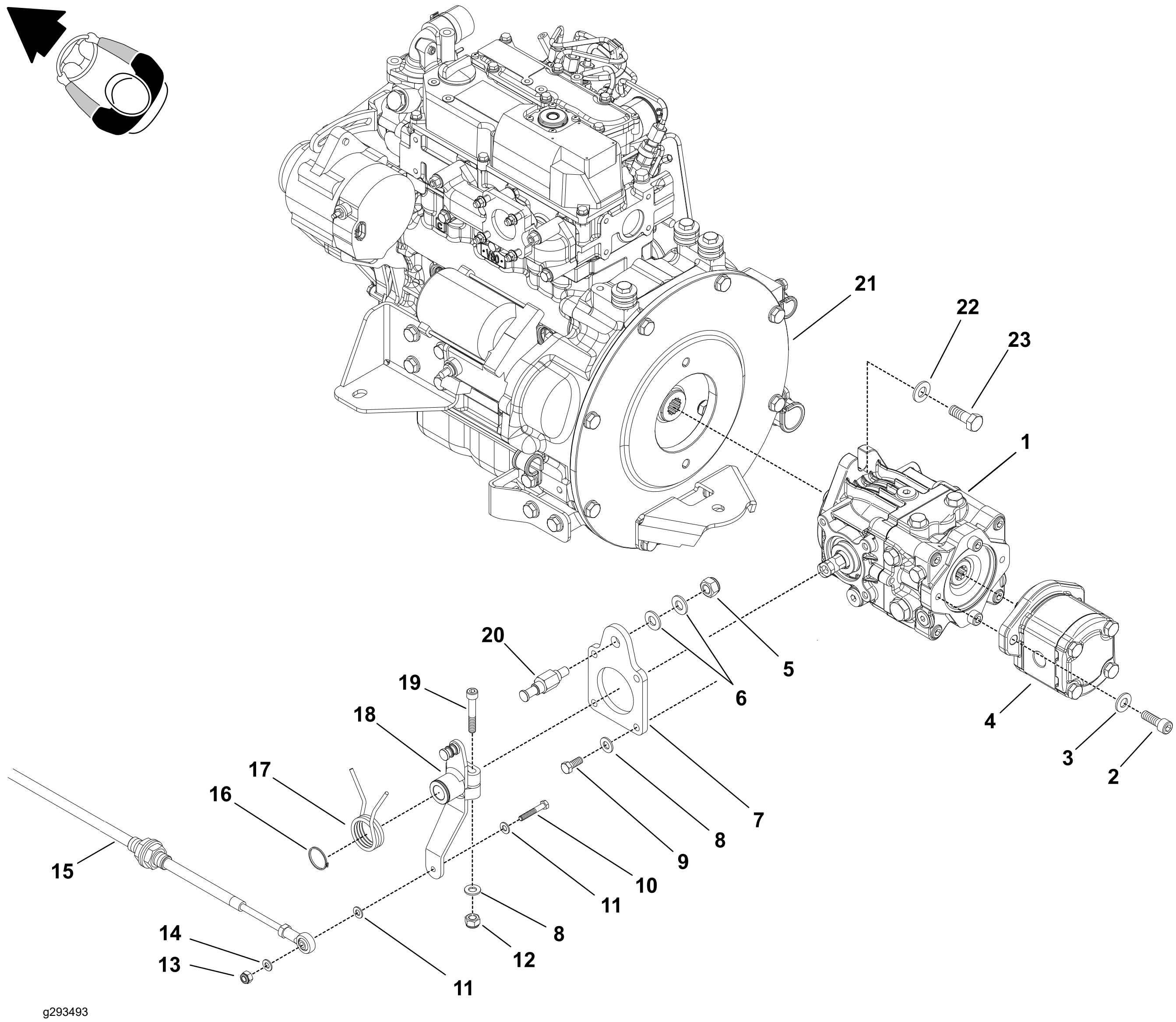


Figure 70

1.	Hydraulic piston pump	9.	Bolt	17.	Return spring
2.	Socket head screw	10.	Bolt	18.	Traction neutral arm
3.	Washer	11.	Washer	19.	Socket head screw
4.	Gear pump	12.	Nut	20.	Hydrostat neutral shaft
5.	Nut	13.	Nut	21.	Engine
6.	Washer	14.	Washer	22.	Washer
7.	Bracket	15.	Traction cable	23.	Bolt
8.	Washer	16.	Retaining ring		

Removing the Hydraulic Pump Assembly

CAUTION

Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to Releasing Pressure from the Hydraulic System (page 5–5).

1. Park the machine on a level surface, set the parking brake, lower the cutting deck, shut off the engine, and remove the key from the key switch.
2. Remove the traction neutral arm assembly; refer to Removing the Traction Neutral Arm Assembly (page 5–81). Carefully position the traction control cable away from the hydraulic pump assembly.
3. Read the General Precautions for Removing and Installing the Hydraulic System Components (page 5–63).
4. Clean the hydraulic pump and all hydraulic connections to prevent hydraulic system contamination.
5. For assembly purposes, label all the hydraulic connections.

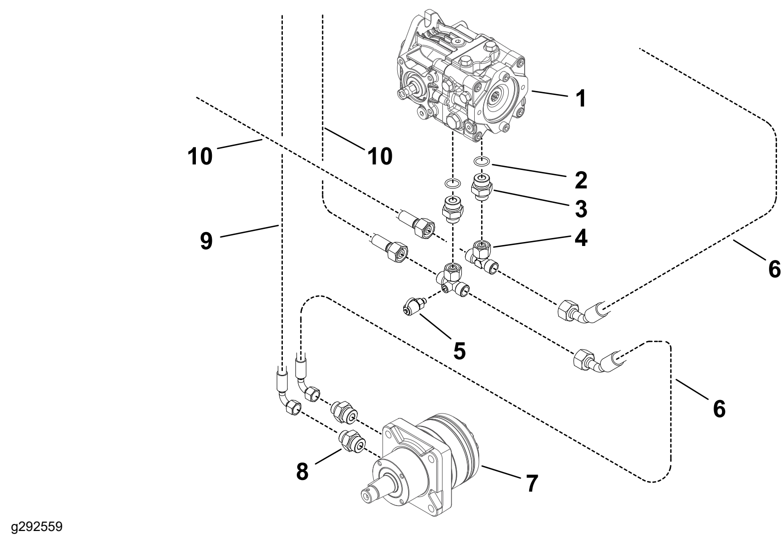


Figure 71

1.	Hydraulic pump	6.	Hose
2.	O-ring	7.	Hydraulic motor
3.	Fitting	8.	Fitting
4.	T fitting adaptor	9.	Hose
5.	Pressure port plug	10.	Hose

Removing the Hydraulic Pump Assembly (continued)

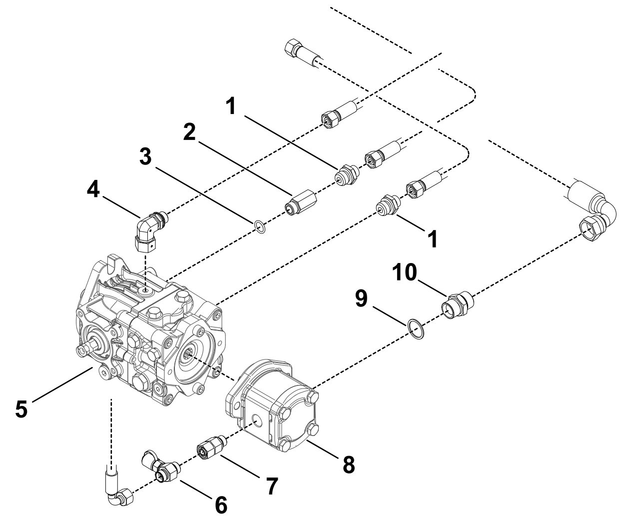


Figure 72

1.	Fitting	6.	T-fitting
2.	One direction valve	7.	Adaptor
3.	O-ring	8.	Gear pump
4.	90º adaptor	9.	Washer
5.	Hydraulic pump	10.	Fitting

6. Disconnect the hoses and tubes from the fittings on the hydraulic pump. Allow the hydraulic lines to drain into a suitable container.
7. Install clean caps or plugs on the openings of pump and disconnected lines to prevent contamination.
8. Remove the bolts (item 23 in Figure 70) and washers (22) that secures the hydraulic pump assembly to the engine.

IMPORTANT

Ensure that you do not damage the machine components while removing the hydraulic pump.

9. Carefully remove the hydraulic pump assembly from the machine.
10. If necessary, remove the hydraulic fittings from the pump. Note the orientation of the fittings for assembly purposes.
11. Remove and discard all the O-rings from the hydraulic hoses, tubes and fittings that were removed.
12. If necessary, remove the 2 socket head screws (item 2 in Figure 70) and 2 washers (3) that secures the gear pump to the hydraulic piston pump. Remove the gear pump from the hydraulic piston pump.

Installing the Hydraulic Pump Assembly

1. If removed, install the gear pump onto the hydraulic piston pump. Secure the gear pump with the 2 washers and 2 socket head screws.
2. If the hydraulic fittings are removed from the pump, lubricate and install the new O-rings to the fittings.
3. Install the fittings into the pump; refer to Installing the Hydraulic Fittings (page 5–10).

IMPORTANT

Ensure that you do not damage the machine components while installing the hydraulic pump.

4. Carefully position the hydraulic pump assembly onto the engine.
5. Secure the hydraulic pump assembly to the engine with the 2 washers and 2 bolts.
6. Use the labels that you attached during the removal process to correctly connect the hydraulic hoses and tubes to the fittings on the hydraulic pump; refer to Installing the Hydraulic Hoses and Tubes (page 5–8).
7. Install the traction neutral arm assembly onto the hydraulic pump assembly; refer to Installing the Traction Neutral Arm Assembly (page 5–81).
8. Check the hydraulic-fluid level in the hydraulic reservoir and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
9. Operate the machine functions slowly until air is out of system; refer to Charging the Hydraulic System (page 5–72).
10. Check and adjust the traction rod for neutral; refer to *Operator's Manual*.

Servicing the Hydraulic Piston Pump

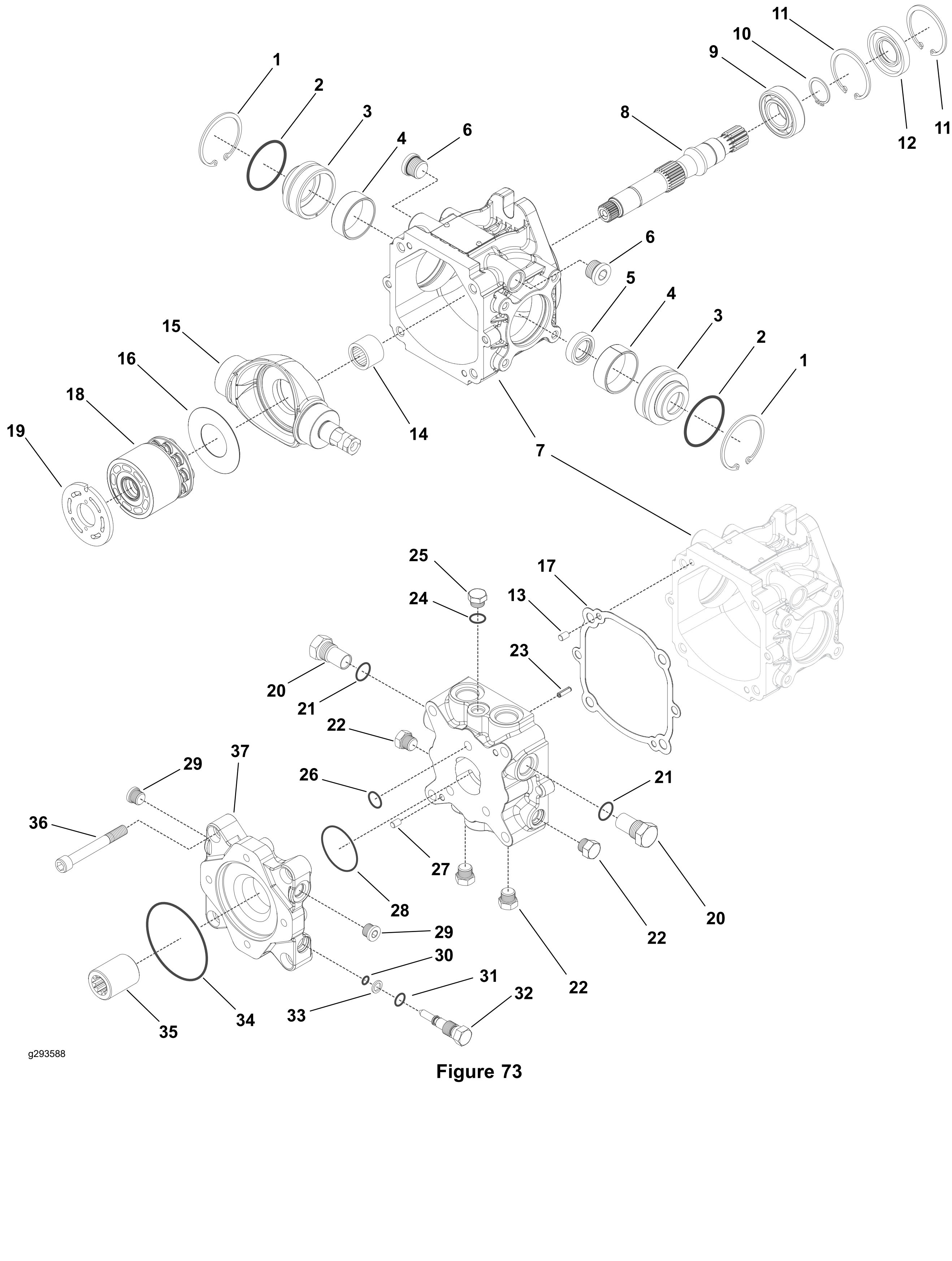


Figure 73

Figure 73 (continued)

1. Retaining ring
2. O-ring
3. Body
4. Inner race
5. Lip seal
6. Plug
7. Hydraulic pump housing
8. Driveshaft
9. Ball bearing
10. Retaining ring
11. Retaining ring
12. Shaft lip seal
13. Pin
14. Needle bearing
15. Swash plate
16. Thrust plate
17. End cap gasket
18. Cylinder block kit
19. Valve plate
20. Plug
21. O-ring
22. Plug
23. Slotted pin
24. O-ring
25. Plug
26. O-ring
27. Pin
28. O-ring
29. Plug
30. O-ring
31. O-ring
32. Plug
33. Back-up ring
34. O-ring
35. Coupling assembly
36. Socket head screw
37. Rear cover

Note: For the hydraulic pump repair information; refer to the Danfoss DDC20 Service Manual.

IMPORTANT

If a hydraulic pump failure occurs; refer to the Traction Circuit Component Failure (page 5–6) for information regarding the importance of removing contamination from the traction circuit.

Servicing the Gear Pump

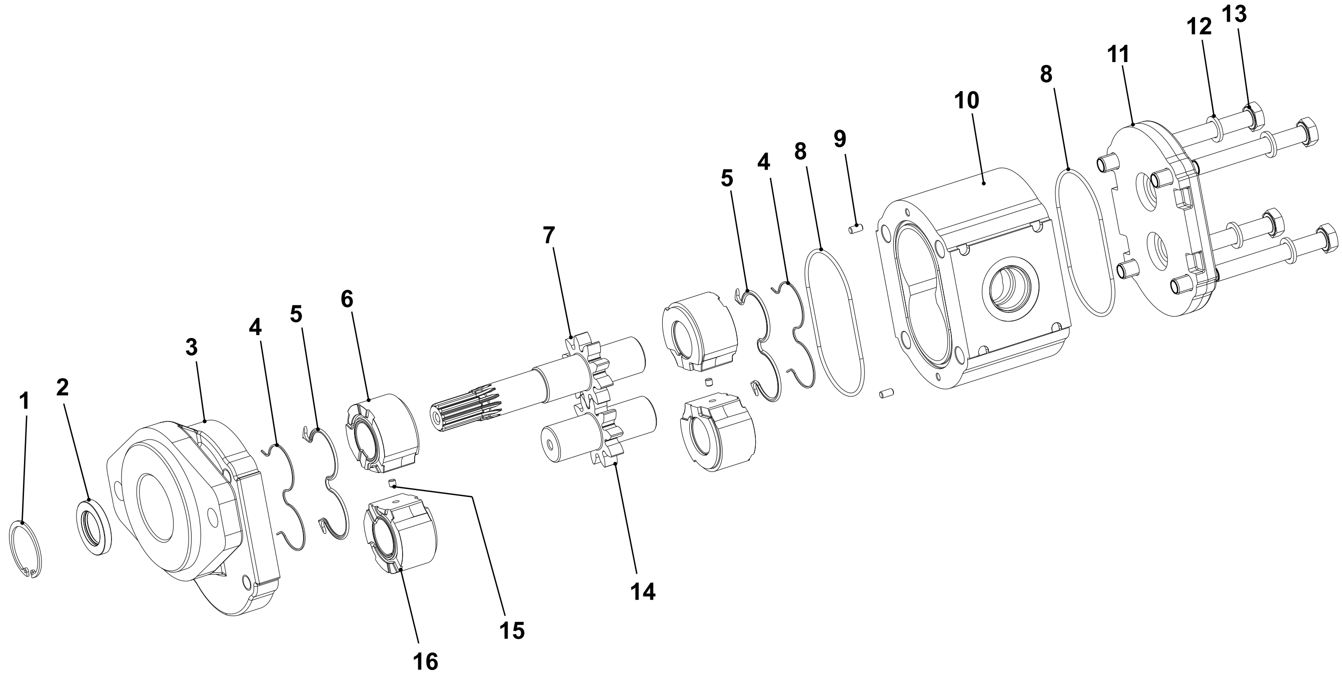


Figure 74

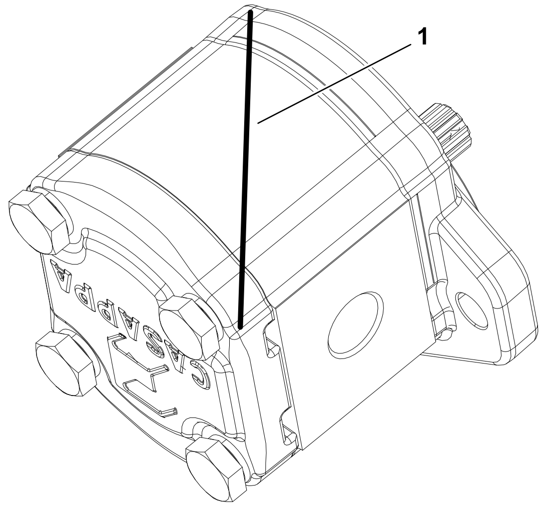
1. Retaining ring
2. Shaft seal
3. Front cover
4. Back-up ring
5. Seal
6. Half thrust block
7. Drive shaft
8. O-ring seal
9. Dowel pin
10. Body
11. Rear cover
12. Washer
13. Bolt
14. Driven gear
15. Dowel pin
16. Half thrust block

Disassembling the Gear Pump

Note: The gear pump must be replaced as a complete assembly. Individual gears, housing, and thrust plates are not available separately. Disassemble the gear pump for cleaning, inspection and seal replacement only.

1. Plug the pump ports and clean the outer surface of the pump with cleaning solvent. Ensure that the work area is clean.

Disassembling the Gear Pump (continued)



g293847

Figure 75

1. Marker line

2. Use a marker to make a diagonal line across the front flange, body and rear cover for assembly purposes (Figure 75).

IMPORTANT

Use caution when clamping the gear pump in a vise to avoid distorting any pump components.

3. Secure the front cover of the pump in a vise with the driveshaft pointing down.
4. Loosen the 4 bolts (13) that secures the pump assembly.
5. Remove the pump from the vise and remove the bolts and washers.
6. Support the pump assembly and gently tap the pump case with a soft-faced hammer to loosen the pump sections. Do not drop the parts or disengage the gear mesh.

IMPORTANT

Mark the relative positions of the gear teeth and thrust plates so that you can be assemble them in the same position. Do not touch the gear surfaces as residue on hands may be corrosive to gear finish.

7. Remove the thrust plates and seals from each pump section. Before removing gear set, apply marking dye to the mating teeth to retain timing. The pump efficiency may be affected if the teeth are not installed in the same position during assembly.

Inspecting the Gear Pump

1. Remove any nicks and burrs from all the gear pump parts with emery cloth.
2. Clean all the gear pump parts with solvent and dry them with compressed air.

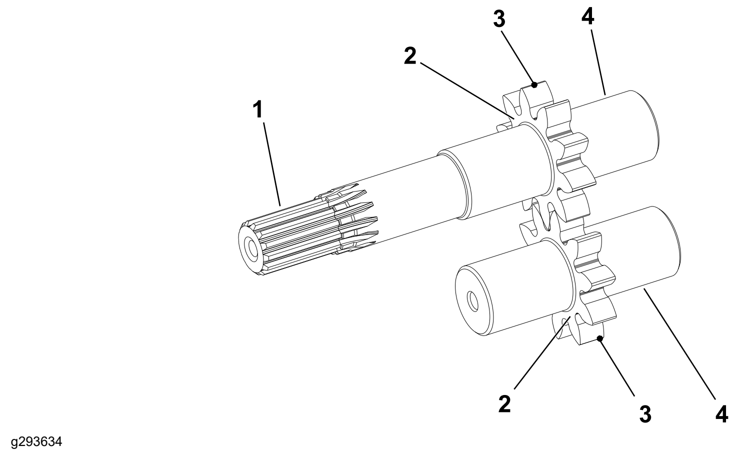


Figure 76

1.	Gear shaft spline	3.	Gear teeth
2.	Gear face edge	4.	Gear shaft

3. Inspect the drive gear and idler gear for the following (Figure 76):
   A. Gear shaft should be free of scoring, rough surfaces, and excessive wear at the bushing points and sealing areas.
   B. Gear teeth should be free from excessive scoring, broken or nicked gear teeth, and visual wear.
   C. Inspect the gear face edge for sharpness because sharp edges of gears will mill into the wear plates.
   D. Bearing areas should not have excessive wear or scoring.
   E. Face of the bearing blocks that are in contact with gears should be free of wear, roughness, or scoring.
4. Inspect the front flange and body for damage or wear.
5. Replace the entire pump assembly if the internal parts are excessively worn or damaged.

Assembling the Gear Pump

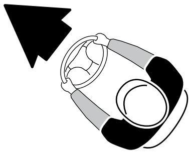
Note: When assembling the gear pump, check the marker line made during the disassembly to ensure that the parts are properly aligned during the assembly.

1. Apply clean hydraulic fluid to all the parts before you assemble them.

   Note: The pressure seals and back-up rings fit in the grooves machined into the thrust plates. The body seals fit in the grooves machined in the body faces.

2. Assemble the pump section starting at the front cover end. Apply grease or petroleum jelly to new section seals to hold them in position during the gear pump assembly.
3. After the pump has been assembled, tighten the bolts by hand. Rotate the driveshaft to check for binding. Protect the shaft if you use pliers.
4. Torque the bolts evenly to **45 N·m (33 ft-lb)** in a crossing pattern.

Front Wheel Motors



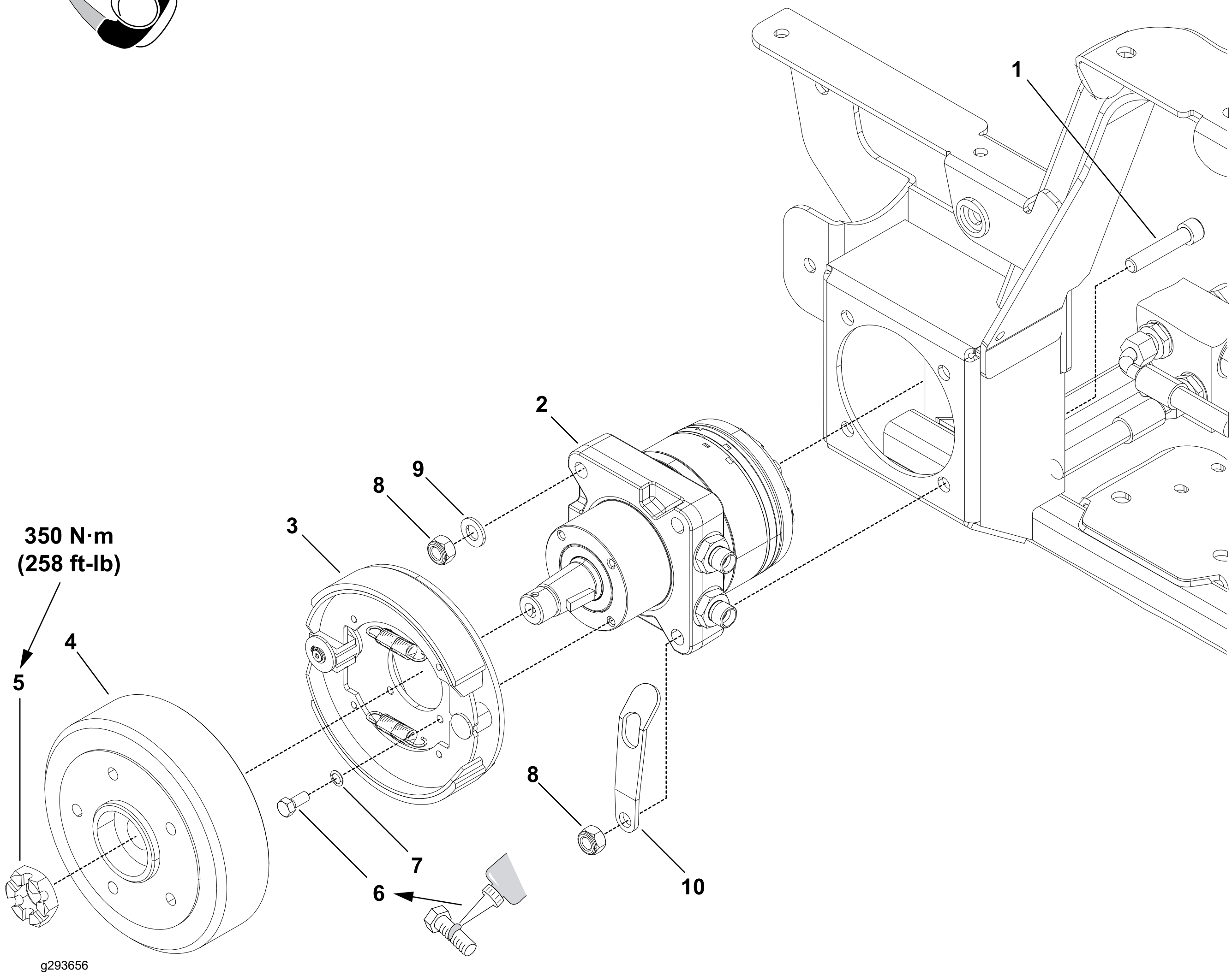


Figure 77

Front Left Wheel (shown)

1. Bolt
2. Hydraulic motor
3. Left brake assembly
4. Brake drum
5. Locknut
6. Bolt
7. Washer
8. Nut
9. Washer
10. Brake cable bracket

Removing the Front Wheel Motors

⚠ CAUTION ⚠

Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to Releasing Pressure from the Hydraulic System (page 5–5).

Removing the Front Wheel Motors (continued)

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Block the rear wheels with chocks to prevent the machine from moving.
3. Loosen, but do not remove the locknut (item 5 in Figure Figure 77) that secures the wheel hub to the wheel motor.
4. Read the General Precautions for Removing and Installing the Hydraulic System Components (page 5–63).

IMPORTANT

Before lifting the machine with a jack, review and follow Jacking Instructions (page 1–7).

5. Lift the machine with a jack to remove the front wheel, support the machine with jack stands.
6. Remove the front wheel, brake drum, wheel hub, and brake assembly from the machine; refer to Servicing the Brake (page 8–3).

Removing the Front Wheel Motors (continued)

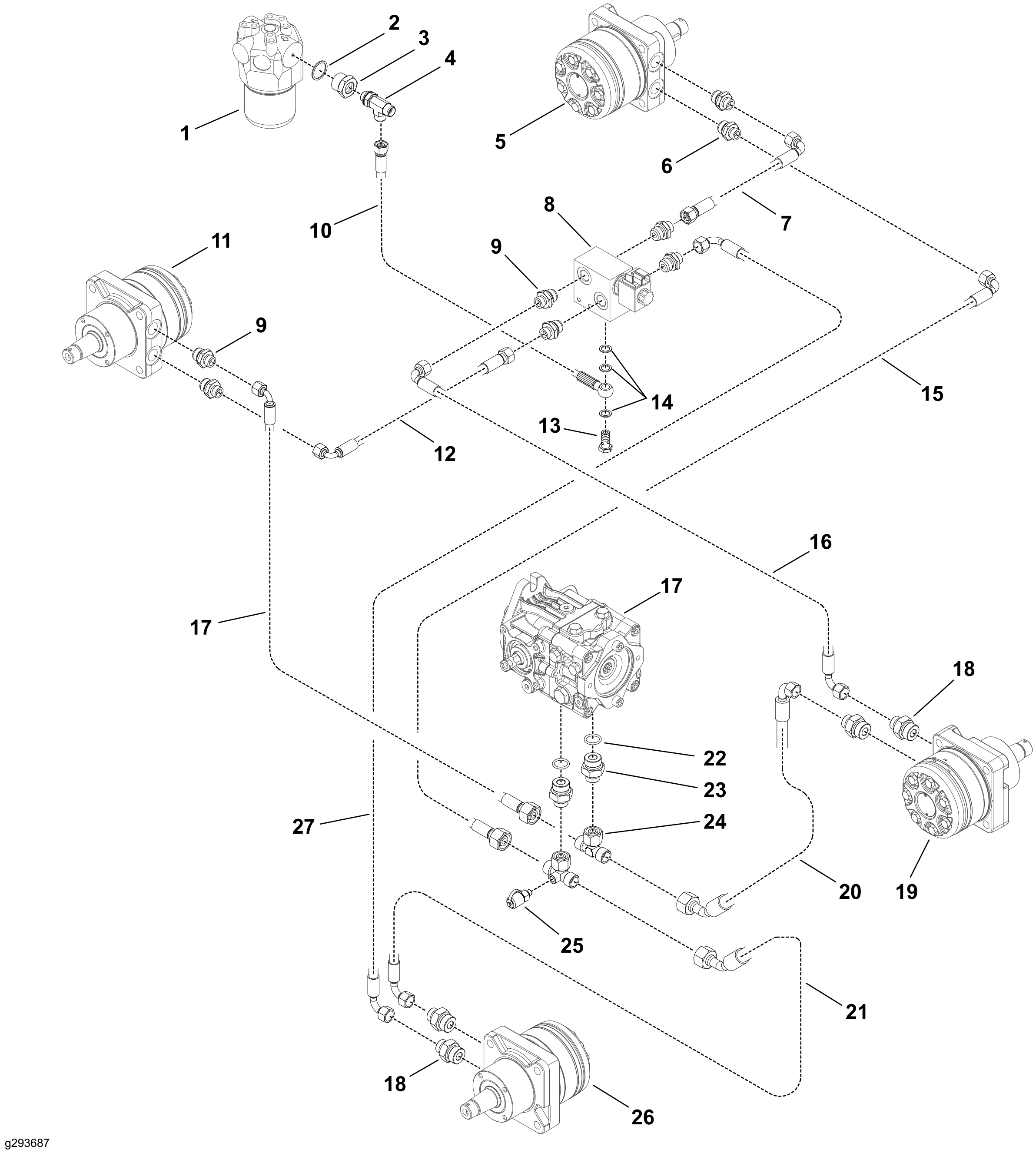


Figure 78

1.	Hydraulic filter	8.	Differential valve	15.	Hose	22.	O-ring
2.	O-ring	9.	Fitting	16.	Hose	23.	Fitting
3.	Adaptor	10.	Hose	17.	Hydraulic pump	24.	T-fitting
4.	T-fitting	11.	Front left wheel motor	18.	Fitting	25.	Plug
5.	Front right wheel motor	12.	Hose	19.	Rear right wheel motor	26.	Rear left wheel motor
6.	Fitting	13.	Bolt	20.	Hose	27.	Hose
7.	Hose	14.	O-ring	21.	Hose		

7. Clean the hydraulic tube ends and fittings on the wheel motor to prevent contaminants from entering into the hydraulic system.
8. For assembly purposes, label all the hydraulic connections at the wheel motor.

Removing the Front Wheel Motors (continued)

9. Loosen and remove the hydraulic tubes from the fittings on the wheel motor. Allow the tubes to drain the hydraulic fluid into a suitable container.
10. Install the clean caps or plugs on the hydraulic tubes and fittings to prevent system contamination.
11. Support the wheel motor to prevent it from falling during removal. Remove the 4 nuts (item 8 in Figure 77), washers (9) and bolts (1) that secures the wheel motor and brake cable bracket to the frame assembly.
12. Note the location of the brake cable bracket (10) for assembly purposes.
13. Remove the wheel motor from the machine.
14. If the hydraulic fittings are to be removed from the wheel motor, mark the fitting orientation for assembly purposes. Remove the fittings from the wheel motor and discard the O-rings from the fittings.

Installing the Front Wheel Motor

1. If the hydraulic fittings were removed from the wheel motor, lubricate and install the new O-rings to the fittings. To properly align and install the fittings into the wheel motor ports, use the marks that you made during the removal process; refer to Installing the Hydraulic Fittings (page 5–10).
2. Position the wheel motor and brake cable bracket onto the frame. Ensure that the ports in the wheel motor are facing towards the rear of the machine (Figure 78).
3. Secure the wheel motor to the frame with the 4 bolts (1), washers (9) and nuts (8). Ensure that the brake cable bracket (10) is positioned as noted during the disassembly.
4. Clean the tapers of the wheel hub and wheel motor shaft.
5. Remove the caps or plugs from the hydraulic tubes and wheel fittings.
6. Lubricate and install the new O-rings to the fittings on the wheel motor. Use the labels that you attached during the removal process to correctly connect the hydraulic tubes to the wheel motor fittings; refer to Installing the Hydraulic Hoses and Tubes (page 5–8).
7. Install the brake assembly, wheel hub, brake drum, and front wheel to the machine; refer to Servicing the Brake (page 8–3).
8. Ensure to torque the locknut (item 5 in Figure 77) to **350 N·m (258 ft-lb)**.
9. Check the hydraulic-fluid level in the hydraulic tank and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
10. Operate the machine functions slowly until air is out of system; refer to Charging the Hydraulic System (page 5–72).
11. Start the engine, check for hydraulic-fluid leaks, repair any leaks as necessary, and fill the hydraulic tank with the correct quantity of new hydraulic fluid before returning the machine to service.

Rear Wheel Motors

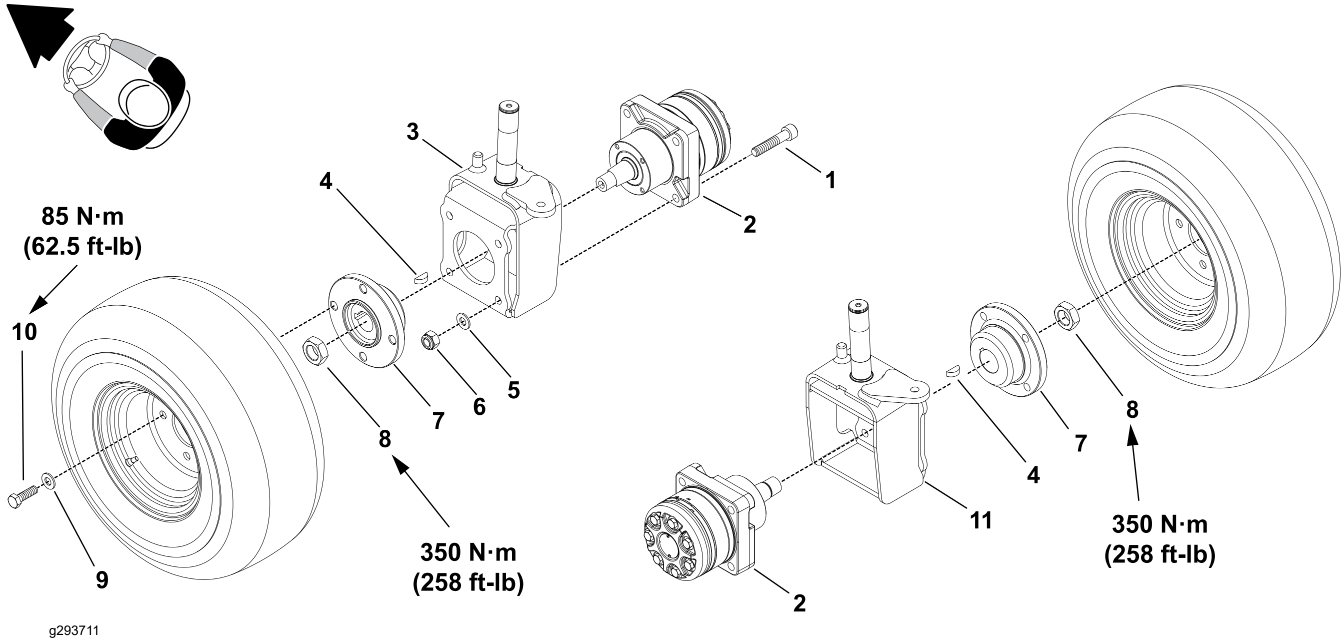


Figure 79

1. Bolt
2. Hydraulic motor
3. Spindle
4. Woodruff key
5. Washer
6. Nut
7. Flange
8. Nut
9. Washer
10. Bolt
11. Spindle

Removing the Rear Wheel Motor

CAUTION

Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to Releasing Pressure from the Hydraulic System (page 5–5).

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Block the front wheels with chocks to prevent the machine from moving.
3. Loosen, but do not remove the locknut (item 8 in Figure 79) that secures the wheel hub to the wheel motor.
4. Read the General Precautions for Removing and Installing the Hydraulic System Components (page 5–63).

IMPORTANT

Before lifting the machine with a jack, review and follow Jacking Instructions (page 1–7).

5. Lift the machine with a jack to remove the rear wheel, support the machine with jack stands.

Removing the Rear Wheel Motor (continued)

6. Remove the rear wheel from the machine; refer to Removing the Wheels (page 7–3).
7. Remove wheel hub from the rear wheel motor as follows:

IMPORTANT

Do not hit the wheel hub, wheel-hub puller, or wheel motor with a hammer while removing or installing. Hammering can damage the wheel motor.

   A. Ensure that the locknut on the wheel motor shaft is loosened at least 2 turns.
   B. Use a wheel hub puller (refer to Special Tools (page 2–15)) to loosen the wheel hub from the wheel motor.
   C. Remove the locknut and wheel hub from the motor shaft. Discard the locknut.
   D. Locate and retrieve the woodruff key (item 4 in Figure 79) from the wheel motor shaft.

Removing the Rear Wheel Motor (continued)

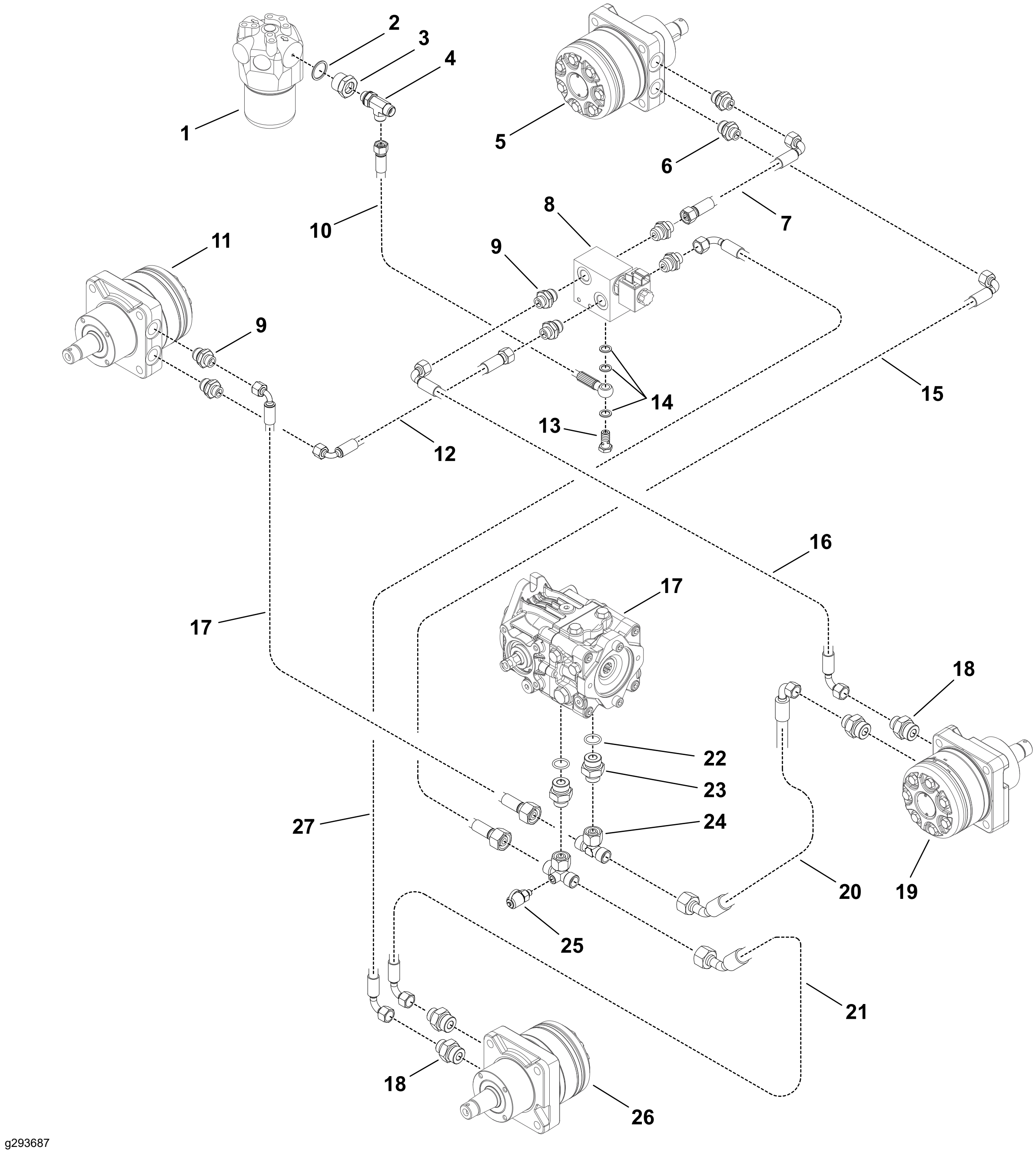


Figure 80

1.	Hydraulic filter	8.	Differential valve	15.	Hose	22.	O-ring
2.	O-ring	9.	Fitting	16.	Hose	23.	Fitting
3.	Adaptor	10.	Hose	17.	Hydraulic pump	24.	T-fitting
4.	T-fitting	11.	Front left wheel motor	18.	Fitting	25.	Plug
5.	Front right wheel motor	12.	Hose	19.	Rear right wheel motor	26.	Rear left wheel motor
6.	Fitting	13.	Bolt	20.	Hose	27.	Hose
7.	Hose	14.	O-ring	21.	Hose		

8. Clean the hydraulic hose ends and fittings on the wheel motor to prevent contaminants from entering into the hydraulic system.

9. For assembly purposes, label all the hydraulic connections at the wheel motor.

Removing the Rear Wheel Motor (continued)

10. Loosen and remove the hydraulic tubes from the fittings on the wheel motor. Allow the hoses to drain into a suitable container.
11. Install clean caps or plugs on the hydraulic hoses and fittings to prevent system contamination.
12. Support the wheel motor to prevent it from falling during removal.
13. Remove the 4 bolts (item 1 in Figure 79), washers (5) and nuts (6) that secures the wheel motor to the spindle.
14. Remove the wheel motor from the machine.
15. If the hydraulic fittings are to be removed from the wheel motor, mark the fitting orientation for assembly purposes. Remove the fittings from the wheel motor and discard the O-rings from the fittings.

Installing the Rear Wheel Motor

1. If the hydraulic fittings were removed from the wheel motor, lubricate and install the new O-rings to the fittings. To properly align and install the fittings into the wheel motor ports, use the marks that you made during the removal process; refer to Installing the Hydraulic Fittings (page 5–10).
2. Position the rear wheel motor to the spindle. Ensure that the ports in the wheel motor are facing toward the front of the machine (Figure 80).
3. Secure the wheel motor to the spindle with the 4 bolts (item 12 in Figure 79), washers and nuts.
4. Remove the caps or plugs that were installed to the hydraulic hoses and fittings during the removal process.
5. Lubricate and install the new O-rings to the fittings on the wheel motor. Use the labels that you attached during the removal process to correctly connect the hydraulic hoses to the wheel motor fittings; refer to Installing the Hydraulic Hoses and Tubes (page 5–8).

IMPORTANT

Before the wheel hub is installed, clean the tapers of the wheel hub and wheel motor shaft. Ensure that the tapers are free of grease, oil, and dirt. Do not use anti-seize lubricant when installing the wheel hub.

6. Position the woodruff key (item 4 in Figure 79) to the keyslot in the wheel motor shaft.

IMPORTANT

Do not re-use the removed locknut to secure the wheel hub to the wheel motor.

7. Install the wheel hub onto the motor shaft and secure with new locknut (item 8 in Figure 79).
8. Ensure to torque the locknut to **350 N·m (258 ft-lb)**.
9. Install the rear wheel to the machine; refer to Installing the Wheels (page 7–4).

Installing the Rear Wheel Motor (continued)

10. After you complete the assembly, ensure that the hydraulic hoses and fittings do not contact anything through the full range of axle motion. Also, check for any hydraulic-fluid leaks.
11. Check the hydraulic-fluid level in the hydraulic tank and add correct quantity of fluid; refer to the *Operator's Manual*.
12. Operate the machine functions slowly until air is out of system; refer to Charging the Hydraulic System (page 5–72).
13. Start the engine, check for hydraulic-fluid leaks, repair any leaks as necessary, and fill the hydraulic tank with the correct quantity of new hydraulic fluid before returning the machine to service.

Servicing the Hydraulic Wheel Motor

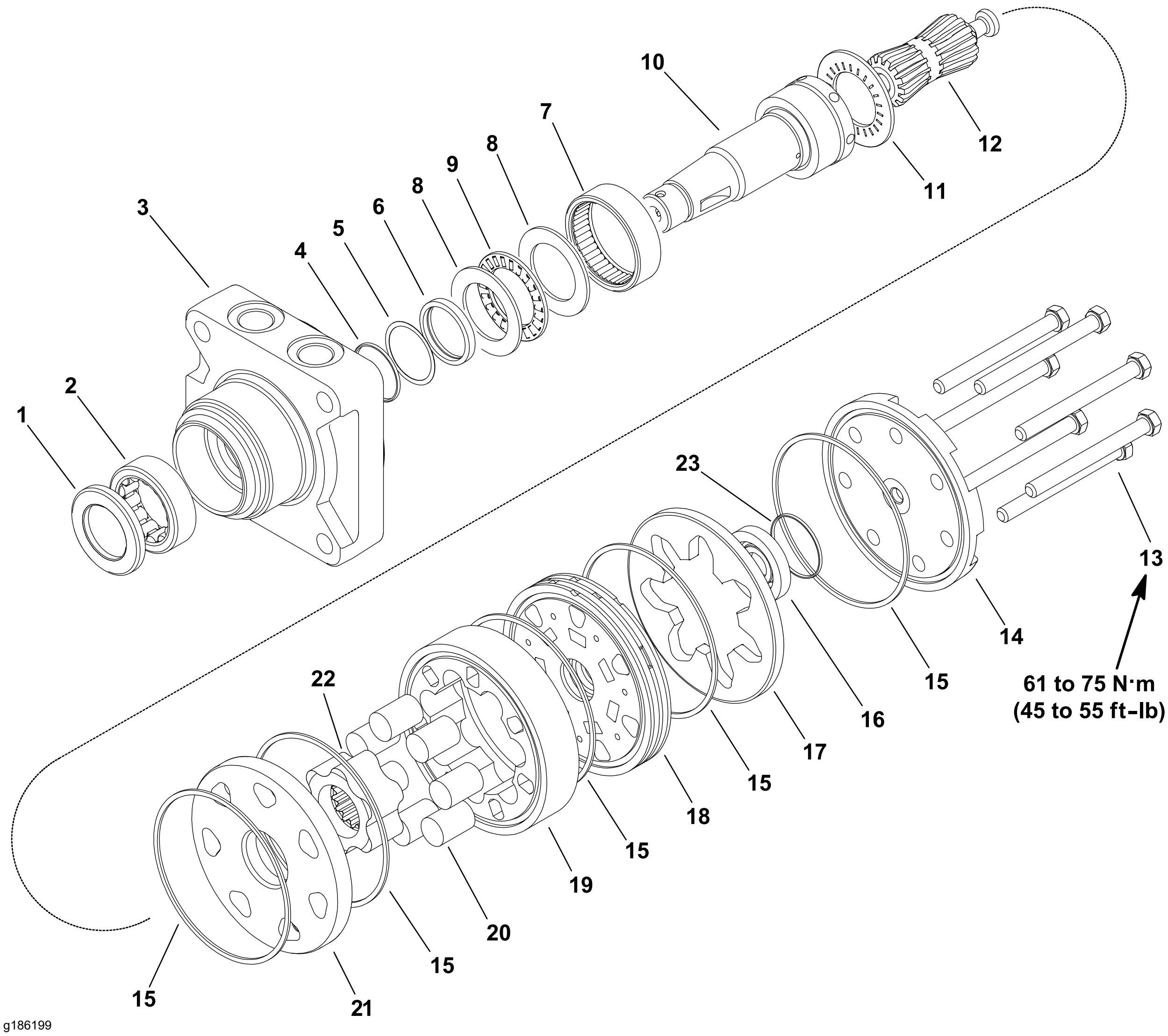


Figure 81

1. Dirt and water seal
2. Outer bearing
3. Housing
4. Back-up ring
5. Back-up washer
6. Shaft seal
7. Inner bearing
8. Thrust washer
9. Thrust bearing
10. Coupling shaft
11. Thrust bearing
12. Drive link
13. Bolt
14. End cover
15. Body seal
16. Commutator
17. Commutator ring
18. Manifold
19. Stator
20. Vane
21. Wear plate
22. Rotor
23. Commutator ring

Servicing the Hydraulic Wheel Motor (continued)

Note: The wheel motors used in this machine are the Parker Torqmotor™ motors of the same basic design with minor differences. The 2 front wheel motors displace **238 cm^3/rev (14.5 in^3/rev)** and the 2 rear wheel motors displace **195 cm^3/rev (11.8 in^3/rev)**.

Note: For the wheel motor repair procedures; refer to Parker Torqmotor™ Service Procedure (TF, TG, TH, and TL Series).

Note: If a wheel motor fails; refer to the Traction Circuit Component Failure (page 5–6) for information regarding the importance of removing contamination from the traction circuit.

Differential Valve

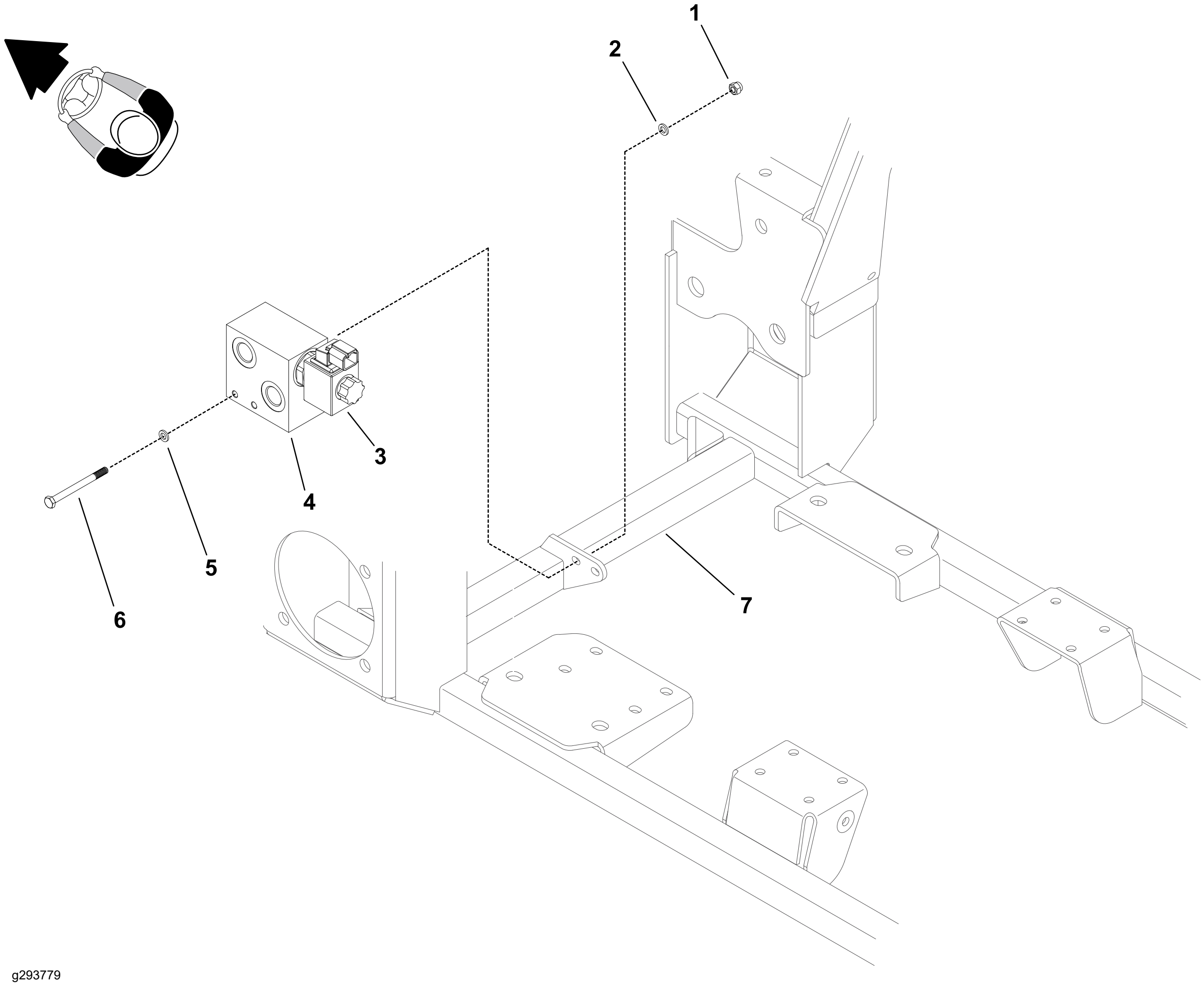


Figure 82

1. Nut
2. Washer
3. Differential valve solenoid
4. Differential valve
5. Washer
6. Bolt
7. Chassis

Removing the Differential Valve

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.

CAUTION

Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to Releasing Pressure from the Hydraulic System (page 5–5).

2. Read the General Precautions for Removing and Installing the Hydraulic System Components (page 5–63).
3. Locate the Differential valve that is attached to front of the chassis (between the two front wheel motors) (Figure 82).

Removing the Differential Valve (continued)

4. For assembly purposes, label all the hydraulic connections. Clean the hydraulic connections before loosening the hydraulic lines.

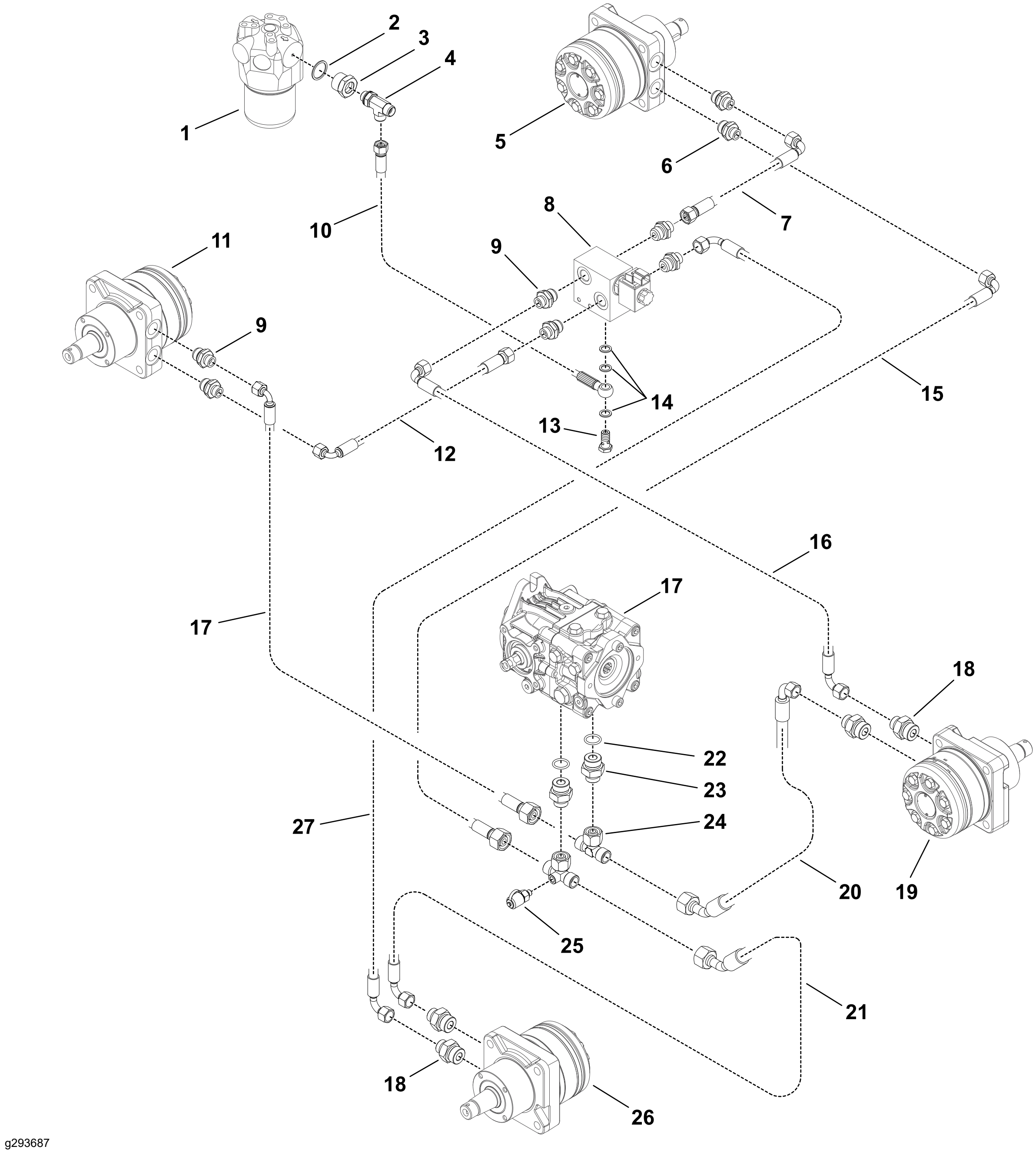


Figure 83

1.	Hydraulic filter	8.	Differential valve	15.	Hose	22.	O-ring
2.	O-ring	9.	Fitting	16.	Hose	23.	Fitting
3.	Adaptor	10.	Hose	17.	Hydraulic pump	24.	T-fitting
4.	T-fitting	11.	Front left wheel motor	18.	Fitting	25.	Plug
5.	Front right wheel motor	12.	Hose	19.	Rear right wheel motor	26.	Rear left wheel motor
6.	Fitting	13.	Bolt	20.	Hose	27.	Hose
7.	Hose	14.	O-ring	21.	Hose		

Removing the Differential Valve (continued)

5. Disconnect the hydraulic hoses and tubes from the fittings in the differential valve. Allow the lines to drain into a suitable container. Remove and discard the O-rings from the fittings.
6. Install clean caps or plugs on the hydraulic lines and fittings to prevent system contamination.
7. Remove the 2 bolts (item 6 in Figure 82), washers (5 and 2) and nuts (1) that secures the differential valve to the chassis.
8. Remove the differential valve from the machine.
9. If necessary, remove the hydraulic fittings from the differential valve. Discard the O-rings that were removed.

Installing the Differential Valve

1. If the hydraulic fittings were removed from the differential valve, lubricate new O-rings with clean hydraulic fluid, position the O-rings to the fittings, and install the fittings into the differential valve; refer to Installing the Hydraulic Fittings (page 5–10).
2. Position the differential valve to the chassis and secure with the 2 bolts (item 6 in Figure 82), washers (5 and 2) and nuts (1).
3. Remove the caps and plugs from the hydraulic lines and fittings that were installed during the removal process.
4. Lubricate and install the new O-rings onto the differential valve fittings.
5. Using the labels that you attached during differential valve removal, correctly connect the hydraulic hoses and tubes to the differential valve; refer to Installing the Hydraulic Hoses and Tubes (page 5–8).
6. After you complete the assembly, ensure that the hydraulic hoses and fittings do not contact anything to the chassis. Also, check for any hydraulic-fluid leaks.
7. Check the hydraulic-fluid level in the hydraulic tank and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
8. Operate the machine functions slowly until air is out of system; refer to Charging the Hydraulic System (page 5–72).
9. Start the engine, check for hydraulic fluid leaks, repair any leaks as necessary, and service the hydraulic tank with the correct quantity of new fluid before returning the machine to service.

Height Of Cut Valve

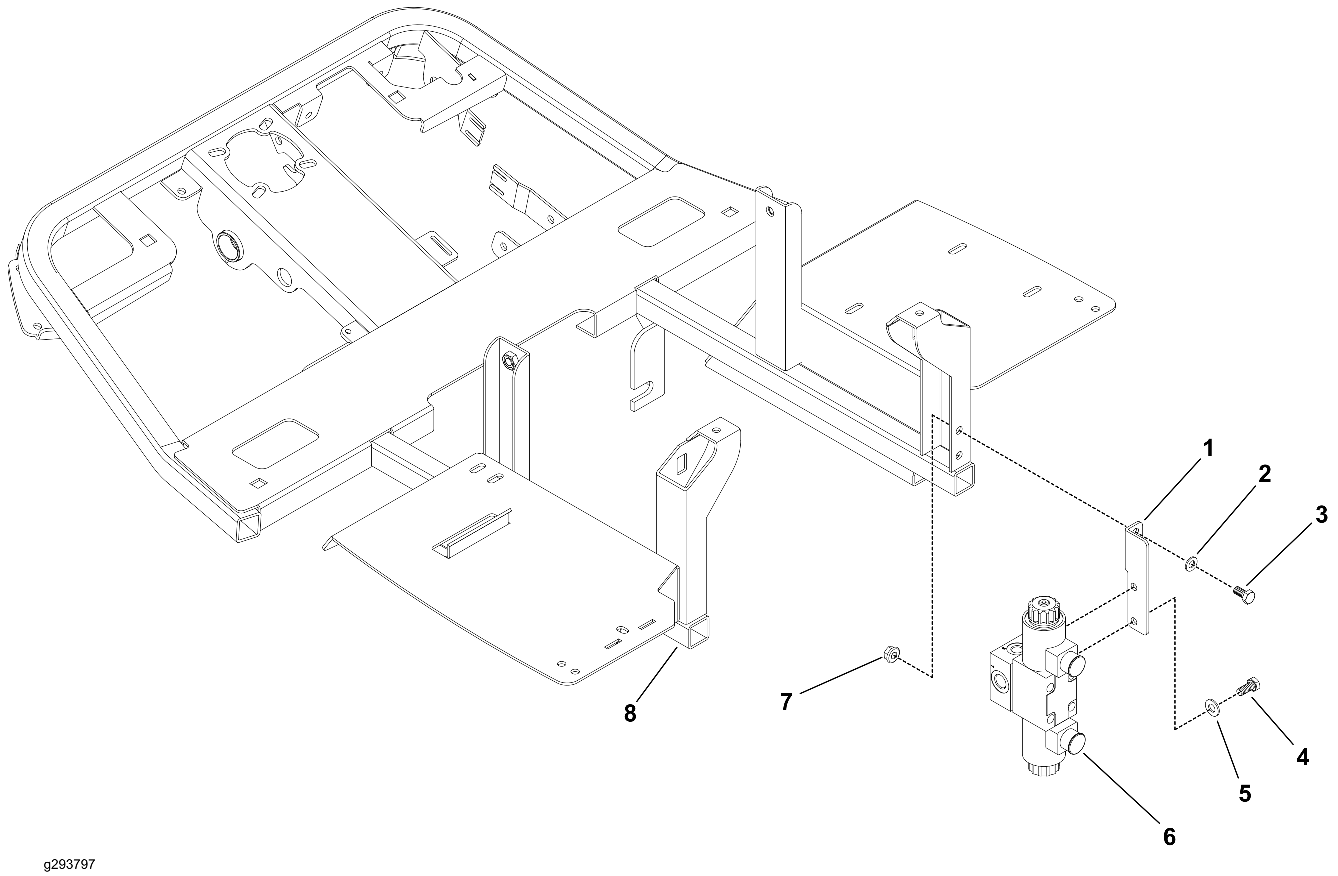


Figure 84

1. Bracket
2. Washer
3. Bolt
4. Bolt
5. Washer
6. Height of cut valve
7. Nut
8. Operators platform

Removing the Height Of Cut Valve

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.

CAUTION

Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to Releasing Pressure from the Hydraulic System (page 5–5).

2. Read the General Precautions for Removing and Installing the Hydraulic System Components (page 5–63).
3. Locate the height of cut valve that is attached to operator platform under the operator seat (Figure 84).
4. For assembly purposes, label all the hydraulic connections. Clean the hydraulic connections before loosening the hydraulic lines.

Removing the Height Of Cut Valve (continued)

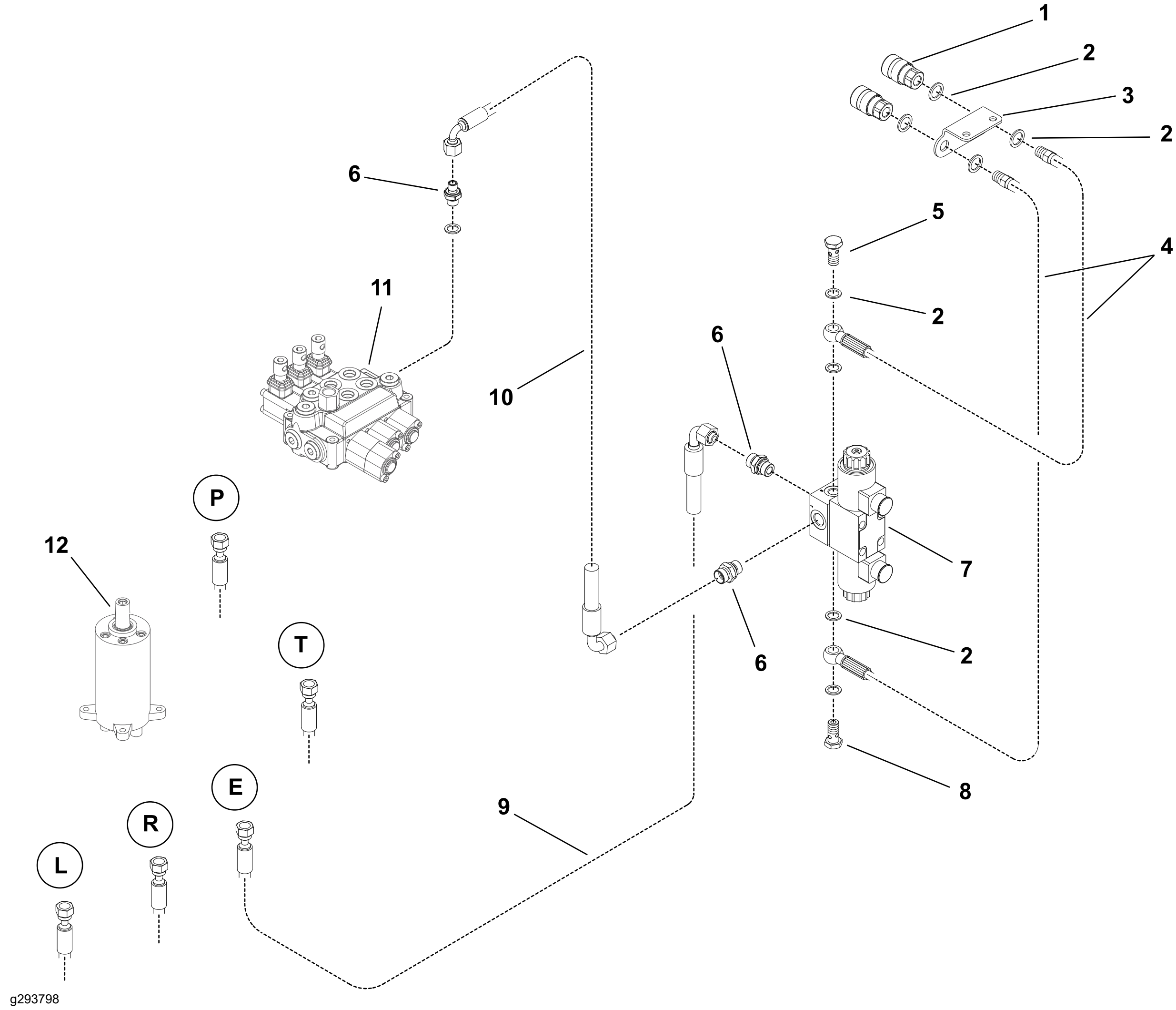


Figure 85

1.	Quick disconnect coupler	5.	Bolt	9.	Hose
2.	O-ring	6.	Fitting	10.	Hose
3.	Bracket	7.	Height of cut valve	11.	Auxiliary control valve
4.	Hose	8.	Bolt	12.	Steering control valve

5. Disconnect the hydraulic hoses and tubes from the fittings in the height of control valve. Allow the lines to drain into a suitable container. Remove and discard the O-rings from the fittings.
6. Install clean caps or plugs on the hydraulic lines and fittings to prevent system contamination.
7. Remove the 2 bolts (item 4 in Figure 84) and washers (5) that secure the height of cut valve to the operator platform.
8. Remove the height of control valve from the machine.
9. If necessary, remove the hydraulic fitting from the height of cut valve. Discard the O-rings that were removed.

Installing the Height Of Cut Valve

1. If the hydraulic fittings were removed from the height of cut valve, lubricate new O-rings with clean hydraulic fluid, position the O-rings to the fittings, and install the fittings into the height of cut valve; refer to Installing the Hydraulic Fittings (page 5–10).
2. Position the height of cut valve to the operator's platform and secure with the 2 bolts (item 4 in Figure 84) and washers (5).
3. Remove the caps and plugs from the hydraulic lines and fittings that were installed during the removal process.
4. Lubricate and install the new O-rings onto the height of cut valve fittings.
5. Use the labels that you attached during height of cut valve removal, correctly connect the hydraulic hoses and tubes to the height of cut valve; refer to Installing the Hydraulic Hoses and Tubes (page 5–8).
6. After you complete the assembly, ensure that the hydraulic hoses and fittings do not contact anything to the chassis. Also, check for any hydraulic-fluid leaks.
7. Check the hydraulic-fluid level in the hydraulic tank and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
8. Operate the machine functions slowly until air is out of system; refer to Charging the Hydraulic System (page 5–72).
9. Start the engine, check for hydraulic-fluid leaks, repair any leaks as necessary, and fill the hydraulic tank with the correct quantity of new hydraulic fluid before returning the machine to service.

Lift Cylinder

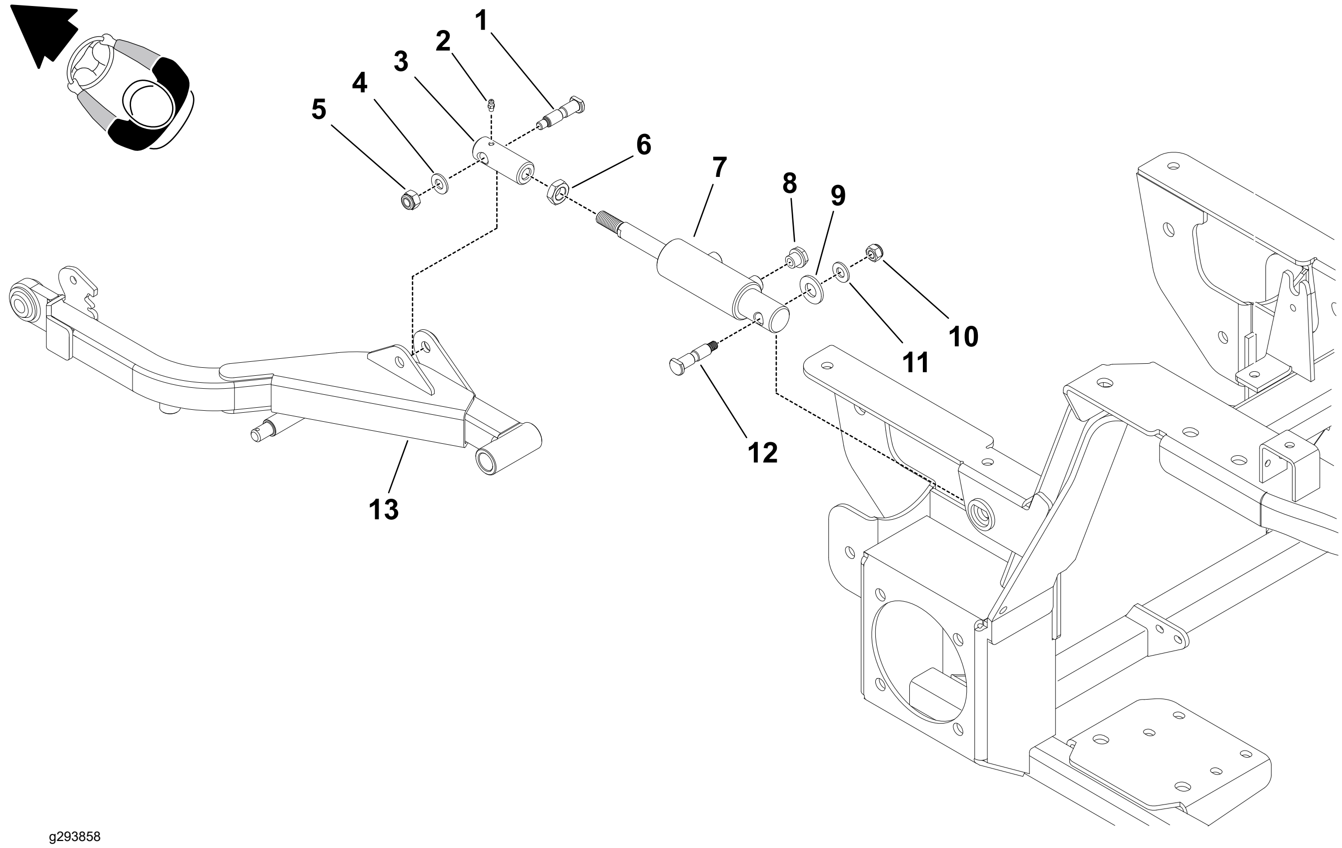


Figure 86

1. Pin
2. Grease fitting
3. Support
4. Washer
5. Nut
6. Nut
7. Lift cylinder
8. Breather cap
9. Washer
10. Nut
11. Washer
12. Pin
13. LH lift arm

Removing the Lift Cylinder

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Read the General Precautions for Removing and Installing the Hydraulic System Components (page 5–63).
3. For assembly purposes, label all the hydraulic connections. Clean the hydraulic connections before loosening the hydraulic lines from the lift cylinder.

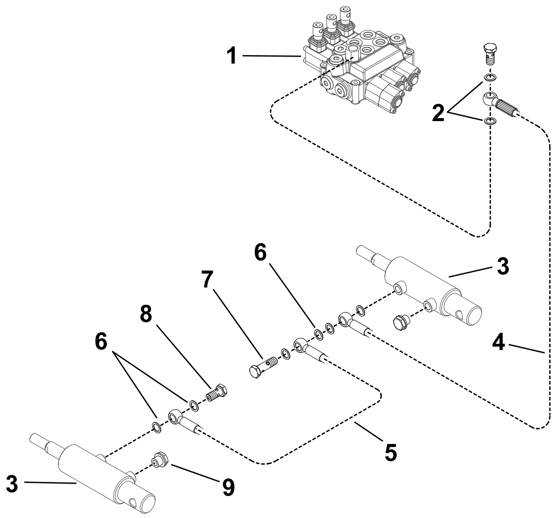
CAUTION

Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to Releasing Pressure from the Hydraulic System (page 5–5).

⚠ WARNING ⚠

Ensure that the cutting deck is fully lowered before loosening the hydraulic lines from the lift cylinders.

If the cutting deck is not fully lowered as the hydraulic lines are loosened, the cutting deck may drop unexpectedly.



g293859

Figure 87

1. Auxiliary control valve
2. O-ring
3. Lift cylinder
4. Hose
5. Hose
6. O-ring
7. Bolt
8. Bolt
9. Breather cap

4. Disconnect the hydraulic hoses from the fittings in the lift cylinder that is to be removed. Allow the hoses to drain into a suitable container. Remove and discard the O-rings from the fittings.
5. Install clean caps or plugs on the hydraulic hoses and fittings to prevent contamination.
6. Remove the nut (item 5 in Figure 86), washer (4) and pin (1) that secures the lift cylinder to the lift arm.
7. Remove the nut (10), washers (9 and 11) and pin (12) that secures the lift cylinder to the chassis.
8. Remove the lift cylinder from the machine.
9. If the hydraulic fittings are to be removed from the lift cylinder, mark the fitting orientation for assembly purposes. Remove the fittings from the lift cylinder and discard the O-rings from the fittings.

Installing the Lift Cylinder

1. If the hydraulic fittings were removed from the lift cylinder, lubricate the new O-rings with clean hydraulic fluid, position the O-rings to the fittings, and install the fittings into the lift cylinder ports; refer to Installing the Hydraulic Fittings (page 5–10). Ensure that the fittings are orientated correctly.
2. Position the lift cylinder to the chassis.

   Note: The lift cylinder barrel end should be attached to the machine frame.
3. Secure the lift cylinder to the chassis with the pin (12), washers (9 and 11) and nut (10).
4. Align the lift cylinder to the lift arm mounting holes. Secure the lift cylinder to the lift arm with the pin (1), washer (4) and nut (5).
5. Remove the caps and plugs that were installed to the hydraulic hoses and fittings during the removal process.
6. Put a coating of clean hydraulic fluid on new fitting O-rings, install the O-rings, and connect the hydraulic hoses to the fittings on the lift cylinder. Tighten the hose connections; refer to Installing the Hydraulic Hoses and Tubes (page 5–8).
7. Lubricate the lift cylinder grease fittings.
8. After you complete the assembly, ensure that the hydraulic hoses and fittings do not contact anything to the chassis. Also, check for any hydraulic-fluid leaks.
9. Check the hydraulic-fluid level in the hydraulic tank and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
10. Operate the machine functions slowly until air is out of system; refer to Charging the Hydraulic System (page 5–72).
11. Start the engine, check for hydraulic-fluid leaks, repair any leaks as necessary, and fill the hydraulic tank with the correct quantity of new hydraulic fluid before returning the machine to service.

Steering Control Valve

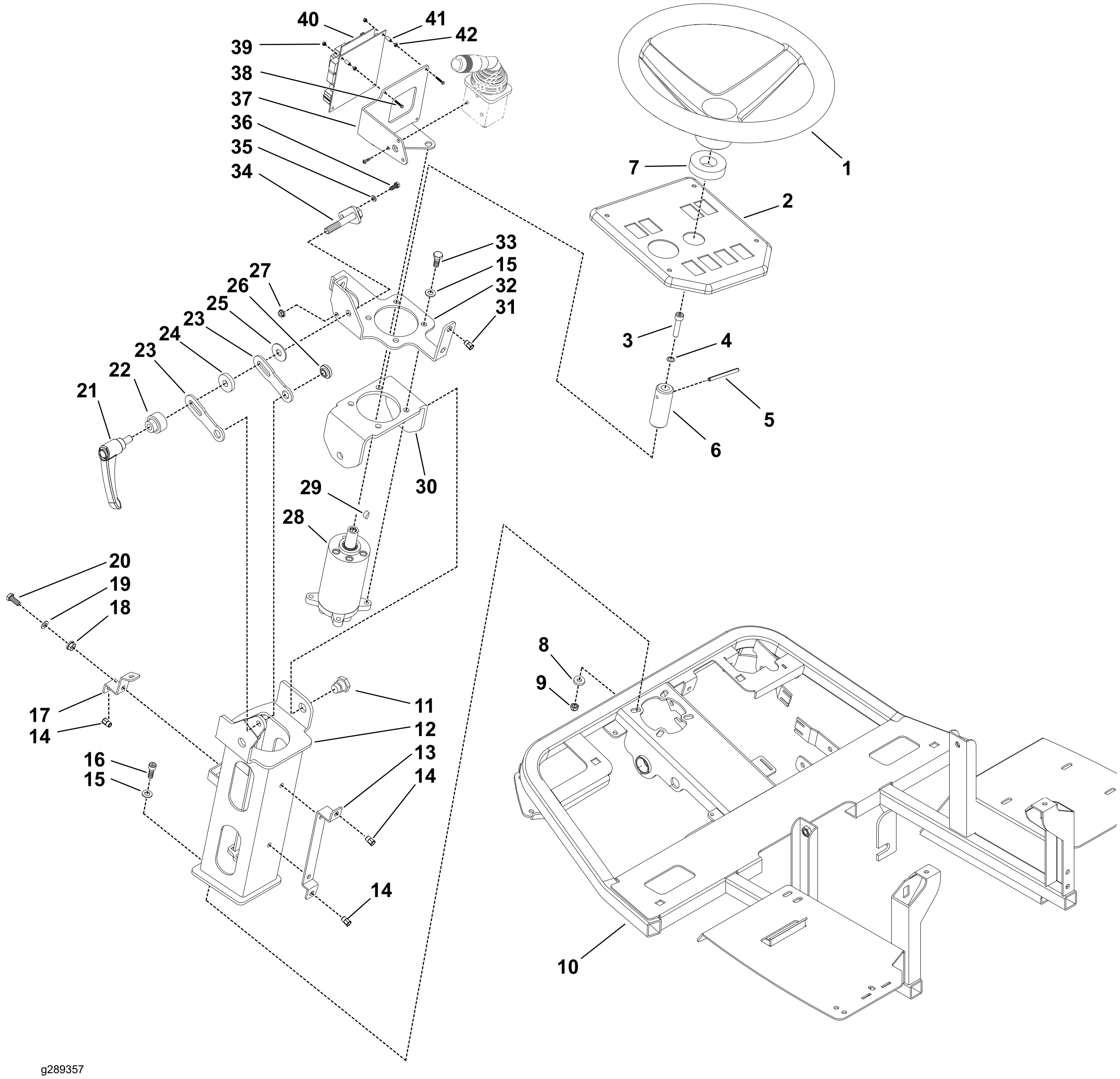


Figure 88

1. Steering wheel
2. Dashboard
3. Socket head screw
4. Washer
5. Pin
6. Bushing
7. Washer
8. Washer
9. Nut
10. Operator platform
11. Pin
12. Steering column
13. Bracket
14. Thread insert
15. Washer
16. Socket head screw
17. Bracket
18. Nut
19. Washer
20. Bolt
21. Handle
22. Bushing
23. Connecting rod
24. Spacer
25. Washer
26. Bushing
27. Nut
28. Steering control valve
29. Shaft key
30. Hinge
31. Thread insert
32. Support
33. Bolt
34. Bolt
35. Washer
36. Bolt
37. Support
38. Bolt
39. Nut
40. Electronic control unit
41. Nylon bushing
42. Nut

Removing the Steering Control Valve

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Remove the steering column components to get access to the steering control valve; refer to Removing the Steering Column (page 7–9).
3. Read the General Precautions for Removing and Installing the Hydraulic System Components (page 5–63).
4. For assembly purposes, label all the hydraulic connections. Note the port designations on the steering control valve.
5. Clean the hydraulic connections before loosening the hydraulic lines.

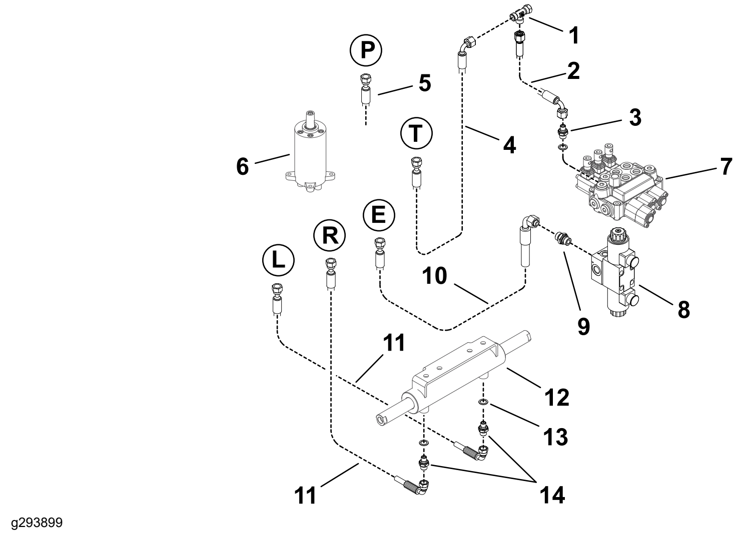


Figure 89

1.	T fitting	8.	Height of cut valve
2.	Hose	9.	Fitting
3.	Fitting	10.	Hose
4.	Hose	11.	Hose
5.	Hose	12.	Steering cylinder
6.	Hydraulic control valve	13.	O-ring
7.	Auxiliary control valve	14.	Fitting

CAUTION

Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to Releasing Pressure from the Hydraulic System (page 5–5).

6. Disconnect the hydraulic lines from the steering control valve. Allow the fluid to drain into a suitable container.
7. Install clean caps or plugs on the hydraulic lines and fittings to prevent contamination.
8. Remove the steering control valve from the steering column by using the Figure 88 as a guide.
9. If necessary, remove the hydraulic fittings from the steering control valve.
10. Remove and discard the O-rings from the fittings.

Installing the Steering Control Valve

1. If the hydraulic fittings were removed from the steering control valve, lubricate new O-rings with clean hydraulic fluid, position the O-rings to the fittings, and install the fittings to the steering control valve; refer to Installing the Hydraulic Fittings (page 5–10).
2. Install the steering control valve onto the steering column by using the Figure 88 as a guide.
3. Remove the caps and plugs that were installed to the hydraulic lines and fittings during the removal process.
4. Lubricate new O-rings and use the labels that you attached during valve removal to connect the hydraulic lines to the fittings on the steering control valve. Tighten the connections; refer to Installing the Hydraulic Hoses and Tubes (page 5–8).
5. After you complete the assembly, ensure that the hydraulic hoses and fittings do not contact anything to the steering column. Also, check for any hydraulic-fluid leaks.
6. Check the hydraulic-fluid level in the hydraulic tank and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
7. Operate the machine functions slowly until air is out of system; refer to Charging the Hydraulic System (page 5–72).
8. Install the removed steering column components; refer to Installing the Steering Column (page 7–9).
9. Start the engine, check for hydraulic-fluid leaks, repair any leaks as necessary, and fill the hydraulic tank with the correct quantity of new hydraulic fluid before returning the machine to service.

Steering Cylinder

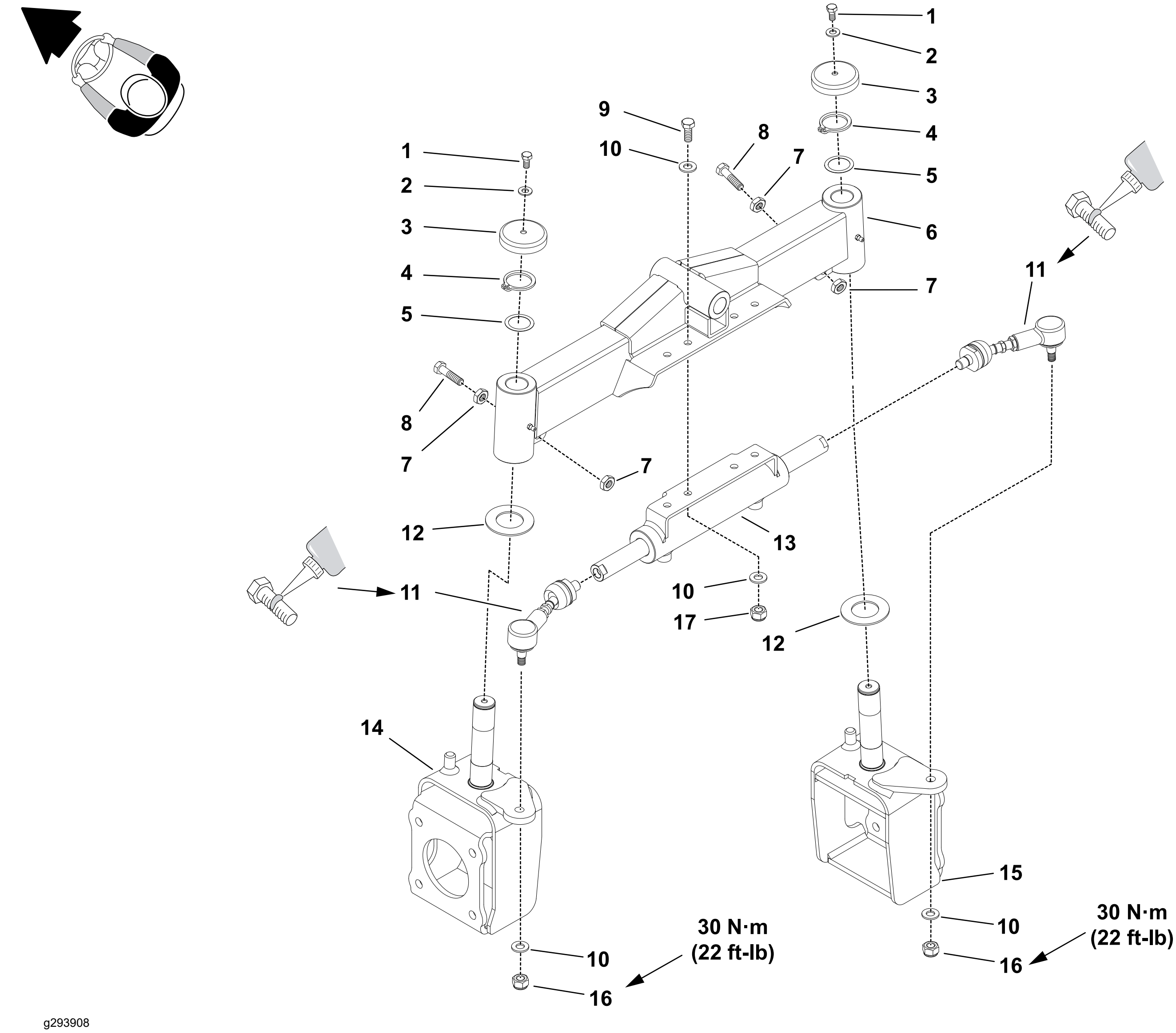


Figure 90

1.	Bolt	7.	Nut	13.	Steering cylinder
2.	Washer	8.	Bolt	14.	Left spindle
3.	Cap	9.	Bolt	15.	Right spindle
4.	Retaining ring	10.	Washer	16.	Nut
5.	Spacer	11.	Tie rod end	17.	Nut
6.	Rear axle	12.	Thrust washer		

Removing the Steering Cylinder

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Read the General Precautions for Removing and Installing the Hydraulic System Components (page 5–63).

CAUTION

Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to Releasing Pressure from the Hydraulic System (page 5–5).

3. For assembly purposes, label all the hydraulic hoses and tubes that are connected to the fittings on the steering cylinder.
4. Clean the hydraulic hose ends before you disconnect the hoses from the steering cylinder.

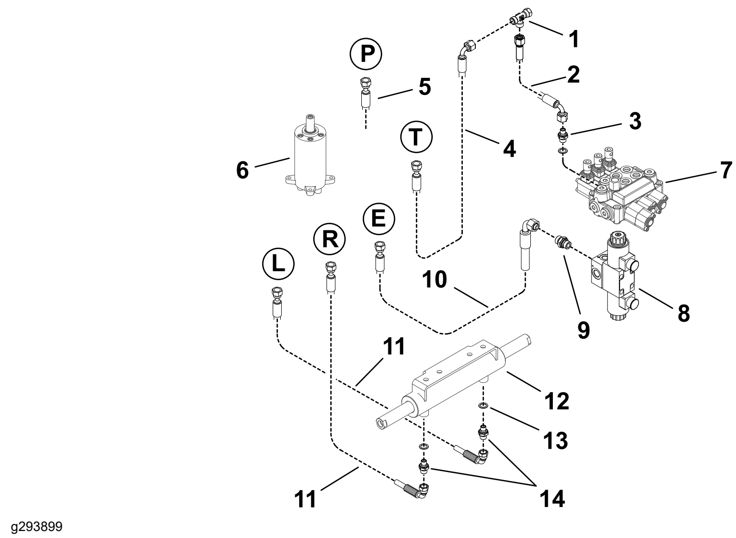


Figure 91

1.	T fitting	8.	Height of cut valve
2.	Hose	9.	Fitting
3.	Fitting	10.	Hose
4.	Hose	11.	Hose
5.	Hose	12.	Steering cylinder
6.	Hydraulic control valve	13.	O-ring
7.	Auxiliary control valve	14.	Fitting

5. Disconnect the hydraulic hoses from the steering cylinder.
6. Install caps or plugs on the disconnected hoses and fittings to prevent contamination.
7. Remove the nuts (item 16 in Figure 90) and washers (10) that secures the steering cylinder tie rod end (11) to the spindle (14 and 15).
8. Remove the 4 bolts (9), washers (10) and nuts (20) that secures the steering cylinder (13) to the rear axle (6).
9. Remove the steering cylinder (13) from the machine.
10. If necessary, remove the tie rod end (11) from the steering cylinder (13).
11. If the hydraulic fittings are to be removed from the steering cylinder, mark the fitting orientation for assembly purposes. Remove the fittings from the steering cylinder and discard the O-rings from the fittings.

Installing the Steering Cylinder

1. If the hydraulic fittings were removed from the steering cylinder, lubricate new O-rings with clean hydraulic fluid, position the O-rings to the fittings, and install the fittings into the steering cylinder ports; refer to Installing the Hydraulic Fittings (page 5–10). Ensure that the fittings are orientated correctly.
2. If removed, apply a coat of thread locking compound onto the threads of tie rod end. Install the tie rod end (11) onto the steering cylinder (13).
3. Position the steering cylinder onto the machine.
4. Secure the steering cylinder (13) to the machine with the 4 bolts (9), washers (10) and nuts (20).
5. Install the steering cylinder tie rod end (11) onto the spindle (14 and 15) and secure with the washer (10) and nut (16).
6. Remove the caps and plugs from the hydraulic hoses and fittings that were installed during the removal process.
7. Lubricate and install the new O-rings on the steering cylinder fittings. Correctly connect the hydraulic hoses to the steering cylinder; refer to Installing the Hydraulic Hoses and Tubes (page 5–8).
8. After you complete the assembly, ensure that the hydraulic hoses and fittings do not contact anything to the chassis. Also, check for any hydraulic-fluid leaks.
9. Check the hydraulic-fluid level in the hydraulic tank and add correct quantity of fluid if necessary; refer to the *Operator’s Manual*.
10. Operate the machine functions slowly until air is out of system; refer to Charging the Hydraulic System (page 5–72).
11. Start the engine, check for hydraulic-fluid leaks, repair any leaks as necessary, and fill the hydraulic tank with the correct quantity of new hydraulic fluid.
12. Check that the steering cylinder does not contact the axle or frame as the steering cylinder moves from one direction to another.
13. Check and adjust the steering stops; refer to the *Operator’s Manual*.

Hopper Lift Cylinder

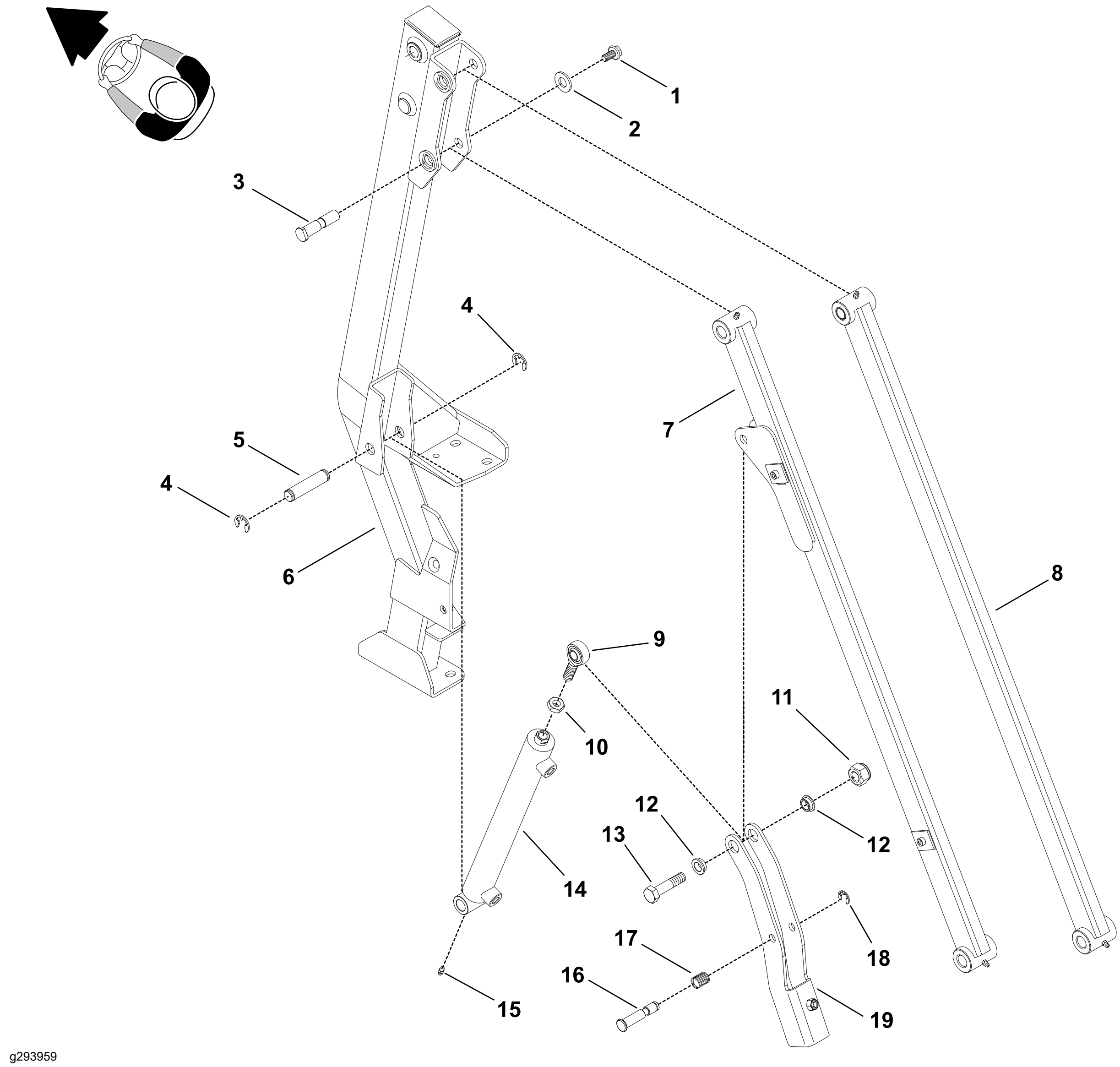


Figure 92

LH Hopper Lift Cylinder (shown)

1.	Bolt	8.	Arm	15.	Grease fitting
2.	Washer	9.	Ball joint	16.	Pin
3.	Pin	10.	Nut	17.	Spring
4.	Snap ring	11.	Nut	18.	Snap ring
5.	Pin	12.	Bushing	19.	Safety handle
6.	LH Bracket	13.	Bolt		
7.	Arm	14.	Hydraulic lift cylinder		

Removing the Hopper Lift Cylinder

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Read the General Precautions for Removing and Installing the Hydraulic System Components (page 5–63).

CAUTION

Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to Releasing Pressure from the Hydraulic System (page 5–5).

3. For assembly purposes, label all the hydraulic hoses and tubes that are connected to the fittings on the hopper lift cylinder.

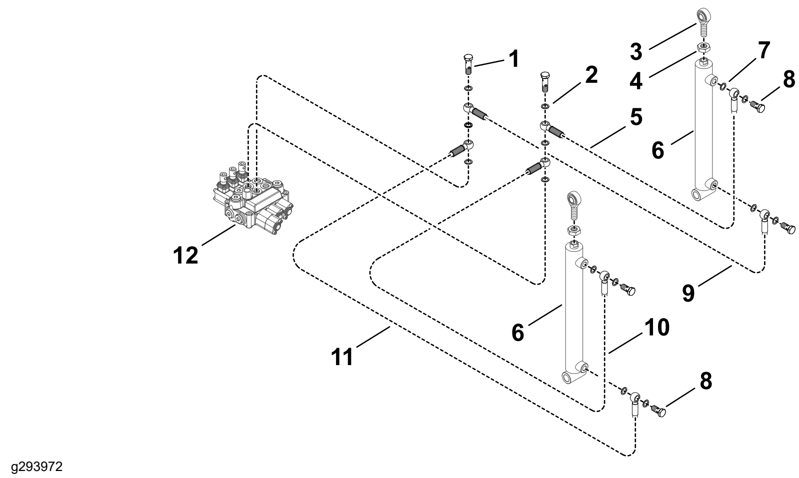


Figure 93

1.	Bolt	7.	O-ring
2.	O-ring	8.	Bolt
3.	Ball joint	9.	Hose
4.	Nut	10.	Hose
5.	Hose	11.	Hose
6.	Hydraulic lift cylinder	12.	Auxiliary control valve

4. Clean the hydraulic hose ends before you disconnect the hoses from the hopper lift cylinder.
5. Disconnect the hydraulic hoses from the hopper lift cylinder.
6. Install caps or plugs on the disconnected hoses and fittings to prevent contamination.
7. Remove the 2 snap rings (item 4 in Figure 92) and pin (5) that secures the hopper lift cylinder (14) to the LH bracket (6).
8. Remove the nut (11) and bolt (13) that secures the hopper lift cylinder (14) and safety handle (19) to the arm (7).
9. Remove the lift cylinder (14) and safety handle (19) from the machine.
10. If the hydraulic fittings are to be removed from the hopper lift cylinder, mark the fitting orientation for assembly purposes. Remove the fittings from the hopper lift cylinder and discard the O-rings from the fittings.

Installing the Hopper Lift Cylinder

1. If the hydraulic fittings were removed from the hopper lift cylinder, lubricate new O-rings with clean hydraulic fluid, position the O-rings to the fittings, and install the fittings into the hopper lift cylinder ports; refer to Installing the Hydraulic Fittings (page 5–10). Ensure that the fittings are orientated correctly.
2. Position the ball joint end of hopper lift cylinder (14) and safety handle (19) onto the arm (7) and secure with the bolt (13) and nut (11).
3. Position the barrel end of the hopper lift cylinder (14) onto the LH bracket (6) and secure with the pin (5) and snap ring (4).
4. Remove the caps and plugs from the hydraulic hoses and fittings that were installed during the removal process.
5. Lubricate and install the new O-rings on the hopper lift cylinder fittings. Correctly connect the hydraulic hoses to the hopper lift cylinder; refer to Installing the Hydraulic Hoses and Tubes (page 5–8).
6. After you complete the assembly, ensure that the hydraulic hoses and fittings do not contact anything to the brackets or arms. Also, check for any hydraulic-fluid leaks.
7. Lubricate the hopper lift cylinder grease fittings.
8. Check the hydraulic-fluid level in the hydraulic tank and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
9. Operate the machine functions slowly until air is out of system; refer to Charging the Hydraulic System (page 5–72).
10. Start the engine, check for hydraulic-fluid leaks, repair any leaks as necessary, and fill the hydraulic tank with the correct quantity of new hydraulic fluid.
11. Operate and check that the hopper lift cylinder does not contact the bracket or arm as the hopper moves up and down.

Hopper Tilt Cylinder

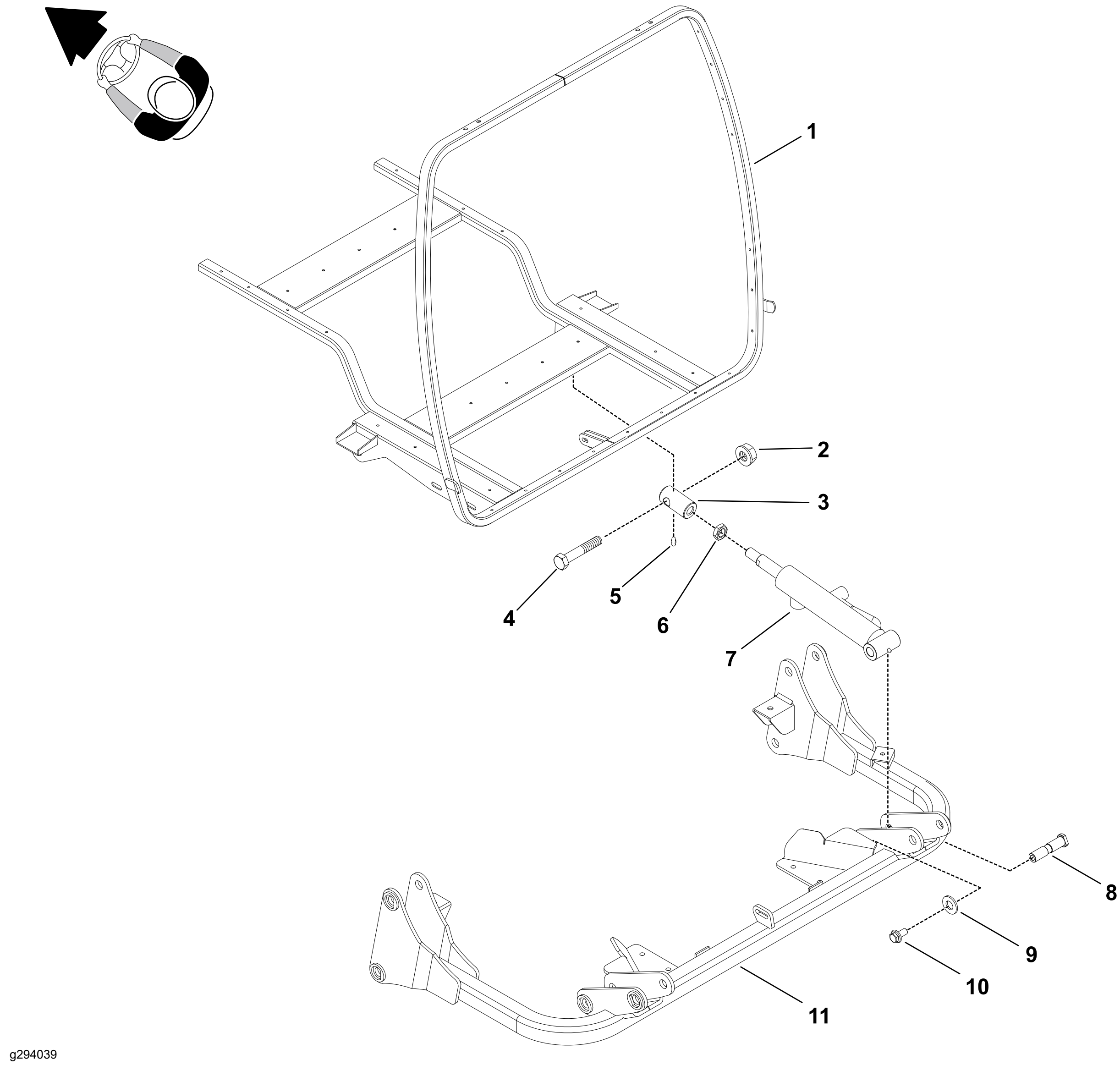


Figure 94

RH Hopper Tilt Cylinder (shown)

1. Hopper frame
2. Nut
3. Support
4. Bolt
5. Grease fitting
6. Nut
7. Hydraulic cylinder
8. Pin
9. Washer
10. Bolt
11. Support frame

Removing the Hopper Tilt Cylinder

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Read the General Precautions for Removing and Installing the Hydraulic System Components (page 5–63).
3. For assembly purposes, label all the hydraulic connections. Clean the hydraulic connections before loosening the hydraulic lines from the hopper tilt cylinder.

Removing the Hopper Tilt Cylinder (continued)

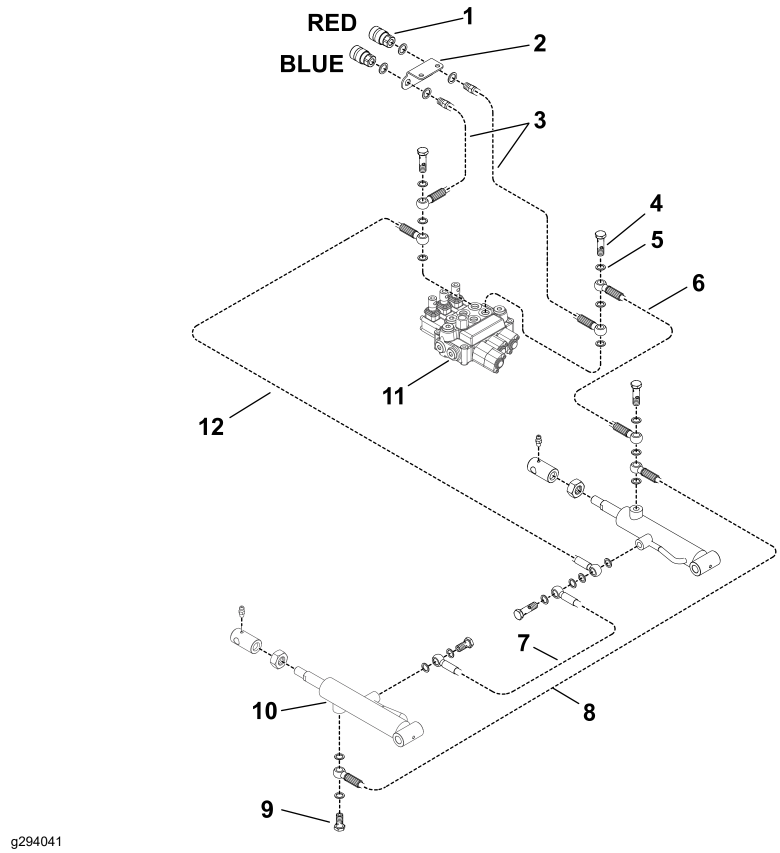


Figure 95

1.	Female quick coupler	7.	Hose
2.	Bracket	8.	Hose
3.	Hose	9.	Bolt
4.	Bolt	10.	Hydraulic cylinder
5.	O-ring	11.	Auxiliary control valve
6.	Hose	12.	Hose

⚠ WARNING ⚠

Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to Releasing Pressure from the Hydraulic System (page 5–5).

4. Disconnect the hydraulic hoses from the fittings in the hopper tilt cylinder that is to be removed. Allow the hoses to drain into a suitable container. Remove and discard the O-rings from the fittings.
5. Install clean caps or plugs on the hydraulic hoses and fittings to prevent contamination.
6. Remove the nut (item 2 in Figure 94) and bolt (4) that secures the hopper tilt cylinder (7) to the hopper frame (1).
7. Remove the bolt (10), washer (9) and pin (8) that secures the hopper tilt cylinder (7) to the support frame (11).
8. Remove the hopper tilt cylinder from the machine.

Removing the Hopper Tilt Cylinder (continued)

9. If the hydraulic fittings are to be removed from the hopper tilt cylinder, mark the fitting orientation for assembly purposes. Remove the fittings from the hopper tilt cylinder and discard the O-rings from the fittings.

Installing the Hopper Tilt Cylinder

1. If the hydraulic fittings were removed from the hopper tilt cylinder, lubricate new O-rings with clean hydraulic fluid, position the O-rings to the fittings, and install the fittings into the hopper tilt cylinder ports; refer to Installing the Hydraulic Fittings (page 5–10). Ensure that the fittings are orientated correctly.
2. Position the hopper tilt cylinder to the support frame.

   Note: The hopper tilt cylinder barrel end should be attached to the support frame (11) (Figure 94).
3. Secure the hopper tilt cylinder barrel end (7) to the support frame (11) with the pin (8), washer (9) and the bolt (10).
4. Position and secure the hopper tilt cylinder rod end (7) to the hopper frame (1) with the bolt (4) and the nut (2).
5. Remove the caps and plugs that were installed to the hydraulic hoses and fittings during the removal process.
6. Put a coating of clean hydraulic fluid on new fitting O-rings, install the O-rings, and connect the hydraulic hoses to the fittings on the hopper tilt cylinder. Tighten the hose connections; refer to Installing the Hydraulic Hoses and Tubes (page 5–8).
7. After you complete the assembly, ensure that the hydraulic hoses and fittings do not contact anything to the frames or arms. Also, check for any hydraulic-fluid leaks.
8. Lubricate the hopper tilt cylinder grease fittings.
9. Check the hydraulic-fluid level in the hydraulic tank and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
10. Operate the machine functions slowly until air is out of system; refer to Charging the Hydraulic System (page 5–72).
11. Start the engine, check for hydraulic-fluid leaks, repair any leaks as necessary, and fill the hydraulic tank with the correct quantity of new hydraulic fluid.
12. Operate and check that the hopper tilt cylinder does not contact the frame or arm as the hopper tilts forward and reverse.

Height Of Cut Cylinder

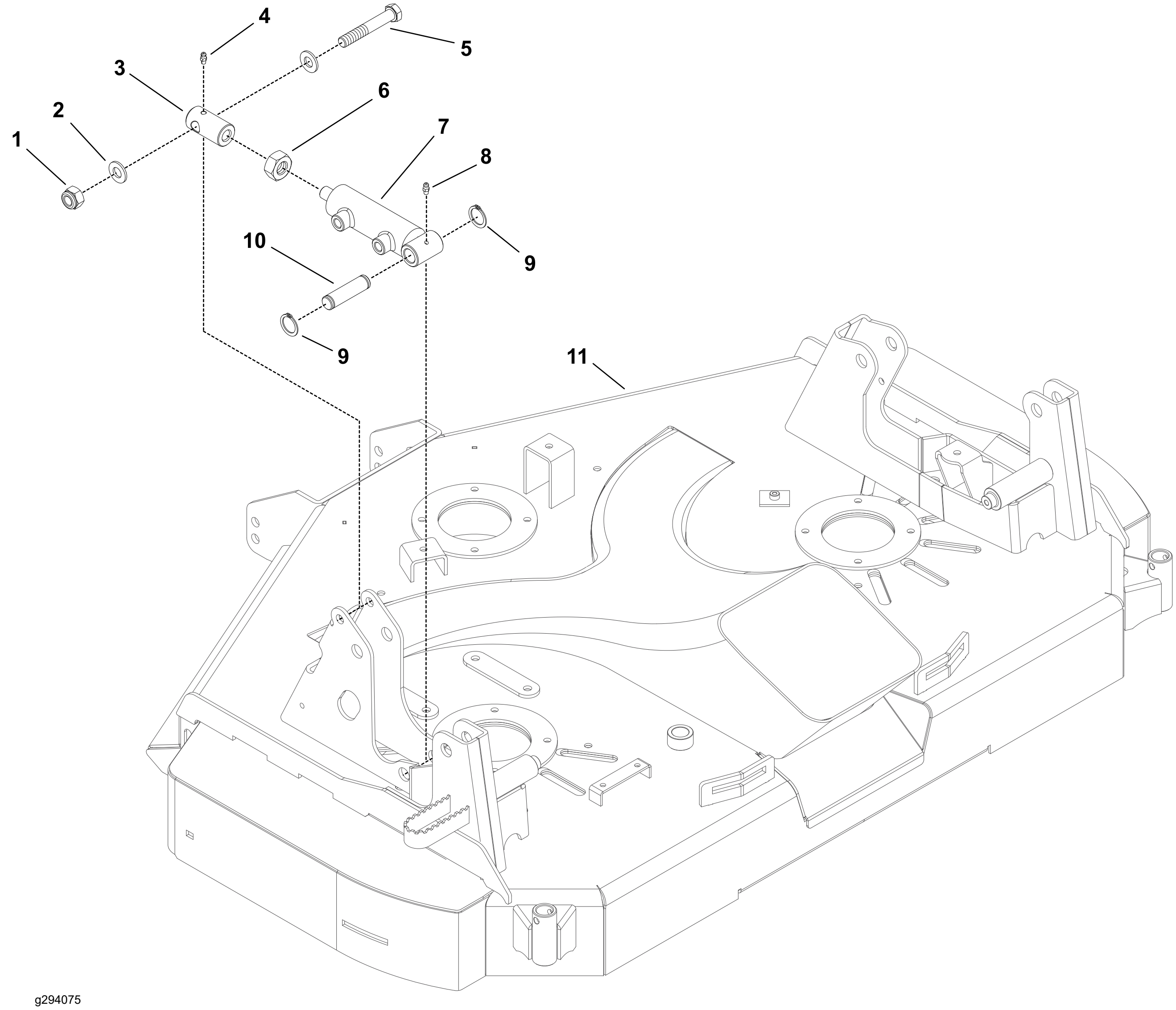


Figure 96

1.	Nut	5.	Bolt	9.	Retaining ring
2.	Washer	6.	Nut	10.	Pin
3.	Support	7.	Hydraulic cylinder	11.	Cutting deck
4.	Grease fitting	8.	Grease fitting		

Removing the Height Of Cut Cylinder

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Read the General Precautions for Removing and Installing the Hydraulic System Components (page 5–63).
3. For assembly purposes, label all the hydraulic connections. Clean the hydraulic connections before loosening the hydraulic lines from the height of cut cylinder.

Removing the Height Of Cut Cylinder (continued)

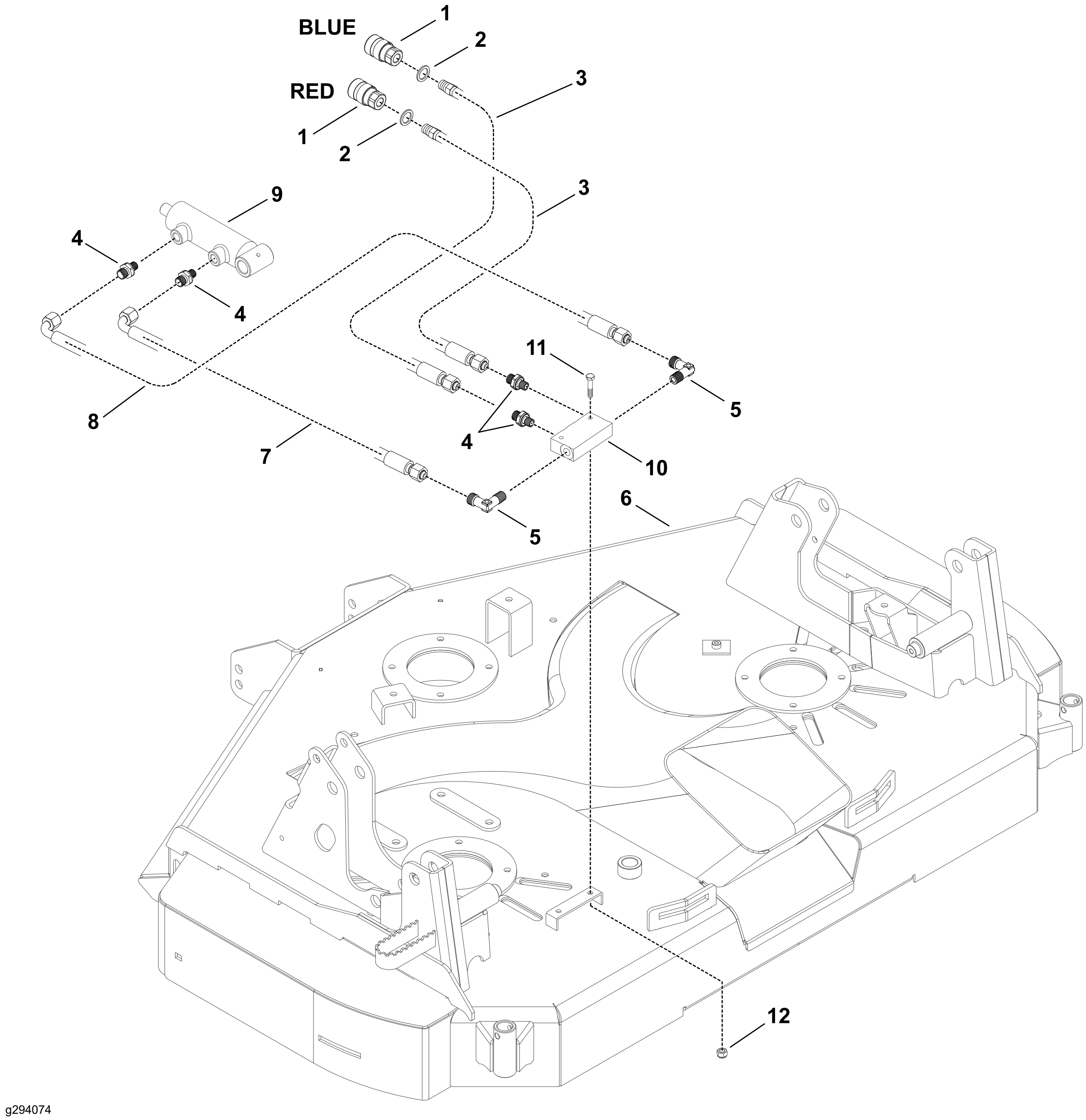


Figure 97

1. Female quick coupler	5. 90º elbow fitting	9. Hydraulic cylinder
2. O-ring	6. Cutting deck	10. Block valve
3. Hose	7. Hose	11. Bolt
4. Fitting	8. Hose	12. Nut

CAUTION

Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to Releasing Pressure from the Hydraulic System (page 5–5).

Removing the Height Of Cut Cylinder (continued)

WARNING

Ensure that the cutting deck is fully lowered before loosening the hydraulic lines from the height of cut cylinder.

4. Disconnect the hydraulic hoses from the fittings in the height of cut cylinder that is to be removed. Allow the hoses to drain into a suitable container. Remove and discard the O-rings from the fittings.
5. Install clean caps or plugs on the hydraulic hoses and fittings to prevent contamination.
6. Remove the nut (item 1 of Figure 96), washers (2) and bolt (5) that secures the height of cut cylinder rod end (7) to the cutting deck.
7. Remove the retaining rings (9) and pin (11) that secures the height of cut cylinder barrel end (7) to the cutting deck.
8. Remove the height of cut cylinder (7) from the cutting deck (11).
9. If the hydraulic fittings are to be removed from the height of cut cylinder, mark the fitting orientation for assembly purposes. Remove the fittings from the height of cut cylinder and discard the O-rings from the fittings.

Installing the Height Of Cut Cylinder

1. If the hydraulic fittings were removed from the height of cut cylinder, lubricate new O-rings with clean hydraulic fluid, position the O-rings to the fittings, and install the fittings into the height of cut cylinder ports; refer to Installing the Hydraulic Fittings (page 5–10). Ensure that the fittings are orientated correctly.
2. Position the height of cut cylinder onto the cutting deck.

   Note: The height of cut cylinder barrel end should be attached towards the machine.
3. Secure the height of cut cylinder barrel end (7) to the cutting deck with the pin (10) and 2 retaining rings (9).
4. Secure the height of cut cylinder rod end (7) to the cutting deck with the bolt (5), 2 washers (2) and nut (1).
5. Remove the caps and plugs that were installed to the hydraulic hoses and fittings during the removal process.
6. Put a coating of clean hydraulic fluid on new fitting O-rings, install the O-rings, and connect the hydraulic hoses to the fittings on the height of cut cylinder. Tighten the hose connections; refer to Installing the Hydraulic Hoses and Tubes (page 5–8).
7. After you complete the assembly, ensure that the hydraulic hoses and fittings do not contact anything to the cutting deck. Also, check for any hydraulic-fluid leaks.
8. Lubricate the height of cut cylinder grease fittings.
9. Check the hydraulic-fluid level in the hydraulic tank and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
10. Operate the machine functions slowly until air is out of system; refer to Charging the Hydraulic System (page 5–72).
11. Start the engine, check for hydraulic-fluid leaks, repair any leaks as necessary, and fill the hydraulic tank with the correct quantity of new hydraulic fluid.

Chute Cleaning Cylinder

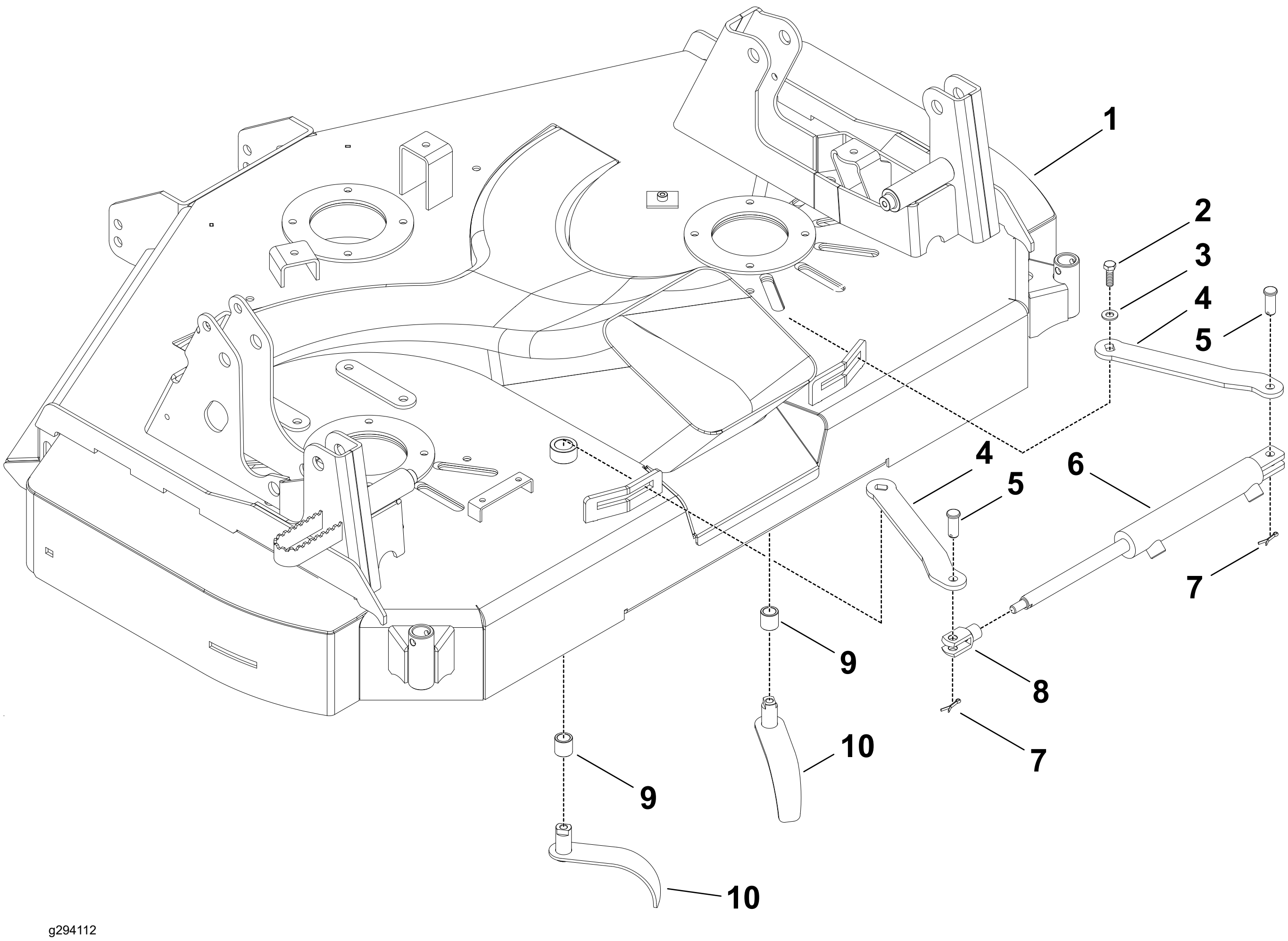


Figure 98

1. Cutting deck
2. Bolt
3. Washer
4. Lever
5. Pin
6. Hydraulic cylinder
7. Split pin
8. Fork
9. Bronze bushing
10. Scraper

Removing the Chute Cleaning Cylinder

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Read the General Precautions for Removing and Installing the Hydraulic System Components (page 5–63).
3. For assembly purposes, label all the hydraulic connections. Clean the hydraulic connections before loosening the hydraulic lines from the chute cleaning cylinder.

Removing the Chute Cleaning Cylinder (continued)

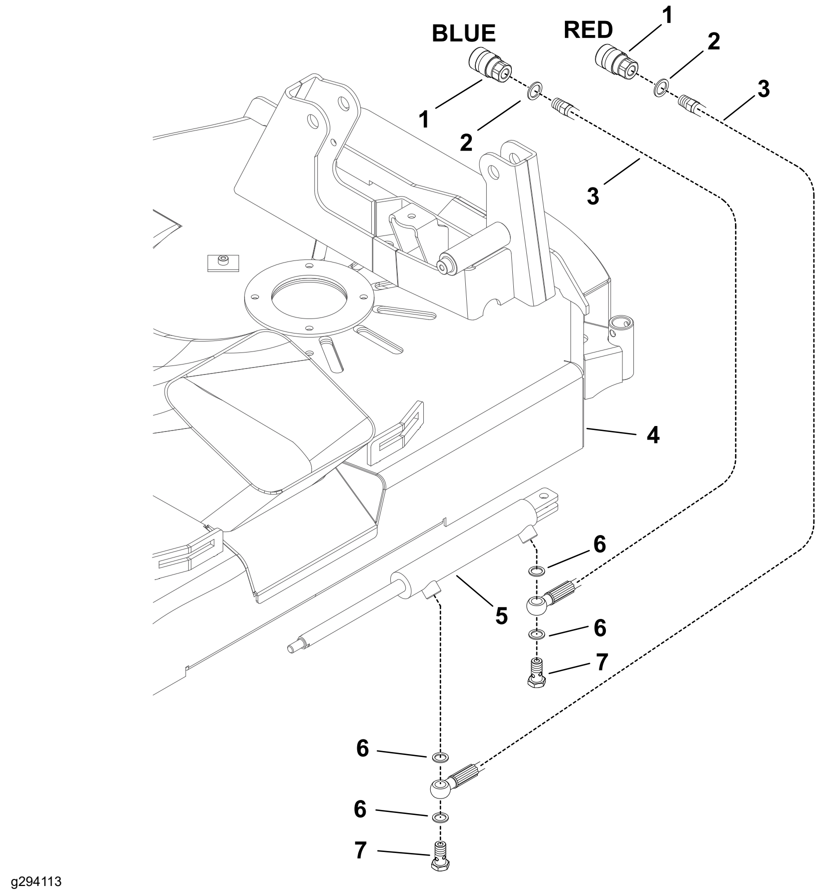


Figure 99

1. Female quick coupler
2. O-ring
3. Hose
4. Cutting deck
5. Hydraulic cylinder
6. O-ring
7. Bolt

CAUTION

Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to Releasing Pressure from the Hydraulic System (page 5–5).

4. Disconnect the hydraulic hoses from the fittings in the chute cleaning cylinder that is to be removed. Allow the hoses to drain into a suitable container. Remove and discard the O-rings from the fittings.
5. Install clean caps or plugs on the hydraulic hoses and fittings to prevent contamination.
6. Remove the split pins (item 7 in Figure 98) and pins (5) that secures the chute cleaning cylinder (6) to the levers (4).
7. Remove the chute cleaning cylinder (5) from the cutting deck (1).
8. If the hydraulic fittings are to be removed from the chute cleaning cylinder, mark the fitting orientation for assembly purposes. Remove the fittings from the chute cleaning cylinder and discard the O-rings from the fittings.

Installing the Chute Cleaning Cylinder

1. If the hydraulic fittings were removed from the chute cleaning cylinder, lubricate new O-rings with clean hydraulic fluid, position the O-rings to the fittings, and install the fittings into the chute cleaning cylinder ports; refer to Installing the Hydraulic Fittings (page 5–10).
2. Position the chute cleaning cylinder onto the lever (4).

   Note: The chute cleaning cylinder barrel end should be towards right side of the machine.
3. Slide and secure the chute cleaning cylinder (6) with the pins (5) and split pins (7).
4. Remove the caps and plugs that were installed to the hydraulic hoses and fittings during the removal process.
5. Put a coating of clean hydraulic fluid on new fitting O-rings, install the O-rings, and connect the hydraulic hoses to the fittings on the chute cleaning cylinder. Tighten the hose connections; refer to Installing the Hydraulic Hoses and Tubes (page 5–8).
6. After you complete the assembly, ensure that the hydraulic hoses and fittings do not contact anything to the cutting deck. Also, check for any hydraulic-fluid leaks.
7. Check the hydraulic-fluid level in the hydraulic tank and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
8. Operate the machine functions slowly until air is out of system; refer to Charging the Hydraulic System (page 5–72).
9. Start the engine, check for hydraulic-fluid leaks, repair any leaks as necessary, and fill the hydraulic tank with the correct quantity of new hydraulic fluid.

Oil Cooler

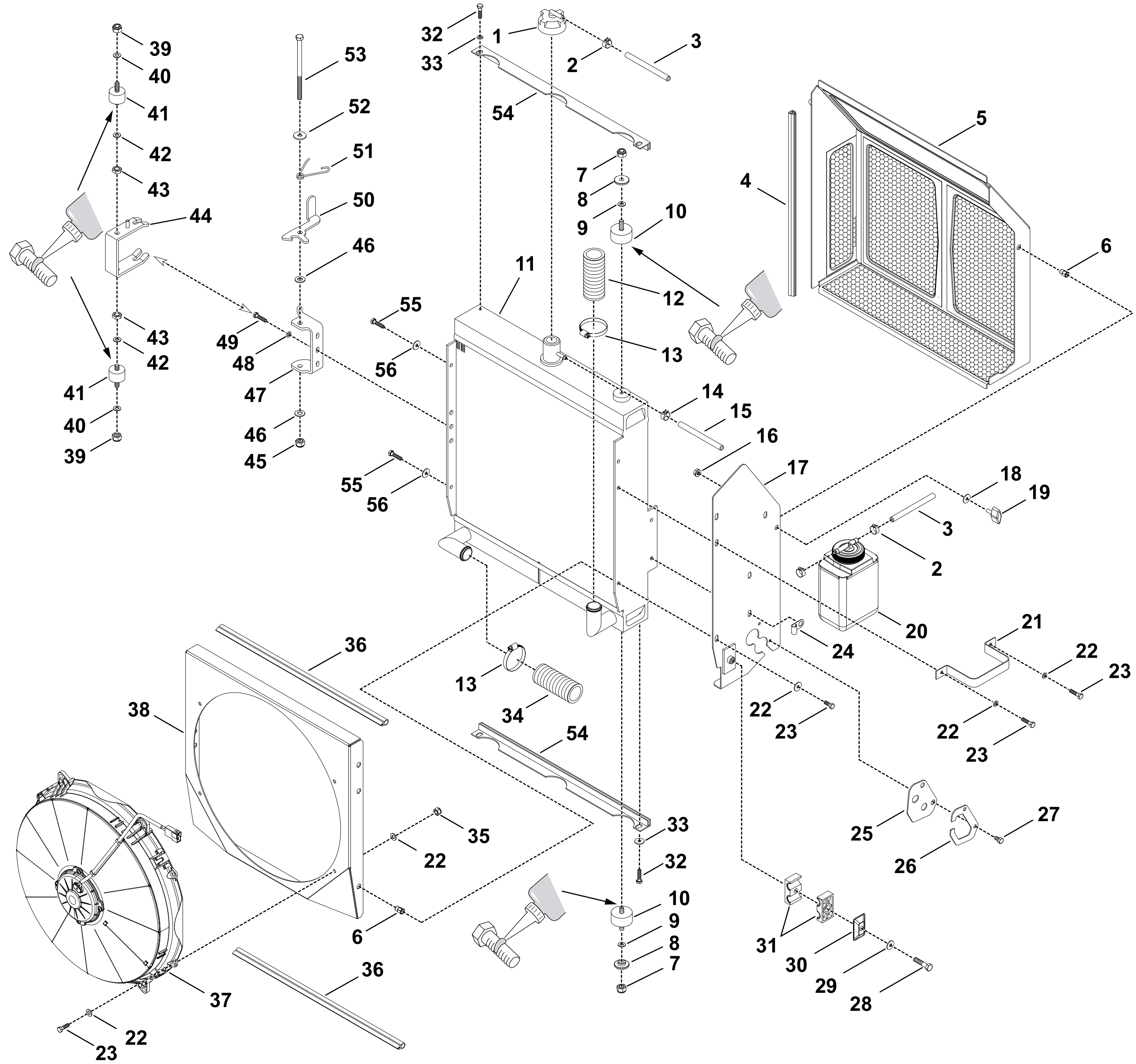


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Figure 100

1. Cap	15. Hose	29. Washer	43. Nut
2. Clamp	16. Nut	30. Plate	44. Bracket
3. Hose	17. Cable guard	31. Collar	45. Nut
4. Gasket	18. Washer	32. Bolt	46. Washer
5. Debris screen	19. Knob	33. Washer	47. Bracket
6. Thread insert	20. Tank	34. Hose	48. Washer
7. Nut	21. Clamp	35. Nut	49. Bolt
8. Bushing	22. Washer	36. Gasket	50. Bracket
9. Washer	23. Bolt	37. Blower	51. Spring
10. Shock absorber	24. Grommet	38. Fan shroud	52. Washer
11. Radiator	25. Gasket	39. Nut	53. Bolt
12. Hose	26. Frame	40. Washer	54. Bracket
13. Clamp	27. Bolt	41. Shock absorber	55. Bolt
14. Clamp	28. Bolt	42. Washer	56. Washer

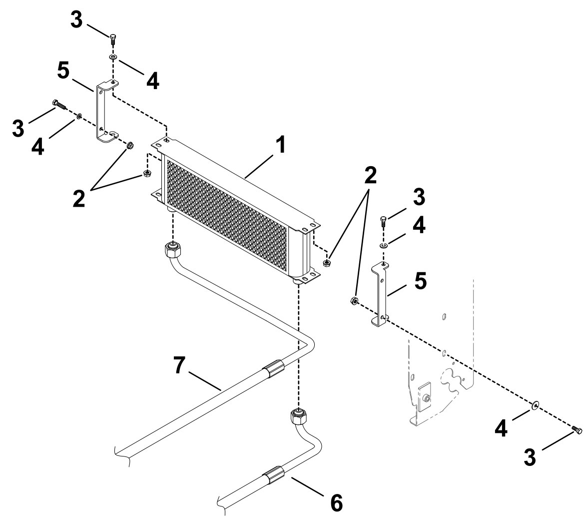

Figure 101

1. Oil cooler
2. Nut
3. Bolt
4. Washer
5. Bracket
6. Hydraulic hose
7. Hydraulic hose

Removing the Oil Cooler

The radiator and oil cooler must be removed from the machine as an assembly; refer to Removing the Radiator (page 4–8).

Inspecting the Oil Cooler

1. Back flush the oil cooler with cleaning solvent. After cleaning the cooler, ensure that all the solvent is drained from the cooler.

WARNING

Use an eye protection such as goggles when using the compressed air to dry the oil cooler.

2. Use the compressed air in the opposite direction of the fluid flow and dry the interiors of the oil cooler.
3. Install the clean plugs on the oil cooler ports. Clean the outer surface of the cooler.

   Note: The oil cooler must be free from corrosion, cracked tubes, or excessive pitting of tubes.

Installing the Oil Cooler

The radiator and oil cooler must be installed into the machine as an assembly; refer to Installing the Radiator (page 4–10).

Chapter 6

Electrical System

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.

Electrical Schematics and Wire Harness Drawings/Diagrams

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

Electronic Control Unit (ECU)

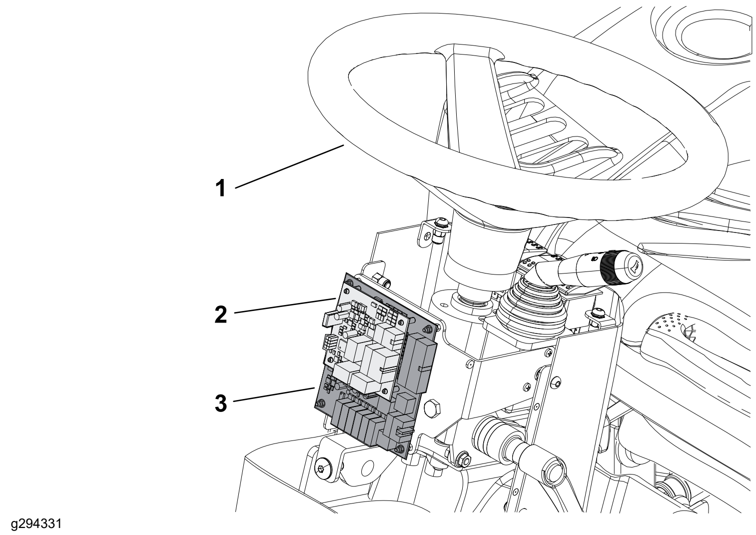

Figure 102

1. Steering wheel
2. Lights electronic control unit
3. Machine electronic control unit

The PLH800 machine is equipped with a machine electronic control unit and lights electronic control unit to monitor and control the electrical components required for safe operation. The electronic control units are located inside the steering column covers.

The machine electronic control unit monitors and controls all safety micro-switches and the engine. The lights electronic control unit monitors and controls the lights.

The machine switches are not operating when the seat is occupied and the key switch is in ON position, you must test the switch, fuses and circuit wiring.

The ECM does not connect to an external computer or hand held device, cannot be re-programmed and does not record intermittent fault data.

Electrical System Quick Checks

Testing the Battery (Open Circuit Test)

Use a multimeter to measure the voltage between the battery terminals; refer to Battery Test Table (page 6–3).

Set the multimeter to the DC volts settings. The battery must be at a temperature of 16°C to 38°C (60°F to 100°F). Ensure that the key is in the OFF position and all the accessories are turned off.

Connect the positive (+) multimeter lead to the positive battery post and negative (-) multimeter lead to the negative battery post.

Measure and record the battery voltage. Use the Battery Test Table (page 6–3) to determine charge level of the battery.

Note: This test provides a relative condition of the battery. The load testing of the battery provides additional and more accurate information; refer to Servicing the Battery (page 6–51).

Battery Test Table

Voltage Measured	Battery Charge Level
12.68 V (or higher)	Fully charged (100%)
12.45 V	75% charged
12.24 V	50% charged
12.06 V	25% charged
11.89 V	0% charged

Testing the Charging System

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

Tool required: Digital multimeter to set DC volts.

Test instructions: Connect the positive (+) multimeter lead to the positive battery post and negative (-) multimeter lead to the negative battery post. Keep the test leads connected to the battery posts and record the battery voltage.

Note: When starting the engine, the battery voltage drops and then must increase once the engine is running.

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

Start the engine and run it at high-idle speed. Allow the battery to charge for a minimum time of 3 minutes. Record the battery voltage.

Note: After running the engine for a minimum time of 3 minutes, the battery voltage must be minimum 0.50 V higher than that of the initial battery voltage.

Refer to the Battery Voltage Table (page 6–4) for an example of a charging system that is functioning.

Battery Voltage Table

At least 0.50 V over the initial battery voltage	
Initial battery voltage	= 12.30 V
Battery voltage after 3 minutes charge	= 12.85 V
Difference	= +0.55 V

Testing the Glow Plug System

This is a fast, simple test that helps to determine the integrity and operation of the glow plug system. Perform this test when you find hard starting (cold engine) on a diesel engine equipped with a glow plug system.

Tool(s) required: Digital multimeter and/or inductive Ammeter (AC/DC Current Transducer).

Test instructions: Properly connect the ammeter to the digital multimeter (refer to the manufacturer's instructions). Set the multimeter to the correct scale. With the key switch in the OFF position, place the ammeter pickup around the main glow plug power supply wire and read the meter prior to activating the glow plug system. Adjust the meter to read zero (if applicable). Activate the glow plug system and record the multimeter results.

The glow plug system of the machine should have a reading of approximately **21 A**.

Checking the Operation of the Interlock Switches

CAUTION

Do not disconnect the safety switches. They are for the operator's protection.

Check the operation of the interlock switches daily for proper operation.

Replace any malfunctioning switches before operating the machine.

The machine is equipped with an Electronic Control Unit (ECU) which monitors the interlock switch operation. The information on the ECU is described in Electronic Control Unit (ECU) (page 6–2).

The interlock system used on this machine includes the key switch, PTO switch, seat switch, traction neutral sensor and parking brake switch.

Testing of the individual interlock switches is included in the Testing the Electrical Components (page 6–6).

Testing the Electrical Components

For accurate resistance and/or continuity checks, electrically disconnect the component being tested from the circuit (e.g., unplug the key switch connector before doing a continuity check of the switch).

Note: Electrical troubleshooting of any 12 V power connection can be performed through voltage drop tests without disconnecting the component.

Note: For engine component testing information; refer to *Yanmar 3TNV76 Service Manual* and *Yanmar 3TNV80F Service Manual*.

IMPORTANT

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

Fuses

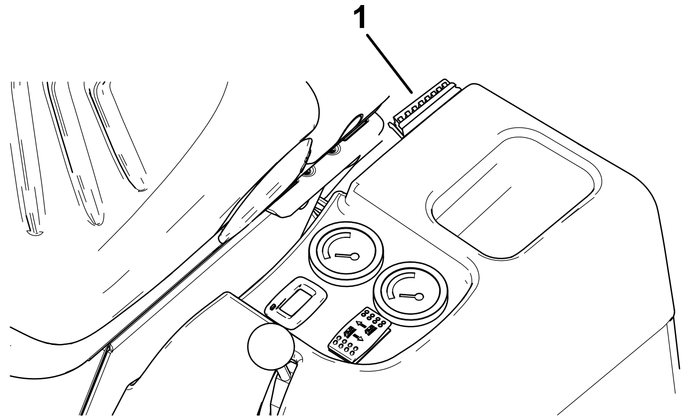

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Figure 103

1. Fuse block

The electrical system is protected by fuses. It requires no maintenance, however, if a fuse blows check the component/circuit for a malfunction or short.

The fuse blocks and fuses are located on the left console next to the operator's seat (Figure 103).

Identification and Function

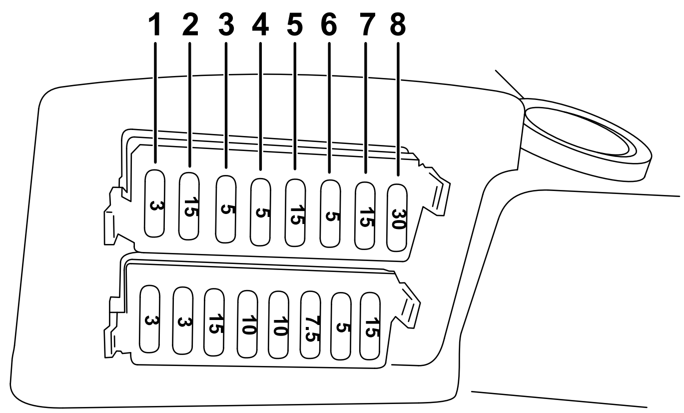

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Figure 104

The fuses are held in the fuse blocks. Use Figure 104 to identify each individual fuse and its correct amperage. Each fuse has the following function:

1. **3 A**: Security circuit.
2. **15 A**: PTO circuit.
3. **5 A**: Electronic Control Unit and buzzer circuit.
4. **5 A**: Differential lock circuit.
5. **15 A**: Mower deck valve and operator's seat circuit.
6. **5 A**: Alternator and dashboard circuit.
7. **15 A**: Work lights, brake lights, full-beam lights, and light control unit circuit.
8. **30 A**: Pull and hazard light switch, spark plugs, and key switch circuit.

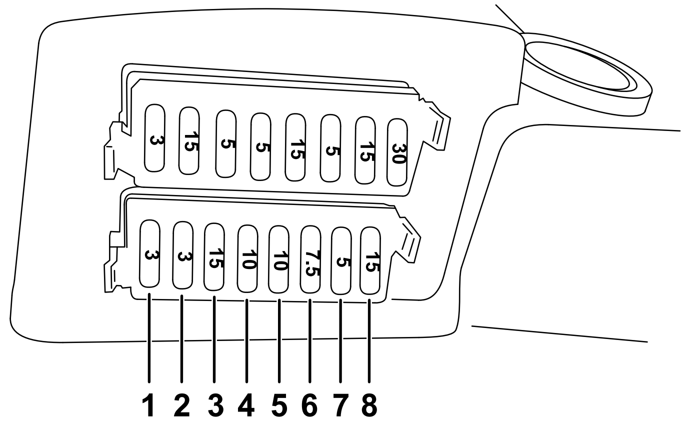

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Figure 105

Use Figure 105 to identify each individual fuse and its correct amperage. Each fuse has the following function:

1. **3 A**: Right steady light and plate light circuit.
2. **3 A**: Left steady light circuit.
3. **15 A**: Full-beam light circuit.
4. **10 A**: Headlight circuit.
5. **10 A**: Warning device circuit.
6. **7.5 A**: Indicator lights circuit.
7. **5 A**: Rotating beacon light circuit.
8. **15 A**: Hazard light switch circuit.

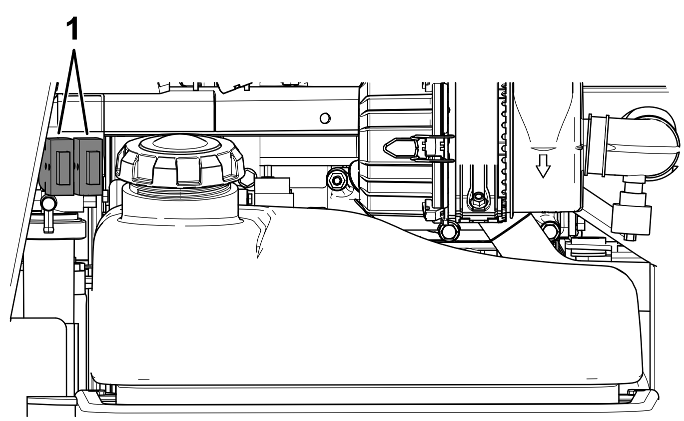

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Figure 106

1. Fuse 40 A

There are 2 fuses of **40 A** that protect the main machine wire harness.

These 2 fuses are located to the left side of the machine and between the roller bar strut and fuel tank (Figure 106).

Testing the Fuses

1. Turn the key switch to the ON position (do not start the engine) and remove the cap for the fuse block. With the fuse installed in the fuse block, use a multimeter to check that 12 VDC exists at both of the terminal test points on the fuse. If 12 VDC exists at 1 of the fuse test points but not at the other, the fuse is damaged.
2. If necessary, remove the fuse from the fuse block for testing. The fuse should have continuity between the fuse terminals.
   A. Ensure that the key switch is in OFF position and the key is removed from the key switch.
   B. Locate the fuse(s) to be tested under the control panel.
   C. Remove the fuse(s) from the fuse holder for testing. The fuse should have continuity between the fuse terminals.

IMPORTANT

If the fuse replacement is necessary, ensure that replacement fuse has the correct rating.

   D. Replace the fuse if testing determines that it is damaged.
   E. After you complete the fuse testing, install the fuse cap.

Key Switch

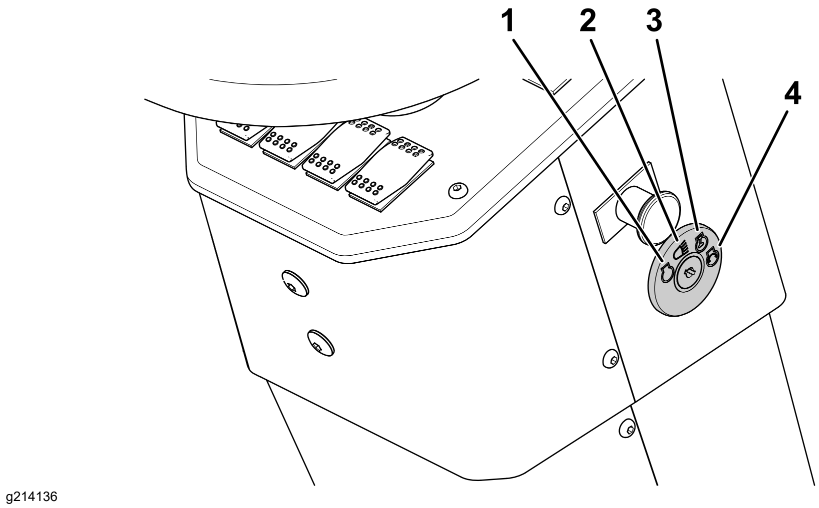

Figure 107

1. OFF position
2. LIGHTS ON position
3. ON/PREHEAT position
4. START position

The key switch is located on right side of the steering column.

The key switch has 4 positions: OFF, LIGHTS ON, ON/PREHEAT, and START (Figure 107).

When the key switch is turned from OFF position to LIGHTS ON position, the work lights illuminate.

The key switch is an input used by electronic control unit to manage various machine functions.

Testing the Key Switch

1. Park the machine on a level surface, lower the cutting deck, set the parking brake, and shut off the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the steering column covers and get access to rear of the key switch; refer to Disassembling the Body Assembly (page 7–6).
4. Disconnect the wire harness connector from the key switch and remove the key switch from the steering column cover.

Testing the Key Switch (continued)

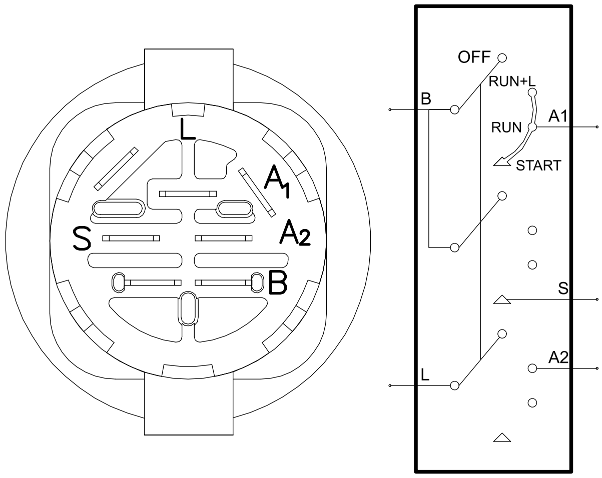

Figure 108

5. The key switch terminals are identified in Figure 108 and the circuitry of the key switch is shown in the Circuit Logic Table (page 6–11). With the use of a multimeter (ohms setting), test the switch functions to determine if the continuity exists between the various terminals for each switch position. Check the continuity between the switch terminals.

Circuit Logic Table

Switch Position	Closed Circuits
OFF	None
LIGHTS ON	B + A1, L + A2
ON/PREHEAT	B + A1
START	B + S + A1

6. Replace the key switch if the testing determines it is damaged.
7. If the key switch testing is correct and a circuit problem still exists, check the wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1).
8. After you complete the testing, connect the machine wire harness connector to the key switch.
9. Install the steering column cover to the steering column; refer to Assembling the Body Assembly (page 7–7).
10. Connect the battery negative (-) cable to the battery.

PTO Switch

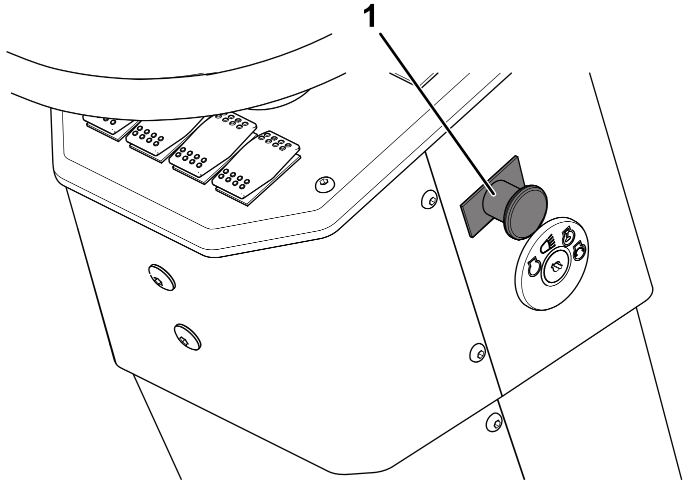

Figure 109

1. PTO switch

The PTO switch is located on right side of the steering column.

Pull it out the PTO switch to engage the PTO electric clutch.

The electronic control unit (ECU) monitors the position of the PTO switch (up or down). Using the inputs from the PTO switch and other switches in the interlock system, the ECU controls the energizing of the electric PTO clutch.

IMPORTANT

During the operation of the machine, if the PTO shuts down due to excessive engine coolant temperature, avoid shutting off the engine. Under this condition, push the PTO knob down, slowly drive to a safe flat area, move the throttle lever to the SLOW position, release the traction pedal, and set the parking brake. Allow the engine to be idle for several minutes while it cools to a safe level and check the cooling system before returning the machine to service.

Testing the PTO Switch

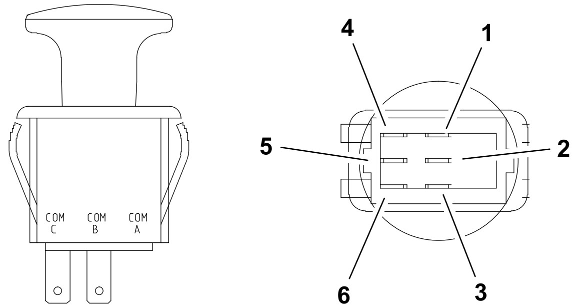

Figure 110

1. COM B terminal
2. NO B terminal
3. NC B terminal
4. COM C terminal
5. NO C terminal
6. NC C terminal

Testing the PTO Switch (continued)

1. Park the machine on a level surface, lower the cutting deck, set the parking brake, and shut off the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the steering column covers and get access to rear of the PTO switch; refer to Disassembling the Body Assembly (page 7–6).
4. Disconnect the wire harness connector from the PTO switch and remove the PTO switch from the steering column cover.
5. The PTO switch terminals are identified in Figure 110 and the circuitry of the PTO switch is shown in the Circuit Logic Table (page 6–13). With the use of a multimeter (ohms setting), test the switch functions to determine if the continuity exists between the various terminals for each switch position. Check the continuity between the switch terminals.

Circuit Logic Table

Switch Position	Closed Circuits
OFF (DOWN)	COM B + NC B COM C + NC C
ON (UP)	COM B + NO B COM C + NO C

6. Replace the PTO switch if the testing determines it is damaged.
7. If the PTO switch testing is correct and a circuit problem still exists, check the wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1).
8. After you complete the testing, connect the machine wire harness connector to the PTO switch.
9. Install the steering column cover to the steering column; refer to Assembling the Body Assembly (page 7–7).
10. Connect the battery negative (-) cable to the battery.

Hazard Light Switch

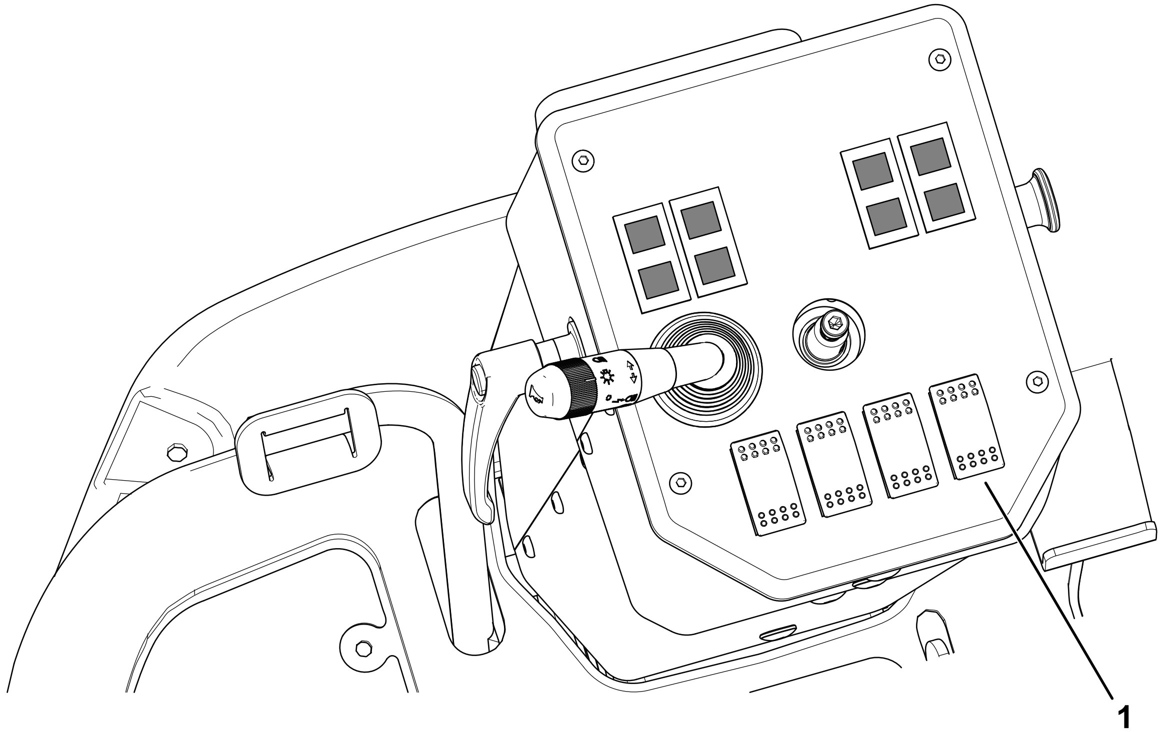

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Figure 111

1. Hazard- light switch

The hazard light switch is located on the dash panel (Figure 111).

The hazard light switch controls the operation of the hazard lights.

Testing the Hazard Light Switch

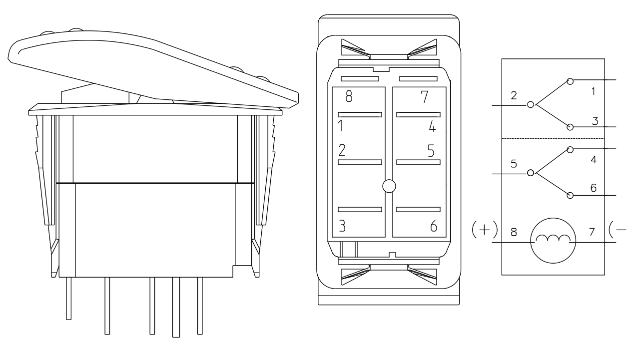

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Figure 112

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1. Park the machine on a level surface, lower the cutting deck, set the parking brake, and shut off the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the dash panel and get access to rear of the hazard light switch; refer to Disassembling the Body Assembly (page 7–6).
4. Disconnect the wire harness connector from the hazard light switch and remove the hazard light switch from the dash panel.

Testing the Hazard Light Switch (continued)

5. The hazard light switch terminals are identified in Figure 112 and the circuitry of the hazard light switch is shown in the Circuit Logic Table (page 6–15). With the use of a multimeter (ohms setting), test the switch functions to determine if the continuity exists between the various terminals for each switch position. Check the continuity between the switch terminals.

Circuit Logic Table

Switch Position	Closed Circuits
ON	2 + 3, 5 + 6
OFF	2+ 1, 5 + 4

6. Replace the hazard light switch if the testing determines it is damaged.
7. If the hazard light switch testing is correct and a circuit problem still exists, check the wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1).
8. After you complete the testing, connect the machine wire harness connector to the hazard light switch.
9. Install the dash panel to the steering column; refer to Assembling the Body Assembly (page 7–7).
10. Connect the battery negative (-) cable to the battery.

Differential Lock Switch

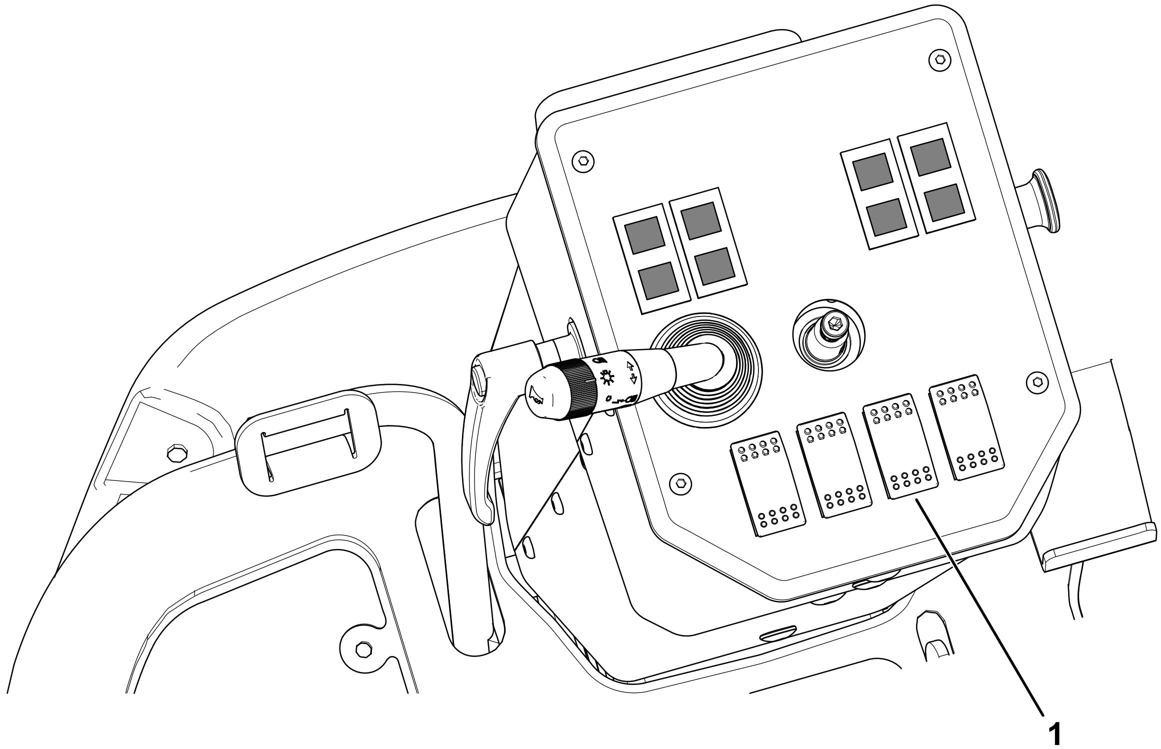


Figure 113

1. Differential lock switch

The differential lock switch is located on the dash panel (Figure 113).

The differential lock switch controls the operation of the differential lock.

Testing the Differential Lock Switch

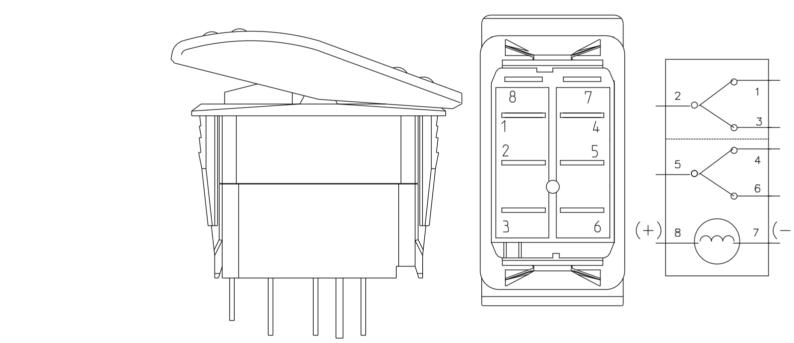


Figure 114

1. Park the machine on a level surface, lower the cutting deck, set the parking brake, and shut off the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the dash panel and get access to rear of the differential lock switch; refer to Disassembling the Body Assembly (page 7–6).
4. Disconnect the wire harness connector from the differential lock switch and remove the differential lock switch from the dash panel.

Testing the Differential Lock Switch (continued)

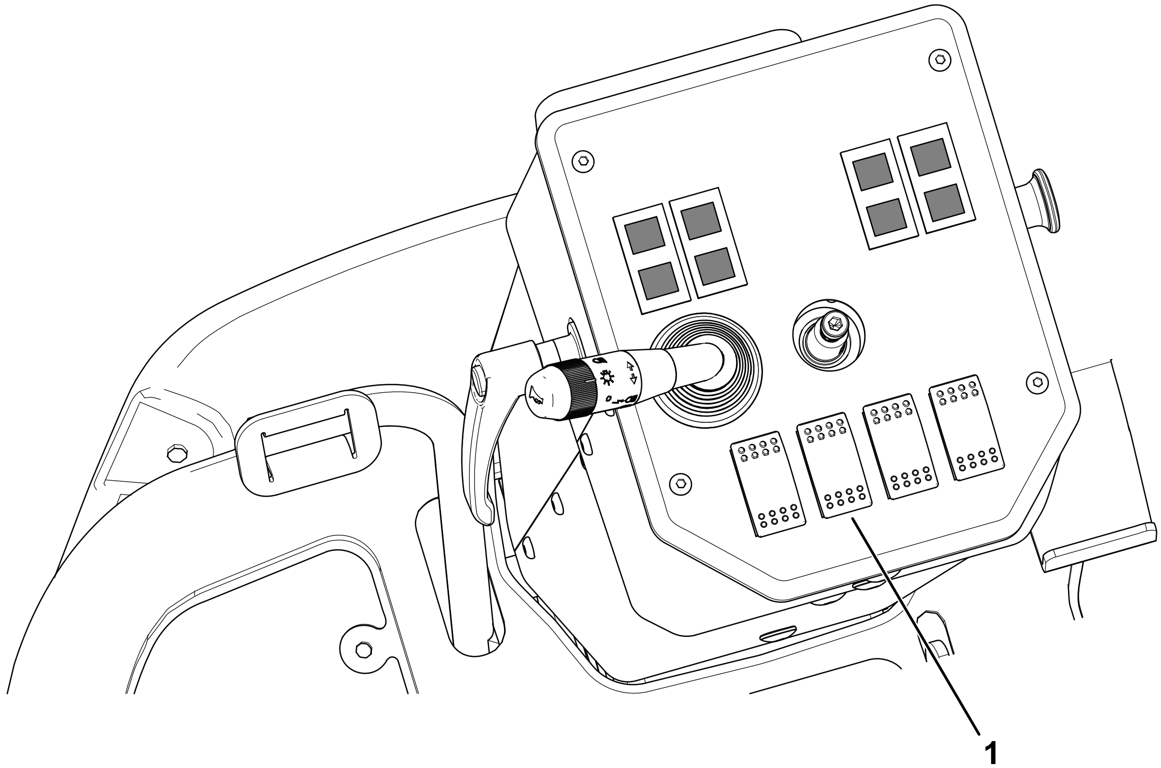
5. The differential lock switch terminals are identified in Figure 114 and the circuitry of the differential lock switch is shown in the Circuit Logic Table (page 6–17). With the use of a multimeter (ohms setting), test the switch functions to determine if the continuity exists between the various terminals for each switch position. Check the continuity between the switch terminals.

Circuit Logic Table

Switch Position	Closed Circuits
ON	2 + 3, 5 + 6
OFF	2+ 1, 5 + 4

6. Replace the differential lock switch if the testing determines it is damaged.
7. If the differential lock switch testing is correct and a circuit problem still exists, check the wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1).
8. After you complete the testing, connect the machine wire harness connector to the differential lock switch.
9. Install the dash panel to the steering column; refer to Assembling the Body Assembly (page 7–7).
10. Connect the battery negative (-) cable to the battery.

Radiator Fan Reversal Switch



g294696

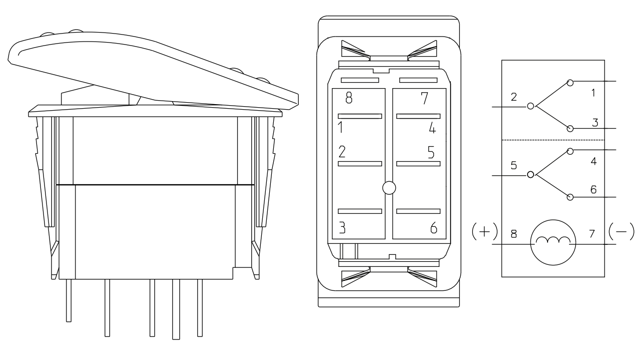
Figure 115

1. Radiator fan reversal switch

The radiator fan reversal switch is located on the dash panel (Figure 115).

The radiator fan reversal switch controls the direction of airflow through the radiator fan.

Testing the Radiator Fan Reversal Switch



g294694

Figure 116

1. Park the machine on a level surface, lower the cutting deck, set the parking brake, and shut off the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the dash panel and get access to rear of the radiator fan reversal switch; refer to Disassembling the Body Assembly (page 7–6).
4. Disconnect the wire harness connector from the radiator fan reversal switch and remove the radiator fan reversal switch from the dash panel.

Testing the Radiator Fan Reversal Switch (continued)

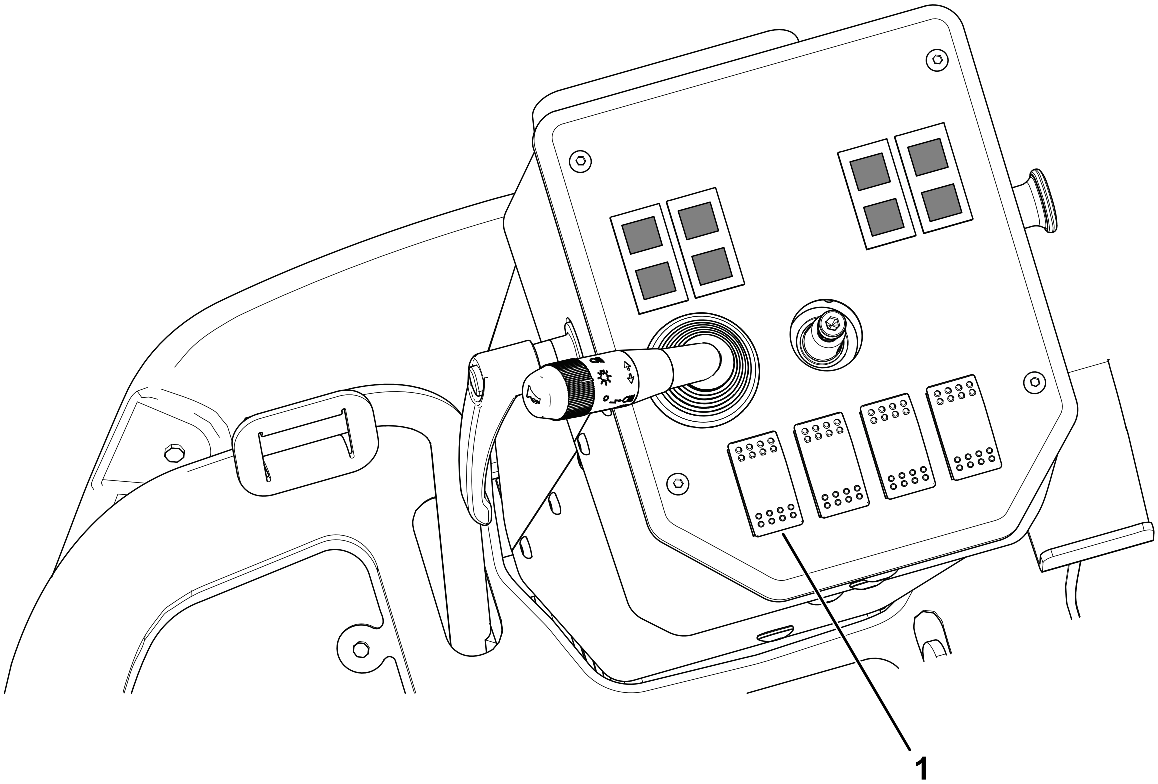
5. The radiator fan reversal switch terminals are identified in Figure 116 and the circuitry of the radiator fan reversal switch is shown in the Circuit Logic Table (page 6–19). With the use of a multimeter (ohms setting), test the switch functions to determine if the continuity exists between the various terminals for each switch position. Check the continuity between the switch terminals.

Circuit Logic Table

Switch Position	Closed Circuits
ON	2 + 3, 5 + 6
OFF	2+ 1, 5 + 4

6. Replace the radiator fan reversal switch if the testing determines it is damaged.
7. If the radiator fan reversal switch testing is correct and a circuit problem still exists, check the wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1).
8. After you complete the testing, connect the machine wire harness connector to the radiator fan reversal switch.
9. Install the dash panel to the steering column; refer to Assembling the Body Assembly (page 7–7).
10. Connect the battery negative (-) cable to the battery.

Beacon Light Switch



g294707

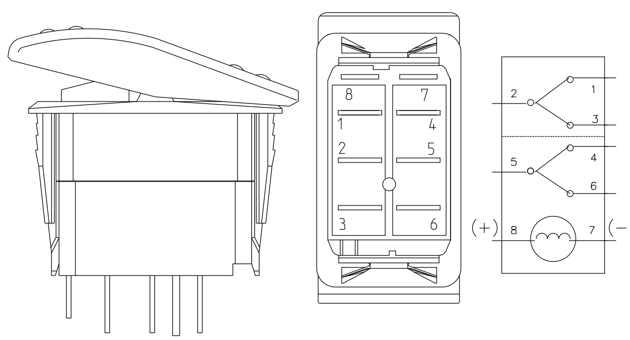
Figure 117

1. Beacon light switch

The beacon light switch is located on the dash panel (Figure 117).

The beacon light switch controls the operation of the beacon light.

Testing the Beacon Light Switch



g294694

Figure 118

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1. Park the machine on a level surface, lower the cutting deck, set the parking brake, and shut off the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the dash panel and get access to rear of the beacon light switch; refer to Disassembling the Body Assembly (page 7–6).
4. Disconnect the wire harness connector from the beacon light switch and remove the beacon light switch from the dash panel.

Testing the Beacon Light Switch (continued)

5. The beacon light reversal switch terminals are identified in Figure 118 and the circuitry of the beacon light switch is shown in the Circuit Logic Table (page 6–21). With the use of a multimeter (ohms setting), test the switch functions to determine if the continuity exists between the various terminals for each switch position. Check the continuity between the switch terminals.

Circuit Logic Table

Switch Position	Closed Circuits
ON	2 + 3, 5 + 6
OFF	2+ 1, 5 + 4

6. Replace the beacon light switch if the testing determines it is damaged.
7. If the beacon light switch testing is correct and a circuit problem still exists, check the wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1).
8. After you complete the testing, connect the machine wire harness connector to the beacon light switch.
9. Install the dash panel to the steering column; refer to Assembling the Body Assembly (page 7–7).
10. Connect the battery negative (-) cable to the battery.

Indicator Lights

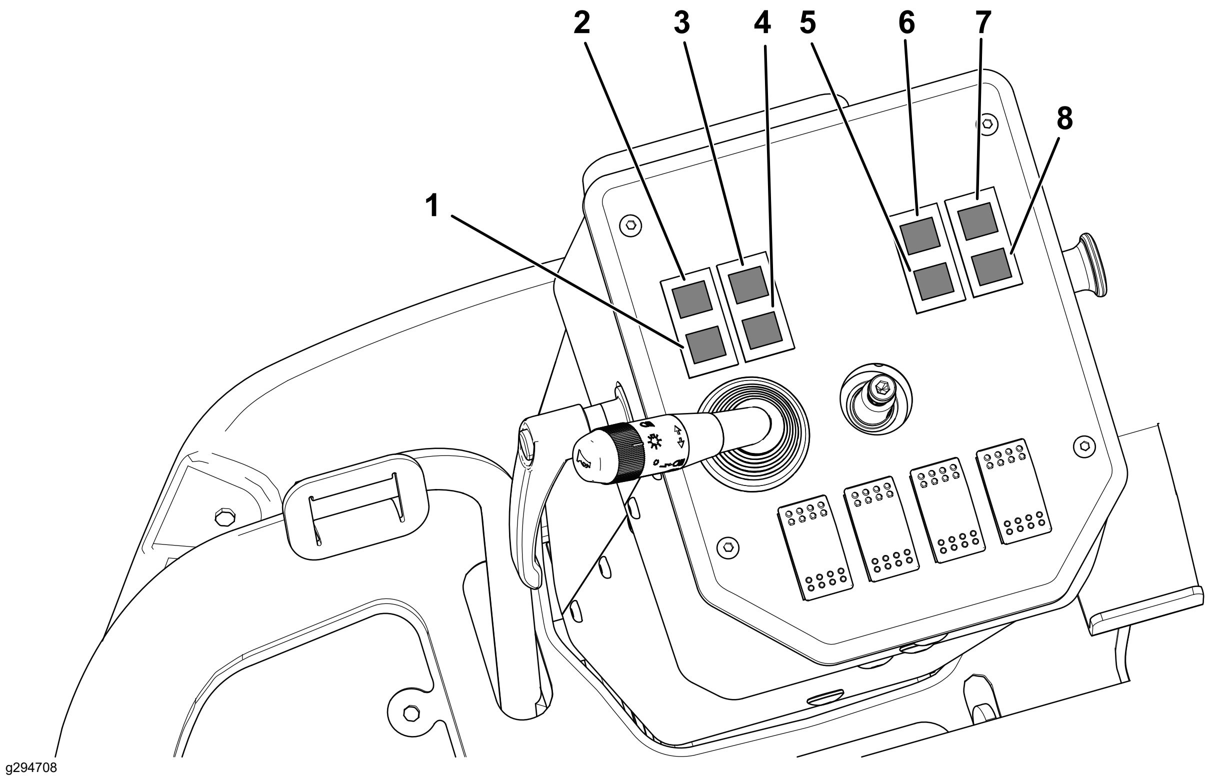


Figure 119

1. Battery charge indicator
2. Glow plug indicator
3. Oil pressure warning indicator
4. Air filter restriction indicator
5. Work light indicator
6. Road light indicator
7. Raised hopper indicator
8. Parking brake indicator

The indicator lights are located on the dash panel.

Battery Charge Indicator Light

The battery charge indicator light should illuminate when the key switch is in the ON position with the engine not running. Also, it should illuminate when the charging circuit is not working properly while the engine is running.

Glow Plug Indicator Light

The glow plug indicator light should illuminate when the key switch is placed in the ON position before placing the key switch in the START position.

Oil Pressure Warning Indicator Light

The engine oil pressure light should illuminate when the key switch is in the ON position with the engine not running. Also, it will illuminate when the engine oil pressure drops below a safe level.

IMPORTANT

If the oil pressure indicator light is illuminated with the engine running, shut off the engine immediately.

Oil Pressure Warning Indicator Light (continued)

To test the oil pressure light and circuit wiring, ground the wire attached to oil pressure switch located on the engine near the oil filter. Turn the key switch to the ON position; the engine oil pressure light should illuminate indicating correct operation of the indicator light and circuit wiring.

Air Cleaner Restriction Indicator Light

The air cleaner restriction indicator light should illuminate when the air cleaner is clogged. If the air cleaner restriction light illuminates, the air filter requires service or replacement.

Work Light Indicator

The work light indicator should illuminate when the work lights are switched ON.

Road Light Indicator

The road light indicator should illuminate when the road lights are switched ON.

Raised Hopper Indicator

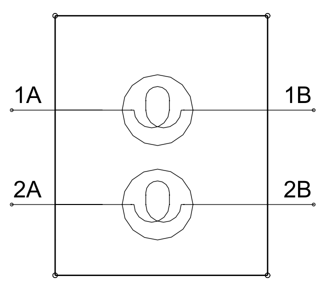
The raised hopper indicator should illuminate when the hopper raises from the normal grass collecting position.

When the raised hopper returns to the normal grass collecting position, the raised hopper indicator light should turn off.

Parking Brake Indicator

The parking brake indicator should illuminate when the parking brake is engaged.

Testing the Indicator Lights

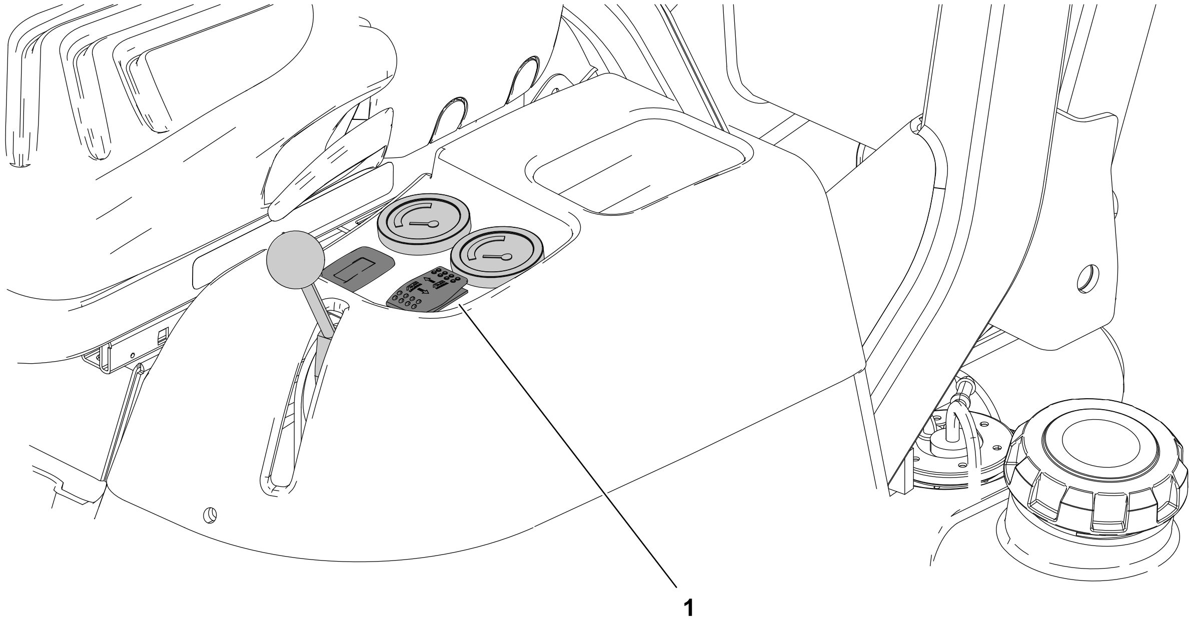


g294709

Figure 120

1. Park the machine on a level surface, lower the cutting deck, set the parking brake, and shut off the engine.
2. Remove the dash panel and get access to rear of the indicator lights; refer to Disassembling the Body Assembly (page 7–6).
3. Apply 12 VDC to the terminals 1A and 2A (Figure 120).
4. Ground the terminals 1B and 2B (Figure 120).
5. Both indicator lights should illuminate.
6. If the indicator does not illuminate, replace the light bulb and check.
7. If the indicator light testing is correct and a circuit problem still exists, check the wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1).
8. Install the dash panel to the steering column; refer to Assembling the Body Assembly (page 7–7).

Height Of Cut Switch



g294710

Figure 121

1. Height of cut switch

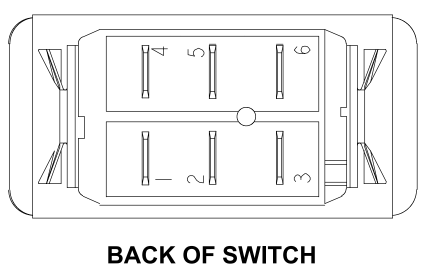
The height of cut switch is used to adjust the mower deck cutting height. The switch is located on the left console.

The engine must be running to allow the height of cut to be raised or lowered.

The height of cut switch controls the solenoid valve coils on the height of cut control valve.

Testing the Height Of Cut Switch

1. Park the machine on a level surface, lower the cutting deck, set the parking brake, and shut off the engine.
2. Ensure that the key switch is in the OFF position and the key is removed from the key switch.
3. Remove the left arm control panel and get access to rear of the switch; refer to Disassembling the Body Assembly (page 7–6).
4. Disconnect the wire harness connector from the height of cut switch.



g223017

Figure 122

Testing the Height Of Cut Switch (continued)

5. The switch terminals are identified in Figure 122 and the circuitry of the switch is shown in the Circuit Logic Table (page 6–25). 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.

Circuit Logic Table

Switch Position	Closed Circuits
RAISE	5 + 4
OFF	None
LOWER	5 + 6

Note: The switch terminals 1, 2, and 3 are not used.

6. Replace the height of cut switch if testing determines that the switch is damaged.

7. If the switch testing is correct and a circuit problem still exists, check the wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1).

8. After you complete the testing, connect the wire harness connector to the switch.

9. Install the left arm control panel to the machine; refer to Assembling the Body Assembly (page 7–7).

Seat Switch

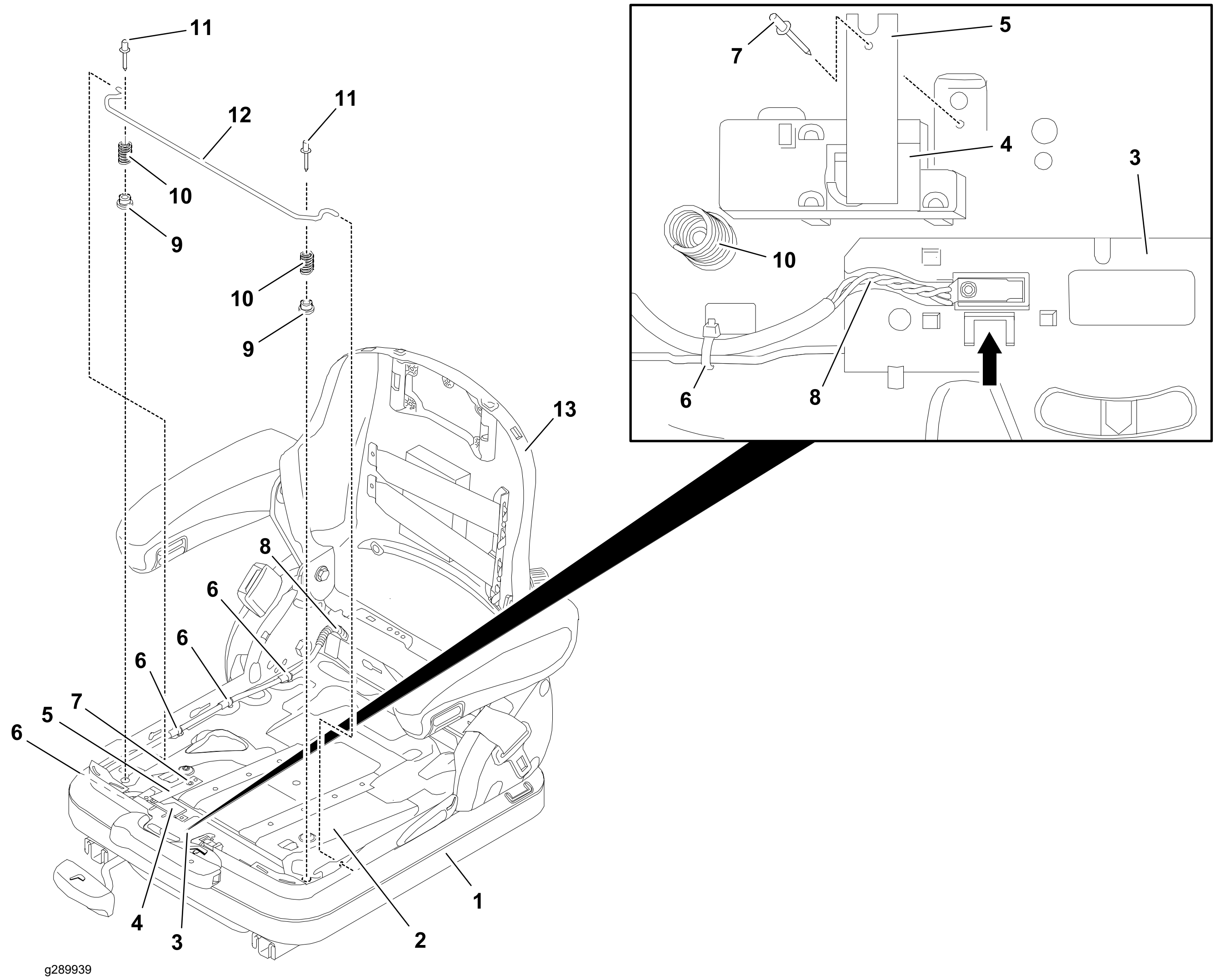


Figure 123

1.	Bellows	6.	Cable ties	11.	Blind rivet
2.	Spring pack	7.	Blind rivet	12.	Switching bracket
3.	Seat level indicator housing	8.	Seat switch with cable	13.	Backrest frame
4.	Cover	9.	Bushing		
5.	Switch plate	10.	Compression springs		

The seat switch normally open and closes when the operator is on the seat. If the traction system or PTO switch is engaged when the operator raises out of the seat, the engine shuts off. The seat switch and its electrical connector are located directly under the seat. Testing of the switch can be done without seat removal by disconnecting the seat wire from the machine wire harness.

The Electronic Control Unit (ECU) monitors the operation of the seat switch.

Testing the Seat Switch

1. Park the machine on a level surface, lower the cutting deck, set the parking brake, and shut off the engine.
2. Ensure that the key switch is in the OFF position. Locate the switch for testing.

Testing the Seat Switch (continued)

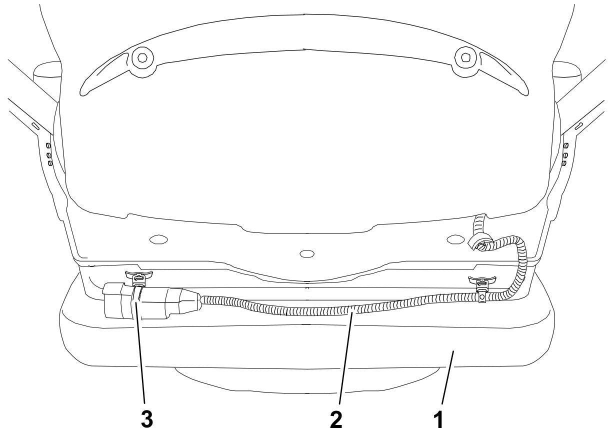


Figure 124

1. Operator seat
2. Seat switch wire harness
3. Seat switch connector

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3. Unplug the machine wire harness electrical connector from the seat switch (Figure 124).
4. Connect a multimeter (ohms setting) across the seat switch harness connector terminals to check the continuity of the seat switch.
   A. With no pressure on the seat, ensure that there is no continuity between the harness terminals of the seat switch.
   B. Press directly onto the seat switch through the seat cushion. Ensure that there is continuity between the harness terminals of the seat switch as the seat cushion approaches the bottom of its travel indicating that the seat switch is functioning.
5. Replace the seat switch if testing determines that the switch is damaged.
6. If the seat switch testing is correct and the circuit problem still exists, check the machine wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1).
7. After you complete the seat switch testing, connect the machine wire harness connector to the seat switch. Check the operation of the seat switch.

Hour Meter

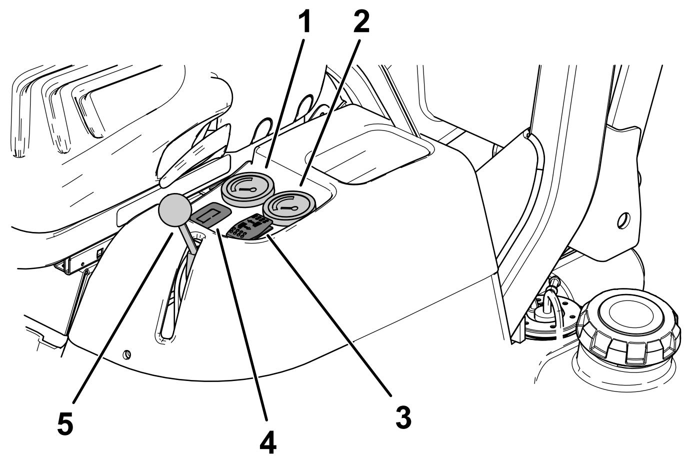


Figure 125

1. Fuel gauge
2. Engine-temperature gauge
3. Height-of-cut switch
4. Hour meter/service due indicator
5. Throttle lever

The hour meter records and displays the accumulated hours of the engine operation.

The service due indicator displays the number of hours until the next engine oil and filter change.

Note: The indicator flashes automatically with “OIL CHANGE” when you need to change the engine oil and filter.

The service due indicator also displays the number of hours until you need to grease the machine.

Note: The indicator flashes automatically with “LUBE” when you need to lubricate the machine.

Push the button ON the hour meter/service due indicator to select the function on the screen.

IMPORTANT

During the first 50 hours while in the oil change mode, take care to not inadvertently hold the button of the hour meter longer than 6-seconds. Holding the button longer than 6-seconds will set the oil service interval from 50 hours to 250 hours.

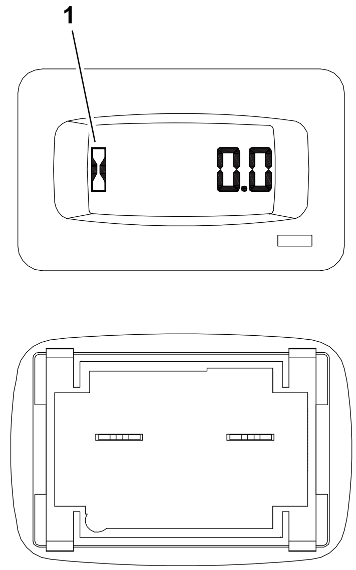
After changing the engine oil and filter or lubricating the machine and mower deck, perform the following:

1. Push the button until you reach the desired screen.
2. Push and hold the button for 6 seconds until the indicator stops flashing.

Note: You cannot reset the total working hours of the machine.

Testing the Hour Meter

1. Park the machine on a level surface, lower the cutting deck, set the parking brake, and shut off the engine.
2. Ensure that the key switch is in the OFF position. Locate the hour meter and disconnect the wire harness electrical connector from the hour meter.



g294786

Figure 126

1. Hourglass icon

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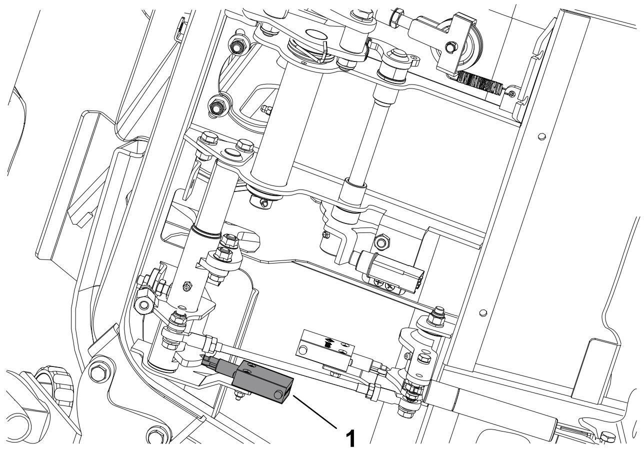
3. Connect the positive (+) terminal of a 12 VDC source to the positive terminal of the hour meter.
4. Connect the negative (-) terminal of the voltage source to the other terminal of the hour meter.
5. The hour meter should move 1/10 of an hour in 6 minutes.
6. Disconnect the voltage source from the hour meter.
7. Replace the hour meter if necessary.
8. Connect the wire harness electrical connector to the hour meter.

Traction Neutral Switch



g294807

Figure 127

1. Neutral switch

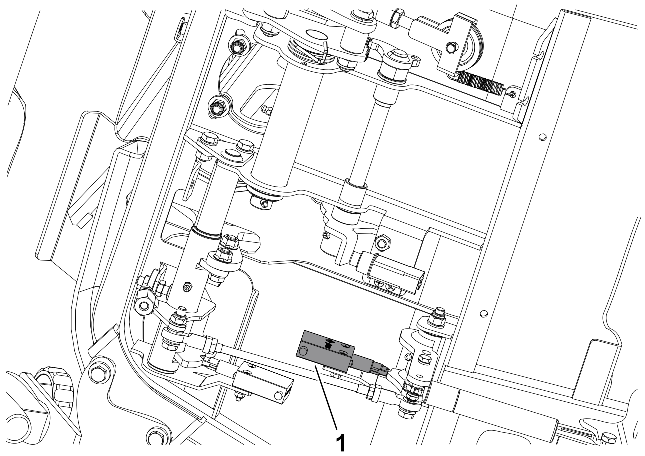
The neutral switch sends signals to the Electronic Control Unit (ECU) about the traction pedal position. The ECU takes the inputs from neutral switch and allows the engine to start.

The neutral switch is located under the operator's platform.

Testing the Traction Neutral Switch

1. Park the machine on a level surface, lower the cutting deck, and shut off the engine.
2. Locate and disconnect the switch connector from the machine wire harness (Figure 127).
3. Connect a multimeter (ohms setting) across the switch connector terminals to check the continuity of the switch as follows:
   A. When the switch plunger is extended, there should be continuity between the switch terminals.
   B. When the switch plunger is pressed, there should not be continuity between the switch terminals.
4. Replace the switch if testing determines that the switch is damaged.
5. If the neutral switch testing is correct and a circuit problem still exists, check the main wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1).
6. After you complete the neutral switch testing, connect the switch connector to the machine wire harness.

Traction Reverse Switch



g294810

Figure 128

1. Reverse switch

The reverse switch sends signals to the Electronic Control Unit (ECU) about the traction pedal position. The ECU takes the inputs from reverse switch and activates the warning buzzer.

The reverse switch is located under the operator's platform.

Testing the Traction Reverse Switch

1. Park the machine on a level surface, lower the cutting deck, and shut off the engine.
2. Locate and disconnect the switch connector from the machine wire harness (Figure 128).
3. Connect a multimeter (ohms setting) across the switch connector terminals to check the continuity of the switch as follows:
   A. When the switch plunger is extended, there should be continuity between the switch terminals.

   B. When the switch plunger is pressed, there should not be continuity between the switch terminals.
4. Replace the switch if testing determines that the switch is damaged.
5. If the reverse switch testing is correct and a circuit problem still exists, check the main wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1).
6. After you complete the reverse switch testing, connect the switch connector to the machine wire harness.

Parking Brake Switch

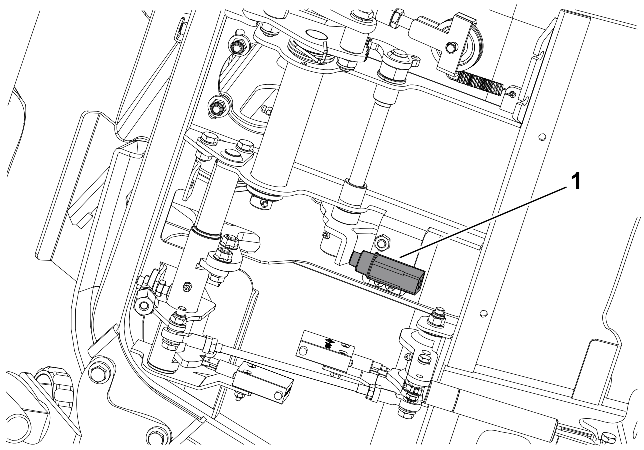


Figure 129

1. Parking brake switch

The parking brake switch is a normally open switch. The Electronic Control Unit (ECU) monitors the operation of the parking brake switch.

The parking brake switch located under the operator's platform.

When the parking brake is not set, the parking brake bracket is away from the target end of the parking brake switch so that the switch is open. When the parking brake is set, the parking brake bracket is positioned on the target end of the parking brake switch so that the switch is closed.

Testing the Parking Brake Switch

1. Park the machine on a level surface, lower the cutting deck, shut off the engine and the key switch is in the OFF position.
2. Locate and disconnect the machine wire harness connector from the parking brake switch (Figure 129).
3. Connect a multimeter (ohms setting) across the switch connector terminals to check the continuity of the switch as follows:
   A. With the parking brake disengaged, there should be no continuity between the switch terminals.
   B. Engage the parking brake, there should be continuity between the switch terminals.
4. Replace the switch if testing determines that the switch is damaged.
5. If the parking brake switch testing is correct and a circuit problem still exists, check the main wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1).
6. After you complete the reverse switch testing, connect the switch connector to the machine wire harness.

Oil Pressure Switch

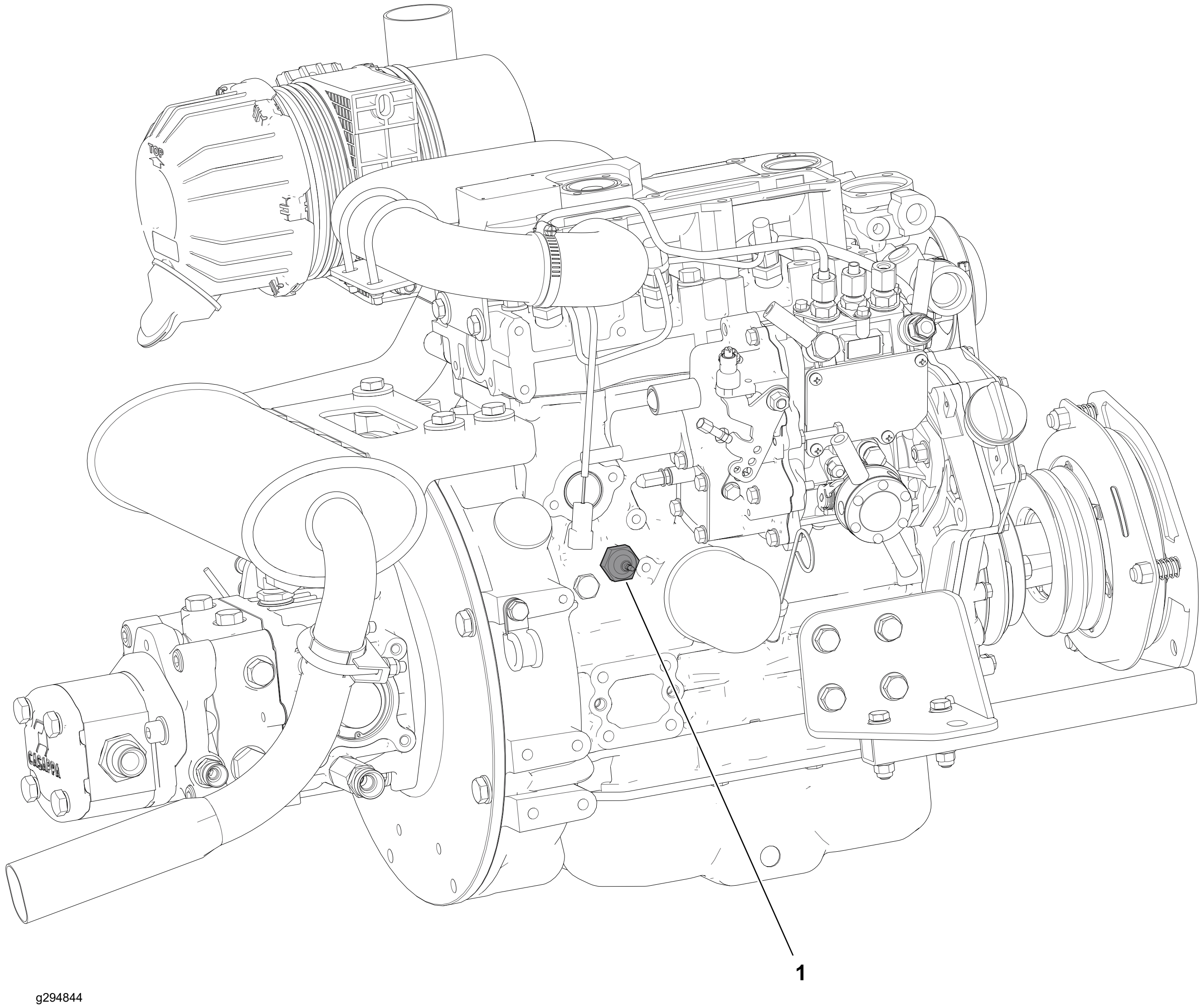


Figure 130

1. Oil pressure switch

The engine oil pressure switch is located on the engine near the oil filter (Figure 130). The oil pressure switch is a normally closed switch that opens with oil pressure.

The oil pressure switch should open at approximately **0.6 bar (8.8 PSI)**.

IMPORTANT

If the oil pressure indicator light is illuminated with the engine running, shut off the engine immediately. Check the indicator light, circuit wiring, pressure switch and engine lubrication system to identify the cause of the illuminated indicator light.

Testing the Oil Pressure Switch

Note: Refer to the *Yanmar 3TNV76 Service Manual* and *Yanmar 3TNV80F Service Manual* for information regarding engine lubrication system and testing.

Testing the Oil Pressure Switch (continued)

1. Park the machine on a level surface, lower the cutting deck, set the key switch to the OFF position and remove the key from the key switch.
2. Locate the engine oil pressure switch on the engine and disconnect the wire harness connector from the switch. Check the switch and the harness connector for damage or corrosion and clean or repair as necessary.
3. Connect a multimeter (ohms setting) to check the continuity of the switch:
   A. With the engine off, the oil pressure switch should be closed so there should be continuity between the switch terminal and the metal switch body.
   B. With the engine running, the oil pressure switch should be open so there should not be continuity between the switch terminal and the metal switch body.
4. Replace the switch if testing determines that the switch is damaged.
5. If the switch tests correctly and a circuit problem still exists, check the machine wire harness; refer to Appendix A (page A–1).
6. After testing, connect the engine wire harness to the switch before returning the machine to service.

PTO Electric Clutch

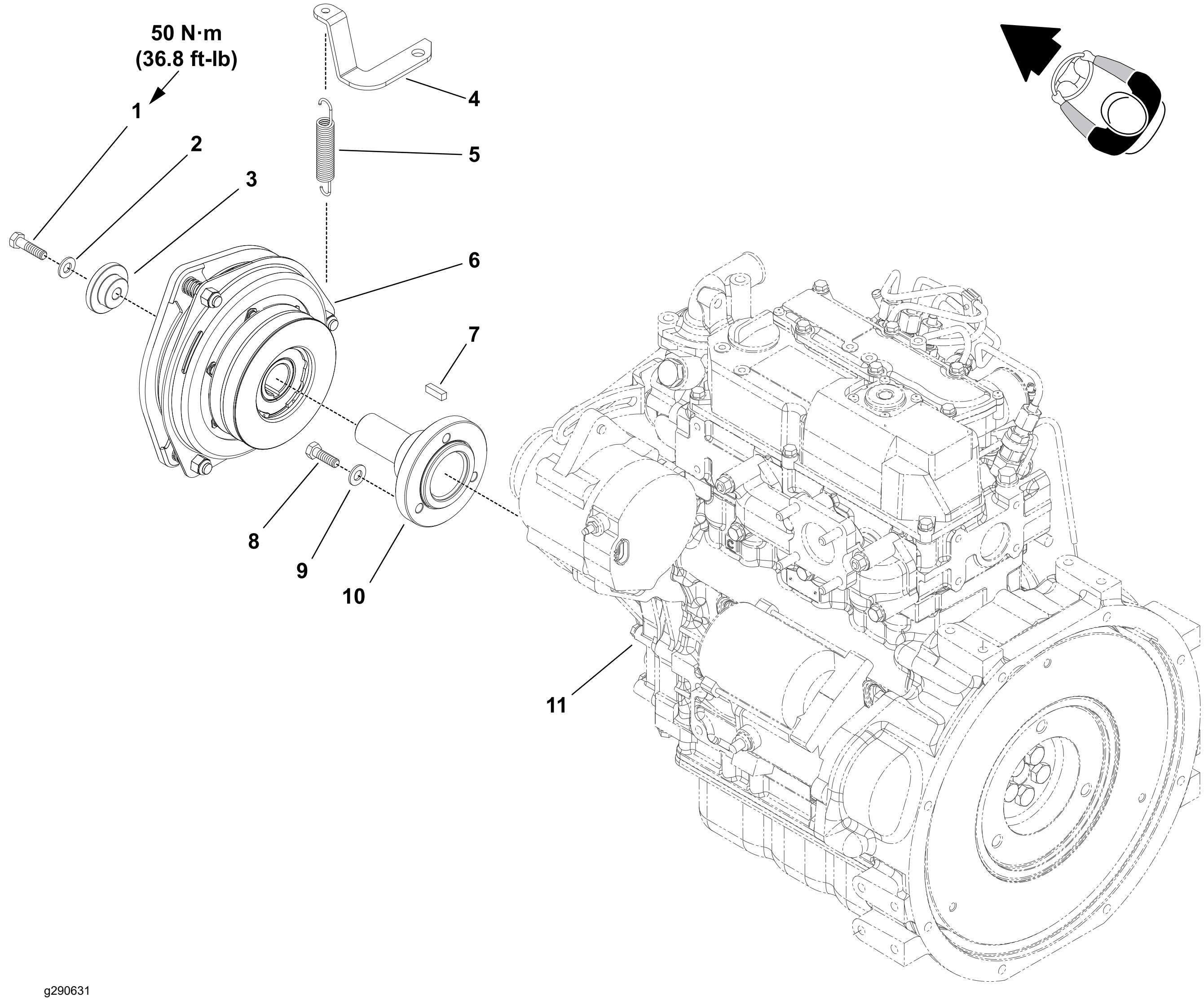


Figure 131

1. Bolt
2. Washer
3. Bushing
4. Bracket
5. Spring
6. Electric clutch
7. Woodruff key
8. Bolt
9. Washer
10. Drive shaft
11. Engine

An electric clutch is used to engage the PTO. The electric clutch is mounted on the engine crankshaft and engages when current is applied to the clutch. The clutch also incorporates a magnetic brake to stop the clutch rotation when the clutch is de-energized.

Testing the PTO Electric Clutch

1. Park the machine on a level surface, lower the cutting deck, set the parking brake, shut off the engine, and remove the key from the key switch.
2. Locate the PTO electric clutch on the engine crankshaft (Figure 131).

Testing the PTO Electric Clutch (continued)

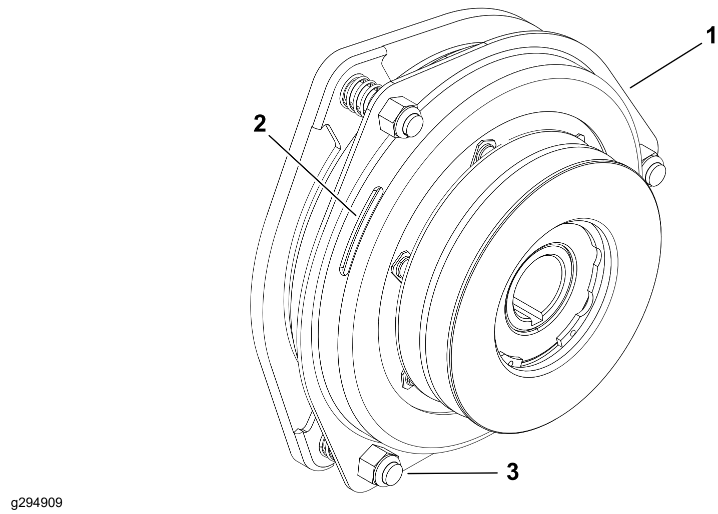


Figure 132

1. PTO electric clutch
2. Access slot
3. Lock nut

3. Unplug the clutch electrical connector from the machine wire harness.

   Note: For accurate clutch resistance measuring, the clutch should be at approximately **21°C (70°F)**.

   Note: Before taking 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.

4. Use a multimeter (ohms setting), check the clutch coil resistance between the 2 terminals of the clutch electrical connector. The coil resistance should be approximately 3.0 ohms. Additionally, check that there is no continuity between either of the clutch wire connector terminals and the clutch frame.

5. Using the access slots in the clutch cover, measure the gap between the clutch rotor and the armature (Figure 132). The gap should be **0.4 to 0.6 mm (0.016 to 0.024 in)** at all the 3 access slots. If gap is incorrect, loosen or tighten the 3 locknuts evenly to achieve correct uniform gap.

6. As an additional test, apply 12 volts to the terminals of the PTO electric clutch. The clutch should engage. If the clutch does not engage when voltage is applied, replace the PTO electric clutch.

7. If the clutch removal is necessary; refer to Electric Clutch (page 8–15).

8. After you complete the PTO electric clutch testing, connect the clutch electrical connector to the machine wire harness.

Fuel Stop Solenoid

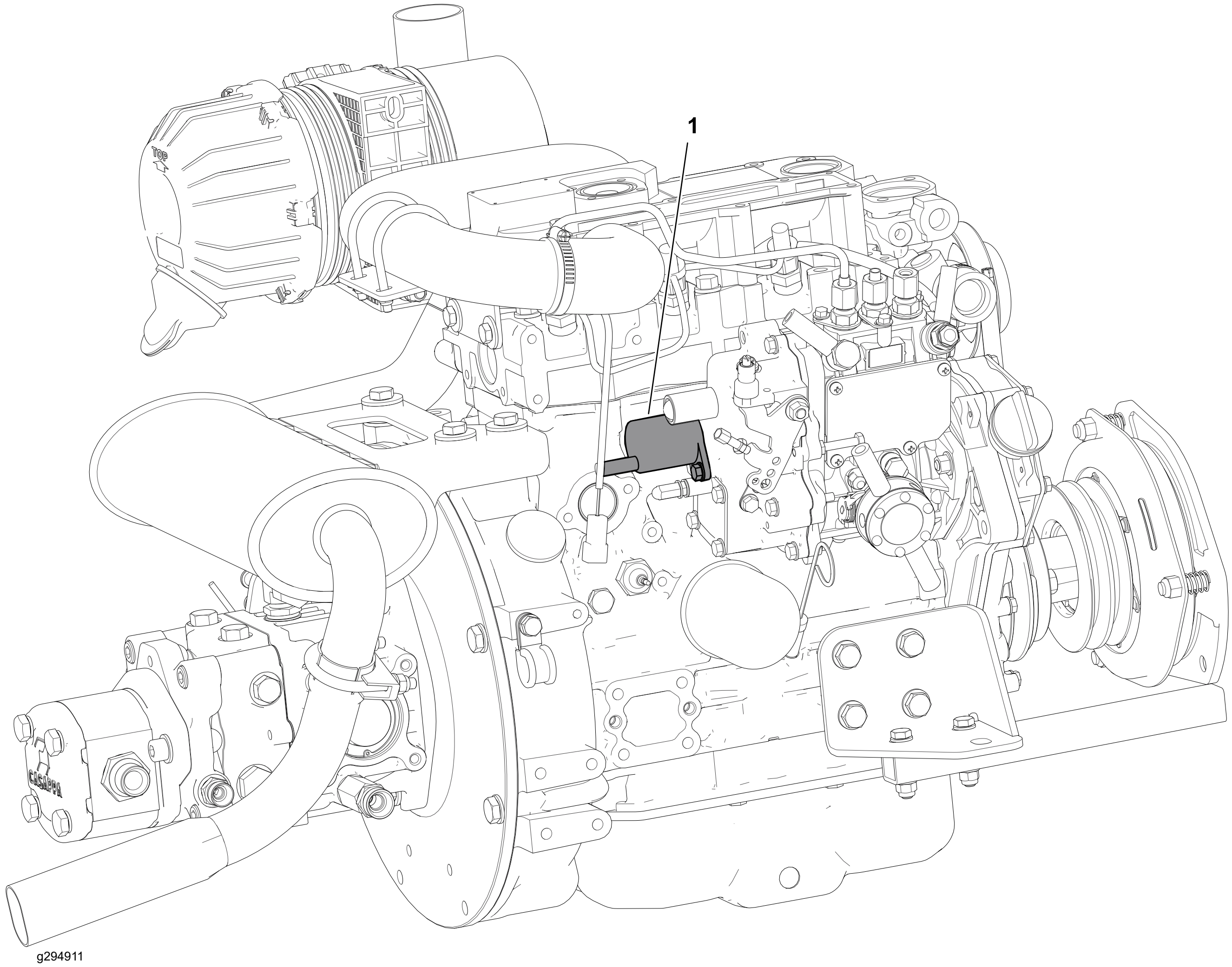


Figure 133

1. Fuel stop solenoid

The fuel stop solenoid must be energized for the diesel engine to run. The solenoid is mounted to the injection pump on the engine (Figure 133).

Testing the Fuel Stop Solenoid (In Place)

Note: Before taking the small resistance readings with a digital multimeter, short the multimeter test leads together. The meter will display 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 you are testing.

1. Park the machine on a level surface, lower the cutting deck, set the parking brake, shut off the engine, and remove the key from the key switch.
2. Locate the fuel stop solenoid on the engine and disconnect the wire harness connector from the solenoid.
3. Use a digital multimeter, touch 1 test lead to the pull coil terminal and the other test lead to the fuel stop solenoid frame (ground). The resistance of the pull coil should be less than 1 ohm (but not zero).

Testing the Fuel Stop Solenoid (In Place) (continued)

4. Use a digital multimeter, touch 1 test lead to the hold coil terminal and the other test lead to the fuel stop solenoid frame (ground). The resistance of the hold coil should be approximately 15 ohms.
5. Replace the fuel stop solenoid if the testing determines that it is damaged.
6. Connect the wire harness connector to the fuel stop solenoid.

Testing the Fuel Stop Solenoid (Live)

1. Park the machine on a level surface, lower the cutting deck, set the parking brake, shut off the engine, and remove the key from the key switch.
2. Locate the fuel stop solenoid on the engine and disconnect the wire harness connector from the solenoid.

   Note: The solenoid can be removed from the engine or tested in place.
3. If the solenoid is removed from the engine, ensure that the solenoid plunger moves freely and is free of dirt, unwanted material, and corrosion.

   Note: When testing the run solenoid, use test leads with at least 14 gauge wire.
4. Connect a positive (+) test lead from a 12 VDC source to the pull coil and hold coil terminals.
5. Touch a negative (-) test lead from the 12 VDC source to the fuel stop solenoid frame (ground). The solenoid should engage, making an audible click, and the plunger should retract.
6. Remove positive (+) voltage from the pull coil terminal. The solenoid should stay engaged.
7. Remove positive (+) voltage from the hold coil terminal. The solenoid should release.
8. Replace the fuel stop solenoid if the testing determines that it is damaged.
9. Connect the wire harness connector to the fuel stop solenoid.

Relays

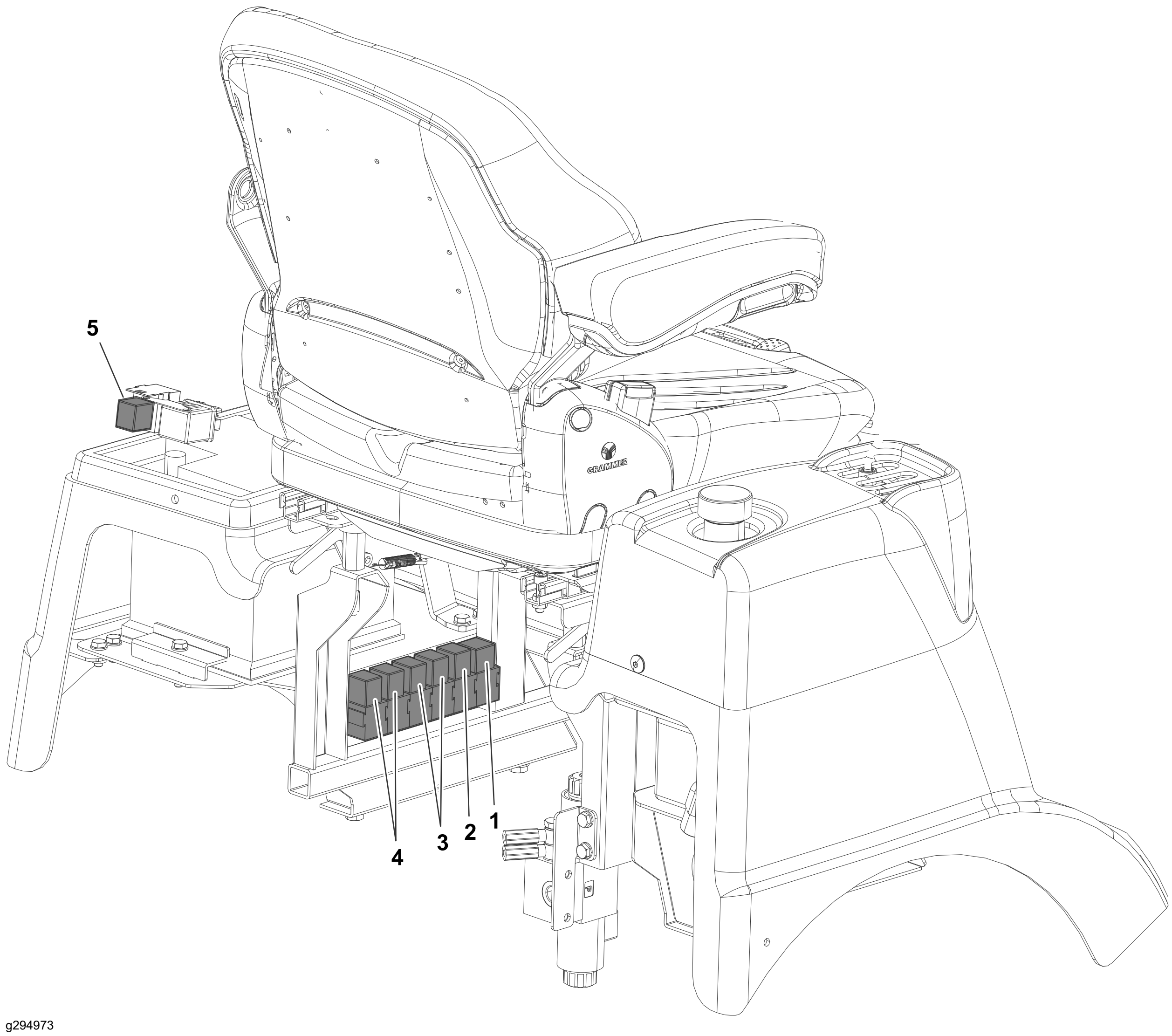


Figure 134

1. Start relay (5 terminals)
2. Glow relay (4 terminals)
3. Forward fan relay (4 terminals)
4. Reverse fan relay (4 terminals)
5. Key relay (4 terminals)

The machines use a number of electrical relays. Some of the relays have four (4) terminals and some have five (5) terminals. The number of terminals the relay has determines how the relay should be tested. A tag near the wire harness relay connector can be used to identify each relay; refer to Figure 134.

- The start relay is attached to the battery support plate under the operator seat. When energized, the start relay allow the electrical current to the engine starter.
- The glow relay is attached to the battery support plate under the operator seat. When energized, the glow relay allow the electrical current to the engine glow plugs.
- The two (2) forward fan relays are attached to the battery support plate under the operator seat. When energized, the forward fan relays allow the electrical current to the radiator fan.

- The two (2) reverse fan relays are attached to the battery support plate under the operator seat. When energized, the reverse fan relays allow the electrical current to the radiator fan.
- The key relay is attached inside the left arm console above the battery. When energized, the key relay allow the electrical current to the machine.

Testing the Relays with 4 Terminals

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. To get access to the glow relay, forward relays and reverse relays, remove the operator seat; refer to Removing the Operator Seat (page 7–17).
3. To get access to the key relay, remove the left console; refer to Disassembling the Body Assembly (page 7–6).
4. To ensure that the machine operation does not occur unexpectedly, disconnect the negative (-) cable from the battery and then disconnect the positive (+) cable from the battery; refer to Servicing the Battery (page 6–51).
5. Locate the relay that is to be tested and disconnect the wire harness connectors from the relay. Remove the relay from the mounting bracket for testing.

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

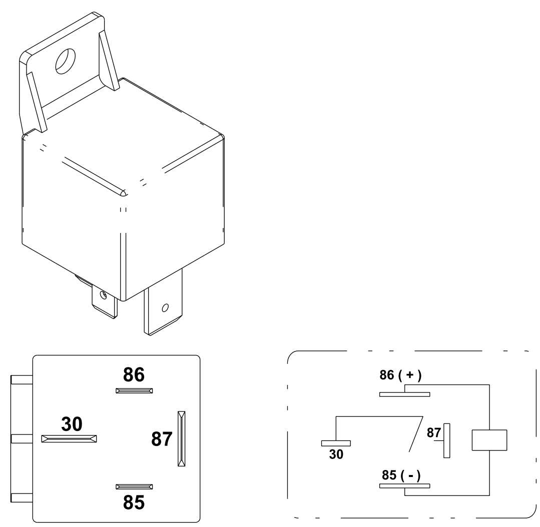


Figure 135

6. Check the coil resistance between the terminals 85 and 86 with a multimeter (ohms setting). The resistance should be approximately 72 ohms.
7. Connect the multimeter (ohms setting) leads to relay terminals 30 and 87. Ground the terminal 85 and apply +12 VDC to terminal 86. The relay should make and break continuity between the terminals 30 and 87 as +12 VDC is applied and removed from terminal 86 (Figure 135).
8. Disconnect the voltage and leads from the relay terminals.
9. Replace the relay if testing determines that the relay is damaged.
10. If the relay testing is correct and a circuit problem still exists, check the main wire harness. Refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1).

Testing the Relays with 4 Terminals (continued)

11. Install and secure the relay onto the mounting bracket. Connect the wire harness electrical connectors to the relay.
12. Connect the positive (+) cable to the battery and then connect the negative (-) cable to the battery; refer to Servicing the Battery (page 6–51).
13. If removed, install the operator seat onto the machine; refer to Installing the Operator Seat (page 7–17).
14. If removed, install the left console onto the machine; refer to Assembling the Body Assembly (page 7–7).

Testing the Relays with 5 Terminals

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. To get access to the start relay, remove the operator seat; refer to Removing the Operator Seat (page 7–17).
3. To ensure that the machine operation does not occur unexpectedly, disconnect the negative (-) cable from the battery and then disconnect the positive (+) cable from the battery; refer to Servicing the Battery (page 6–51).
4. Locate the relay that is to be tested and disconnect the wire harness connectors from the relay. Remove the relay from the mounting bracket for testing.

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

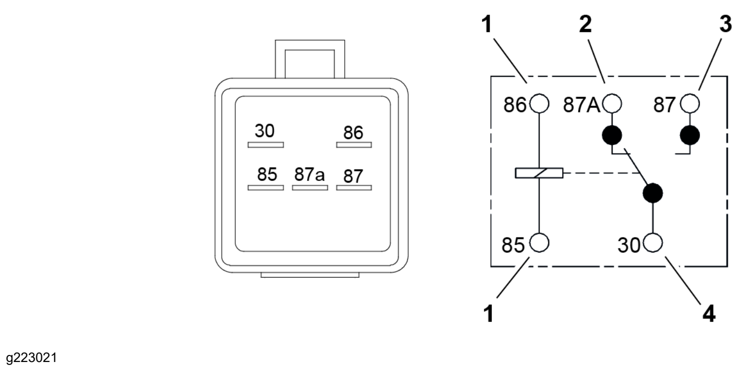


Figure 136

1. Coil terminal
2. Normally closed term.
3. Normally open term.
4. Common terminal

5. Using a multimeter (ohms setting), measure coil resistance between terminals 85 and 86 (Figure 136). Resistance should be between 70 and 90 ohms (Figure 136).
6. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground the terminal 86 and apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87 as +12 VDC is applied and removed from terminal 85.
7. Disconnect voltage from terminal 85 and multimeter lead from terminal 87.
8. Connect multimeter (ohms setting) leads to relay terminals 30 and 87A. Apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87A as +12 VDC is applied and removed from terminal 85.

Testing the Relays with 5 Terminals (continued)

9. Replace the relay if testing determines that the relay is damaged.
10. If the relay testing is correct and a circuit problem still exists, check the main wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1).
11. Install and secure the relay onto the mounting bracket. Connect the wire harness electrical connectors to the relay after you complete the testing.
12. Connect the positive (+) cable to the battery and then connect the negative (-) cable to the battery; refer to Servicing the Battery (page 6–51).
13. If removed, install the operator seat onto the machine; refer to Installing the Operator Seat (page 7–17).

Diode Assembly

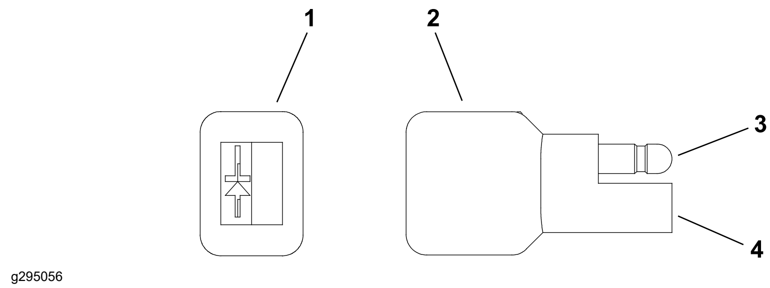


Figure 137

1. End of the diode body
2. Diode assembly
3. Male terminal
4. Female terminal

The diode assembly is used in the main wire harness. The diode can be identified by their black color and diode symbol on the end of the diode body.

The diode assembly is used to protect the PTO clutch from reverse polarity in the electrical circuit.

The diode assembly is used to protect the engine shut off solenoid from voltage spikes in the electrical circuit.

Testing the Diode Assembly

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Locate and get access to the diode assembly near PTO electric clutch near the engine and remove cable tie that secures diode to wire harness. Unplug the diode from the wire harness for testing.
3. The diode can be tested using a digital multimeter (diode test or ohms setting); refer to Diode Test Table (page 6–43).

Diode Test Table

Multimeter Red Lead (+) on Terminal	Multimeter Black Lead (-) on Terminal	Continuity
Female	Male	Yes
Male	Female	No

4. If testing determines that diode is faulty, replace diode assembly.
5. After diode testing is complete, make sure that diode is fully installed into wire harness connector and secured to harness with cable tie.

Slope Sensor (Optional)

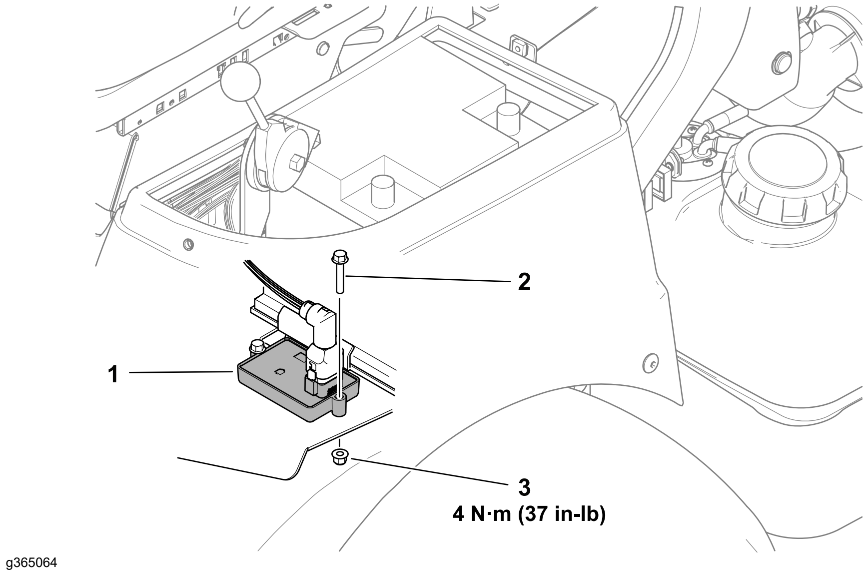


Figure 138

1. Slope sensor module
2. Cap screw (2 each)
3. Flange nut (2 each)

The optional slope sensor module is located under the battery cover. Once installed and calibrated, the optional slope sensor module monitors the angle of the machine during operation, and notifies the operator of a potentially dangerous condition via an LED light on the dashboard and an audible alarm. Switched and unswitched power for the slope sensor is provided through the machine expansion port. In addition to the 30 Amp fuse in the fuse block protecting the unswitched power supply to the expansion port, an additional 2 Amp fuse is included in the slope sensor wire harness to protect the slope sensor module. The slope sensor module cannot be tested directly.

Calibrating the Slope Sensor

1. Park the machine on a level surface, lower the cutting units and set the key switch to the OFF position.
2. Remove the battery cover.
3. Remove the plug from the calibration connectors and connect the calibration connectors together as shown; refer to Figure 139.

Calibrating the Slope Sensor (continued)

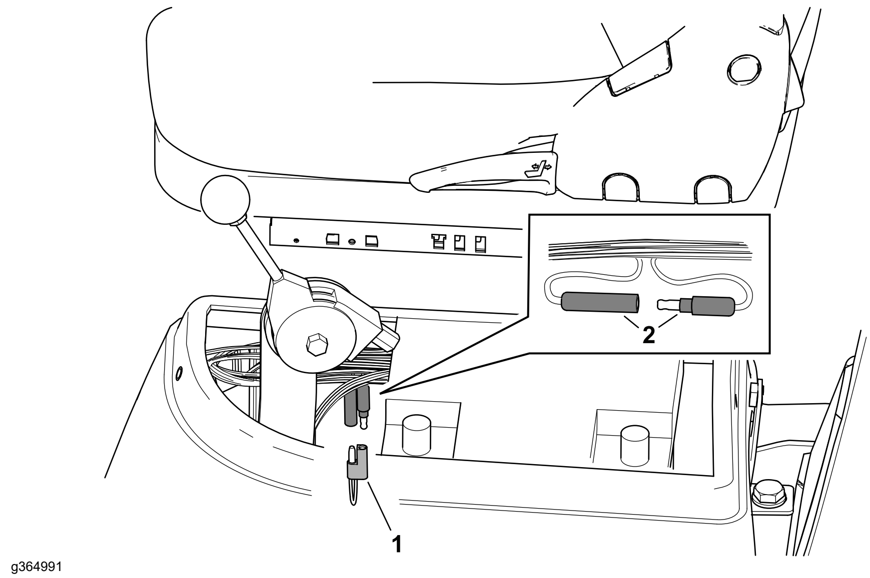


Figure 139

1. Plug
2. Calibration connectors

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4. Set the key switch to the ON position, but do not start the engine.
5. The LED light on the dashboard should blink as the sensor calibrates.
6. When the LED light on the dashboard stops blinking, set the key switch to the OFF position.
7. Disconnect the calibration connectors and install the plug onto the connectors.
8. Carefully test the slope sensor operation before returning the machine to service:
   A. Set the key switch to the START position. The LED light on the dashboard should illuminate for 5 seconds to indicate that the sensor is functioning properly.
   B. During machine operation, the light and alarm indicates the severity of the slope:
      - No light – normal operating conditions.
      - Slow, flashing light – moderate slop (approximately 11 to 14°).
      - Fast, flashing light and audible alarm – steep slope (approximately 15° or more); proceed to a more shallow slope.

Removing and Installing the Slope Sensor Module

Refer toFigure 138 for this procedure.

1. Park the machine on a level surface, lower the cutting units, set the key switch to the OFF position and remove the key from the key switch.
2. Remove the battery cover.
3. Disconnect the wire harness from the slope sensor module.
4. Check the harness connector and sensor module for damage or corrosion and clean or repair if necessary.
5. Remove the slope sensor module from the machine.

Removing and Installing the Slope Sensor Module (continued)

6. When installing the slope sensor module, tighten the fasteners that secure the sensor module to the plate to **4 N·m (37 in-lb)**.

7. Connect the wire harness and calibrate the slope sensor; refer to Calibrating the Slope Sensor (page 6–44).

Testing the Slope Sensor LED

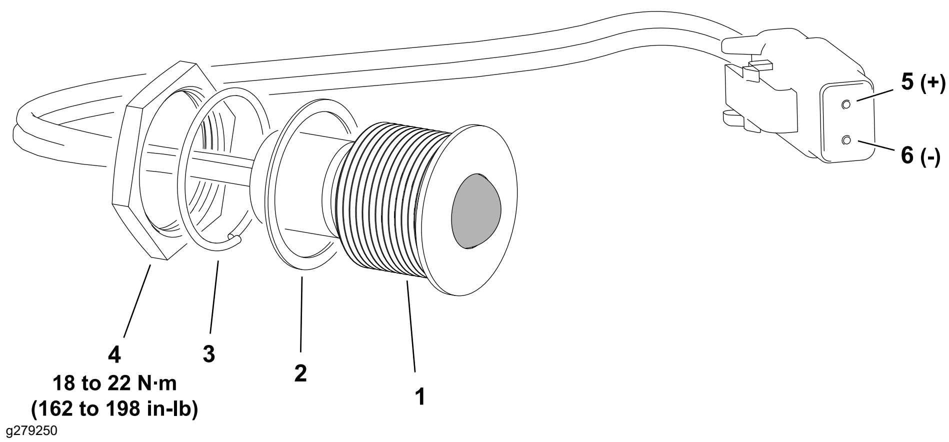


Figure 140

1. LED (Light Emitting Diode)
2. Gasket
3. Lock washer
4. Hex nut
5. Red wire (+)
6. Black wire (-)

The slope sensor LED is located on the dashboard near the steering wheel. Electrical current for the LED is provided as an output from the slope sensor module. When the key switch is set to the START position, the LED light should illuminate for 5 seconds to indicate that the sensor is functioning properly. During machine operation, the light and the audible alarm indicates the severity of the slope:

- No light – normal operating conditions.
- Slow, flashing light – moderate slop (approximately 11 to 14°).
- Fast, flashing light and audible alarm – steep slope (approximately 15° or more); proceed to a more shallow slope.

1. Ensure that the key switch is OFF and key is removed from the switch.
2. Remove the lower front steering tower cover and disconnect the LED connector from the wire harness.

   Note: The TED (Light Emitting Diode) and is polarity sensitive.

3. Connect a 12 VDC power source (machine battery) to the LED terminals. The LED should only illuminate when the positive (+) lead of the power supply is connected to the positive (+) red wire, and the negative (-) lead of the power supply is connected to the negative (-) black wire.

4. Replace the LED if necessary. Tighten the LED hex nut from **18 to 22 N·m (162 to 198 in-lb)**.

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

6. Connect the wire harness, install the steering tower cover and test the LED before returning the machine to service.

Testing the Slope Sensor Alarm

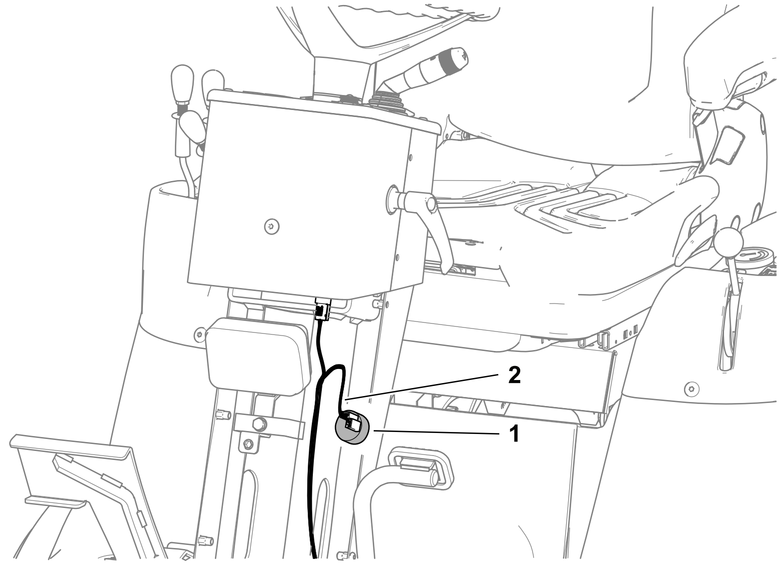


Figure 141

1. Audible alarm
2. Wire harness

During operation, the audible alarm sounds to notify the operator when the machine is operating on a steep slope and should proceed to a more shallow slope. Electrical current for the alarm is provided as an output from the slope sensor module. The audible alarm is located on the steering tower in front of the operator.

1. Park the machine on a level surface, lower the cutting units and set the key switch to the OFF position.
2. Remove the lower front steering tower cover to access the audible alarm and disconnect the machine wire harness from the alarm.
3. Check the harness connector and audible alarm for damage or corrosion and clean or repair if necessary.

IMPORTANT

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

4. Correctly connect 12VDC power to the terminals as shown. The alarm should sound. Replace the alarm if necessary.

Testing the Slope Sensor Alarm (continued)

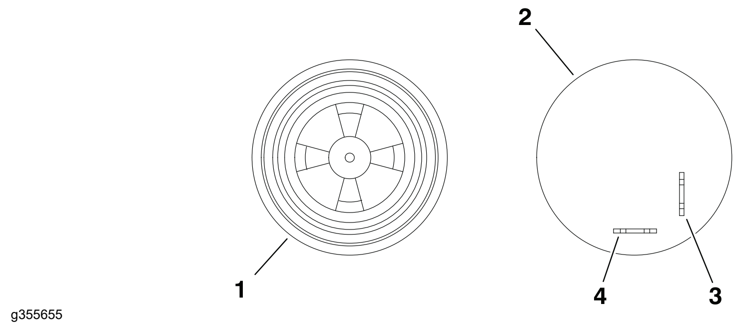


Figure 142

1. Front view
2. Rear view
3. Positive (+) terminal
4. Negative (−) terminal

---

5. Reconnect the machine wire harness to the alarm, install the steering tower cover before returning the machine to service.

Service and Repairs

Battery Storage

If you store the machine for more than 30 days:

1. Ensure that the key switch is in the OFF position. Remove the battery and charge it fully; refer to Servicing the Battery (page 6–51).
2. Either store the battery on a shelf or on the machine.
3. Disconnect the cables if the battery is kept on the machine.
4. Store the battery in a cool atmosphere to avoid quick deterioration of the battery charge.
5. To prevent the battery from freezing during storage, ensure that you charge it fully; refer to Servicing the Battery (page 6–51).

Battery Care

1. The battery-electrolyte level must be properly maintained. The top of the battery must be kept clean. If the machine is stored in a location where the temperatures are extremely high, the battery will discharge more rapidly than if the machine is stored in a location where the temperatures are cool.

⚠ WARNING ⚠

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

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

IMPORTANT

Do not remove battery fill caps while cleaning.

2. Check the battery condition weekly or after every 50 hours of operation. Keep the terminals and entire battery case clean because a dirty battery will discharge slowly.
   A. Clean the battery by washing entire case with a solution of baking soda and water. Flush the battery case with clear water.
   B. Coat the battery posts and cable connectors with the battery terminal protector (refer to Special Tools (page 2–15)) or petroleum jelly to prevent corrosion.
3. Tighten the battery cables on the battery terminals to provide a good electrical contact.

Battery Care (continued)

⚠ WARNING ⚠

Connecting the cables to the wrong battery post could result in personal injury and/or damage to the electrical system.

Ensure that the cables are properly connected to the correct battery posts before operating the machine.

4. If corrosion occurs at the battery terminals, disconnect the cables. Always disconnect the negative (-) cable first. Clean the cable clamps and terminals separately. Connect the cables with the positive (+) cable first. Apply a layer of terminal protector (Toro Part No. 107-0392) or a light coat of petroleum jelly to the terminals to reduce corrosion after you make the connections.
5. Check the battery-electrolyte level every 25 operating hours and every 30 days if machine is in storage.
6. Maintain the cell level with the distilled or demineralized water.

   Note: Do not fill the cells above the fill line.

Servicing the Battery

The battery is the heart of the electrical system. With the regular and correct service, the battery life can be extended. Additionally, the battery and electrical component failure can be prevented.

CAUTION

Battery-electrolyte is corrosive and can burn skin and eyes and damage clothing.

While working with the batteries, use extreme caution to avoid splashing or spilling of the electrolyte. Always wear the safety goggles and a face shield while working with batteries.

Removing and Installing the Battery

WARNING

Battery terminals or metal tools could short against metal machine components causing sparks. Sparks can cause the battery gasses to explode, resulting in personal injury.

- **When removing or installing the battery, do not allow the battery terminals to touch any metal parts of the machine.**
- **Do not allow metal tools to short between the battery terminals and metal parts of the machine.**

WARNING

Incorrect battery cable routing could damage the machine and cables causing sparks. Sparks can cause the battery gasses to explode, resulting in personal injury.

- **Always disconnect the negative (black) battery cable before disconnecting the positive (red) cable.**
- **Always connect the positive (red) battery cable before connecting the negative (black) cable.**

1. Park machine on a level surface, lower cutting deck, shut off the engine, and engage parking brake.
2. Remove the left console and get access to the battery; refer to Disassembling the Body Assembly (page 7–6).

Removing and Installing the Battery (continued)

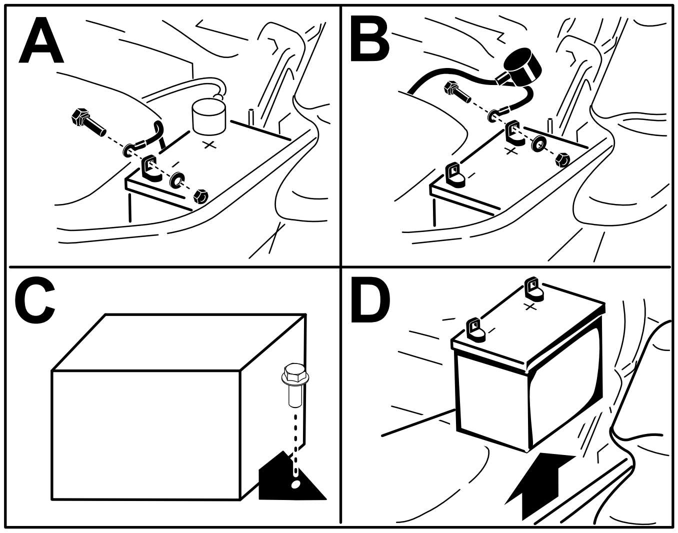


Figure 143

3. Loosen and remove the negative (-) cable from the battery. After you disconnect the negative cable from the battery, loosen and remove the positive cable (+) from the battery (Figure 143).
4. Loosen the bolt that secures the battery retainer.
5. Carefully remove the battery from the machine.
6. Install the battery in reverse order and ensure to connect and tighten the positive (+) cable to the battery before connecting negative (-) cable. Use 2 wrenches when tightening the cables.

   Note: Before connecting the negative (ground) cable to the battery, connect a digital multimeter (set to DC Amps) between the negative battery post and the negative (ground) cable connector. The reading should be less than 0.1 A. If the reading is 0.1 A or more, the electrical system of the machine should be tested for short circuits or damaged components and repaired.
7. Install the left console onto the machine; refer to Assembling the Body Assembly (page 7–7).

Inspecting, Maintaining, and Testing the Battery

1. Do the following inspections and maintenance:
   A. Check for cracks. Replace the battery if cracked or leaking.
   B. Check the battery terminal posts for corrosion. Use the wire brush to clean corrosion from the posts.

IMPORTANT

Before cleaning the battery, tape or block the vent holes of the filler caps and ensure that the caps are tight.

   C. Check for the signs of wetness or leakage on the top of the battery which might indicate a loose or missing filler cap, overcharging, loose terminal post, or overfilling. Also, check the battery case for dirt and oil. Clean the battery with a solution of baking soda and water, then rinse it with clean water.
   D. Check that the cover seal is not broken away. Replace the battery if the seal is broken or leaking.
   E. Check the electrolyte level in each cell. If the level is below the tops of the plates in any cell, fill all the cells with distilled water between the minimum and maximum fill lines. Charge at 15 to 25 A for 15 minutes to allow sufficient mixing of the electrolyte; refer to Charging the Battery (page 6–55).
2. Perform the hydrometer test of the battery-electrolyte.

IMPORTANT

Ensure that the area around the cells is clean before opening the battery caps.

   A. Use a hydrometer to measure the specific gravity of each cell. Pull the electrolyte in and out of the hydrometer barrel before taking a reading to warm-up the hydrometer. At the same time, take the temperature of the cell.
   B. Temperature correct each cell reading. For each 5.5°C (10°F) above 27°C (80°F) add 0.004 to the specific gravity reading. For each 5.5°C (10°F) below 27°C (80°F) subtract 0.004 from the specific gravity reading; refer to the Cell Specific Gravity Example (page 6–53).

Cell Specific Gravity Example

Cell Temperature	100°F
Cell Specific Gravity	1.245
38°C minus 27°C equals 11°C (100°F minus 80°F equals 20°F)	
11°C multiply by 0.004/5.5°C equals 0.008 (20°F multiply by 0.004/10°F equals 0.008)	
ADD (conversion above)	0.008
Correction to 27°C (80°F)	1.253

   C. If the difference between the highest and lowest cell specific gravity is 0.050 or more or the lowest cell specific gravity is less than 1.225, charge the battery.
   D. Charge at the rate and time given in Charging the Battery (page 6–55) or until all cells specific gravity is 1.225 or greater with the difference in

specific gravity between the highest and lowest cell is less than 0.050. If you can not meet these charging conditions, replace the battery.

3. Do a high-discharge test with an adjustable load tester. This is 1 of the most reliable means of testing a battery as it simulates the cold-cranking test. A commercial battery load tester is required to do this test.

CAUTION

Follow the manufacturer's instructions when using a battery load tester.

A. Check the voltage across the battery terminals before testing the battery. If the voltage is less than 12.4 VDC, charge the battery before continuing the test; refer to Charging the Battery (page 6–55).

B. Ensure that the battery terminals are free of corrosion.

C. Measure the electrolyte temperature of the center battery cell.

D. Connect a battery load tester to the battery terminals following the manufacturer's instructions. Connect a digital multimeter to the battery terminals.

E. If you charge the battery, apply a 150 A load for 15 seconds to remove the surface charge. Wait for 10 minutes before proceeding with load test.

F. Apply a test load of 270 A (1/2 the cranking performance rating of the battery) for 15 seconds.

G. After test load has been applied for 15 seconds, take a test voltage reading and then remove the load. Record the test voltage reading.

H. Use the Minimum Voltage Table (page 6–54), determine the minimum voltage for the center cell electrolyte temperature reading.

Minimum Voltage Table

Minimum Voltage	Battery-Electrolyte Temperature	
9.6	70 °F (and up)	21.1 °C (and up)
9.5	60 °F	16 °C
9.4	50 °F	10 °C
9.3	40 °F	4 °C
9.1	30 °F	-1 °C
8.9	20 °F	-7 °C
8.7	10 °F	-12 °C
8.5	0 °F	-18 °C

I. If the test voltage is below the minimum, replace the battery. If the test voltage is at or above the minimum, return the battery to service.

4. After you make the connections, apply terminal protector (Toro Part No. 107-0392) or a light layer of grease on all the battery posts and cable connectors to reduce corrosion.

Charging the Battery

To minimize damage to the battery and allow the battery to charge fully, do the following slow charging procedure. You can do this charging procedure with a constant current battery charger that is locally available.

IMPORTANT

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

Note: Use specific gravity of the battery cells is the most accurate procedure of determining the battery condition.

1. Determine the battery charge level from either its specific gravity or open circuit voltage.

Battery Charge Level	Specific Gravity	Open Circuit Voltage
100%	1.265	12.68
75%	1.225	12.45
50%	1.190	12.24
25%	1.155	12.06
0%	1.120	11.89

2. Determine the charging time and rate using the manufacturer's battery charger instructions or the following Battery Charge Level Table (page 6–55).

Battery Charge Level Table

Battery Reserve Capacity (Minutes)	Battery Charge Level (Percent of Fully Charged)			
	75%	50%	25%	0%
80 or less	3.8 hrs @ 3 A	7.5 hrs @ 3 A	11.3 hrs @ 3 A	15 hrs @ 3 A
81 to 125	5.3 hrs @ 4 A	10.5 hrs @ 4 A	15.8 hrs @ 4 A	21 hrs @ 4 A
126 to 170	5.5 hrs @ 5 A	11 hrs @ 5 A	16.5 hrs @ 5 A	22 hrs @ 5 A
171 to 250	5.8 hrs @ 6 A	11.5 hrs @ 6 A	17.3 hrs @ 6 A	23 hrs @ 6 A
above 250	6 hrs @ 10 A	12 hrs @ 10 A	18 hrs @ 10 A	24 hrs @ 10 A

Charging the Battery (continued)

⚠ CAUTION ⚠

Charging a frozen battery can cause explosion and can cause personal injury. Let the battery warm to 15.5°C (60°F) before connecting to a charger.

- **Charge the battery in a well-ventilated place to dissipate the gases produced from the charging.**
- **These gases are explosive; keep open flame and electrical spark away from the battery. Do not smoke.**
- **Inhaling the battery gases can cause nausea.**
- **Unplug the charger from the electrical outlet before connecting or disconnecting the charger leads from the battery posts.**

3. Follow the battery charger manufacturer's instructions, connect the charger cables to the battery posts. Ensure that you make a good connection.
4. Charge the battery following the manufacturer's instructions.
5. Occasionally check the temperature of the battery-electrolyte. If the temperature is more than 52°C (125°F) or the electrolyte is violently gassing or spewing, lower and temporarily stop the charging rate.
6. Three hours before the end of the charging, measure the specific gravity of a battery cell once per hour.

   Note: The battery is fully charged when the cells are gassing freely at a low charging rate and there is less than a 0.003 change in specific gravity for 3 consecutive readings.

Chassis

Table of Contents

Additional Reference Materials

Grammer Seats Repair Manual

General Information

The *Operator's Manual* provides information regarding the operation, general maintenance, and maintenance intervals for your ProLine H800 machines. Refer to the *Operator's Manual* for additional information when servicing the machine.

Service and Repairs

Wheels

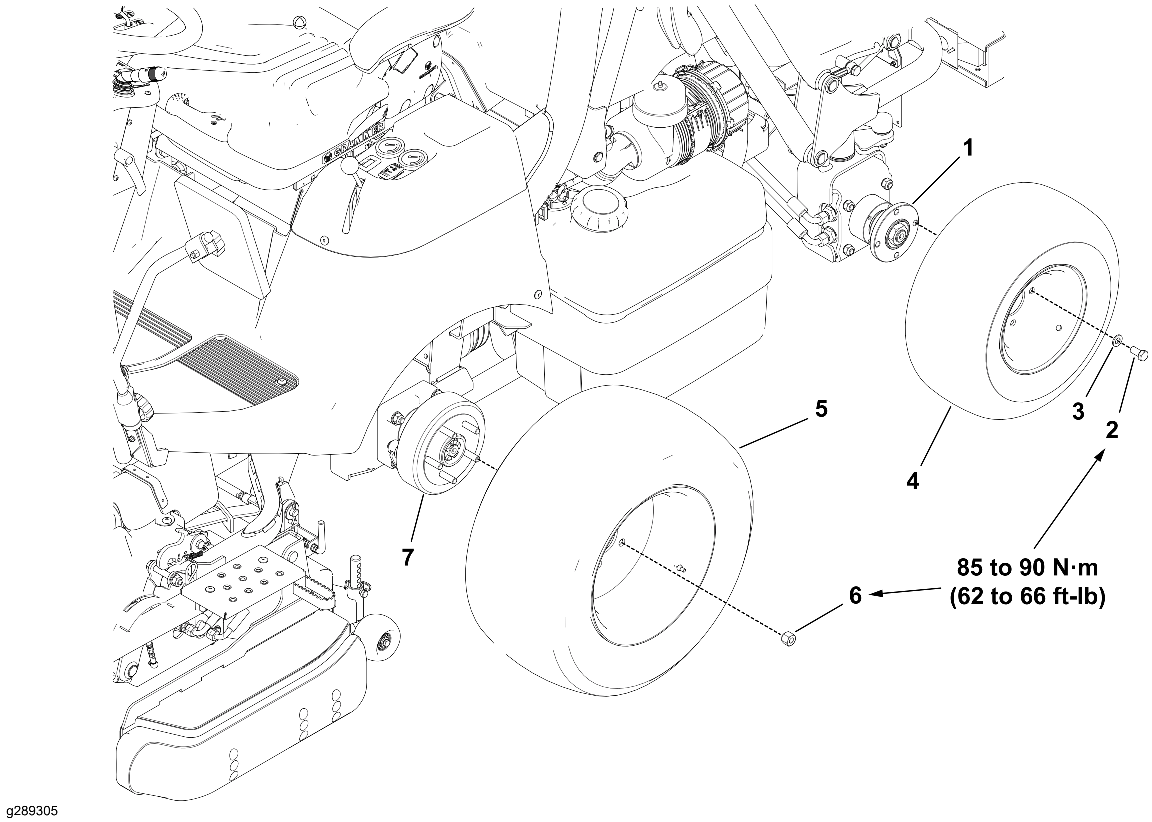


Figure 144

1. Rear wheel hub
2. Rear wheel lug bolt
3. Washer
4. Rear wheel assembly
5. Front wheel assembly
6. Front wheel lug nut
7. Front wheel hub

Removing the Wheels

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Block the wheels that are not removed with chocks to prevent the machine from moving.
3. Loosen, but do not remove the wheel-lug nuts or bolts that attach the wheel to the machine.

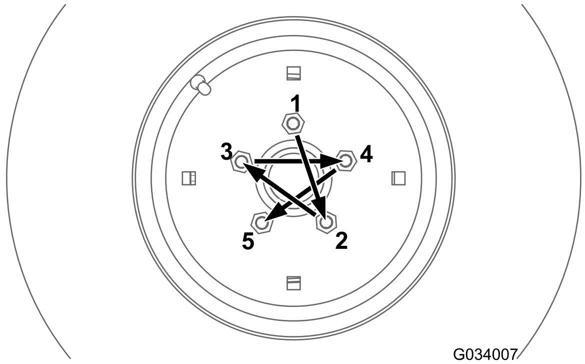
IMPORTANT

Before lifting the machine with a jack, review and follow Jacking Instructions (page 1–7).

4. Lift the machine with a jack until the wheel to be removed is off the ground. Support the machine with appropriate jack stands.
5. Remove the wheel-lug nuts or bolts that attach the wheel to the machine, and remove the wheel.

Installing the Wheels

1. Install the wheel to the machine with the wheel-lug nuts or bolts.
2. Lower the machine to the ground.



g034007

Figure 145

WARNING

Failure to maintain proper torque could result in failure or loss of wheel and may result in personal injury.

Maintain the proper torque of the wheel-lug nuts or bolts.

3. Torque the wheel-lug nuts or bolts evenly to **85 to 90 N·m (62 to 66 ft-lb)** in a crossing pattern (Figure 145).
4. Check and adjust the tire pressures; refer to *Operator's Manual*.

Body Assembly

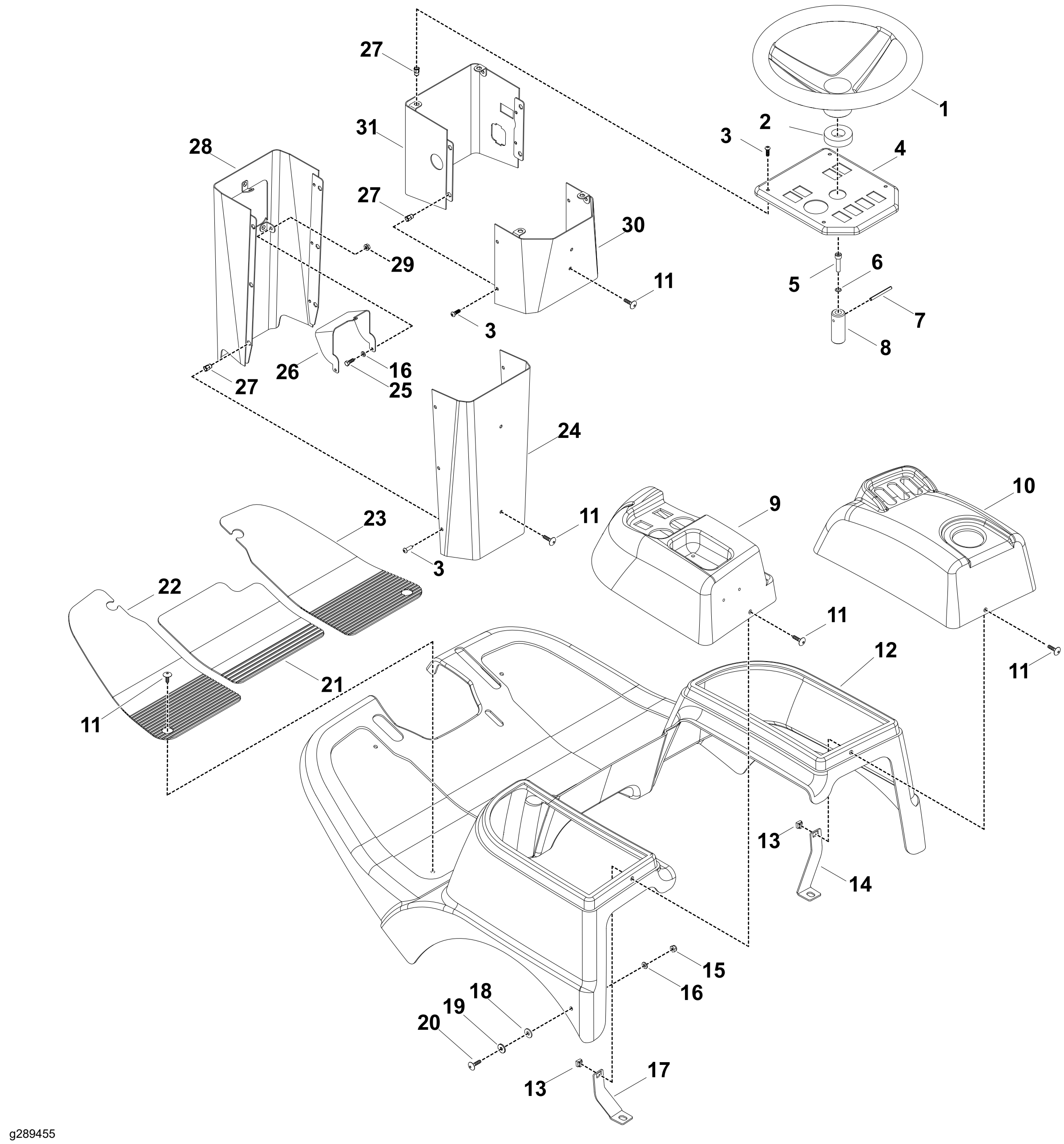


Figure 146

1.	Steering wheel	9.	Console-left	17.	Bracket	25.	Bolt
2.	Washer	10.	Console-right	18.	Washer	26.	Column support
3.	Screw	11.	Screw	19.	Washer	27.	Thread insert
4.	Dashboard-center	12.	Fairing	20.	Screw	28.	Cover
5.	Socket head screw	13.	Cage nut	21.	Footboard pad	29.	Nut
6.	Washer	14.	Bracket	22.	Footboard pad	30.	Cover
7.	Pin	15.	Nut	23.	Footboard pad	31.	Cover
8.	Bushing	16.	Washer	24.	Cover		

Disassembling the Body Assembly

1. Park the machine on a level surface, set the parking brake, lower the cutting deck, shut off the engine, and remove the key from the key switch.
2. Use a punch and hammer to remove the pin (7) from the steering wheel. Discard the pin.
3. Remove the steering wheel (1) and washer (2) from the steering column.
4. Remove the socket head screw (5) and washer (6) that secures the bushing (8) to the steering control valve. Use a suitable tool and pull the bushing (5) from the steering control valve.
5. Locate and retrieve the shaft key from the steering control valve.
6. Remove the screws (3) that secures the dashboard (4) to the steering column.
7. For assembly purpose, label the electrical wire harness connectors. Unplug the electrical wire harness connectors from the dashboard.
8. Remove the steering column covers from the steering column as necessary (Figure 146).

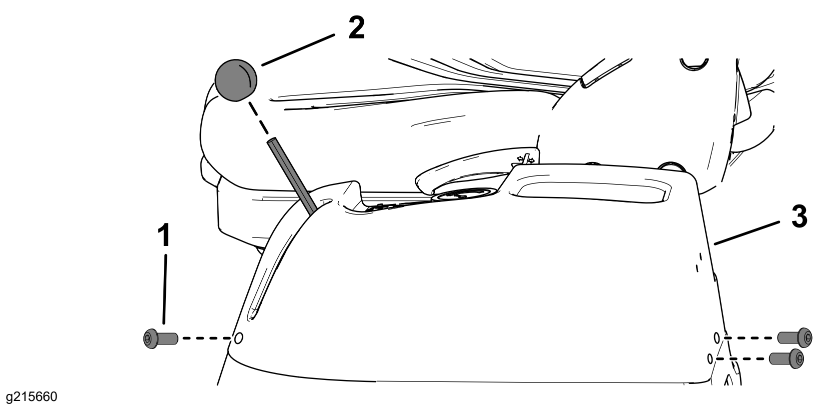


Figure 147

1. Screw
2. Throttle-lever knob
3. Console-left

9. Remove the throttle lever knob (item 2 in Figure 147).
10. Remove the 3 screws (item 1 in Figure 147) that secures the left console to the fairing.
11. Lift the console and set it aside.

Disassembling the Body Assembly (continued)

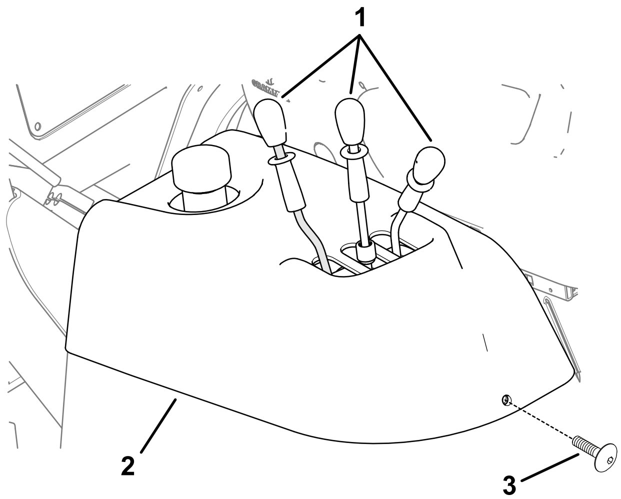


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Figure 148

1. Control-lever knob
2. Console-right
3. Screw

12. Remove the knobs and control levers from the auxiliary control valve (item 1 in Figure 148).
13. Remove the 2 screws (item 3 in Figure 148) that secure the right console to the fairing.
14. Lift the right console and set aside.

Assembling the Body Assembly

1. If removed, install the right console onto the fairing and secure with the 2 screws (Figure 148.)
2. Install the control levers and knobs onto the auxiliary control valve.
3. If removed, install the left console onto the fairing and secure with the 3 screw (Figure 147). Install the throttle lever knob.
4. If removed, install the steering column covers using the Figure 146 as a guide.
5. Connect the electrical wire harness connectors to the center dashboard.
6. Install the dashboard to the steering column and secure it with the screws.
7. Install the shaft key into the steering control valve.
8. Install the bushing (8) onto the steering control valve and secure with the washer (6) and socket head screw (5).
9. Install the washer (2) and steering wheel (1) onto the steering column and secure with a new pin (7).

Steering Column

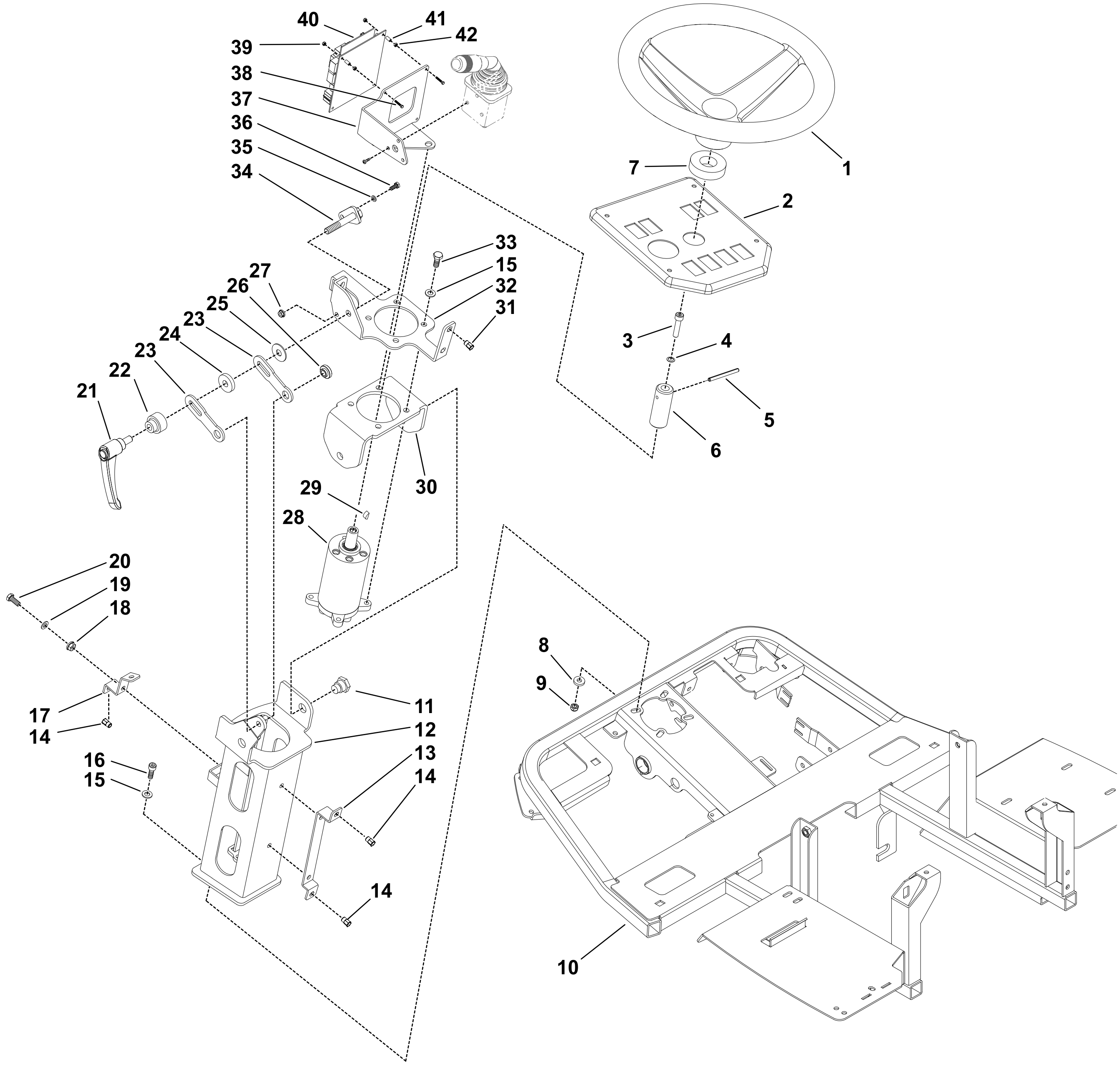

Figure 149

1. Steering wheel
2. Dashboard
3. Socket head screw
4. Washer
5. Pin
6. Bushing
7. Washer
8. Washer
9. Nut
10. Operator platform
11. Pin
12. Steering column
13. Bracket
14. Thread insert
15. Washer
16. Socket head screw
17. Bracket
18. Nut
19. Washer
20. Bolt
21. Handle
22. Bushing
23. Connecting rod
24. Spacer
25. Washer
26. Bushing
27. Nut
28. Steering control valve
29. Shaft key
30. Hinge
31. Thread insert
32. Support
33. Bolt
34. Bolt
35. Washer
36. Bolt
37. Support
38. Bolt
39. Nut
40. Electronic control unit
41. Nylon bushing
42. Nut

Removing the Steering Column

1. Park the machine on a level surface, set the parking brake, lower the cutting deck, shut off the engine, and remove the key from the key switch.
2. Use a punch and hammer to remove the pin (5) from the steering wheel. Discard the pin.
3. Remove the steering wheel (1) and washer (7) from the steering column.
4. Remove the socket head screw (3) and washer (4) that secures the bushing (6) to the steering control valve (28). Slide and remove the bushing (6) from the steering control valve (28).
5. Locate and retrieve the shaft key (29) from the steering control valve (28).
6. Remove the screws that secures the dashboard (2) to the steering column.
7. For assembly purpose, label the electrical wire harness connectors. Unplug the electrical wire harness connectors from the dashboard.
8. Remove the steering column covers from the steering column; refer to Disassembling the Body Assembly (page 7–6).
9. For assembly purpose, label the hydraulic pipes to show their position on the steering control valve.
10. Disconnect the hydraulic pipes from the steering control valve. Install clean caps or plugs on the hydraulic pipes and fittings to prevent system contamination; refer to Removing the Steering Control Valve (page 5–113).
11. Disassemble the steering column as necessary (Figure 149).

Installing the Steering Column

1. Assemble the steering column using the Figure 149 as a guide.
2. Remove the caps or plugs that were installed to the hydraulic pipes and fittings during removal process.
3. Use the tags that you attached during removal to correctly connect the hydraulic pipes to the steering control valve; refer to Installing the Steering Control Valve (page 5–114).
4. Install the steering wheel covers onto the steering column; refer to Assembling the Body Assembly (page 7–7).
5. Use the tags that you attached during removal to correctly connect the electrical wire harness connectors to the dashboard.
6. Install the dashboard to the steering column and secure it with the screws.
7. Install the shaft key (29) into the steering control valve (28).
8. Install the bushing (6) onto the steering control valve and secure with the washer (4) and socket head screw (3).
9. Install the washer (7) and steering wheel (1) onto the steering column and secure with a new pin (5).

Lift Arms

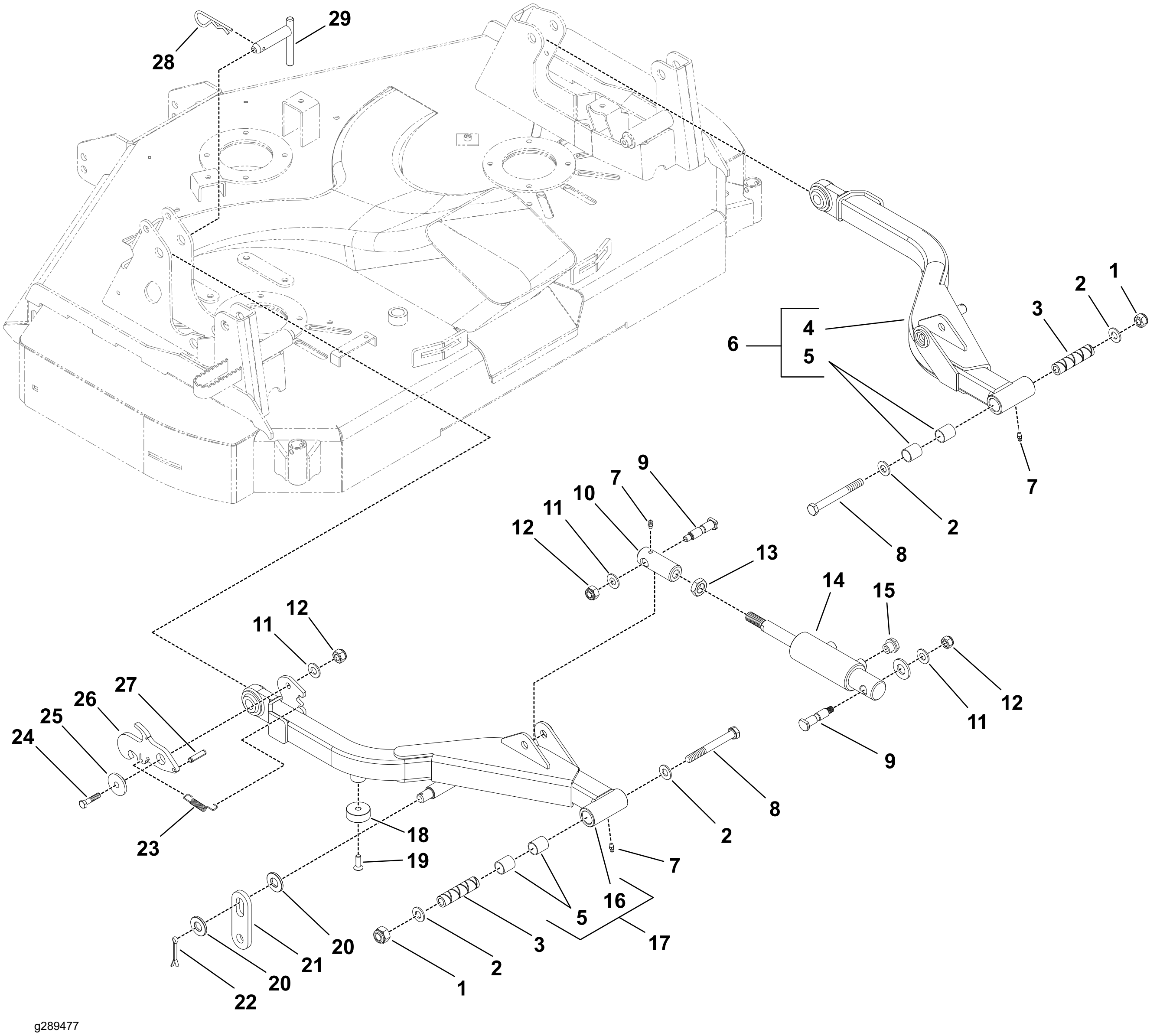

Figure 150

1.	Nut	11.	Washer	21.	Plate
2.	Washer	12.	Nut	22.	Split pin
3.	Bushing	13.	Nut	23.	Spring
4.	Lift arm RH	14.	Lift cylinder	24.	Bolt
5.	Bushing	15.	Breather cap	25.	Bushing
6.	Lift arm assembly RH	16.	Lift arm LH	26.	Lever
7.	Grease fitting	17.	Lift arm assembly LH	27.	Pin
8.	Bolt	18.	Rubber washer	28.	Spring pin
9.	Pin	19.	Screw	29.	Pin
10.	Support	20.	Plastic washer		

Removing the Lift Arms

1. Park the machine on a level surface, set the parking brake, lower the cutting deck, shut off the engine, and remove the key from the key switch.
2. Remove the cutting deck from the lift arms; refer to the *Operator's Manual*.

CAUTION

When changing the tires or performing other service, use correct jacks and supports. Make sure that the machine is parked on a solid, level surface such as a concrete floor. Prior to raising machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use jack stands to support the raised machine. If the machine is not properly supported by jack stands, the machine may move or fall, which may result in personal injury.

3. Chock the rear wheels and jack up front of the machine. Support the machine on jack stands; refer to Jacking Instructions (page 1–7).
4. Remove the front wheel next to the lift arm that is to be removed; refer to Removing the Wheels (page 7–3).
5. Remove the nut (12), washer (11) and pin (9) that secures the lift cylinder (14) to the lift arm. Separate the lift cylinder (14) from the lift arm.
6. Remove the nut (1), washers (2) and bolt (8) that secures the lift arm to the frame. Remove the lift arm from the frame.
7. Disassemble the lift arm as necessary (Figure 150).

Installing the Lift Arms

1. Assemble the lift arm (Figure 150).
2. Position the lift arm to the frame and secure the lift arm with the bolt (8), washers (2) and nut (1).
3. Align the lift cylinder with the lift arm. Slide the pin (9) through the lift arm and cylinder end. Secure the pin with the washer (11) and nut (12).
4. Install the front wheel next to the lift arm that was removed; refer to Installing the Wheels (page 7–4).
5. Install the cutting deck onto the lift arms; refer to the *Operator's Manual*.
6. Lubricate the lift arm grease fittings.
7. After assembly is completed, raise and lower the cutting deck to verify that the hydraulic hoses and fittings do not contact anything.
8. Check the height-of-cut and leveling of mover deck; refer to the *Operator's Manual*.

Traction Pedal

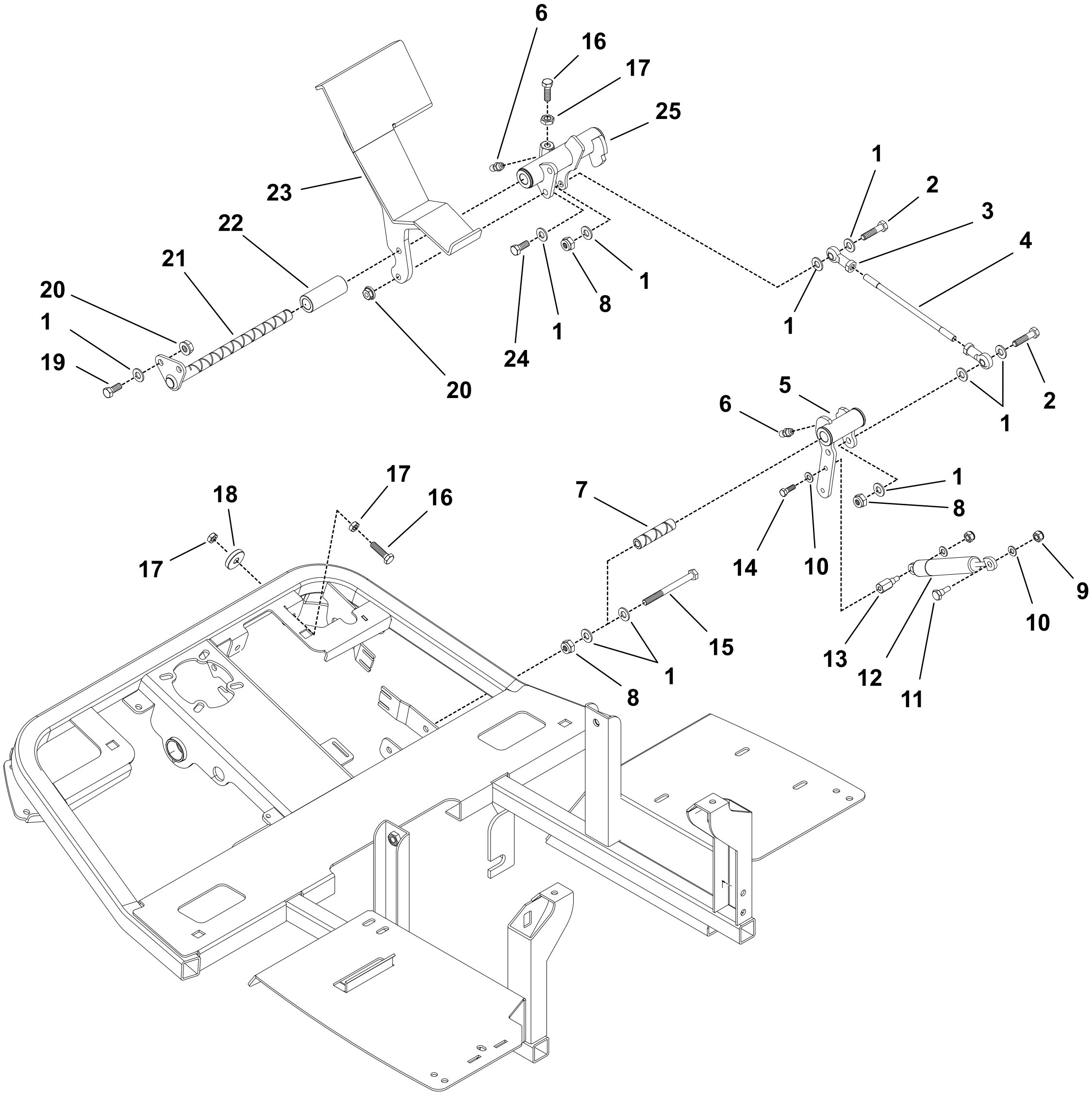

Figure 151

1. Washer	10. Washer	19. Bolt
2. Bolt	11. bolt	20. Nut
3. Rod end	12. Shock absorber	21. Pin
4. Traction rod	13. Pin	22. Spacer
5. Linkage bellcrank	14. Bolt	23. Traction pedal
6. Grease fitting	15. Bolt	24. Bolt
7. Bushing	16. Bolt	25. Traction pedal pin
8. Nut	17. Washer	
9. Nut	18. Washer	

Removing the Traction Pedal

1. Park the machine on a level surface, set the parking brake, lower the cutting deck, shut off the engine, and remove the key from the key switch.
2. Disconnect the battery negative cable from battery terminal and then disconnect positive cable from battery; refer to *Operator's Manual*.
3. For assembly purposes, label the electrical wire harness connectors. Disconnect the machine wire harness connectors from the micro switches.

Removing the Traction Pedal (continued)

4. Disassemble the traction pedal as needed using the Figure 151 as a guide. When removing the pin (21), make sure to support traction pedal pin (25) to prevent damage.

Installing the Traction Pedal

1. Apply a coat of grease to outer diameter of the pin (21) and bushing (7).
2. Apply a coat of grease to inner diameter of the spacer (22), traction pedal pin (25) and linkage bellcrank (5).
3. Assemble the traction pedal using the Figure 151 as a guide.
4. After the traction pedal assembly, make sure that there is no binding in pedal movement. Ensure that the traction pedal returns to the centered position when released. Correct any sticking or binding before the machine operation.
5. Plug the machine wire harness connectors into the micro switches.
6. After assembly of the traction pedal, adjust the traction pedal; refer to *Operator's Manual*. Make sure that the traction rod does not contact anything through both forward and reverse directions.
7. Connect positive battery cable from battery terminal and then connect negative cable to battery; refer to *Operator's Manual*.

Brake Pedal

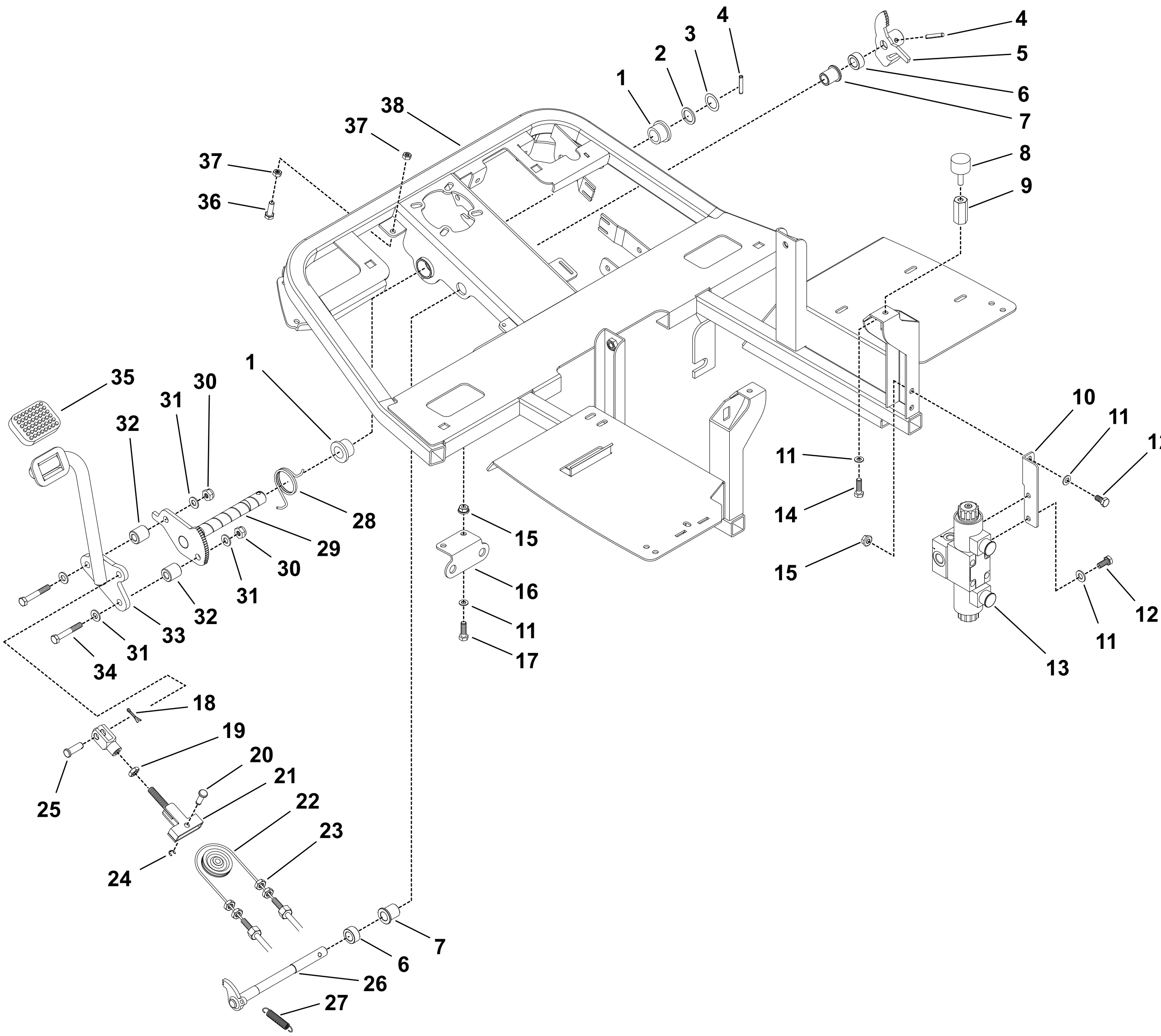

Figure 152

1. Bushing
2. Spacer
3. Spacer
4. Spring pin
5. Brake lock
6. Spacer
7. Bushing
8. Rubber pad
9. Column
10. Bracket
11. Washer
12. Bolt
13. Solenoid valve
14. Bolt
15. Nut
16. Bracket
17. Bolt
18. Cotter pin
19. Nut
20. Pin
21. Fork
22. Pulley
23. Brake cable
24. Snap ring
25. Pin
26. Camshaft
27. Spring
28. Brake pedal spring
29. Brake pedal pin
30. Nut
31. Washer
32. Spacer
33. Brake pedal
34. Bolt
35. Brake pedal cap
36. Bolt
37. Nut
38. Operator platform

Removing of Brake Pedal

1. Park the machine on a level surface, set the parking brake, lower the cutting deck, shut off the engine, and remove the key from the key switch.
2. Block the wheels with chocks to prevent the machine from moving.
3. Disconnect the battery negative cable from battery terminal and then disconnect positive cable from battery; refer to *Operator’s Manual*.
4. Disconnect the electrical wire harness connector from the parking brake switch.
5. Disassemble the brake pedal as needed using the Figure 152 as a guide.

Installing the Brake Pedal

1. Apply a coat of grease on outer diameter of the brake pedal pin (29) and inner diameter of the bushing (1).
2. Assemble the brake pedal using the Figure 152 as a guide.
3. After the brake pedal assembly, make sure that there is no binding in pedal movement and also that pedal returns to the centered position when released. Correct any sticking or binding before the machine operation.
4. Plug the machine wire harness connectors into the parking brake micro switch.
5. After assembly of the brake pedal, adjust the brake pedal; refer to *Operator’s Manual*. Make sure that the brake pedal does not contact anything through both forward and reverse directions.
6. Connect positive battery cable from battery terminal and then connect negative cable to battery; refer to *Operator’s Manual*.

Operator Seat

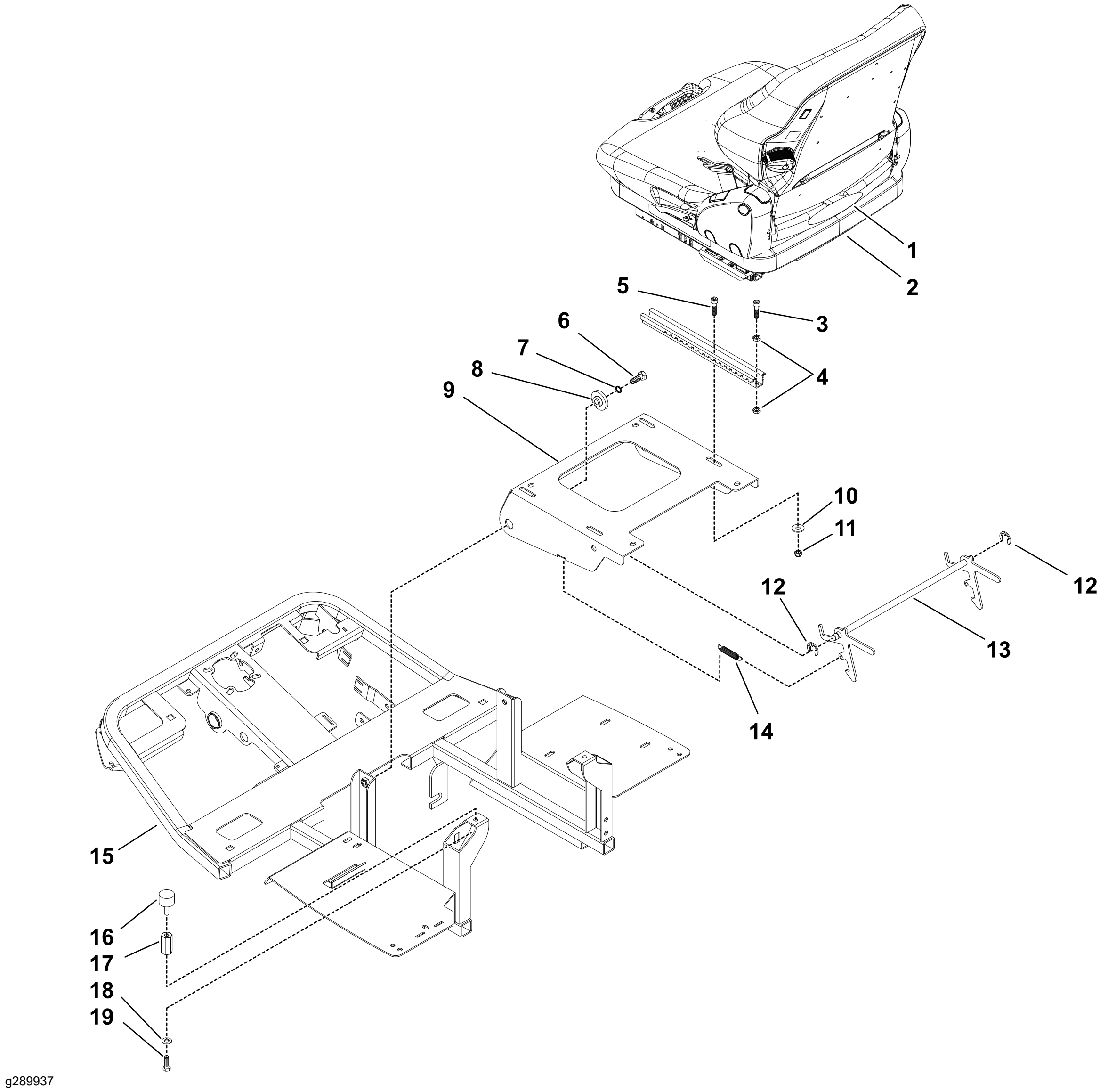

Figure 153

1.	Seat switch connector	8.	Bushing	15.	Operator platform
2.	Seat	9.	Seat support	16.	Rubber pad
3.	Socket head screw	10.	Washer	17.	Column
4.	Nut	11.	Nut	18.	Washer
5.	Socket head screw	12.	Snap ring	19.	Bolt
6.	Bolt	13.	Seat hook		
7.	Washer	14.	Spring		

Removing the Operator Seat

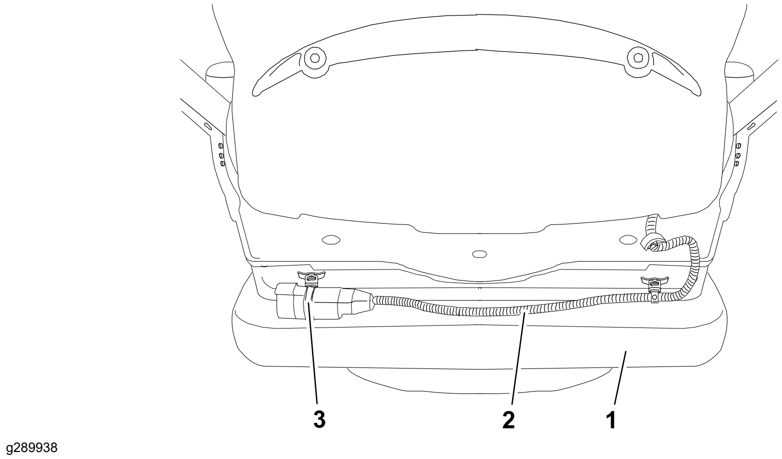

Figure 154

1. Operator seat
2. Seat switch wire harness
3. Seat switch connector

1. Park the machine on a level surface, set the parking brake, lower the cutting deck, shut off the engine, and remove the key from the key switch.
2. Disconnect the battery negative cable from the battery; refer to *Operator's Manual*.
3. Disconnect the seat electrical connector from the machine wire harness (Figure 154).
4. Slide the operator seat (2) to forward; refer to *Operator's Manual*.
5. Remove the 4 socket head screws (5), washers (10) and nut (11) that secures the operator seat (2) to the seat support (9).

IMPORTANT

Make sure to not damage the electrical harness while removing the operator seat.

6. Lift and remove the operator seat (2) from the seat support (9).

Installing the Operator Seat

IMPORTANT

Make sure to not damage the electrical harness while installing the operator seat.

1. Carefully position the operator seat (2) onto the seat support (9).
2. Position the operator seat (2) onto the seat support (9) and secure with the 4 socket head screws (5), washers (10) and nuts (11).
3. Connect the seat electrical connector to the machine wire harness (Figure 154).
4. Connect the battery negative cable from the battery; refer to *Operator's Manual*.

Servicing the Operator Seat

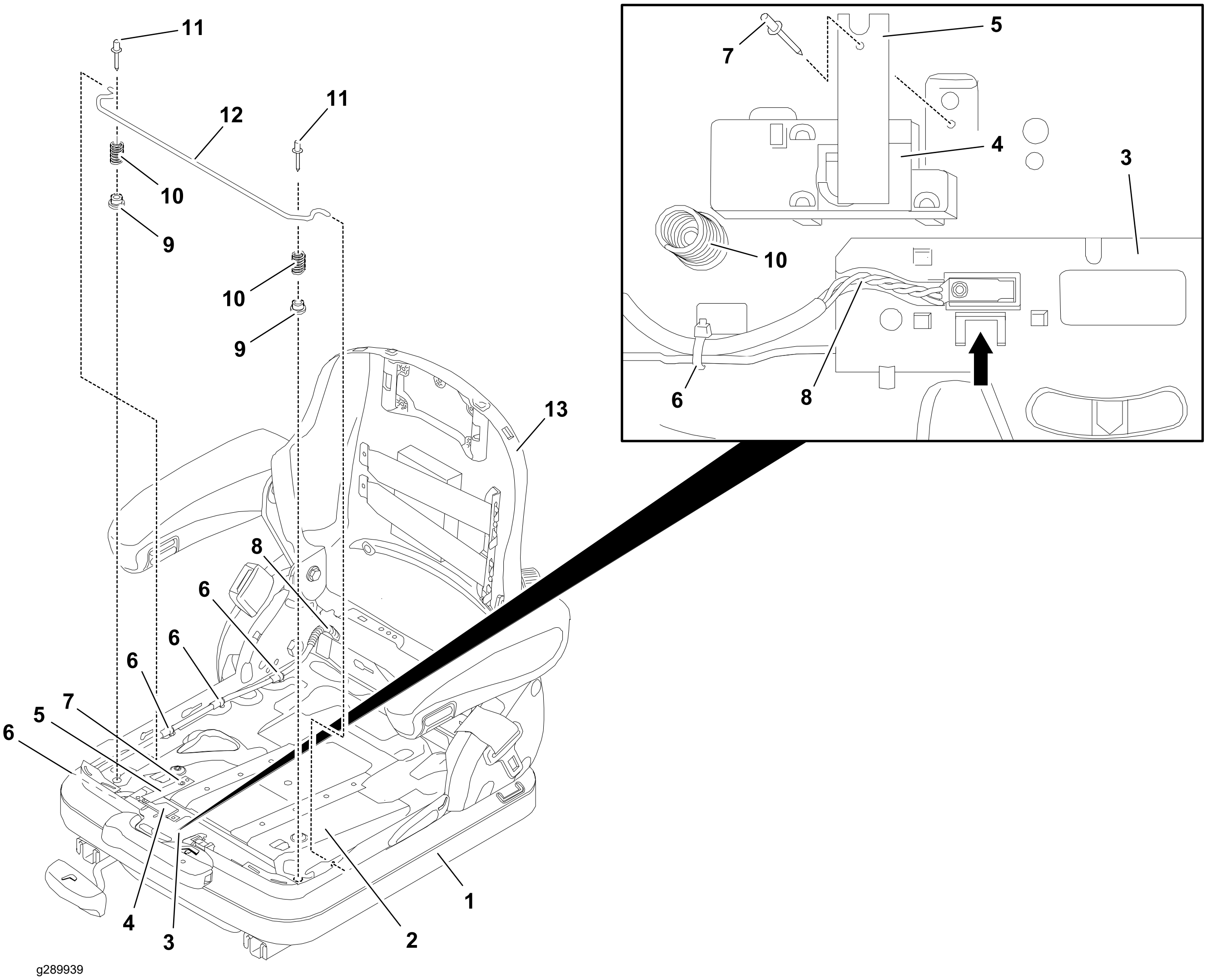

Figure 155

1. Bellows
2. Spring pack
3. Housing of the seat level indicator
4. Cover
5. Switch plate
6. Cable ties
7. Blind rivet
8. Seat switch with cable
9. Bushing
10. Compression springs
11. Blind rivet
12. Switching bracket
13. Backrest frame

For servicing the operator seat, see the Grammer Seats Repair Manual.

Frame Assembly

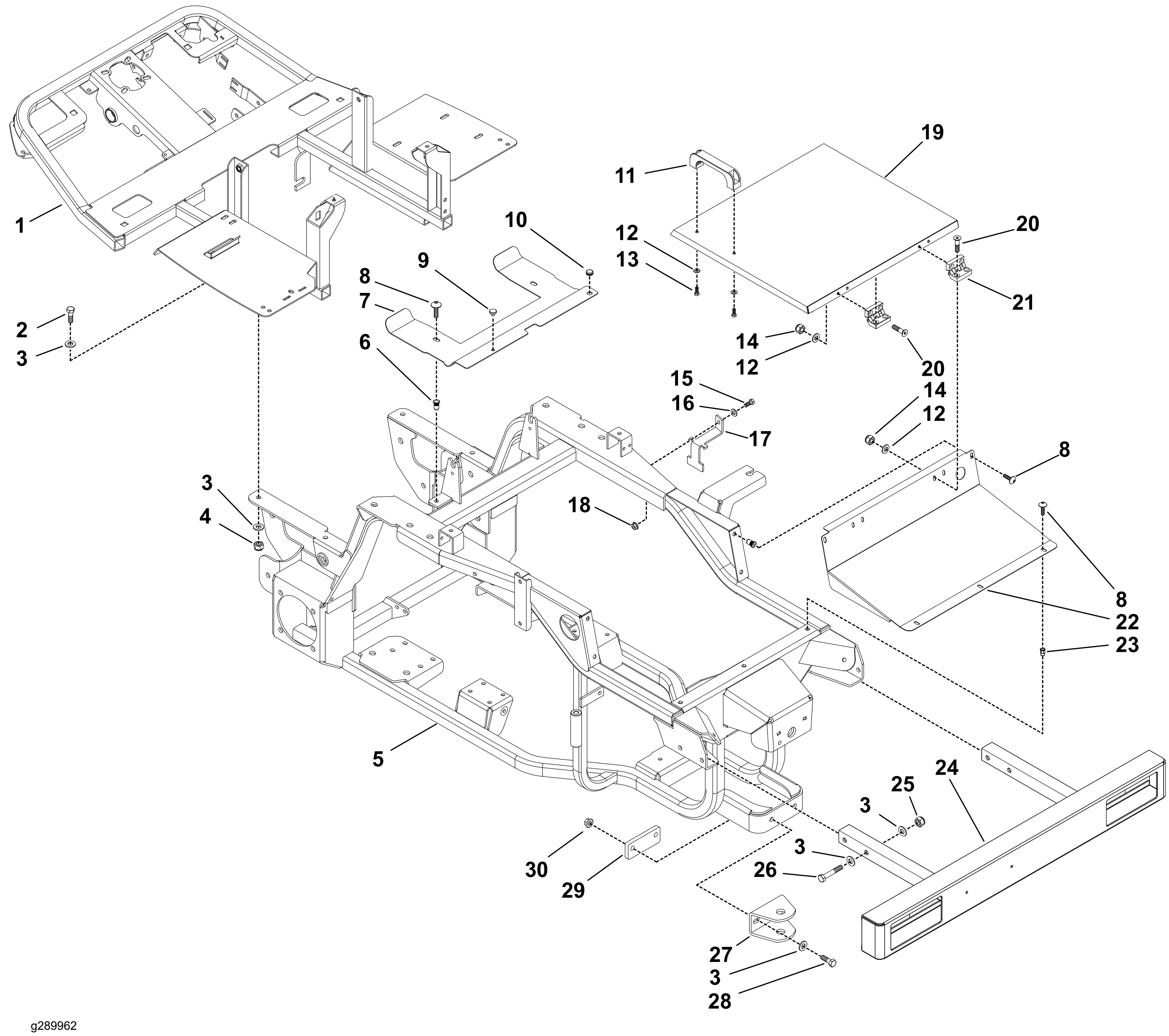

Figure 156

1.	Operator platform	11.	Handle	21.	Plastic hinge
2.	Bolt	12.	Washer	22.	Rear engine cover
3.	Washer	13.	Screw	23.	Thread insert
4.	Nut	14.	Nut	24.	Rear bumper
5.	Frame	15.	Bolt	25.	Nut
6.	Thread insert	16.	Washer	26.	Bolt
7.	Front engine cover	17.	Bracket	27.	Tow bar
8.	Screw	18.	Nut	28.	Bolt
9.	Magnet	19.	Hood	29.	Bracket
10.	Rubber plug	20.	Screw	30.	Nut

Disassemble and assemble the frame assembly using the Figure 156 as a guide.

Chapter 8

Axle and PTO

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.

Service and Repairs

Servicing the Brake

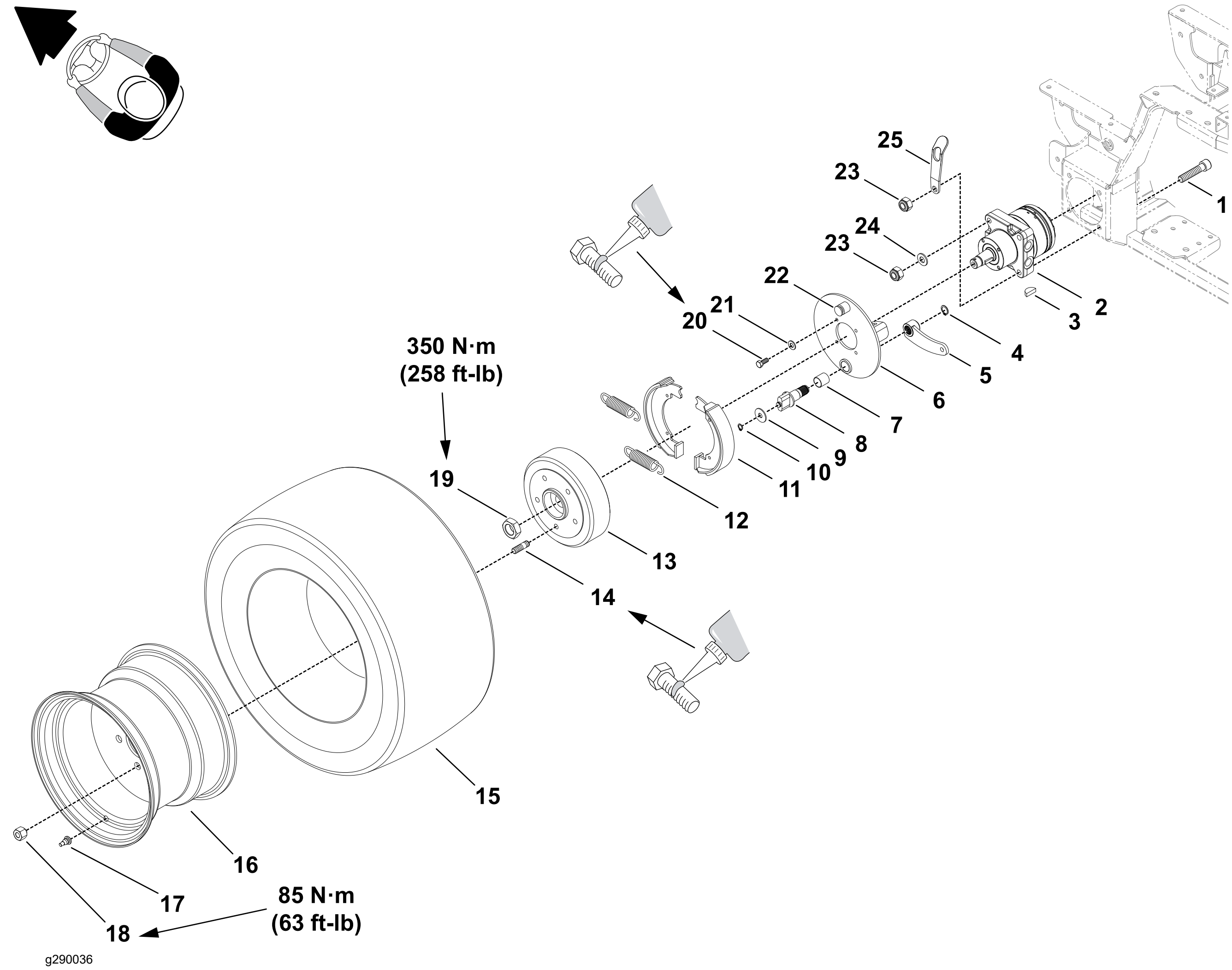

Figure 157

1. Bolt
2. Hydraulic motor
3. Woodruff key
4. Retaining ring
5. Brake lever
6. Brake plate
7. Bushing
8. Brake caliper
9. Washer
10. Retaining ring
11. Brake shoe
12. Spring
13. Brake drum
14. Stud
15. Tire
16. Wheel rim
17. Valve
18. Wheel lug nut
19. Nut
20. Bolt
21. Washer
22. Camshaft
23. Nut
24. Washer
25. Brake cable bracket

Disassembling the Brakes

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, and remove the key from the key switch.
2. Block the wheels with chocks to prevent the machine from moving.
3. Remove the front wheel; refer to Removing the Wheels (page 7–3). Make sure that the machine is raised and supported with appropriate jack stands.

Disassembling the Brakes (continued)

4. Loosen, but do not remove the locknut (19) securing the wheel hub to the motor shaft.
5. Ensure that the parking brake is disengaged.
6. Remove the clevis pin that secures the brake cable to the brake lever (5). Position the brake cable away from the brake lever.
7. Remove the lock nut (19) from the motor shaft.
8. Slide and remove the brake drum (13) from the motor shaft. Locate and retrieve the square key (3).

IMPORTANT

Do not hit the wheel motor with a hammer during the brake drum removal or installation. Hammering may cause damage to the wheel motor.

9. Remove the brake return springs (12) from the brake shoes (11).
10. Remove brake shoe (11) from the brake plate (6).
11. If desired, the complete brake assembly can be removed from the machine by removing the 4 bolts (20) and washers (21).
12. If necessary, remove the retaining ring (4) that secures the brake lever (5) to the brake caliper (8). Remove the brake lever (5), brake caliper (8) and bushing (7) from the brake plate (6).

Assembling the Brakes

1. Remove the rust and debris from all brake parts with a wire brush prior to installation. Clean all parts.
2. Visually examine the brake shoes and contact surfaces of the brake drum for excessive wear. Replace the parts that are worn and damaged.
3. If the brake lever (5) and caliper (8) was removed from the brake plate (6), lightly lubricate the outer diameter of the brake caliper (8) and inner diameter of bushing (7) and brake lever (5).
4. Install the brake caliper (8), bushing (7) and brake lever (5) into the brake plate (6) and secure with the snap ring (4).
5. If removed, install the brake plate (6) onto the wheel motor (2) and secure with the 4 bolts (20) and washers (21).
6. Lightly lubricate the brake shoe pivot points with general purpose grease.
7. Position the 2 brake shoes on the brake plate.
8. Install the 2 springs onto the brake shoes. Make sure that the brake shoes are properly positioned to pivot and caliper points.
9. Position the square key (3) in the wheel motor shaft (2), then install the brake drum (13).
10. Secure the brake drum (13) onto the wheel motor shaft (2) with the nut (19).
11. Position the brake cable end to the brake cable lever (5) and secure with the clevis pin.
12. Install the wheel assembly; refer to Installing the Wheels (page 7–4).
13. Check and adjust the brakes; refer to the *Operator's Manual*.
14. Lower the machine to the ground.

Assembling the Brakes (continued)

WARNING

Failure to maintain proper torque could result in failure or loss of the wheel and may result in personal injury.

Maintain the proper torque of the wheel-lug nuts.

15. Torque tighten the nut (19) that secure the brake drum (13) onto the wheel motor shaft (2) to **350 N·m (258 ft-lb)**.

CAUTION

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

16. Check for the operation of the brake, before you return the machine to operation.

Burnish Brake Shoes

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

1. Bring the machine to full speed and apply the brakes to rapidly stop the machine without skidding or locking up the wheels.
2. Repeat this procedure 10 times. To avoid the overheating the brakes, wait 1 minute between each stop.

Rear Axle assembly

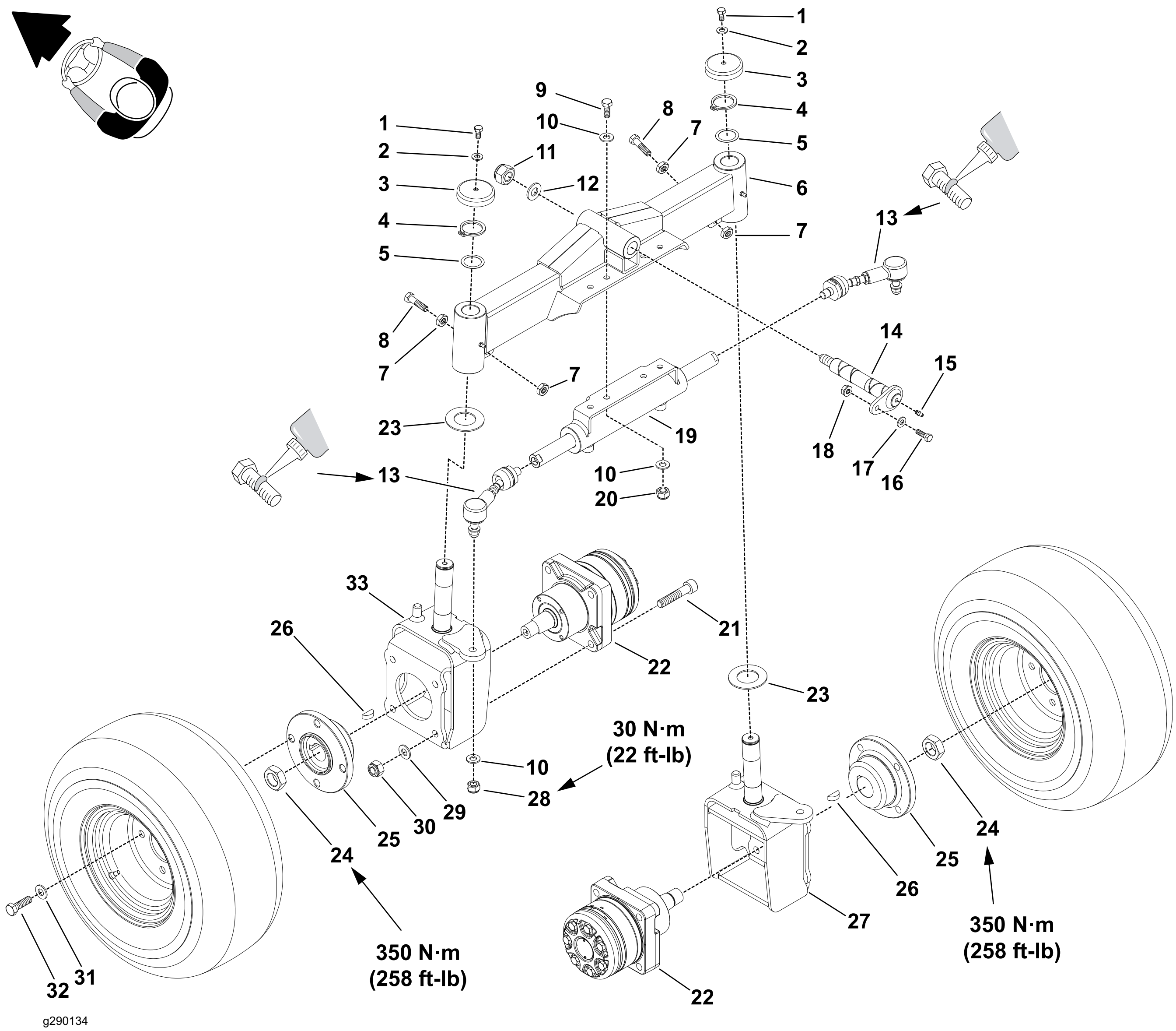

Figure 158

1. Bolt	12. Thrust washer	23. Thrust washer
2. Washer	13. Tie rod end	24. Nut
3. Cap	14. Pin	25. Flange
4. Retaining ring	15. Grease fitting	26. Woodruff key
5. Spacer	16. Bolt	27. RH spindle
6. Rear axle	17. Washer	28. Nut
7. Nut	18. Nut	29. Washer
8. Bolt	19. Steering cylinder	30. Nut
9. Bolt	20. Nut	31. Washer
10. Washer	21. Bolt	32. Bolt
11. Nut	22. Rear hydraulic motor	33. LH spindle

Removing the Rear Axle

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Block the front wheels with chocks to prevent the machine from moving.

Removing the Rear Axle (continued)

3. Remove the hopper assembly; refer to Removing the Hopper Assembly (page 9–3).
4. Jack up the machine (just ahead of the rear wheels) until clearance exists to allow rear axle removal. Support the machine with the jack stands or appropriate load holding device to prevent it from falling; refer to Jacking Instructions (page 1–7).
5. Remove the rear wheels; refer to Removing the Wheels (page 7–3).
6. Thoroughly clean the hydraulic hose ends and fittings on the steering cylinder to prevent hydraulic system contamination.

   Note: To ease assembly, label the hydraulic hoses to show their correct position on the steering cylinder.
7. Disconnect the hydraulic hoses from the steering cylinder (19). Put caps or plugs on all fittings and hoses to prevent contamination.
8. Remove the steering cylinder; refer to Removing the Steering Cylinder (page 5–115).
9. Remove the rear wheel motor; refer to Removing the Rear Wheel Motor (page 5–96).
10. If necessary, remove the steering spindle assembly; refer to Removing the Steering Spindle (page 8–11).
11. Remove the nut (11), thrust washer (12), bolt (16), washer (17) and nut (18) that secures the pin (14) to the chassis.
12. Support the rear axle (6) to prevent it from falling.
13. Remove the pin (14) that secures the rear axle (6) to the chassis. This will release the rear axle from the chassis. Carefully pull the entire axle assembly from the machine.
14. Remove the additional rear axle components as necessary (Figure 158).
15. If the bushings in the rear axle are worn or damaged, replace the bushings; refer to Servicing the Rear Axle (page 8–9).

Installing the Rear Axle

1. Install all the rear axle components that were removed (Figure 158).
2. Thoroughly clean the rear axle pin (14). Inspect the pin for wear or damage and replace if necessary.
3. Apply a coat of grease onto the surface of the pin (14).
4. Carefully position the rear axle (6) onto the chassis and secure with the pin (14).
5. Secure the pin (14) to the chassis with bolt (16), washer (17), nut (18), thrust washer (12) and nut (11).
6. If removed, install the steering spindle assembly; refer to Installing the Steering Spindle (page 8–12).
7. Install the rear wheel motor; refer to Installing the Rear Wheel Motor (page 5–99).
8. Install the steering cylinder; refer to Installing the Steering Cylinder (page 5–117).
9. Install the wheels; refer to Installing the Wheels (page 7–4).
10. Lubricate all the grease fittings in the rear axle assembly.
11. Check and adjust the rear wheel alignment; refer to *Operator's Manual*.
12. Check and adjust the rear wheel toe-in; refer to *Operator's Manual*.

Installing the Rear Axle (continued)

13. Check and adjust the steering stops; refer to *Operator’s Manual*.
14. Lower the machine and install the hopper assembly; refer to Installing the Hopper Assembly (page 9–4).
15. Check the hydraulic-fluid level in the hydraulic tank and add correct quantity of fluid if necessary; refer to the *Operator’s Manual*.
16. Ensure that there is no contact between the machine components including hydraulic hoses while the rear wheels move lock to lock. Adjust if necessary.
17. Operate the machine and check for hydraulic-fluid leaks, repair any leaks as necessary.

Servicing the Rear Axle

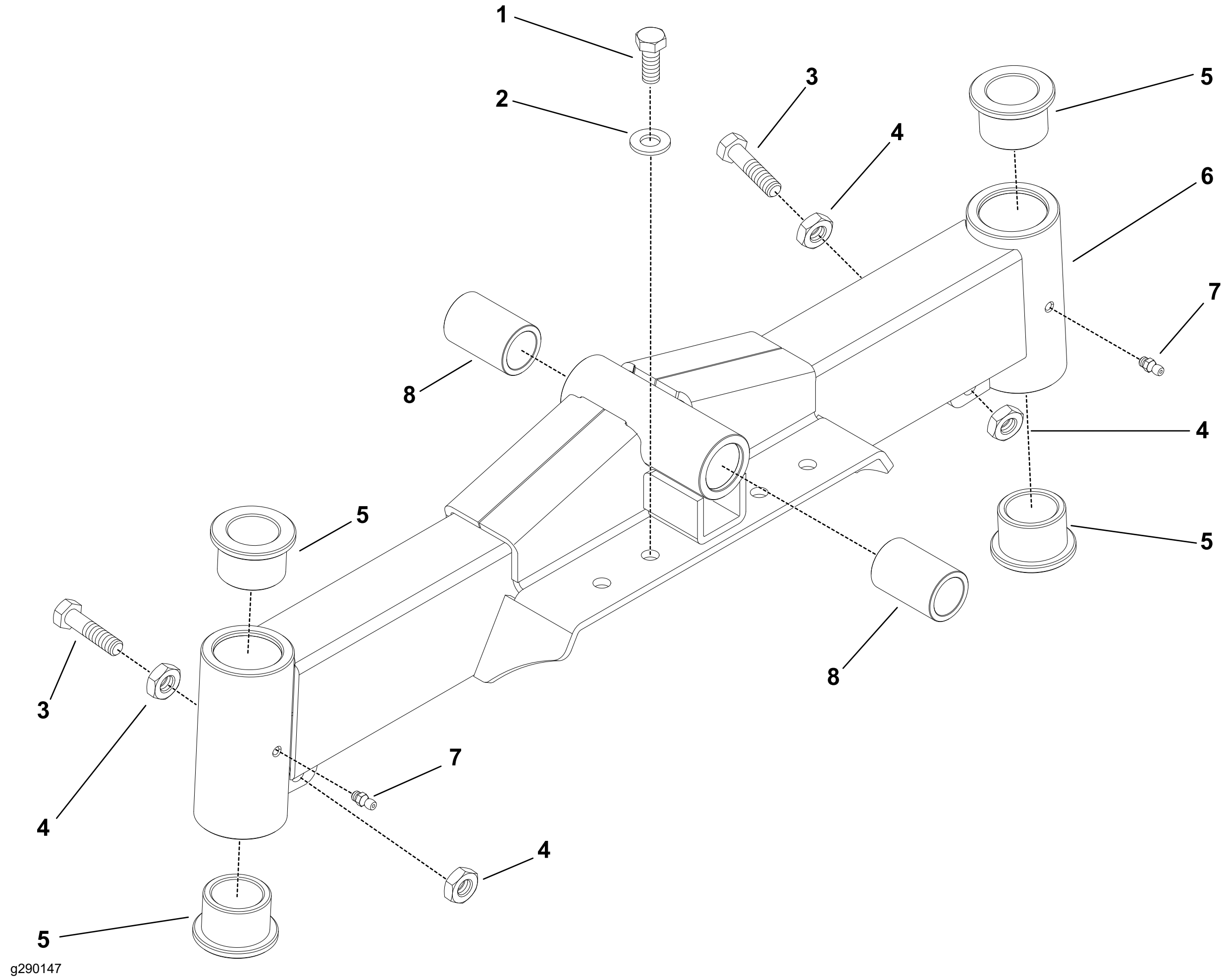

Figure 159

1. Bolt	4. Nut	7. Grease fitting
2. Washer	5. Flange bushing	8. Bushing
3. Bolt	6. Rear axle	

Rear Axle Pivot Bushing

The rear axle must be held in place snugly by the axle pivot pin. Excessive movement of the axle, which is characterized by erratic steering, might indicate worn axle pivot bushing (8). To correct the problem, replace the bushings as below:

1. Remove the rear axle from the machine; refer to Removing the Rear Axle (page 8–6).
2. Use a bushing removal tool to extract both the axle pivot bushings (8) from the rear axle (6).

   Note: Take care not to damage bore of the pivot tube during the bushing (8) removal.
3. Clean inside of the tube to remove all the dirt and foreign material.
4. Apply a coat of grease to inside and outside of the new bushings (8).
5. Press the new bushings (8) into the rear axle (6). Bushing (6) must be flush with the axle tube after installation.
6. Install the rear axle onto the machine; refer to Installing the Rear Axle (page 8–7).

Rear Axle Housing Bushings

The rear axle steering spindle shafts must fit snugly in the rear axle. Excessive movement of the steering spindle shaft in the axle might indicate that the flange bushings (5) are worn or damaged and must be replaced as below:

1. Remove the rear axle from the machine; refer to Removing the Rear Axle (page 8–6).
2. Use a bushing removal tool to extract the flange bushings (5) from the rear axle (6).

   Note: Take care not to damage bore of the bore during the bushing (5) removal.
3. Clean the inside of the bore to remove all the dirt and foreign material.
4. Apply a coat of grease to the inside and outside of the new flange bushings (5).
5. Press the bushings (5) into the rear axle (6) bore. Press the bushing (6) into the bore until the flange shoulder bottoms on the bore.
6. Install the rear axle onto the machine; refer to Installing the Rear Axle (page 8–7).

Steering Spindle

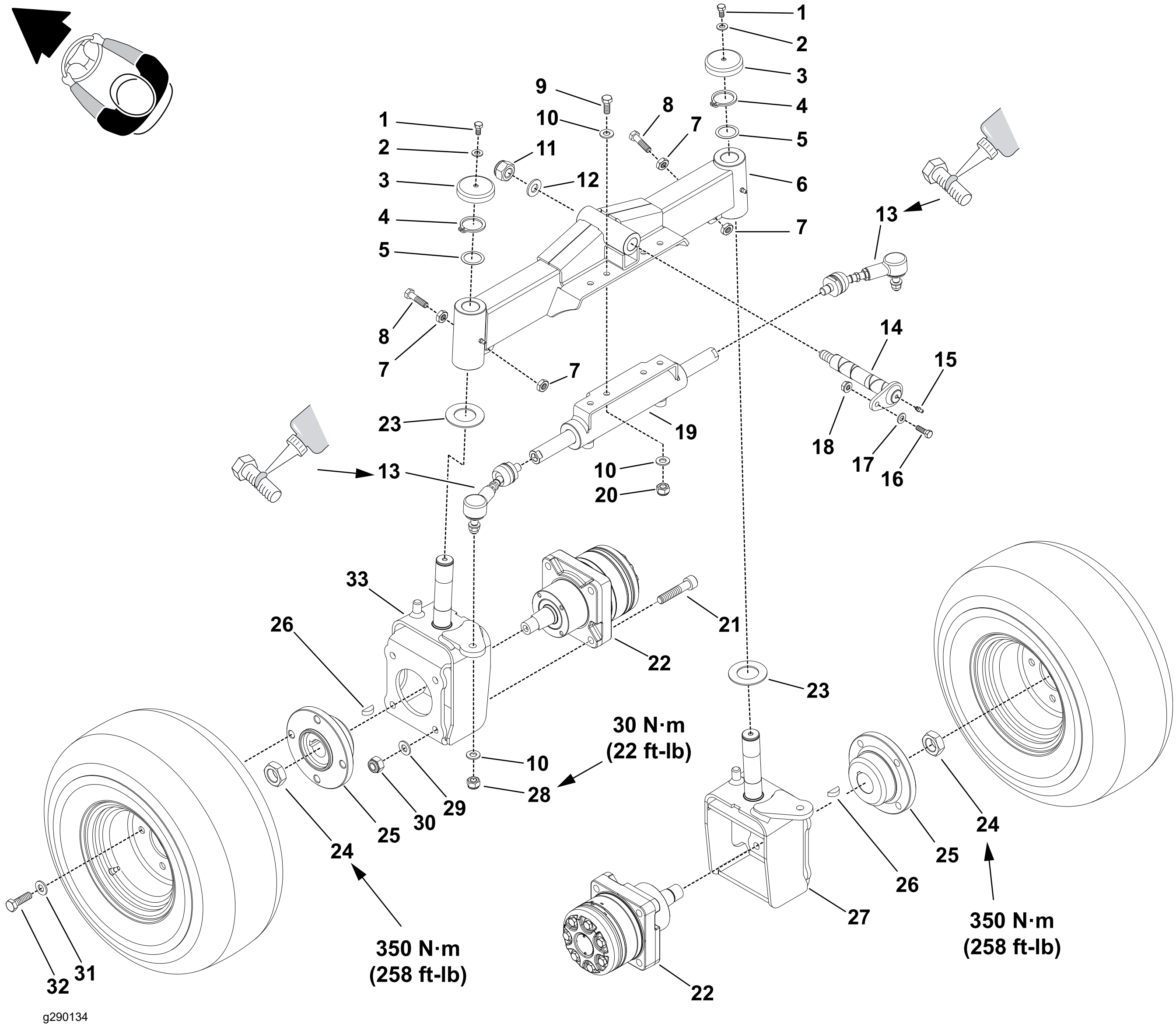

Figure 160

1. Bolt
2. Washer
3. Cap
4. Retaining ring
5. Spacer
6. Rear axle
7. Nut
8. Bolt
9. Bolt
10. Washer
11. Nut
12. Thrust washer
13. Tie rod end
14. Pin
15. Grease fitting
16. Bolt
17. Washer
18. Nut
19. Steering cylinder
20. Nut
21. Bolt
22. Rear hydraulic motor
23. Thrust washer
24. Nut
25. Flange
26. Woodruff key
27. RH spindle
28. Nut
29. Washer
30. Nut
31. Washer
32. Bolt
33. LH spindle

Removing the Steering Spindle

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, and remove the key from the key switch.
2. Block the wheels with chocks to prevent the machine from moving.

Removing the Steering Spindle (continued)

3. Remove the hopper assembly; refer to Removing the Hopper Assembly (page 9–3).
4. Remove the rear wheel; refer to Removing the Wheels (page 7–3).
5. Loosen, but not remove the locknut (24) that securing the wheel flange (2) to the motor shaft (22).
6. Remove the nut (28) and washer (10) that secures the steering tie rod (13) to the spindle (27 or 33).
7. Carefully pry the steering tie rod end (13) from the spindle (27 or 33) with a ball joint pickle fork.
8. Remove the rear wheel motor; refer to Removing the Rear Wheel Motor (page 5–96).
9. Support the spindle to prevent from falling.

CAUTION

The weight of the steering spindle assembly is heavy.

Support the steering spindle assembly when removing it to prevent it from falling and causing personal injury.

10. Remove the bolt (1), washer (2), cap (3) and retaining ring (4) that secures the spindle (27 or 33) into the rear axle (6). Slide and remove the spindle from the rear axle.
11. Locate and retrieve the spacer (5) and thrust washer (23) from the spindle.
12. Clean the spindle. Inspect the shaft for wear or damage and replace the spindle, if the shaft is worn or damaged.
13. Clean and inspect the thrust washer (23) and flange bushings inside the rear axle. Replace the components that are worn or damaged as necessary; refer to Servicing the Rear Axle (page 8–9).

Installing the Steering Spindle

1. Apply a light coat of grease to the steering spindle shaft.
2. Install the thrust washer (23) onto the steering spindle shaft and slide the spindle (27 or 33) up through the rear axle (6).
3. Hold the spindle in place and install the spacer (5) and retaining ring (4) onto the end of the steering spindle. Ensure that the retaining ring is fully seated in the shaft groove.
4. Place the cap (3) on top of the spindle and secure with the washer (2) and bolt (1).
5. Install the rear wheel motor; refer to Installing the Rear Wheel Motor (page 5–99).

IMPORTANT

Before installing the tie rod end, clean the tapers of the steering spindle and tie-rod end. Ensure that the tapers are free from grease, oil, rust, and dirt. Do not use anti-seize lubricant, when you install the tie rod end.

Installing the Steering Spindle (continued)

6. Connect the tie-rod end to the steering spindle and secure with the washer (10) and nut (28).
7. Lubricate the spindle through the grease fitting on the axle. Grease should purge from the ends of the steering spindle shaft identifying that the grease cavity is completely filled. Wipe up excess grease.
8. Install the wheels; refer to Installing the Wheels (page 7–4).
9. Lubricate all the grease fittings in the rear axle assembly.
10. Check and adjust the rear wheel alignment; refer to *Operator's Manual*.
11. Check and adjust the rear wheel toe-in; refer to *Operator's Manual*.
12. Check and adjust the steering stops; refer to *Operator's Manual*.
13. Lower the machine and install the hopper assembly; refer to Installing the Hopper Assembly (page 9–4).
14. Check the hydraulic-fluid level in the hydraulic tank and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
15. Ensure that there is no contact between the machine components including hydraulic hoses while the rear wheels move lock to lock. Adjust if necessary.
16. Operate the machine and check for hydraulic-fluid leaks, repair any leaks as necessary.

PTO Drive Belt

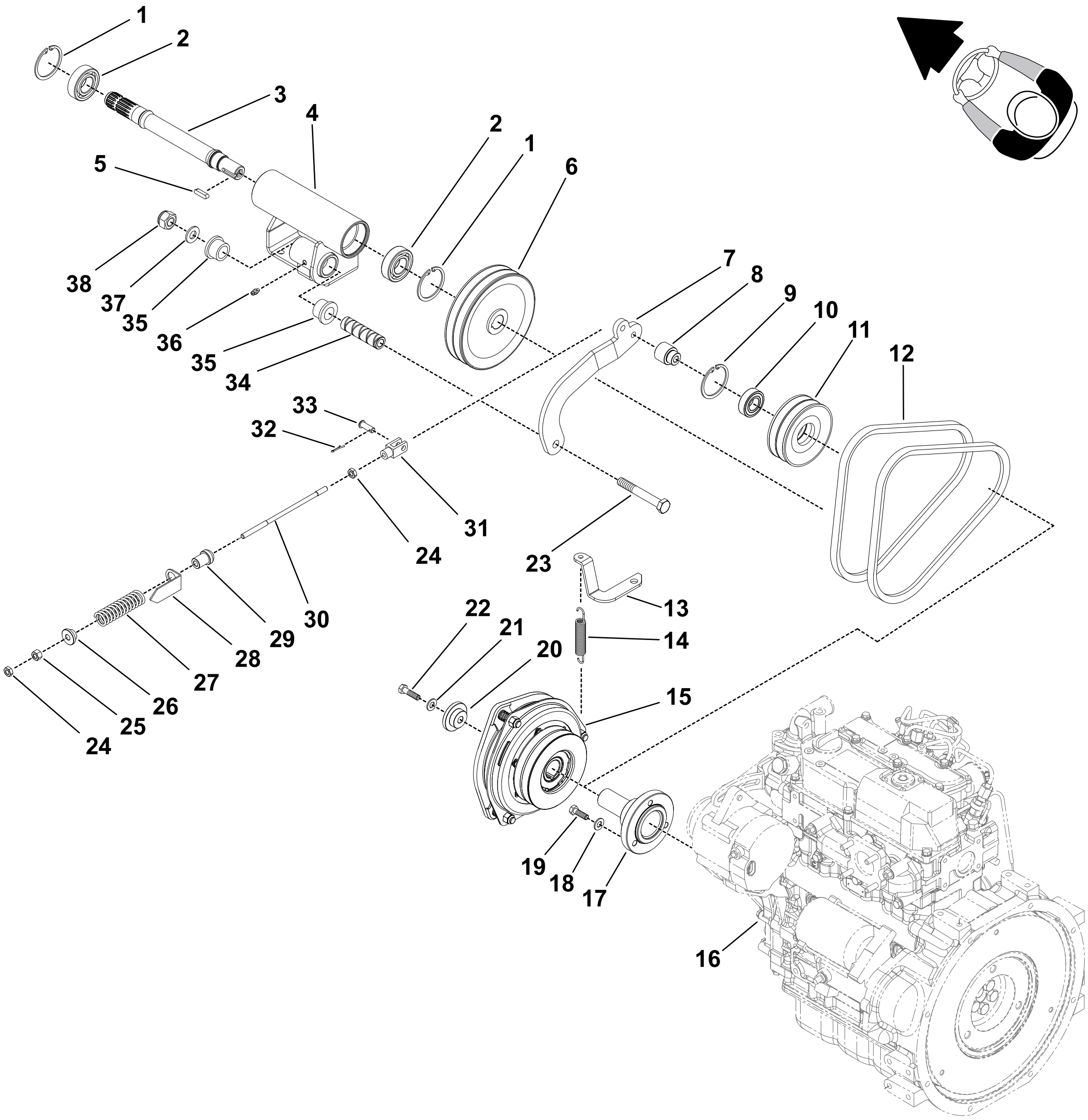

Figure 161

1. Retaining ring
2. Ball bearing
3. Shaft
4. Dust flange
5. Shaft key
6. Pulley
7. Belt tension lever
8. Bushing
9. Retaining ring
10. Bearing
11. Pulley
12. PTO belt
13. Bracket
14. Spring
15. Electric clutch
16. Engine
17. Drive shaft
18. Washer
19. Bolt
20. Bushing
21. Washer
22. Bolt
23. Bolt
24. Nut
25. Nut
26. Spring guide
27. Spring
28. Belt tension indicator
29. Nylon guide
30. Rod
31. Fork
32. Cotter pin
33. Pin
34. Pin
35. Flange bushing
36. Grease fitting
37. Washer
38. Nut

Note: Refer to *Operator's Manual* for information regarding PTO drive belt removal, installation and adjustment.

Electric Clutch

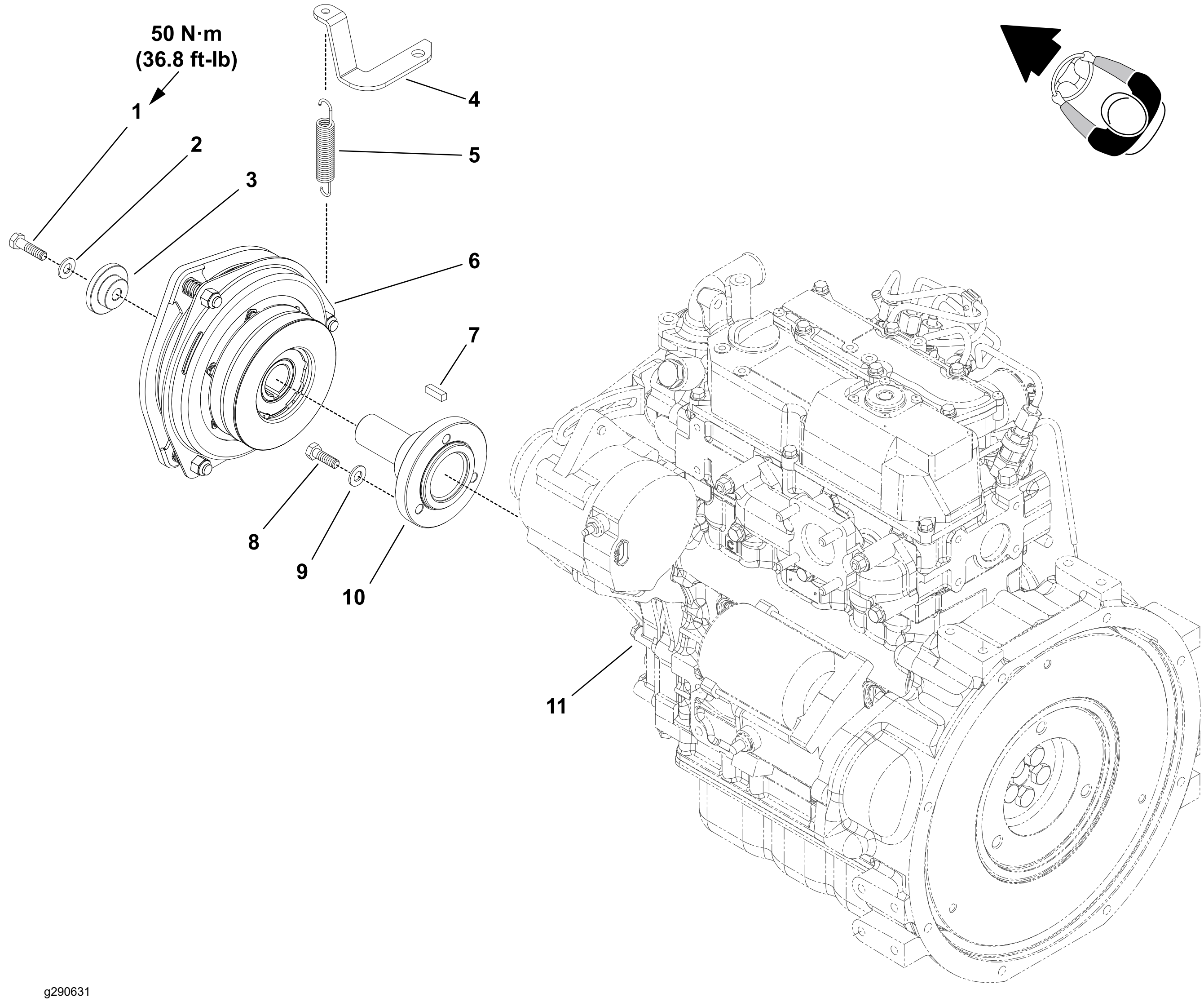

Figure 162

1.	Bolt	5.	Spring	9.	Washer
2.	Washer	6.	Electric clutch	10.	Drive shaft
3.	Bushing	7.	Woodruff key	11.	Engine
4.	Bracket	8.	Bolt		

Removing the Electric Clutch

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Disconnect the electrical connector from the electric clutch.
3. Remove the PTO drive belt from the machine; refer to *Operator's Manual*.
4. Remove the bolt (1) and washer (2) that secures the electric clutch (6) to the drive shaft (10).
5. Slide and remove the electric clutch (6) and bushing (3) from the drive shaft (10).
6. Locate and retrieve the woodruff key (7).
7. If required, remove the drive shaft (10) from the engine (11) by removing the 3 bolts (8) and washers (9).

Installing the Electric Clutch

1. If removed, install the drive shaft (10) onto the engine (11) and secure with the 3 bolts (8) and washers (9).
2. Clean the drive shaft (10) and position the woodruff (7) into the drive shaft slot.
3. Slide and install the electric clutch (6) and bushing (3) onto the drive shaft (10).
4. Secure the electric clutch (6) with the bolt (1) and washer (2). Torque tighten the bolt (1) to **50 N·m (36.8 ft-lb)**.
5. Install the PTO drive belt onto the machine; refer to *Operator's Manual*.
6. Check the PTO belt tension; refer to *Operator's Manual*.
7. Check and adjust the electric clutch gap; refer to *Operator's Manual*.
8. Connect the machine wire harness to the electric clutch.

PTO Driveshaft

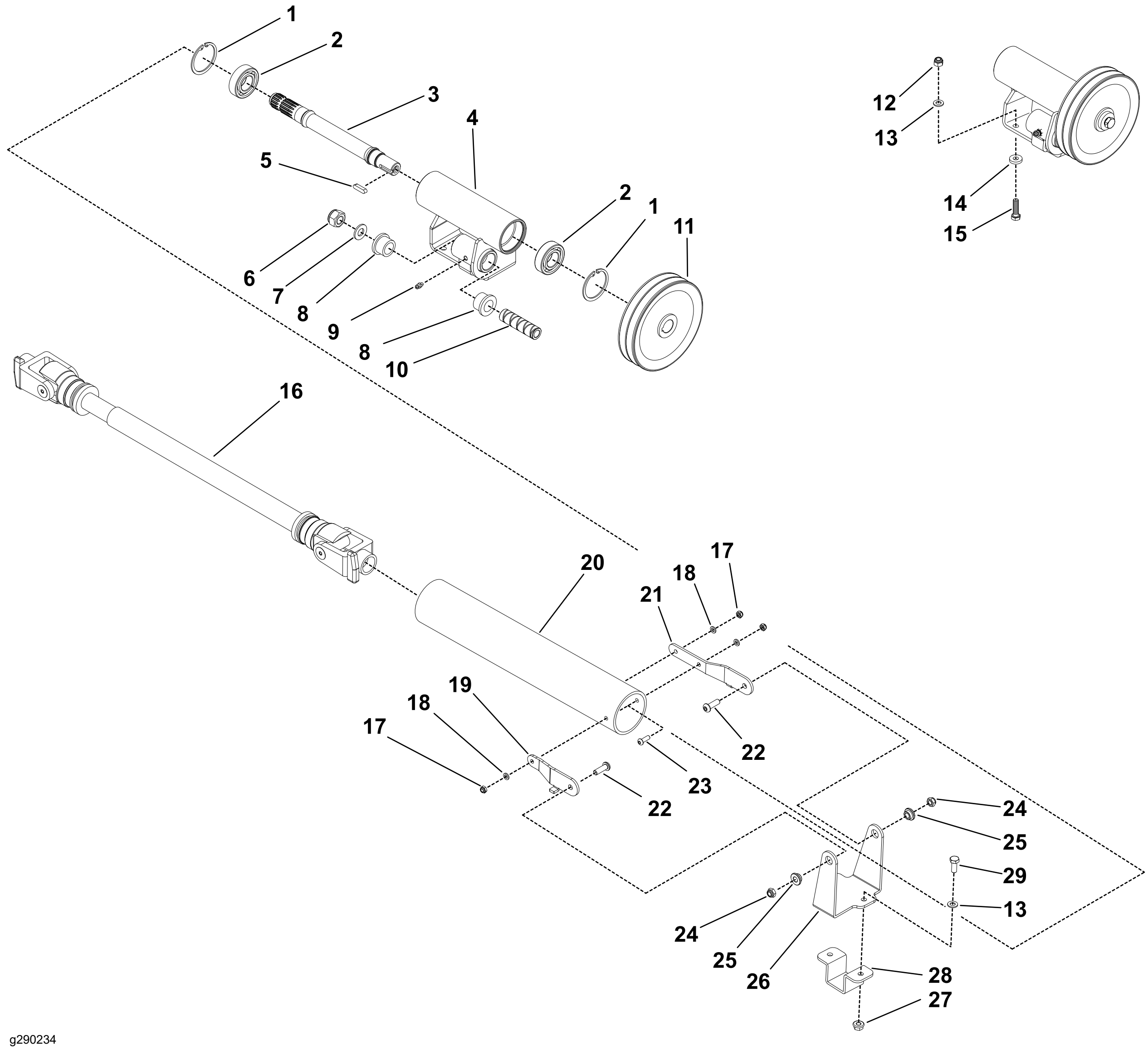

Figure 163

1. Retaining ring
2. Bearing
3. Shaft
4. Dust flange
5. Shaft key
6. Nut
7. Washer
8. Flange bushing
9. Grease fitting
10. Pin
11. Pulley
12. Nut
13. Washer
14. Washer
15. Bolt
16. Drive shaft
17. Nut
18. Washer
19. Bracket
20. Polyethylene tube protector
21. Bracket
22. Socket head screw
23. Socket head screw
24. Nut
25. Bushing
26. Fork
27. Nut
28. Bracket
29. Bolt

WARNING

Do not start the engine and engage the PTO switch when the PTO driveshaft is disconnected from the cutting deck. If you start the engine and the PTO shaft is allowed to rotate, serious personal injury and machine damage could result.

Disconnect the PTO electric clutch electrical connector whenever the PTO driveshaft is disconnected from the cutting deck.

Removing the PTO Driveshaft

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.

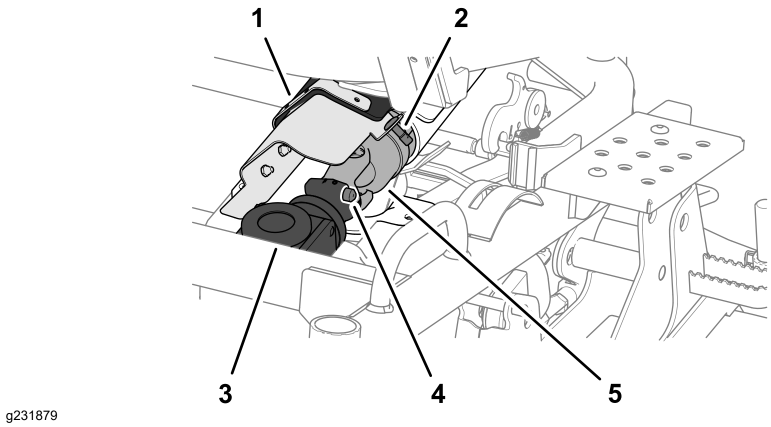

Figure 164

1. U-joint cover
2. Quarter-turn fastener
3. Mower-deck gearbox
4. Spring-loaded pin
5. End yoke (driveshaft)

2. Disconnect the end yoke of the PTO driveshaft from the cutting deck gearbox shaft as follows:
   A. Rotate the quarter turn fastener (item 2 in Figure 164) and open the universal joint cover (1) from the cutting deck.
   B. Press the spring loaded pin (4) and slide the end yoke of the driveshaft towards the engine.
3. Disconnect the end yoke of the PTO driveshaft from the PTO shaft as follows:
   A. Press the spring loaded pin on the end yoke and slide the end yoke of the driveshaft away from the engine.
   B. Remove the nuts (27), washers (13), bolt (29) and bracket (28) that secures the polyethylene tube protector (20) to the chassis.
4. Remove the PTO drive shaft (16) with polyethylene tube protector (20) from the machine.
5. If necessary, remove the PTO drive shaft (16) from the polyethylene tube protector (20) using the Figure 163 as a guide.

Installing the PTO Driveshaft

IMPORTANT

If the driveshaft tube and shaft were separated, ensure that the slip shaft yoke and slip tube yoke are aligned when the tube and shaft are assembled. Misalignment of the yokes will result in shortened driveshaft life and will cause unnecessary vibration when the cutting deck is operated.

1. If removed, install the PTO driveshaft (16) into the polyethylene tube protector (20) using the Figure 163 as a guide.
2. Position the PTO driveshaft to the machine.

   Note: Ensure that the slip shaft yoke is toward the cutting deck gearbox shaft.
3. Align the splines of the PTO driveshaft end yoke onto the PTO shaft. Press the spring loaded pin and slide the PTO driveshaft end yoke onto the PTO shaft.
4. Release the spring loaded pin and check that the PTO driveshaft end yoke is locked onto the PTO shaft.
5. Secure the polyethylene tube protector (20) with the bracket (28), bolt (29), washers (13) and nuts (27) to the chassis.
6. Align the splines of the PTO driveshaft end yoke onto the cutting deck gearbox shaft. Press the spring loaded pin and slide the PTO driveshaft end yoke onto the cutting deck gearbox shaft.
7. Release the spring loaded pin and check that the PTO driveshaft end yoke is locked onto the cutting deck gearbox shaft.
8. Close the universal joint cover (item 1 in Figure 164) and secure with the quarter turn fastener.
9. Lubricate the PTO driveshaft grease fittings; refer to *Operator's Manual*.

Servicing the Driveshaft

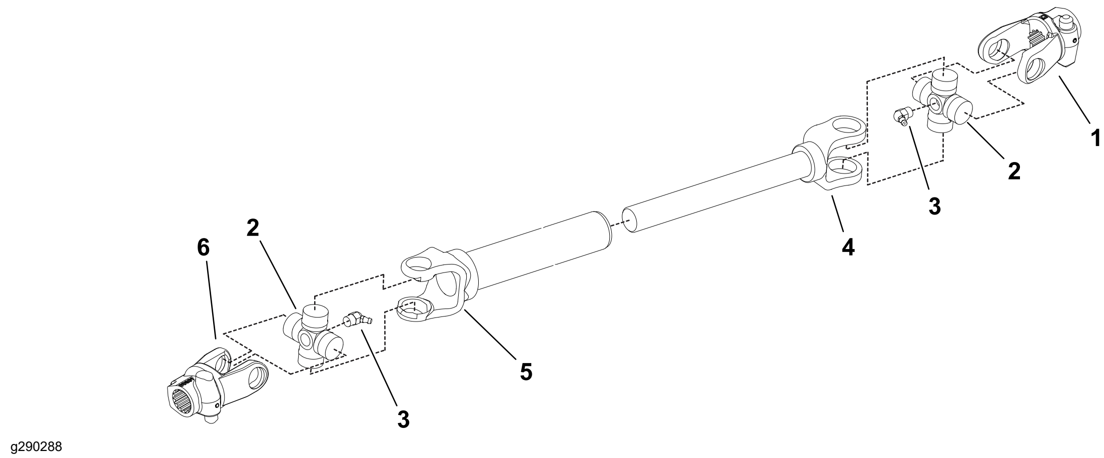

Figure 165

1. End yoke
2. Universal joint kit (cross and bearing)
3. Grease fitting
4. Slip shaft yoke
5. Slip tube yoke
6. End yoke

Disassembling the Driveshaft

1. Remove the PTO driveshaft from the machine; refer to Removing the PTO Driveshaft (page 8–18).

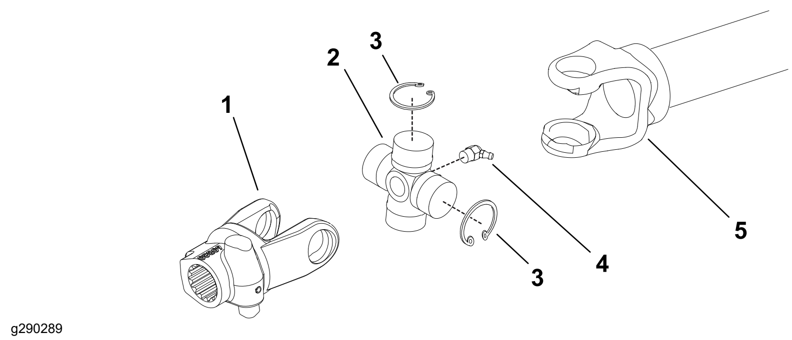

Figure 166

1. End yoke
2. Cross and bearing kit
3. Snap ring
4. Grease fitting
5. Shaft yoke

2. Remove the snap rings (3) that secures the cross and bearing kit in the yokes.

IMPORTANT

Support the yokes when removing and installing the bearings to prevent damage.

3. Use a press to remove the cross and bearing (2) from the yokes.
4. Clean the driveshaft yoke (5) and end yoke (1).
5. Inspect the driveshaft yoke (5) and end yoke (1) for wear, pitting or other noticeable damage. Replace the parts that are worn or damaged.

Assembling the PTO Driveshaft

1. Install the new cross and bearings as follows:
   A. Apply a thick layer of grease to the bearing bores in the end yoke and shaft yoke.
   B. Press 1 bearing partially into the yoke.
   C. Insert the cross into the yoke and bearing.
   D. Hold the cross in alignment and press the bearing in until it hits the yoke.
   E. Install the snap ring into the yoke groove to secure installed bearing.
   F. Place second bearing into the yoke bore and onto the cross shaft. Press the bearing into the yoke and secure with the snap ring.
   G. Repeat the procedure for the other yoke.
   H. Apply grease to the cross until it comes out of all the 4 bearing cups.
2. Ensure that the assembled joint moves without any binding. Lightly rap the yoke lugs with a soft-faced hammer to remove slight binding. If binding continues, disassemble the joint to identify the source of binding.
3. Install the PTO driveshaft onto the machine; refer to Installing the PTO Driveshaft (page 8–19).

PTO Shaft Assembly

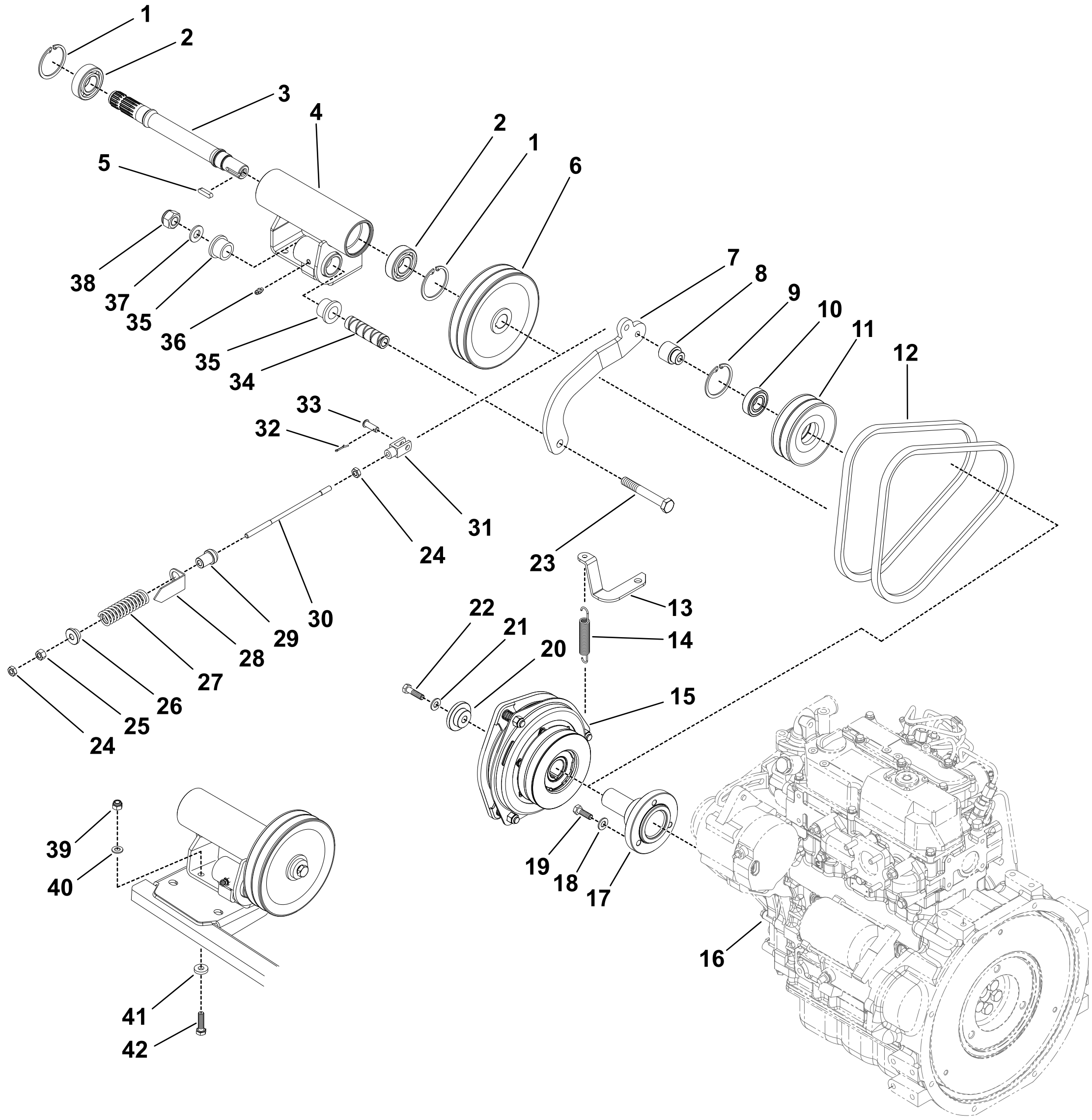

Figure 167

1. Retaining ring
2. Ball bearing
3. Shaft
4. Dust flange
5. Shaft key
6. Pulley
7. Belt tension lever
8. Bushing
9. Retaining ring
10. Bearing
11. Pulley
12. PTO belt
13. Bracket
14. Spring
15. Electric clutch
16. Engine
17. Drive shaft
18. Washer
19. Bolt
20. Bushing
21. Washer
22. Bolt
23. Bolt
24. Nut
25. Nut
26. Spring guide
27. Spring
28. Belt tension indicator
29. Nylon guide
30. Rod
31. Fork
32. Cotter pin
33. Pin
34. Pin
35. Flange bushing
36. Grease fitting
37. Washer
38. Nut
39. Nut
40. Washer
41. Washer
42. Bolt

WARNING

Do not start the engine and engage the PTO switch when the PTO driveshaft is disconnected from the cutting deck. If you start the engine and the PTO shaft is allowed to rotate, serious personal injury and machine damage could result.

Disconnect the PTO electric clutch electrical connector whenever the PTO driveshaft is disconnected from the cutting deck.

Removing the PTO Shaft Assembly

1. Park the machine on a level surface, lower the cutting deck, shut of the engine, set the parking brake and remove the key from the key switch.
2. Remove the PTO driveshaft from the machine; refer to Removing the PTO Driveshaft (page 8–18).
3. Remove the PTO drive belt from the machine; refer to *Operator's Manual*.
4. Remove the cotter pin (32) and pin (33) that secures the fork (31) to the belt tension lever (7). Separate the fork (31) from the belt tension lever (7).
5. Support the PTO shaft assembly (4) to prevent from falling.
6. Remove the nuts (39), washers (40 and 41) and bolts (42) that secures the PTO shaft assembly (4) to the chassis. Carefully remove the PTO shaft assembly (4) from the machine.
7. Disassemble the PTO shaft assembly; refer to Disassembling the PTO Shaft Assembly (page 8–24).

Installing the PTO Shaft Assembly

1. If disassembled, assemble the PTO shaft assembly; refer to Assembling the PTO Shaft Assembly (page 8–25).
2. Carefully position the PTO shaft assembly (4) onto the chassis.
3. Secure the PTO shaft assembly (4) onto the chassis with bolts (42), washers (41 and 40) and nuts (39).
4. Position the fork (31) onto the belt tension lever (7) and secure with the pin (33) and cotter pin (32).
5. Install the PTO drive belt to the machine; refer to *Operator's Manual*.
6. If necessary, adjust the PTO clutch gap; refer to *Operator's Manual*.
7. Check and adjust the PTO belt tension; refer to *Operator's Manual*.
8. Install the PTO driveshaft to machine; refer to Installing the PTO Driveshaft (page 8–19).

Servicing the PTO Shaft Assembly

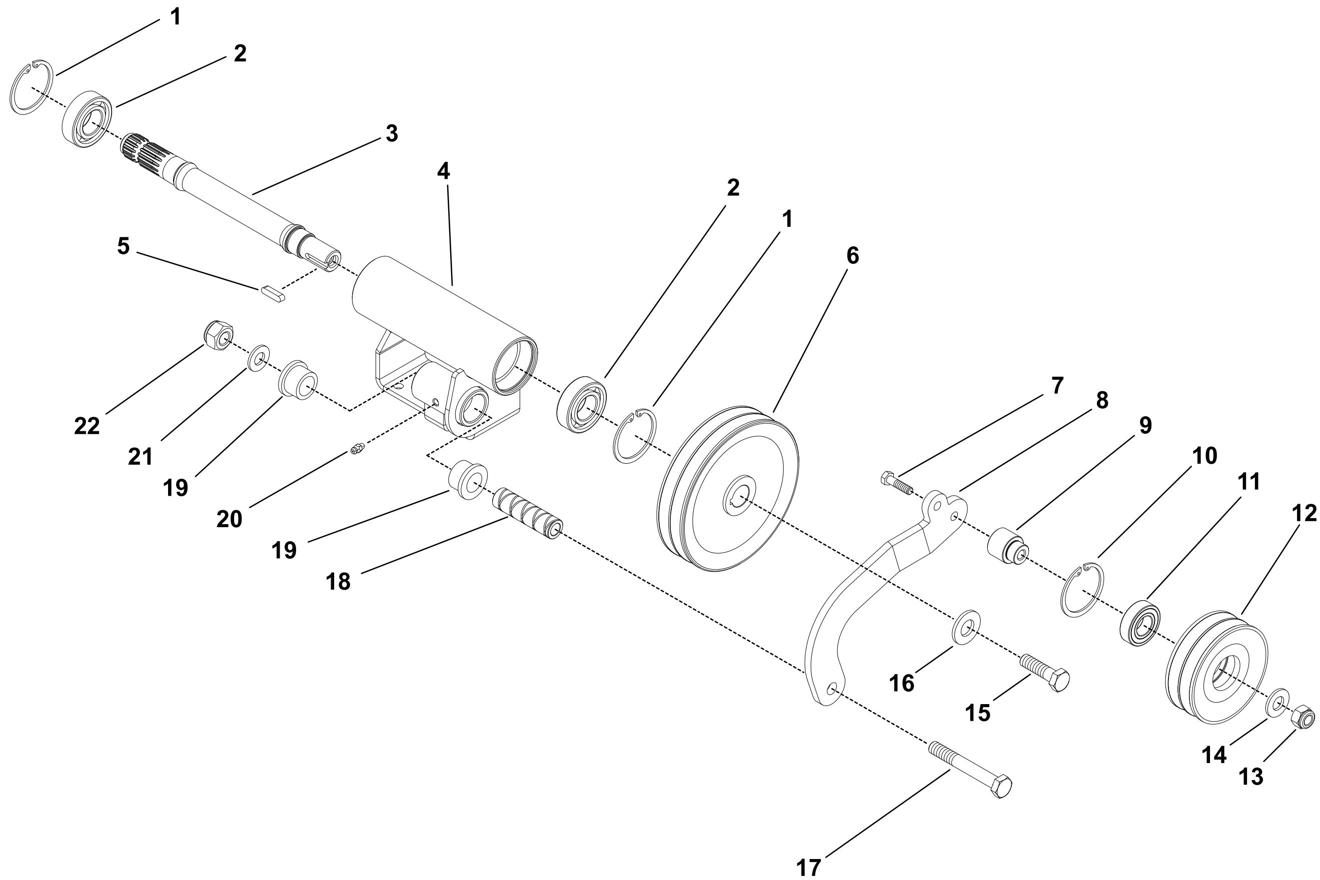

Figure 168

1.	Retaining ring	9.	Bushing	17.	Bolt
2.	Ball bearing	10.	Retaining ring	18.	Pin
3.	Shaft	11.	Bearing	19.	Flange bushing
4.	Dust flange	12.	Pulley	20.	Grease fitting
5.	Shaft key	13.	Nut	21.	Washer
6.	Pulley	14.	Washer	22.	Nut
7.	Bolt	15.	Bolt		
8.	Belt tension lever	16.	Washer		

Disassembling the PTO Shaft Assembly

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake and remove the key from the key switch.
2. Remove the PTO shaft assembly from the machine; refer to Removing the PTO Shaft Assembly (page 8–23).
3. Remove the bolt (15) and washer (16) that secures the pulley (6) to the PTO shaft (3). Use a puller and remove the pulley (6) from the PTO shaft (3).
4. Locate and retrieve the shaft key (5).
5. Remove the nut (13), washer (14) and bolt (7) that secures the pulley (12) to the belt tension lever (8). Separate the pulley assembly from the belt tension lever.
6. Remove the retaining ring (10) that secures the bearing (11) to the pulley (12). Use a press to remove the bushing (9) and bearing (11) from the pulley (12). Discard the bearing (11).

Disassembling the PTO Shaft Assembly (continued)

7. Remove the bolt (17), nut (22) and washer (21) that secures the belt tension lever (8) to the dust flange (4). Remove the belt tension lever from the dust flange.
8. Remove the retaining rings (1) that secures the bearings (2) and shaft (3) into the dust flange (4).
9. Use a press to remove the bearings (2) and PTO shaft (3) from the dust flange (4).
10. Use a press to remove the pin (18) and flange bushings (19) from the dust flange (4).
11. If required, remove the grease fitting (20) from the dust flange (4).
12. Clean the PTO shaft (3) and dust flange (4).
13. Inspect the PTO shaft (3) and dust flange (4) for wear, pitting or other noticeable damage. Replace the parts that are worn or damaged.

Assembling the PTO Shaft Assembly

1. Apply a coat of grease to inner surfaces of bushings (19) and outer surface of the pin (18).
2. Use a press and install the bushings (19) and pin (18) into the dust flange (4). If removed, install the grease fitting (20) to the dust flange (4).
3. Apply anti-seize lubricant to the PTO shaft. Use a press and install the bearings (2) and PTO shaft (3) into the dust flange (4). Secure the bearings (2) with the 2 retaining rings (1).
4. Install the belt tension lever (8) onto the dust flange (4) and secure with the bolt (17), washer (21) and nut (22).
5. Position the shaft key (5) onto the PTO shaft slot. Install the pulley (6) onto the PTO shaft (3) and secure with the washer (16) and bolt (15).
6. Use a press and install the bearing (11) and bushing (9) into the pulley (12).
7. Install the pulley (12) onto the belt tension lever (8) and secure with the bolt (7), washer (14) and nut (13).
8. Install the PTO shaft assembly onto the machine; refer to Installing the PTO Shaft Assembly (page 8–23).

Servicing the Gearbox Assembly

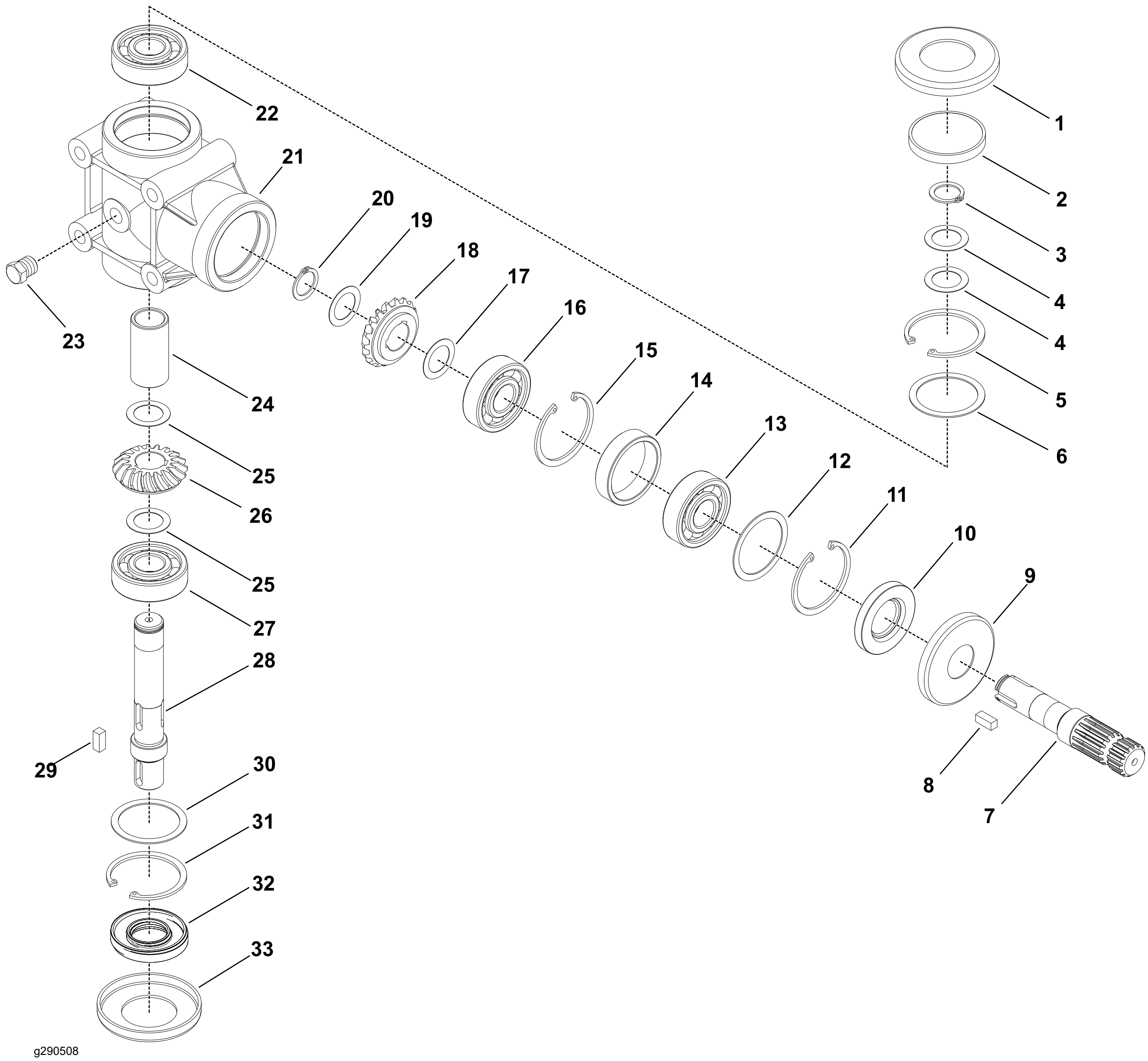

Figure 169

1. Cover
2. Cap
3. Retaining ring
4. Spacer
5. Retaining ring
6. Spacer
7. Shaft
8. Shaft key
9. Cover
10. Seal
11. Retaining ring
12. Spacer
13. Bearing
14. Spacer
15. Retaining ring
16. Bearing
17. Spacer
18. Gear
19. Spacer
20. Retaining ring
21. Gearbox housing
22. Bearing
23. Plug
24. Spacer
25. Spacer
26. Gear
27. Bearing
28. Shaft
29. Shaft key
30. Spacer
31. Retaining ring
32. Cap
33. Cover

Note: For removing and installing the gearbox from the machine, refer to the *Operator's Manual*.

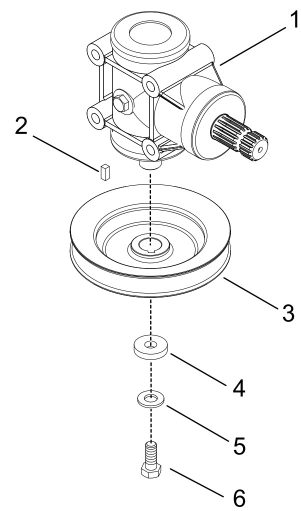

Figure 170

1. Gearbox assembly
2. Shaft key
3. Pulley
4. Spacer
5. Washer
6. Bolt

Remove the bolt (6) and washer (5) that secures the pulley (3) to the gearbox (1). Use a puller and remove the pulley (3) and spacer (4) from the gearbox (1).

Locate and retrieve the shaft key (2).

Disassembling the Gearbox

1. Remove the plug (23) and drain the gearbox oil from the gearbox assembly.
2. Remove the cover (1) and cap (2) from the gearbox assembly.
3. Remove the retaining ring (3) and 2 spacers (4) from the shaft (28).
4. Remove the retaining ring (5) and spacer (6) from the gearbox assembly.
5. Remove the cover (33) and cap (32) from the gearbox assembly.
6. Remove the retaining ring (31) and spacer (30) from the gearbox assembly.
7. Use a press and remove the shaft (28) with bearing (27), 2 spacers (25), gear (26) and spacer (24) from the gearbox assembly.
8. Use press and remove the spacer (24), gear (26), 2 spacers (25) and bearing (27) from the shaft (28).
9. Locate and retrieve the shaft key (29).
10. Use a press and remove the bearing (22) from the gearbox assembly.
11. Remove the cover (9) and seal (10) from the gearbox assembly.
12. Remove the retaining ring (11) and spacer (12) from the gearbox assembly.
13. Remove the retaining ring (20) from the shaft (7).
14. Use a press and remove the shaft (7) from the gearbox assembly.
15. Remove the bearing (13) and spacer (14) from the gearbox assembly.
16. Remove the retaining ring (15), bearing (16), spacer (17), gear (18) and spacer (19) from the gearbox assembly.
17. Locate and retrieve the shaft key (8).
18. Discard the bearings, seals, caps and covers of the gearbox assembly.
19. Clean the gearbox components and inspect for wear or damage. Replace the components that are worn or damaged.

Assembling the Gearbox

1. Position the spacer (19), gear (18), spacer (17), new bearing (16) and retaining ring (15) into the gearbox housing (21).
2. Install the spacer (14) and bearing (13) into the gearbox housing (21).
3. Install the shaft (7) into the gearbox housing (21).
4. Position the shaft key (8) into the key hole between the shaft (7) and gear (18) and secure the shaft key (8) with the retaining ring (20).
5. Install the spacer (12) and retaining ring (11) into the gearbox housing (21).
6. Install the new seal (10) and cover (9) onto the gearbox housing (21).
7. Install the new bearing (27) and spacer (25) onto the shaft (28).
8. Position the shaft key (29) into the key hole of the shaft (28).
9. Slide the gear (26) onto the shaft (28) and make sure the shaft key (29) is properly seated into the gear (26) key hole.
10. Slide the spacers (25 and 24) onto the shaft (28).
11. Slowly insert the shaft (28) assembly into the gearbox housing (21). Make sure that the gears (18 and 26) are properly seated.
12. Install the spacer (30) and retaining ring (31) into the gearbox housing (21).
13. Install the bearing (22), spacer (6) and retaining ring (5) into the gearbox housing (21).
14. Slide the 2 spacers (4) onto the shaft (28) and secure with the retaining ring (3).
15. Install the new caps (2 and 32) and new covers (1 and 33) onto the gearbox housing (21).
16. Fill the gearbox with the gearbox oil; refer to *Operator's Manual*.

Hopper Assembly

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.

Service and Repairs

Hopper Assembly

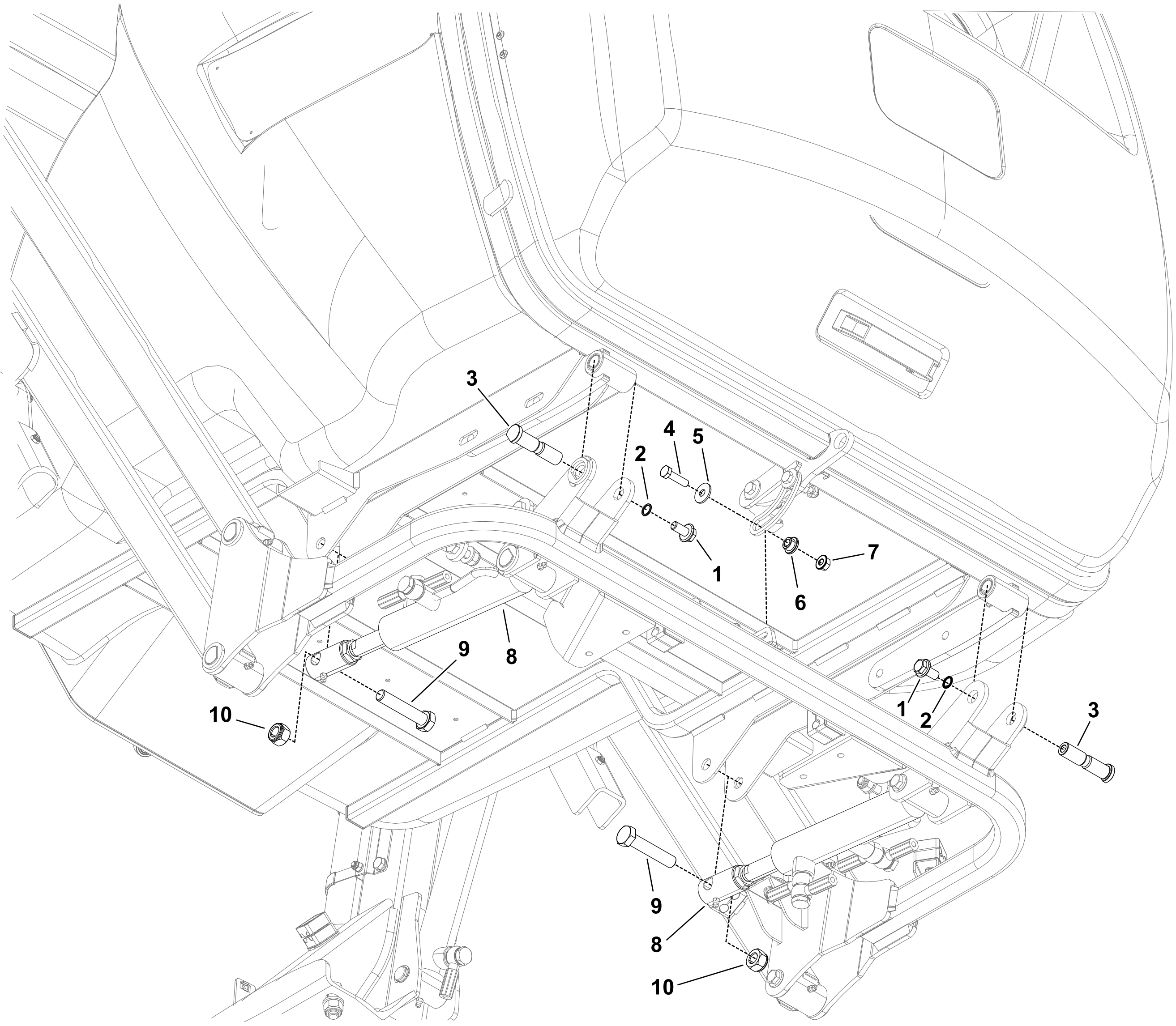

Figure 171

1. Bolt	5. Washer	9. Bolt
2. Washer	6. Flange bushing	10. Nut
3. Pin	7. Nut	
4. Bolt	8. Hydraulic cylinder	

Removing the Hopper Assembly

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake and remove the key from the key switch.
2. Disconnect the hopper micro switch connector from the machine wire harness.
3. Support the hydraulic actuators (8) before loosening the mounting fasteners.
4. Remove the nut (10) and bolt (9) that secures the hydraulic cylinder to the hopper assembly.

Removing the Hopper Assembly (continued)

5. Remove the bolt (1) and washer (2) that secures the pin (3) to the machine frame.
6. Support the hopper assembly before removing the pin (8).
7. Slide and remove the pin (3) that secures the hopper assembly to the machine frame.

   Note: Two people are required to lift the hopper assembly from the machine.
8. Lift and remove the hopper assembly from the machine.
9. If required, disassemble the hopper frame assembly as required; refer to Disassembling the Hopper Frame Assembly (page 9–7).

Installing the Hopper Assembly

1. If disassembled, assemble the hopper frame assembly; refer to the Assembling the Hopper Frame Assembly (page 9–7).
2. Position the hopper assembly onto the machine. Make sure that the hopper assembly is properly seated in its position to attach with the fasteners.
3. Apply a coat of grease to the pin (3).
4. Slide the pin (3) and secure the hopper assembly to the machine frame.
5. Secure the pin (3) with the washer (2) and bolt (1).
6. Position the hydraulic cylinders (8) onto the hopper assembly and secure with the bolt (9) and nut (10).
7. Connect the hopper micro switch connector to the machine wire harness connector.
8. Check and align the hopper assembly to the chute seal; refer to *Operator's Manual*.
9. Lubricate the grease fittings; refer to *Operator's Manual*.
10. Check for correct operation of the hopper assembly and adjust the hopper assembly sensor; refer to *Operator's Manual*.

Hopper Frame Assembly

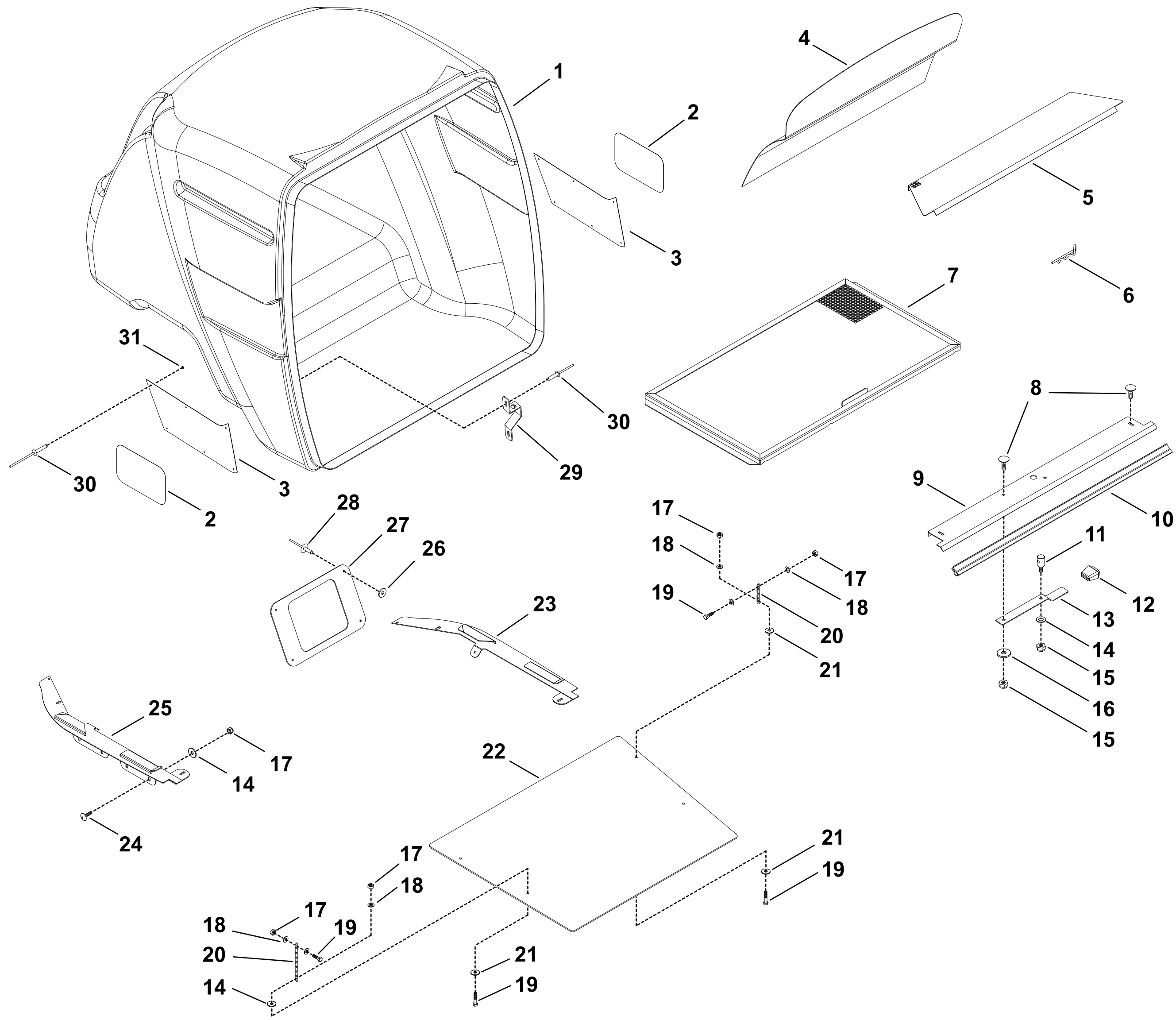

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Figure 172

1. Hopper assembly
2. Decal
3. Decal support
4. Front grass catcher screen
5. Grass catcher screen
6. Spring pin
7. Inside grass catcher screen
8. Carriage bolt
9. Cross rail
10. Hopper screen gasket
11. Pin
12. Knob
13. Hook
14. Washer
15. Nut
16. Washer
17. Nut
18. Washer
19. Bolt
20. Chain
21. Washer
22. Grass catcher plastic panel
23. Support
24. Screw
25. Guide
26. Washer
27. Plate
28. Rivet
29. Bracket
30. Rivet
31. Washer

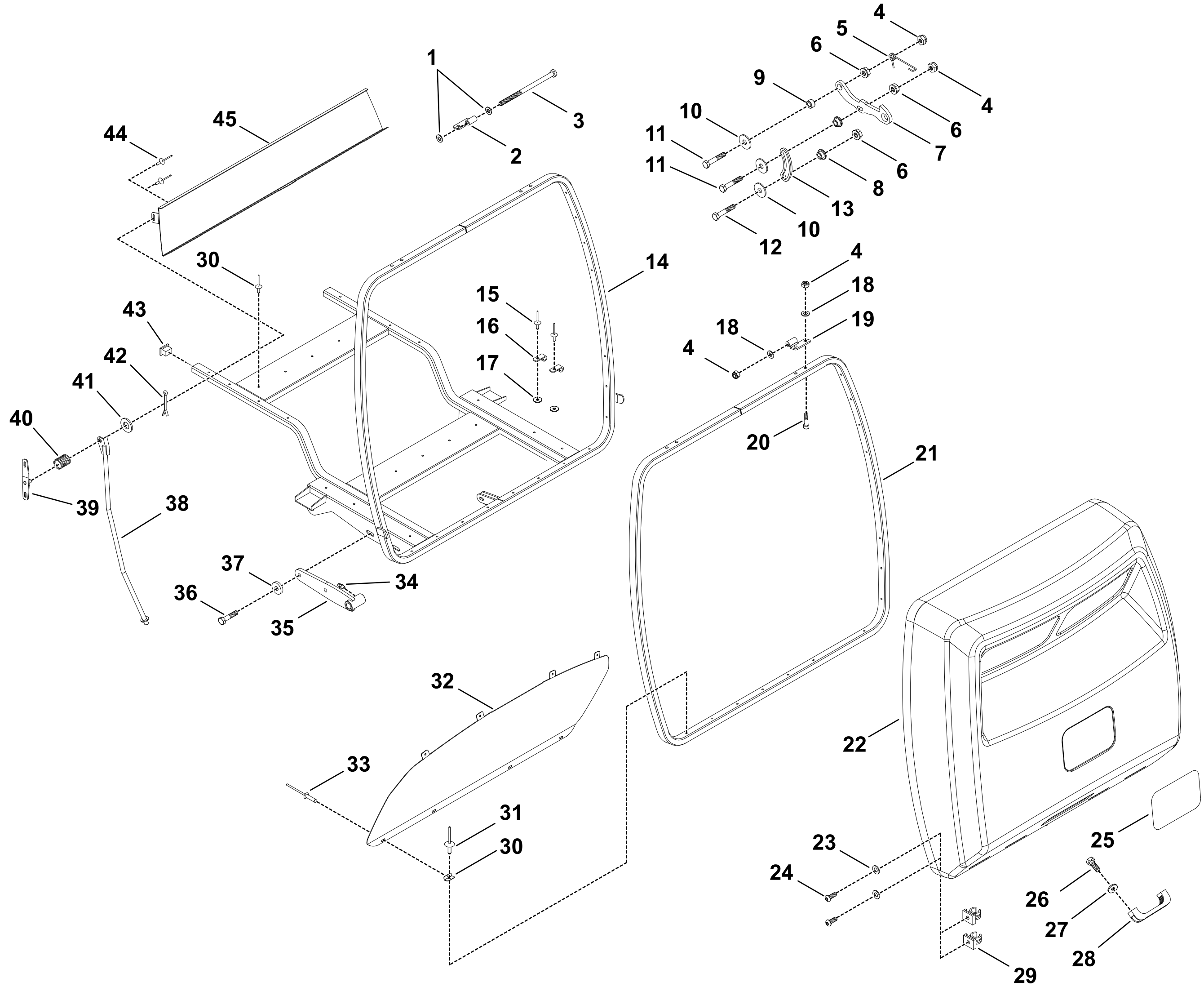


Figure 173

1.	Washer	16.	Grommet	31.	Rivet
2.	Hinge	17.	Washer	32.	Plate
3.	Bolt	18.	Washer	33.	Rivet
4.	Nut	19.	Hinge	34.	Grease fitting
5.	Spring	20.	Socket head screw	35.	Hinge
6.	Nut	21.	Frame	36.	Bolt
7.	Hook	22.	Hopper cover	37.	Washer
8.	Flange bushing	23.	Washer	38.	Rod
9.	Spacer	24.	Screw	39.	Support
10.	Washer	25.	Decal	40.	Spring
11.	Bolt	26.	Screw	41.	Washer
12.	Bolt	27.	Washer	42.	Split pin
13.	Connecting rod	28.	Handle	43.	Plastic cap
14.	Frame	29.	Collar	44.	Rivet
15.	Rivet	30.	Bracket	45.	Grass catcher screen

Disassembling the Hopper Frame Assembly

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake and remove the key from the key switch.
2. Remove the hopper assembly from the machine; refer to Removing the Hopper Assembly (page 9–3).
3. Disassemble the hopper frame assembly using the Figure 172 and Figure 173 as a guide.
4. If required, disassemble the hopper; refer to Disassembling the Hopper (page 9–9).

Assembling the Hopper Frame Assembly

1. If disassembled, assemble the hopper; refer to Assembling the Hopper (page 9–9).
2. Assemble the hopper frame assembly using the Figure 172 and Figure 173 as a guide.
3. Install the hopper assembly onto the machine frame; refer to Installing the Hopper Assembly (page 9–4).
4. Check and align the hopper assembly to the chute seal; refer to *Operator's Manual*.
5. Lubricate the grease fittings; refer to *Operator's Manual*.
6. Check for correct operation of the hopper assembly and adjust the hopper assembly sensor; refer to *Operator's Manual*.

Hopper

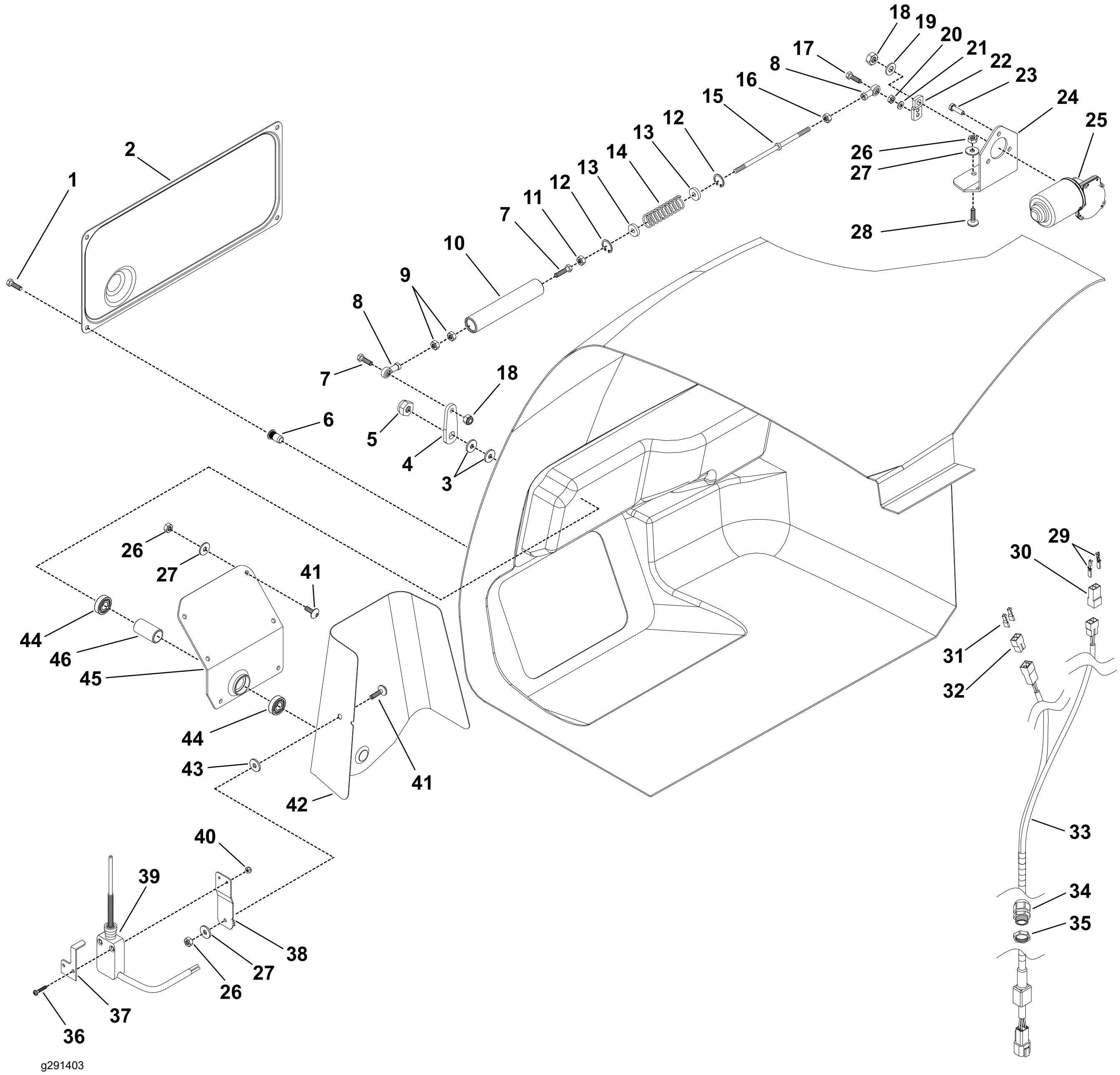


Figure 174

1. Bolt
2. Cover
3. Spacer
4. Bracket
5. Nut
6. Thread insert
7. Bolt
8. Eye end
9. Nut
10. Body
11. Nut
12. Retaining ring
13. Washer
14. Spring
15. Rod
16. Nut
17. Bolt
18. Nut
19. Washer
20. Nut
21. Washer
22. Connecting rod
23. Bolt
24. Support
25. Motor
26. Nut
27. Washer
28. Screw
29. Connector pin
30. Connector
31. Connector pin
32. Connector
33. Wire harness
34. Union fitting
35. Plastic nut
36. Screw
37. Bracket
38. Sensor support
39. Microswitch
40. Nut
41. Screw
42. Manifold
43. Washer
44. Bearing
45. Spreader support
46. Spacer

Disassembling the Hopper

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake and remove the key from the key switch.
2. Remove the hopper assembly from the machine; refer to Removing the Hopper Assembly (page 9–3).
3. Disassemble the hopper using the Figure 174 as a guide.
4. Note the location of the electrical connectors for assembly purposes.

Assembling the Hopper

1. Assemble the hopper using the Figure 174 as a guide.
2. Connect the electrical connectors as noted during the disassembly.
3. Install the hopper assembly onto the machine frame; refer to Installing the Hopper Assembly (page 9–4).
4. Check and align the hopper assembly to the chute seal; refer to *Operator's Manual*.
5. Lubricate the grease fittings; refer to *Operator's Manual*.
6. Check for correct operation of the hopper assembly and adjust the hopper assembly sensor; refer to *Operator's Manual*.

Hopper Lift Frame Assembly

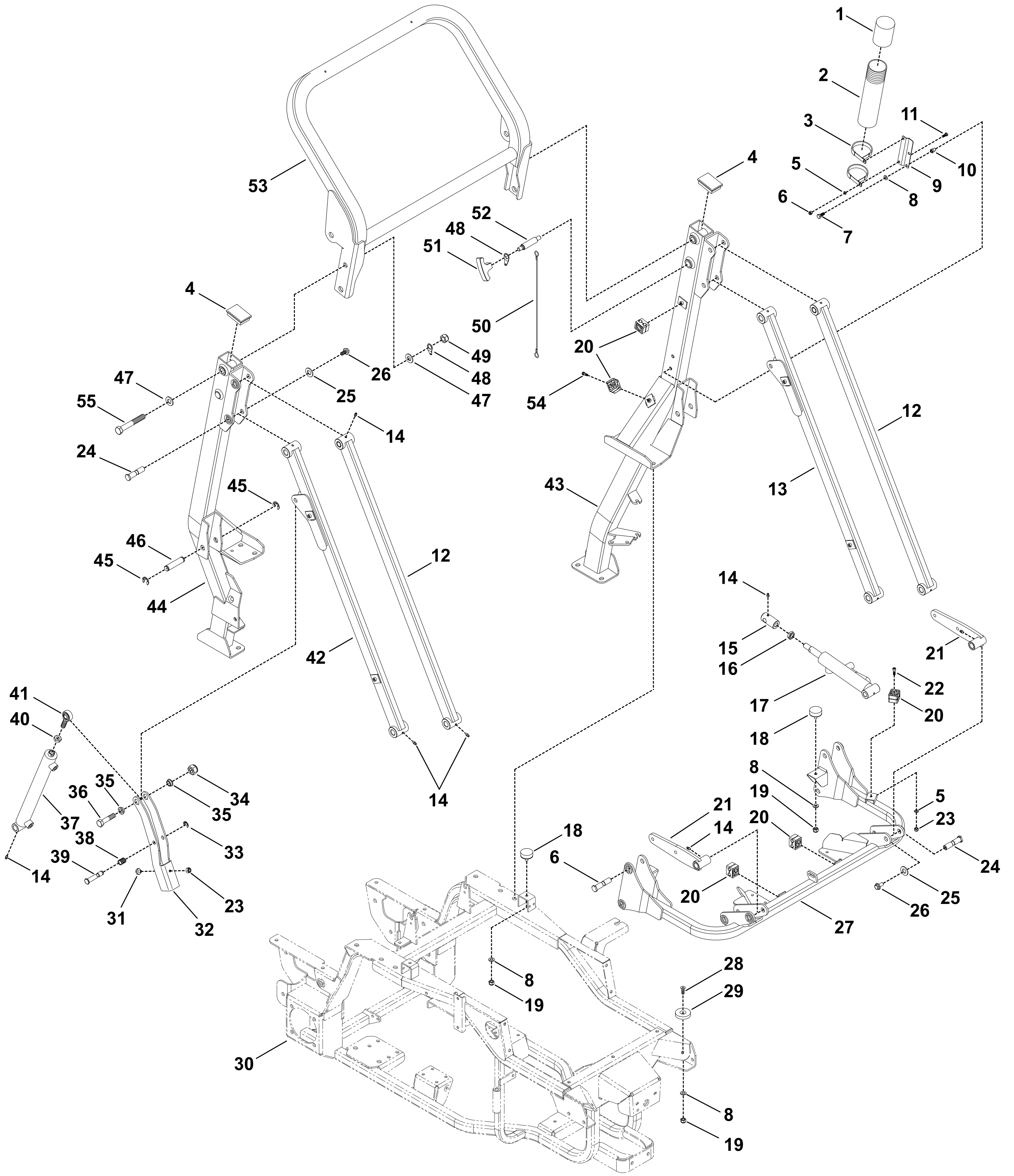


Figure 175

Figure 175 (continued)

1.	Tube cap	20.	Collar	39.	Pin
2.	Tube	21.	Hopper hinge	40.	Nut
3.	Clamp	22.	Socket head screw	41.	Ball joint
4.	Cap	23.	Nut	42.	Arm
5.	Washer	24.	Pin	43.	RH Bracket
6.	Nut	25.	Washer	44.	LH Bracket
7.	Bolt	26.	Bolt	45.	Snap ring
8.	Washer	27.	Support frame	46.	Pin
9.	Bracket	28.	Screw	47.	Washer
10.	Thread insert	29.	Support	48.	Plate
11.	Bolt	30.	Chassis	49.	Nut
12.	Arm	31.	Magnet	50.	Cable
13.	Arm	32.	Safety handle	51.	Knob
14.	Grease fitting	33.	Snap ring	52.	Pin
15.	Support	34.	Nut	53.	Roll bar
16.	Nut	35.	Bushing	54.	Socket head screw
17.	Hydraulic cylinder	36.	Bolt	55.	Bolt
18.	Rubber pad	37.	Hydraulic cylinder		
19.	Nut	38.	Spring		

Disassembling the Hopper Lift Frame Assembly

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake and remove the key from the key switch.
2. Remove the hopper assembly from the machine; refer to Removing the Hopper Assembly (page 9–3).
3. For assembly purposes, tag the hydraulic hoses to show their correct position on the hydraulic cylinders.
4. Disconnect the hydraulic hoses from the hydraulic cylinders. Install the clean caps or plugs on the hydraulic hoses and fittings to prevent hydraulic system contamination.
5. Disassemble the hopper lift frame assembly using the Figure 175 and Figure 176 as a guide.

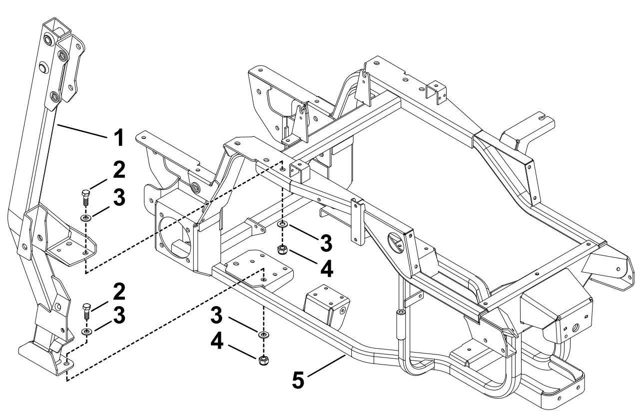


Figure 176

1. LH Bracket
2. Bolt
3. Washer
4. Nut
5. Chassis

Assembling the Hopper Lift Frame Assembly

1. Clean the pin (24). Inspect the pin (24) for wear or damage and replace if necessary.
2. Assemble the hopper lift frame assembly using the Figure 175 and Figure 176 as a guide.
3. Remove the caps or plugs that were installed to the hydraulic hoses and fitting during the disassembly process.
4. Use the tags that marked during disassembly to correctly connect the hydraulic hoses to the hydraulic cylinders.
5. Install the hopper assembly onto the machine frame; refer to Installing the Hopper Assembly (page 9–4).
6. Check and align the hopper assembly to the chute seal; refer to *Operator's Manual*.
7. Lubricate the grease fittings; refer to *Operator's Manual*.
8. Check the hydraulic fluid level in the hydraulic tank; refer to *Operator's Manual*.
9. Check for correct operation of the hopper lift frame assembly.
10. Check the hydraulic cylinder connections for leaks.

Chute Assembly

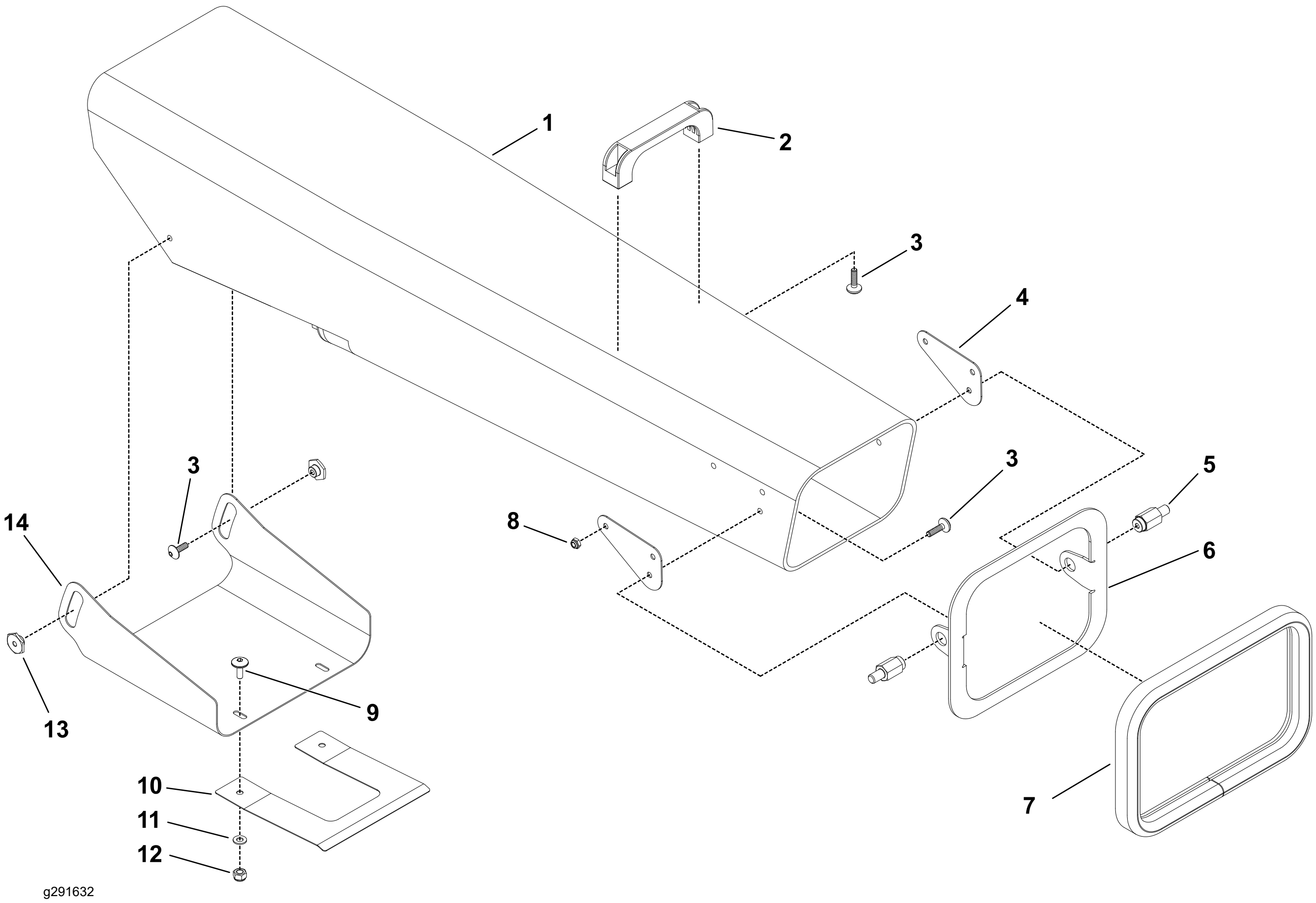


Figure 177

1. Chute	6. Bracket	11. Washer
2. Handle	7. Chute rubber seal	12. Nut
3. Screw	8. Nut	13. Pin
4. Bracket	9. Screw	14. Chute bracket
5. Pin	10. Plate	

Disassembling the Chute Assembly

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake and remove the key from the key switch.
2. Remove the chute assembly from the machine; refer to *Operator's Manual*.
3. Disassemble the chute assembly using the Figure 177 as a guide.

Assembling the Chute Assembly

1. Assemble the chute assembly using the Figure 177 as a guide.
2. Install the chute assembly onto the machine; refer to *Operator's Manual*.

Chapter 10

Cutting Unit

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.

Service and Repairs

WARNING

Do not start the engine and engage the PTO switch when the PTO driveshaft is disconnected from the cutting deck. If you start the engine and the PTO shaft is allowed to rotate, serious personal injury and machine damage could result.

If the PTO driveshaft is disconnected from the cutting deck, disconnect the PTO electric clutch electrical connector.

CAUTION

Do not work on the cutting deck or lift arms with the engine running.

Always shut off the engine and remove the key from the key switch before working on the cutting deck.

Idler Assembly

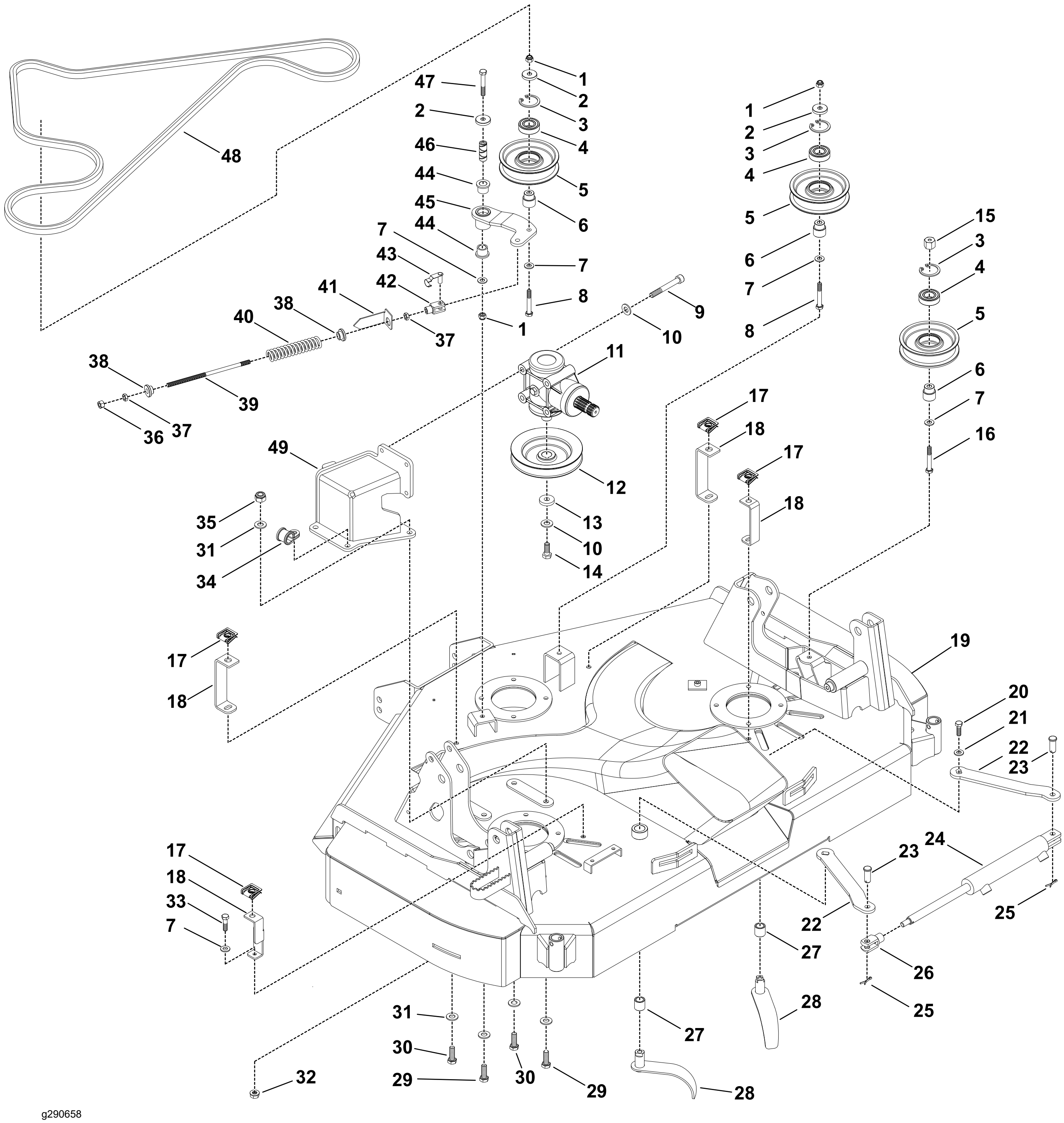


Figure 178

Figure 178 (continued)

1.	Nut	14.	Bolt	27.	Bronze bushing	40.	Spring
2.	Washer	15.	Nut	28.	Scraper	41.	Belt tension indicator
3.	Retaining ring	16.	Bolt	29.	Bolt	42.	Fork
4.	Bearing	17.	Plate nut	30.	Bolt	43.	Fork
5.	Pulley	18.	Bracket	31.	Washer	44.	Flange bushing
6.	Bushing	19.	Cutting deck fairing	32.	Nut	45.	Cutting deck belt tightener
7.	Washer	20.	Bolt	33.	Bolt	46.	Pin
8.	Bolt	21.	Washer	34.	Clamp	47.	Bolt
9.	Socket head screw	22.	Lever	35.	Nut	48.	Belt
10.	Washer	23.	Pin	36.	Nut	49.	Gearbox support
11.	Gearbox assembly	24.	hydraulic cylinder	37.	Nut		
12.	Pulley	25.	Split pin	38.	Bushing		
13.	Washer	26.	Fork	39.	Rod		

Removing the Idler Assembly

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Disconnect the PTO driveshaft from the cutting deck; refer to *Operator's Manual*.

CAUTION

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

Be careful when removing tension from the spring of the idler arm.

3. Remove the cutting deck belt from the cutting deck; refer to *Operator's Manual*.
4. Remove the idler assembly components as needed from the cutting deck using Figure 178 as a guide.
5. Note the location of the washers, spacers and bolts as idler assemblies are being removed.

Installing the Idler Assembly

1. Install the removed idler components onto the cutting deck using Figure 178 as a guide.
2. Make sure that the washers, spacers and bolts are properly placed with the idler assemblies.
3. Make sure that the idler assemblies are properly secured with the retaining rings.

CAUTION

Be careful when installing the idler spring. The spring is under heavy load and may cause personal injury.

4. Install the drive belt pulley; refer to *Operator's Manual*.
5. Lubricate the idler arm grease fitting; refer to *Operator's Manual*.

Installing the Idler Assembly (continued)

6. Attach the PTO driveshaft and install the cutting deck covers; refer to *Operator's Manual*.

Blade Spindle

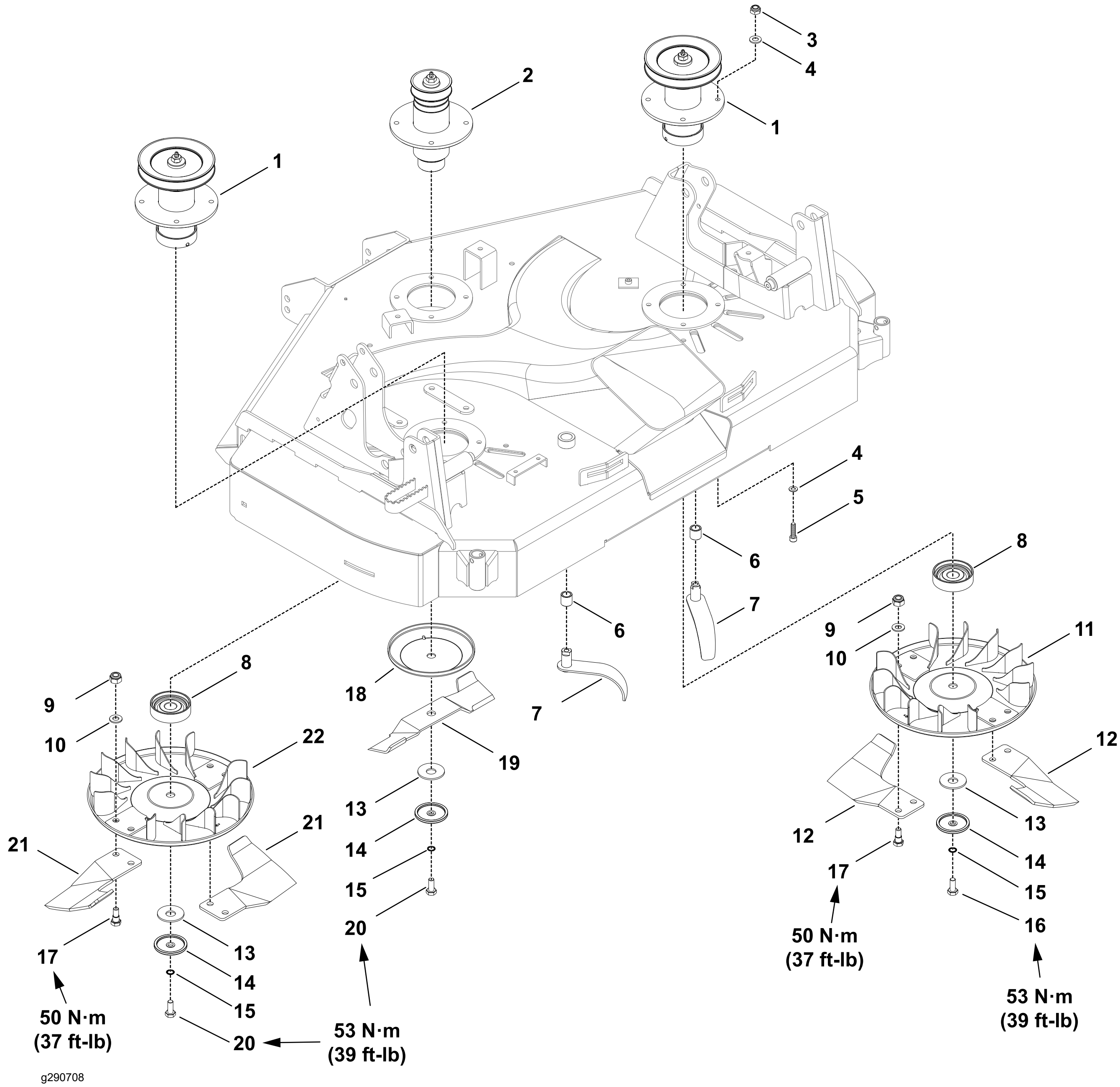


Figure 179

1. Blade spindle
2. Center blade spindle
3. Nut
4. Washer
5. Socket head screw
6. Bronze bushing
7. Scraper
8. Oil seal
9. Nut
10. Washer
11. RH blade disc
12. RH blade
13. Bevel washer
14. Cover
15. Washer
16. Bolt
17. Bolt
18. Central blade disc
19. Central blade
20. Bolt
21. LH blade
22. LH blade disc

Removing the Blade Spindle

1. Park the machine on a level surface, raise the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch. Support the cutting deck so that it cannot fall accidentally.
2. Remove the PTO driveshaft, belt covers and drive belt from the cutting deck; refer to *Operator's Manual*.
3. Remove the blade discs and cutting blades from the blade spindles; refer to *Operator's Manual*.
4. Remove the 4 socket head screws (5), washers (4) and nuts (3) that secures blade spindles to the cutting deck.
5. Lift and remove the blade spindles from the cutting deck.

Installing the Blade Spindle

1. Position the blade spindles onto the cutting deck.
2. Secure the blade spindles with the 4 socket head screws (5), washers (4) and nuts (3).
3. Install the blade discs and cutting blades onto the blade spindles; refer to *Operator's Manual*.
4. Slowly rotate the cutting blades to verify that the blades do not contact any deck components.
5. Install the drive belt onto the cutting deck and adjust the drive belt tension; refer to *Operator's Manual*.

IMPORTANT

A pneumatic grease gun can produce high pressure inside the spindle housing that can damage the spindle seals. Thus, do not use a pneumatic grease gun for greasing of the spindle housings.

6. Attach a hand pump grease gun to grease fitting on spindle housing and fill housing cavity with grease until grease starts to come out of lower seal; refer to *Operator's Manual*.
7. Install the covers and PTO drive shaft onto the cutting deck; refer to *Operator's Manual*.

Servicing the Blade Spindle

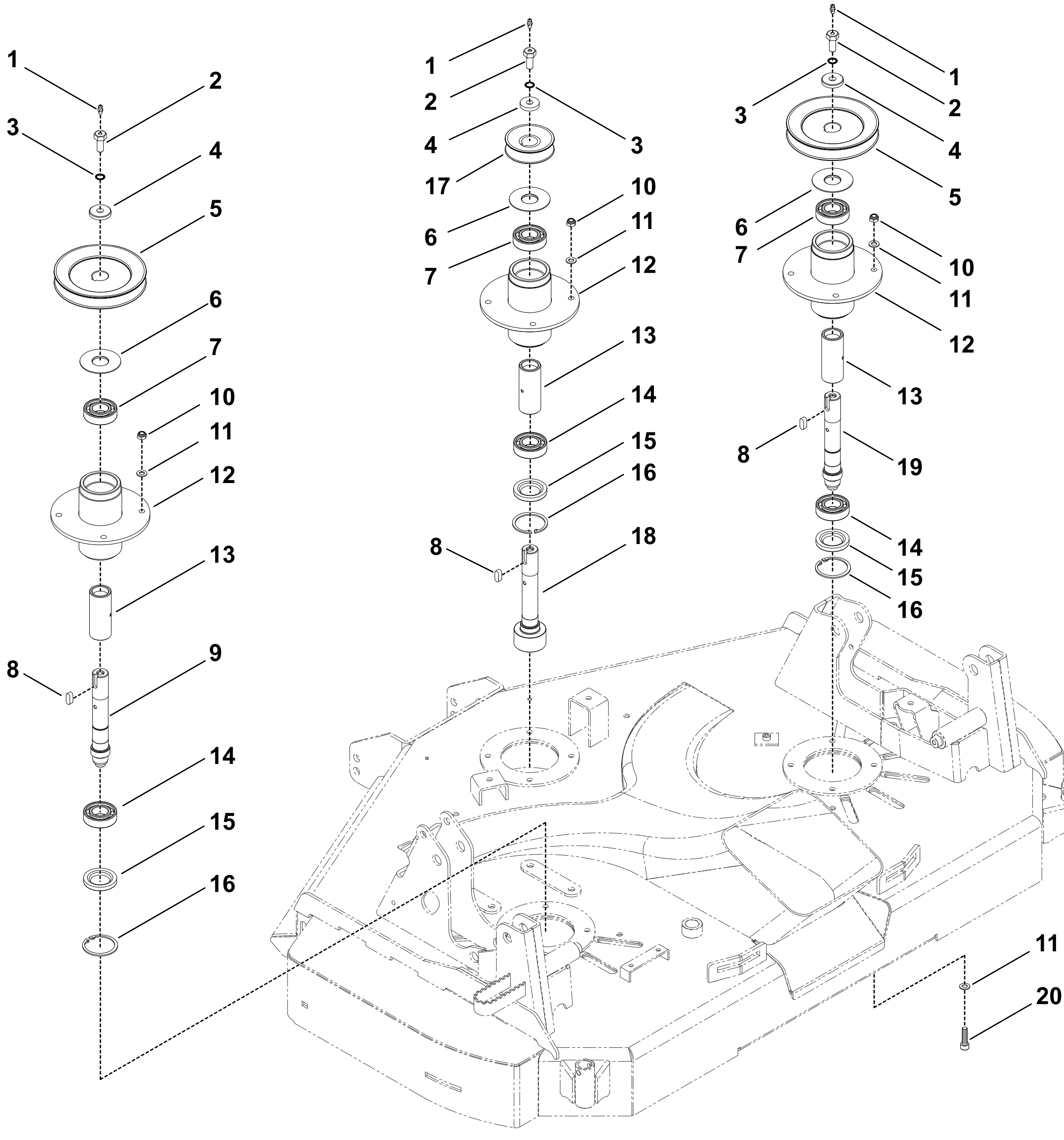


Figure 180

1. Grease fitting
2. Bolt
3. Seal
4. Thrust washer
5. Pulley
6. Cover
7. Bearing
8. Shaft key
9. LH spindle shaft
10. Nut
11. Washer
12. Spindle hub
13. Spacer
14. Bearing
15. Oil seal
16. Retaining ring
17. Pulley
18. Center spindle shaft
19. RH spindle shaft
20. Socket head screw

Disassembling the Blade Spindle

1. Remove the grease fitting (1) from the bolt (2).
2. Remove the bolt (2), seal (3) and thrust washer (4) that secures the pulley (5 or 17) to the spindle shaft.
3. Slide and remove the pulley from the spindle shaft.
4. Locate and retrieve the shaft key (8).
5. Remove the cover (6) from the spindle hub.

Disassembling the Blade Spindle (continued)

6. Remove the retaining ring (16) and oil seal (15) from the spindle hub.
7. Use a press to remove the spindle shaft from the spindle hub.
8. Use a press and carefully remove the bearings (7 and 14) and spacer (13) from the spindle hub.
9. Thoroughly clean the parts and inspect for any damage or wear. Replace the components as necessary.

Assembling the Blade Spindle

1. Inspect the spindle shaft and spacer (13) to make sure that there are no burrs or nicks that could possibly damage the oil seals.
2. Lubricate the spindle shaft, spacer and bearings with grease.
3. Slide the bearing (14) and spacer (13) onto the spindle shaft.
4. Use a press to install the spindle shaft into the spindle hub.
5. Use a press and slide the bearing (7) into the spindle hub. Make sure that the bearings (7 and 14) are properly seated into the spindle hub.
6. Apply a coat of grease to the lips of the oil seal (15).

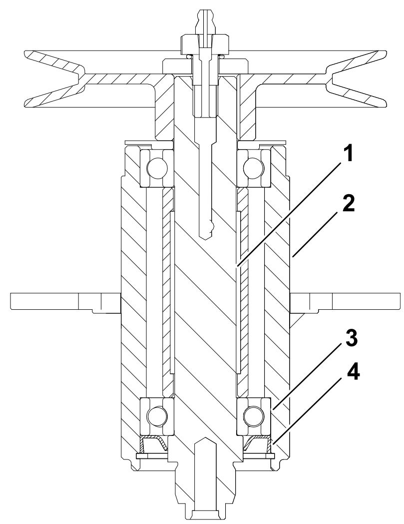


Figure 181

1. Spindle shaft
2. Spindle hub
3. Bearing
4. Oil seal

---

7. Install the oil seal (15) into the spindle hub.

   Note: The oil seal (15) must have the lip facing out (Figure 181).

8. Install the retaining ring (16) into the spindle hub.
9. Carefully position the cover (6) onto the spindle hub.
10. Position the shaft key (8) in the spindle shaft groove and slide the pulley. Make sure the shaft key (8) is properly seated in between the spindle shaft and pulley.
11. Secure the pulley (5 or 17) with the thrust washer (4), seal (3) and bolt (2).
12. Install the grease fitting (1) onto the bolt (2).

Assembling the Blade Spindle (continued)

IMPORTANT

Pneumatic grease guns can produce air pockets when filling large cavities and therefore, are not recommended to be used for proper greasing of spindle housings.

13. Attach a hand pump grease gun to grease fitting on housing and fill housing cavity with grease.
14. Rotate the spindle shaft to make sure that it turns freely.

Caster Wheel and Flat Frame Assembly

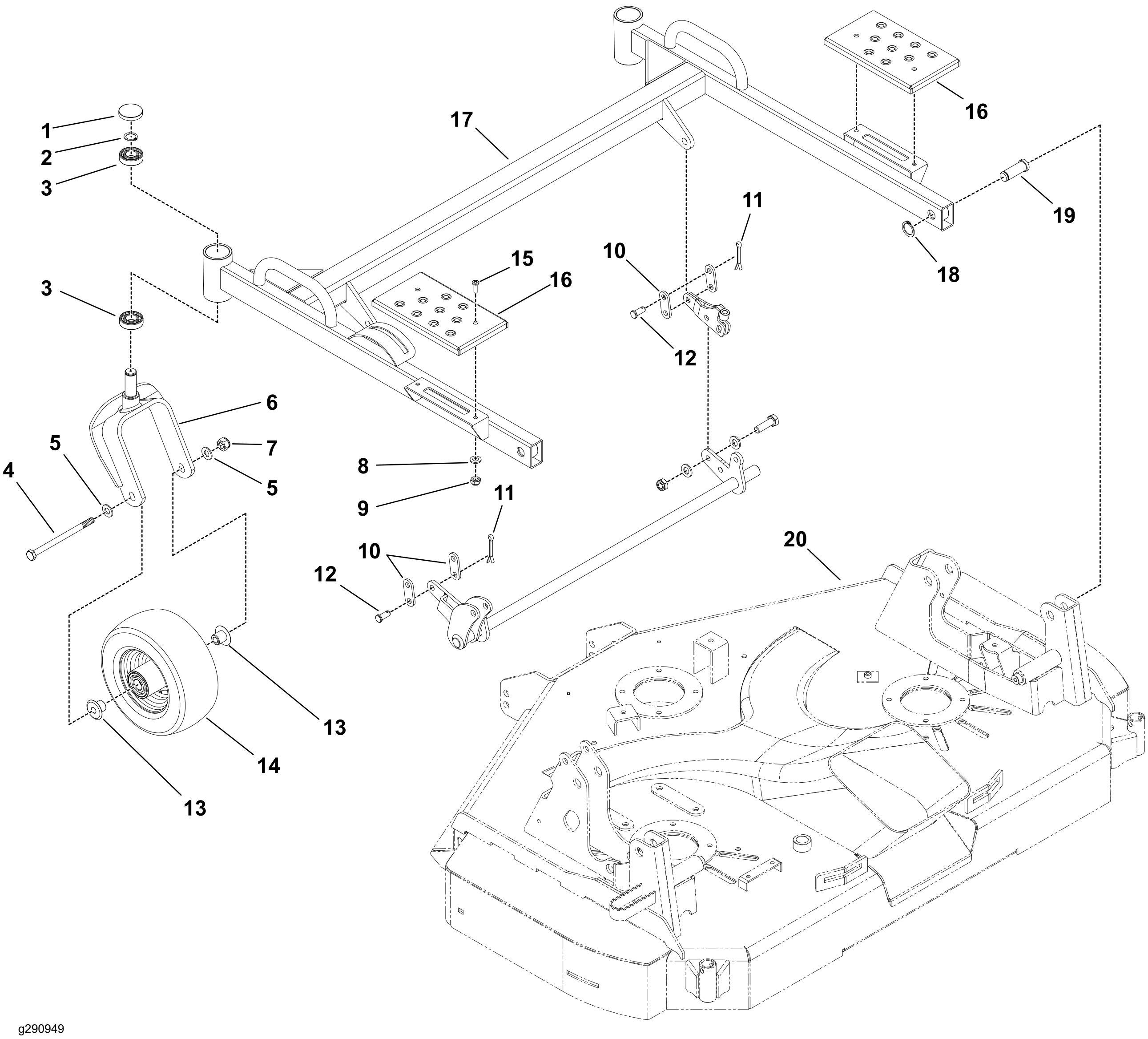


Figure 182

1. Cap
2. Retaining ring
3. Bearing
4. Bolt
5. Washer
6. Caster fork
7. Nut
8. Washer
9. Nut
10. Plate
11. Split pin
12. Pin
13. Flange bushing
14. Caster wheel
15. Bolt
16. Footrest
17. Flat frame assembly
18. Retaining ring
19. Pin
20. Cutting deck

Disassembling the Caster Wheel and Flat Frame Assembly

1. Park the machine on a level surface, raise the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Disassemble the caster wheel as needed using the Figure 182 as a guide.
3. Disassemble the flat frame assembly as needed using the Figure 182 as a guide.

Assembling the Caster Wheel and Flat Frame Assembly

1. Assemble the flat frame assembly using the Figure 182 as a guide.
2. Assemble the caster wheel using the Figure 182 as a guide.
3. Check and level the cutting deck; refer to *Operator's Manual*.

Cutting Deck Rollers and Skids

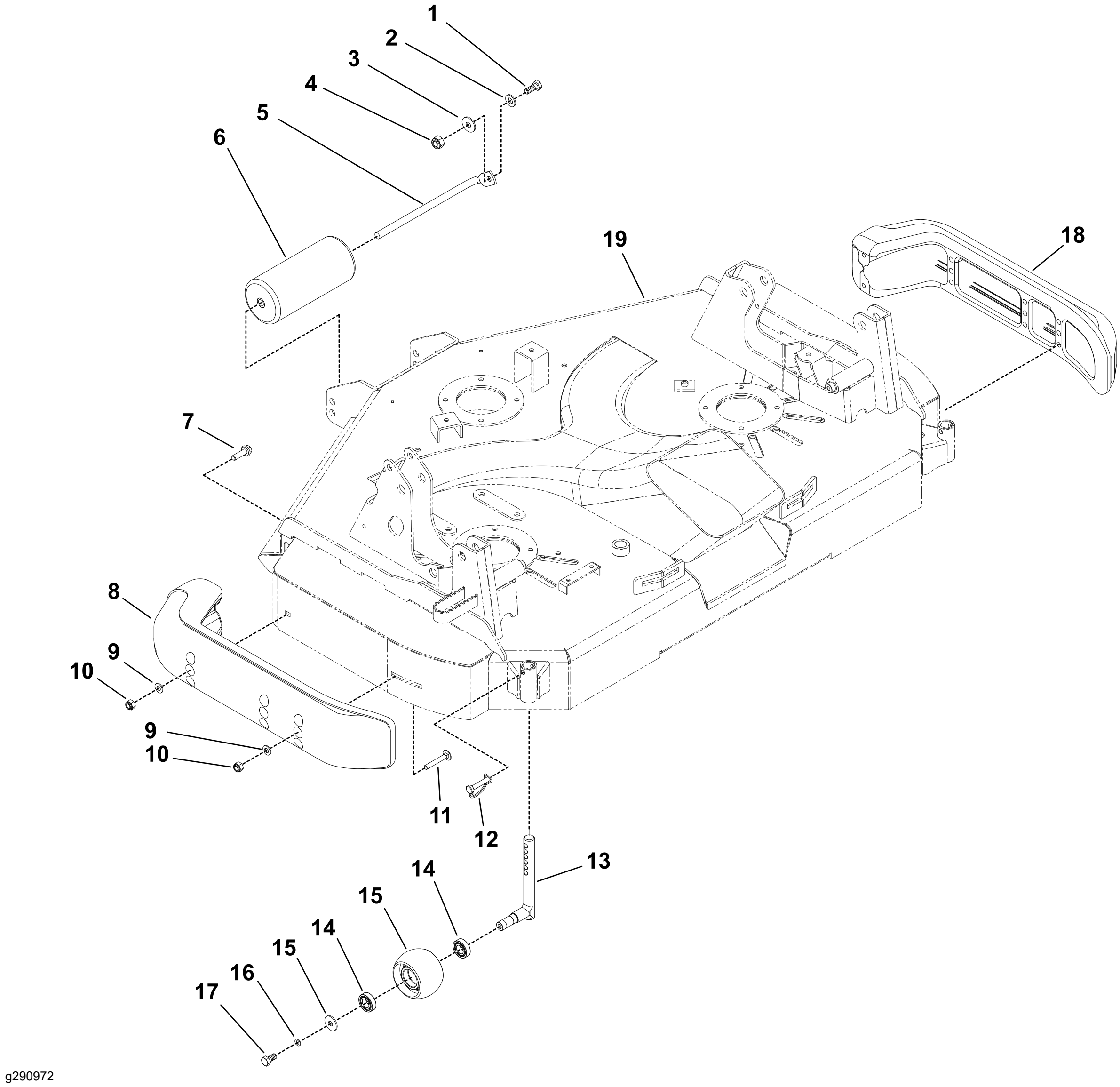


Figure 183

1.	Bolt	8.	LH skid	15.	Roller
2.	Washer	9.	Washer	16.	Washer
3.	Washer	10.	Nut	17.	Bolt
4.	Nut	11.	Carriage bolt	18.	RH skid
5.	Roller shaft	12.	Pin	19.	Cutting deck
6.	Roller	13.	Roller pin		
7.	Bolt	14.	Bearing		

Removing the Cutting Deck Rollers and Skids

1. Park the machine on a level surface, raise the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Remove the cutting deck rollers and skids from the cutting deck using the Figure 183 as a guide.

Installing the Cutting Deck Rollers and Skids

1. Install the skids to the cutting deck using the Figure 183 as a guide. Ensure to install the skids in the same mounting hole height position (lower or upper).

Installing the Cutting Deck Rollers and Skids (continued)

2. Install the cutting deck rollers to the cutting deck using the Figure 183 as a guide. Tighten the nut (4) until the roller will not rotate, then loosen the nut only enough to allow the roller to rotate freely. Ensure to install the cutting deck rollers in the same mounting hole height position (lower or upper).
3. Check and adjust the level of the cutting deck; refer to *Operator's Manual*.

Height Of Cut Linkage

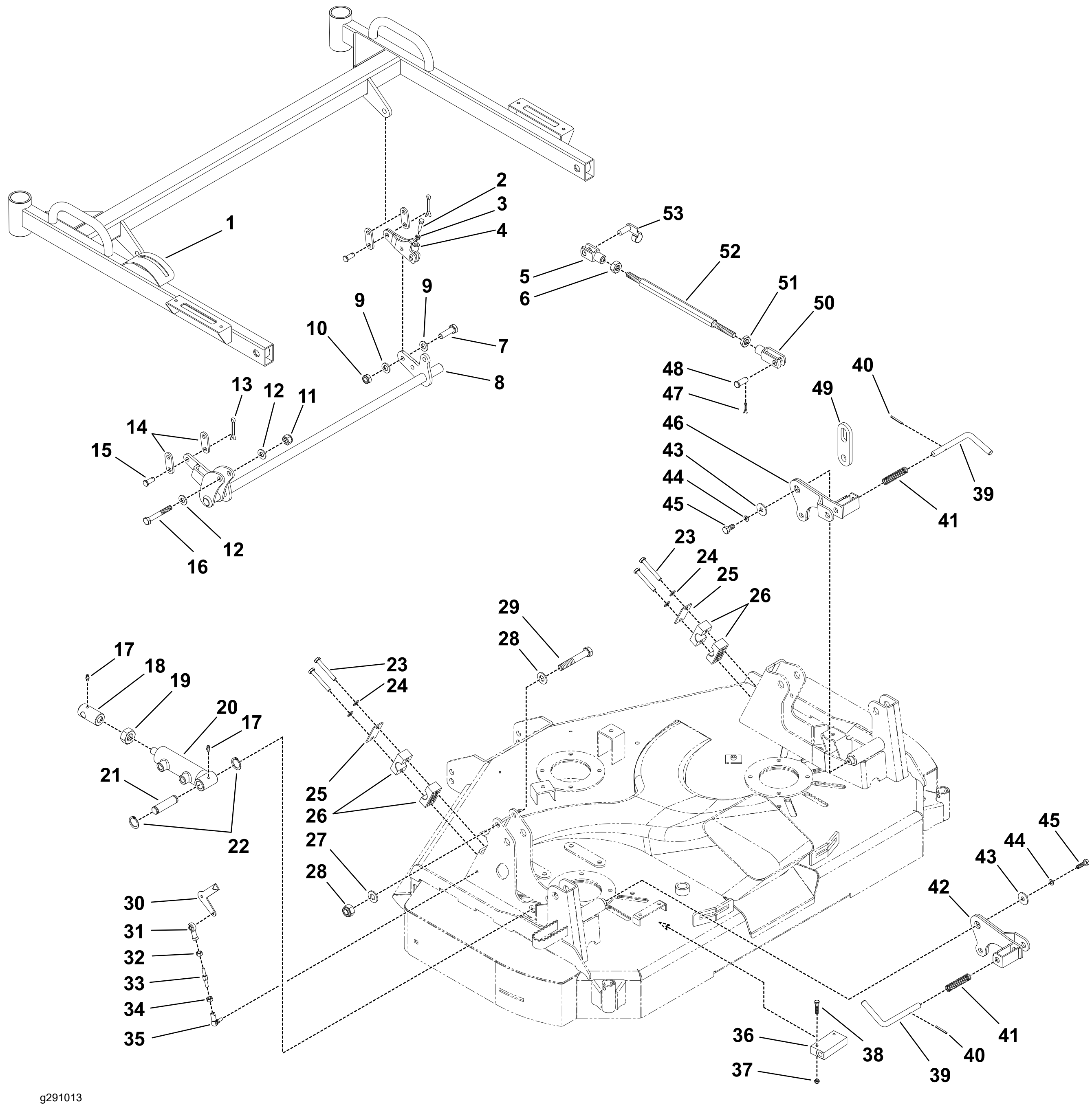


Figure 184

Figure 184 (continued)

1.	Frame	19.	Nut	37.	Nut
2.	Bolt	20.	Hydraulic cylinder	38.	Bolt
3.	Nut	21.	Pin	39.	Unhooking pin
4.	Bracket	22.	Retaining ring	40.	Pin
5.	Fork	23.	Bolt	41.	Spring
6.	Nut	24.	Washer	42.	Lever
7.	Bolt	25.	Plate	43.	Washer
8.	Bracket	26.	Block	44.	Washer
9.	Washer	27.	Washer	45.	Bolt
10.	Nut	28.	Nut	46.	Lever
11.	Nut	29.	Bolt	47.	Split pin
12.	Washer	30.	HOC indicator	48.	Pin
13.	Split pin	31.	Eye end	49.	Plate
14.	Plate	32.	Nut	50.	Fork
15.	Pin	33.	HOC rod	51.	Nut
16.	Bolt	34.	Nut	52.	Rod
17.	Grease fitting	35.	Articulation	53.	Clip
18.	Support	36.	Lock valve		

Removing the Height Of Cut Linkage

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Remove the Height Of Cut components from the cutting deck using the Figure 184 as a guide.

Assembling the Height Of Cut Linkage

1. Install the Height Of Cut components to the cutting deck using the Figure 184 as a guide.
2. Lubricate the grease fittings.
3. Check and adjust the level of the cutting deck; refer to *Operator's Manual*.
4. Check and adjust the Height Of Cut pointer; refer to *Operator's Manual*.

Cutting Deck Covers

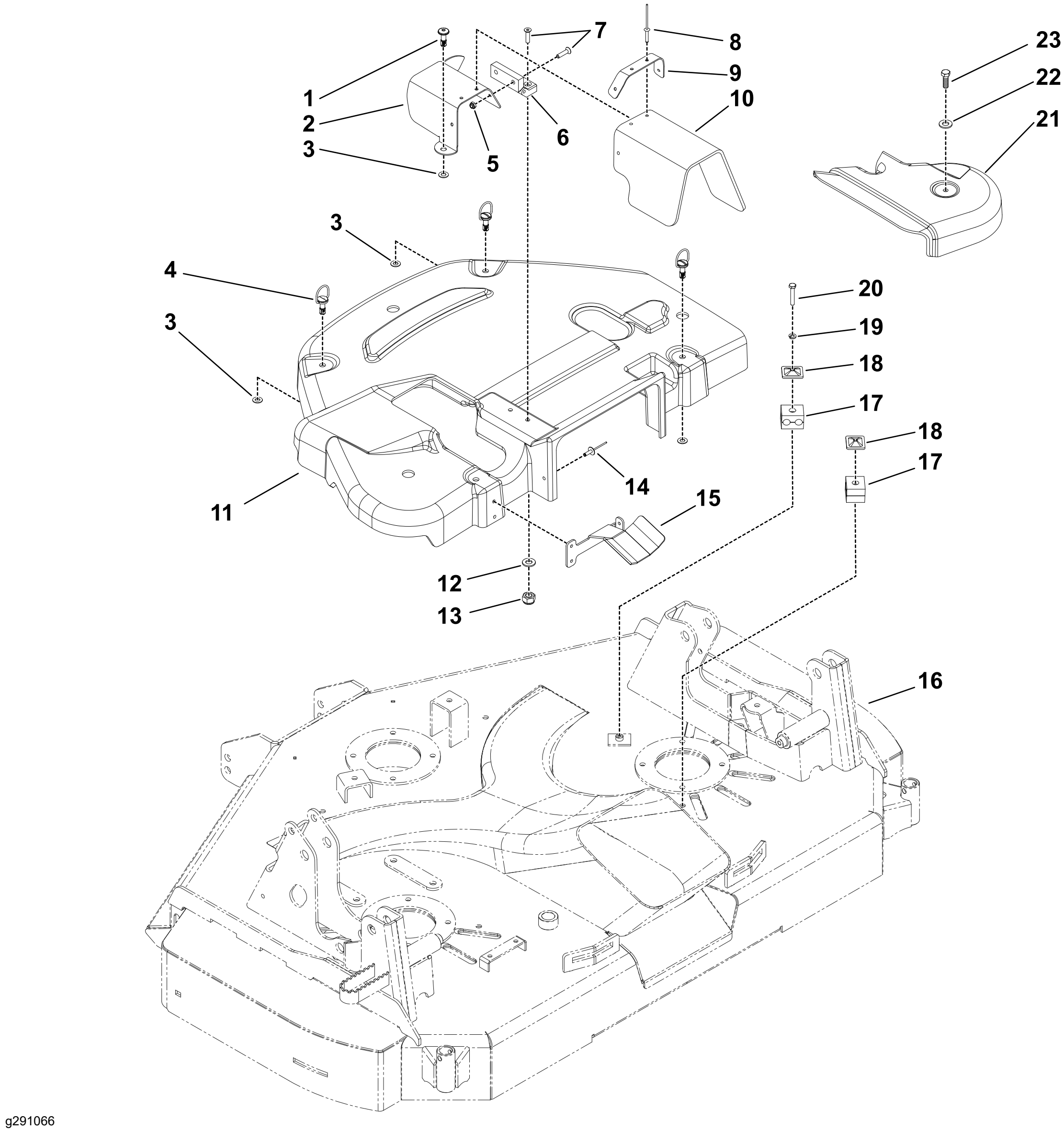


Figure 185

1. Quarter turn fastener
2. Cover
3. Washer
4. Quarter turn fastener
5. Nut
6. Plastic hinge
7. Screw
8. Rivet
9. Bracket
10. Rubber guard
11. Cutting deck cover
12. Washer
13. Nut
14. Rivet
15. Hose protector
16. Cutting deck
17. Collar
18. Plate
19. Washer
20. Bolt
21. Pulley cover
22. Washer
23. Bolt

Disassembling the Cutting Deck Covers

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Remove the cutting deck covers from the cutting deck; refer to *Operator's Manual*.
3. Disassemble the cutting deck covers using the Figure 185 as a guide.

Assembling the Cutting Deck Covers

1. Assemble the cutting deck covers using the Figure 185 as a guide.
2. Install the cutting deck covers onto the cutting deck; refer to *Operator’s Manual*.

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 or OG	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

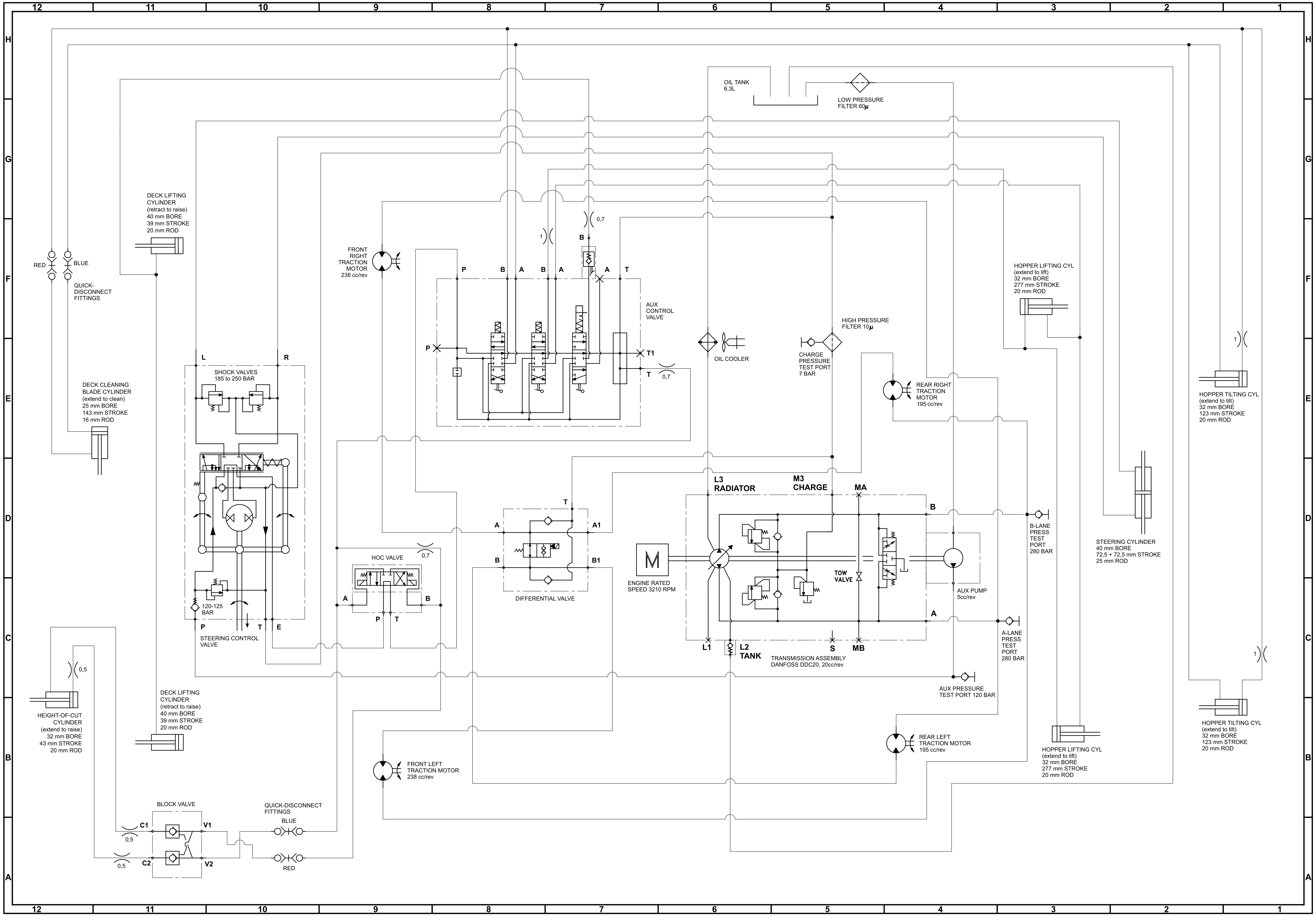
The individual wires of the electrical harness diagrams in this chapter identify both the wire color and the wire size.

Examples:

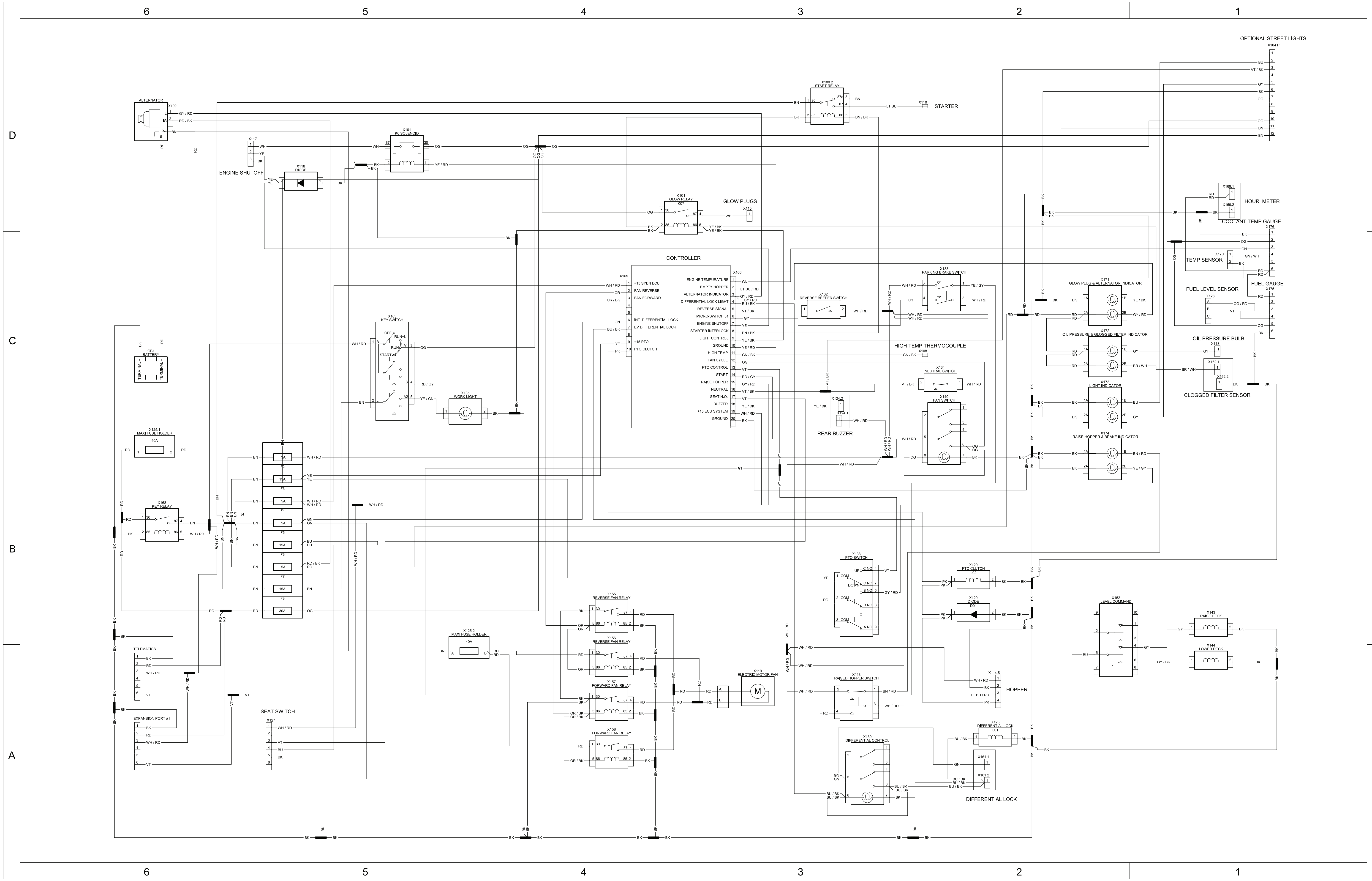
- 16 BK = 16 AWG (American Wire Gauge) wire that has a black insulator.
- 050 R = 0.5 mm metric wire that has a red insulator (AWG equivalents for metric wire appear in the following table).

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

Hydraulic Schematic



Electrical Schematic - Main



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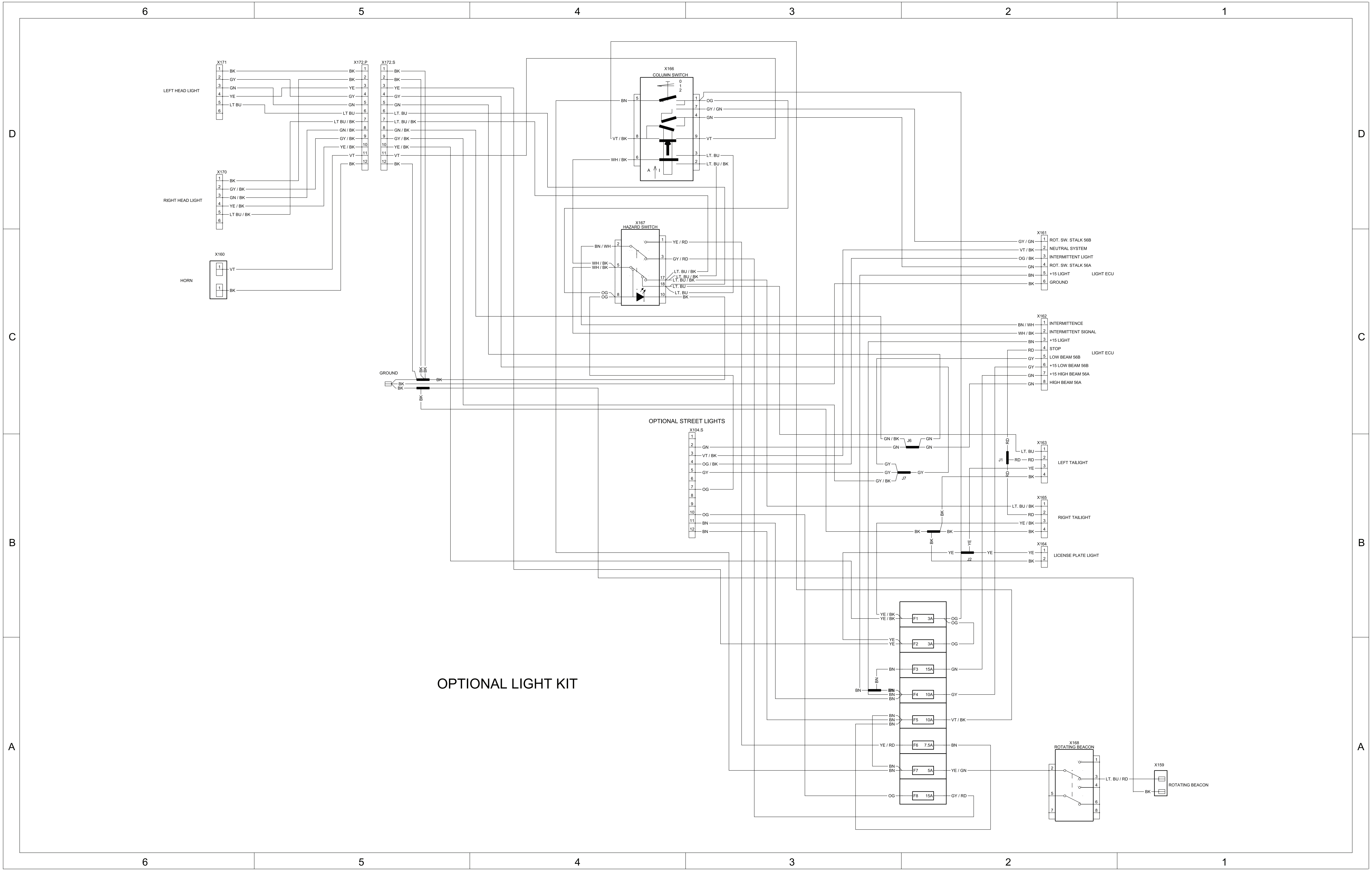

6
5
4
3
2
1
D
C
B
A
X171
LEFT HEAD LIGHT
X170
RIGHT HEAD LIGHT
X160
HORN
X172.P
X172.S
X166
COLUMN SWITCH
X167
HAZARD SWITCH
GROUND
X161
ROT. SW. STALK 56B
NEUTRAL SYSTEM
INTERMITTENT LIGHT
ROT. SW. STALK 56A
+15 LIGHT
GROUND
LIGHT ECU
X162
INTERMITTENCE
INTERMITTENT SIGNAL
+15 LIGHT
STOP
LOW BEAM 56B
+15 LOW BEAM 56B
+15 HIGH BEAM 56A
HIGH BEAM 56A
LIGHT ECU
OPTIONAL STREET LIGHTS
X104.S
X163
LEFT TAILIGHT
X165
RIGHT TAILIGHT
X164
LICENSE PLATE LIGHT
J1
J2
J6
J7
F1 3A
F2 3A
F3 15A
F4 10A
F5 10A
F6 7.5A
F7 5A
F8 15A
X168
ROTATING BEACON
X159
ROTATING BEACON
OPTIONAL LIGHT KIT

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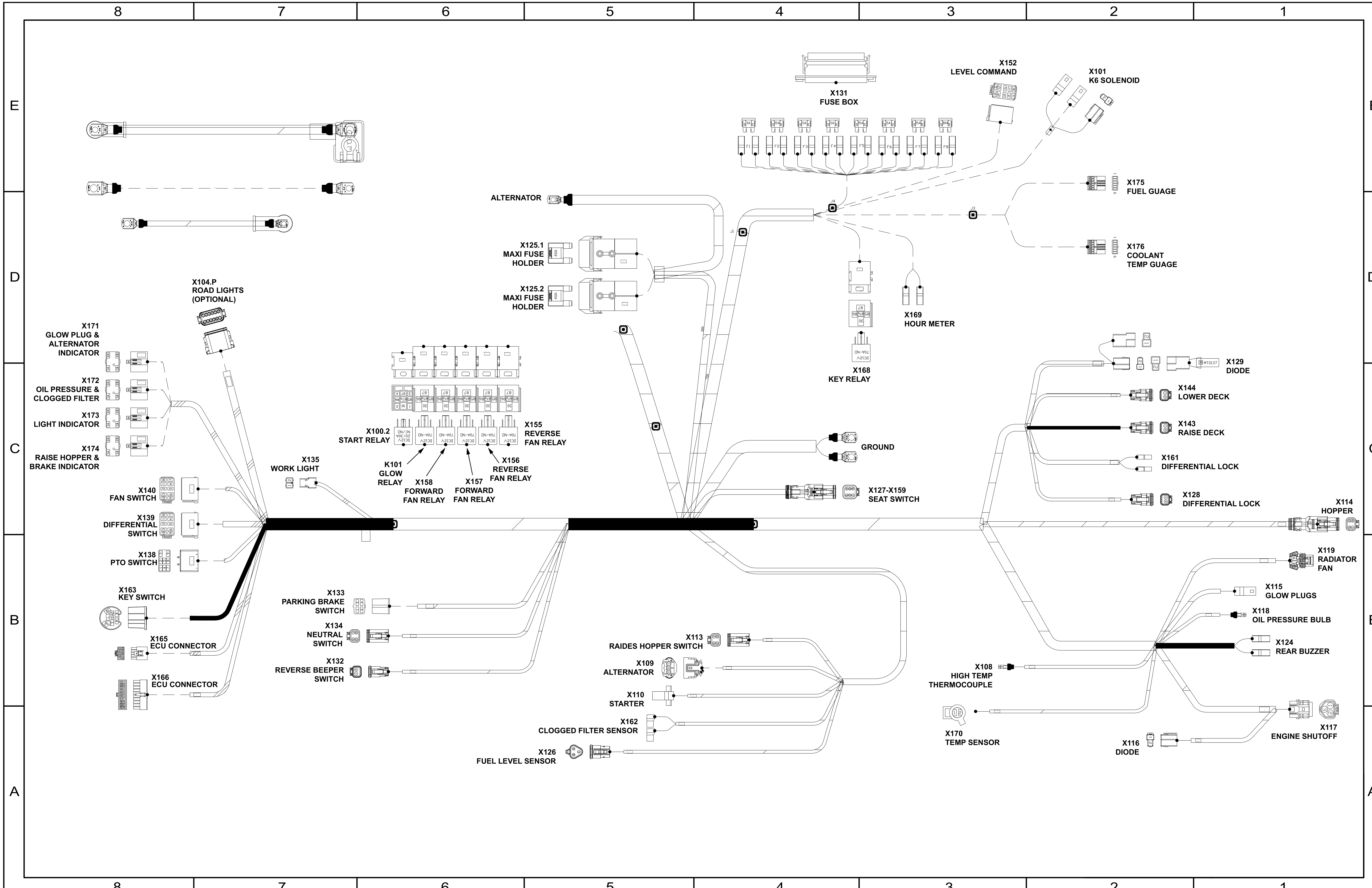
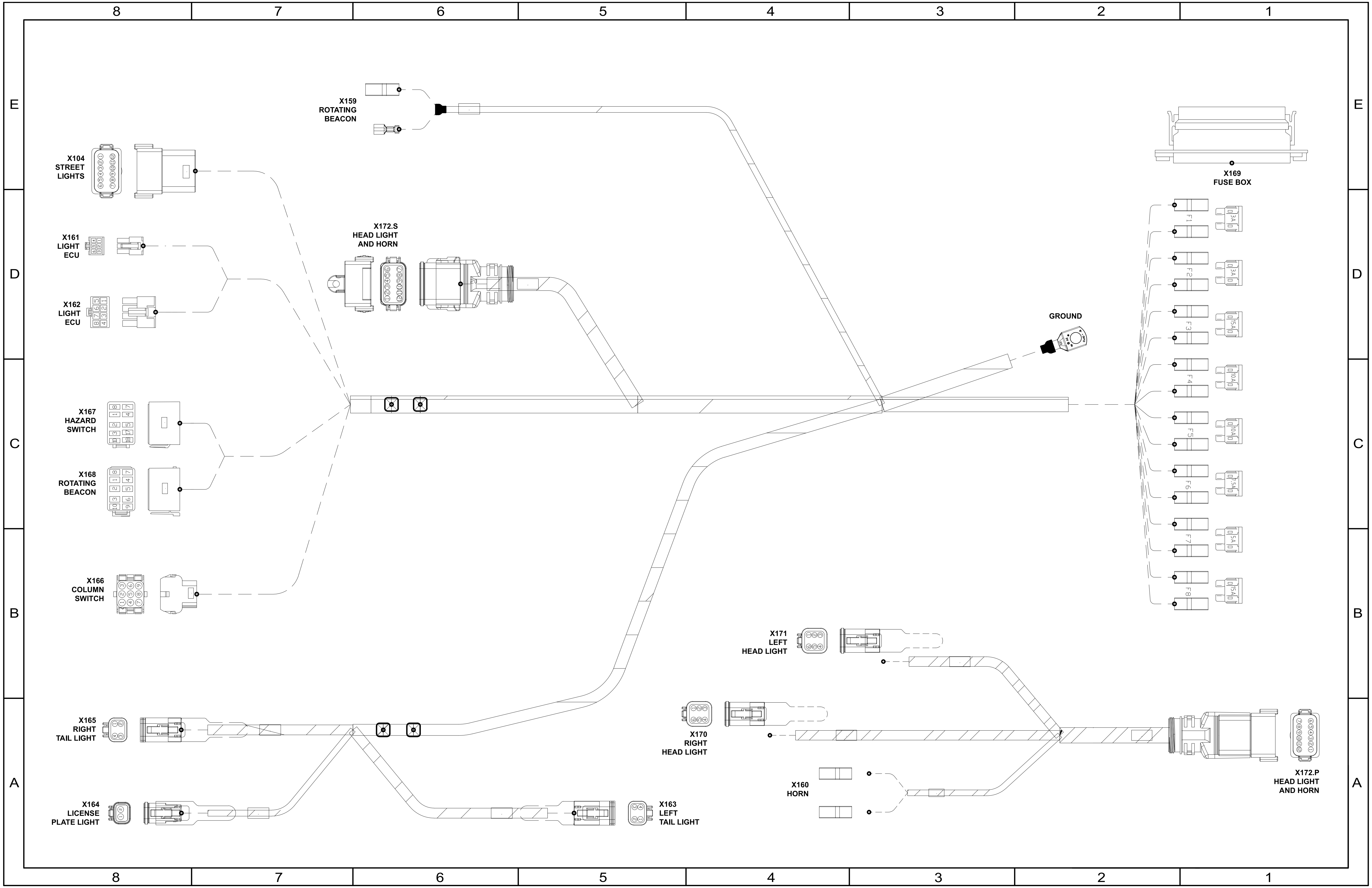
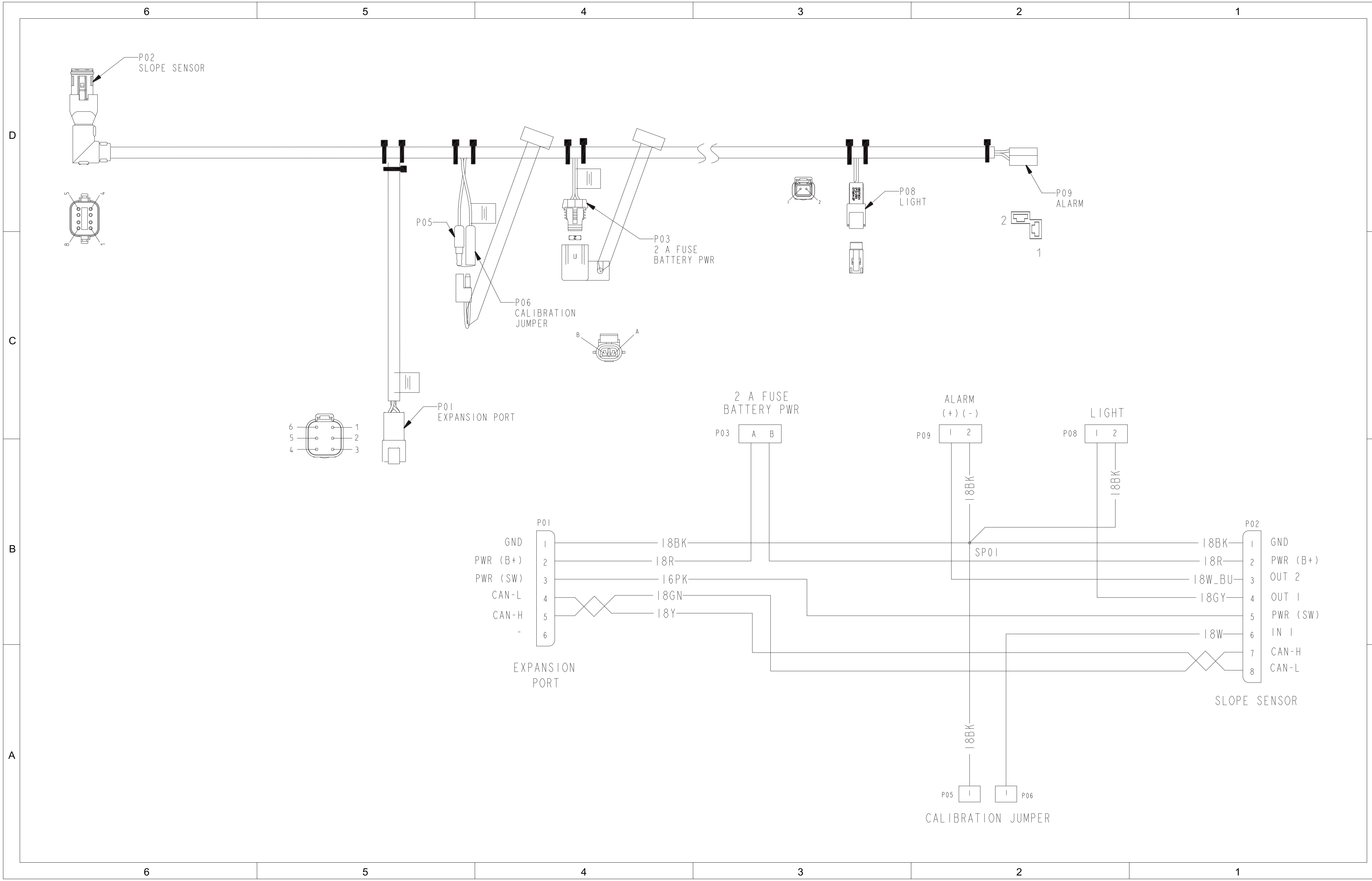
Wire Harness Diagram - Main



g295223


X159
ROTATING
BEACON
X104
STREET
LIGHTS
X169
FUSE BOX
X172.S
HEAD LIGHT
AND HORN
X161
LIGHT
ECU
X162
LIGHT
ECU
GROUND
X167
HAZARD
SWITCH
X168
ROTATING
BEACON
X166
COLUMN
SWITCH
X171
LEFT
HEAD LIGHT
X165
RIGHT
TAIL LIGHT
X170
RIGHT
HEAD LIGHT
X172.P
HEAD LIGHT
AND HORN
X160
HORN
X164
LICENSE
PLATE LIGHT
X163
LEFT
TAIL LIGHT
g295814

Wire Harness – Slope Sensor (Optional)



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