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Count on it.

Service Manual

Groundsmaster 360

(4-Wheel Drive Models with Yanmar Engine)

8111 Lyndale Avenue South
Bloomington, MN 55420

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

Revision History

Revision	Date	Description
A	2016	Initial issue.
B	03/2018	Updated Engine, Electrical chapters and Foldout Drawings. Added Revision History and published in new format.
C	03/2019	Updated Chassis chapter.
D	07/2020	Updated Electrical chapter and Foldout Drawings.

Reader Comments

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

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NOTES:

Preface

The purpose of this publication is to provide the service technician with the information for troubleshooting, testing, and repair of the major systems and components of 4-Wheel Drive Groundsmaster 360 machines that are powered by a Yanmar diesel engine.

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.

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Figure 1

Service Procedure Icons

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

Critical Process

This icon is used to highlight:

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

Critical Torque

This icon is used to highlight an assembly torque requirement that is different than what is recommended in the Standard Torque Tables; refer to Torque Specifications (page 2–4).

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 TNV (Tier 4) Series Service Manual

Yanmar TNV (Tier 4) Series Troubleshooting Manual

Parker Torqmotor™ Service Procedure (TC, TB, TE, TJ, TF, TG, TH and TL Series)

Eaton Parts and Repair Information: 5 Series Steering Control Units

Valeo Compressor Service Manual

Chapter 1

Safety

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Safety Instructions

The Groundsmaster 360 has been tested and certified by Toro for compliance with existing safety standards and specifications. Although hazard control and accident prevention are dependent partially upon the design and configuration of the machine, these factors are also dependent on the awareness, concern, and proper training of the personnel involved in the operation, transport, maintenance, and storage of the machine. The improper use or maintenance by the operator or owner of the machine can result in injury or death.

⚠ 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*, *Operator's Training DVD*, and all of the operating and safety decals 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. To perform a site survey, follow the procedure outlined in the *Operator's Manual*.

Before Operating the Machine

- Review and understand the contents of the *Operator's Manuals* and *Operator's Training DVD* 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.
- 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.
- Tighten any loose nuts, bolts, or screws to ensure that the machine is in safe operating condition.
- Ensure that the interlock switches are adjusted correctly so that the engine does not start unless the traction pedal is in the NEUTRAL position, the PTO switch is in the OFF (disengaged) position, and either the seat is occupied or the parking brake is applied.
- 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 fuel.
  - Fill the fuel tank outdoors and only to the bottom of the filler neck. Do not overfill the fuel tank.
  - Replace the fuel tank and fuel container caps securely after refuelling the machine.

Before Operating the Machine (continued)

- 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 HOC pin.

IMPORTANT

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

- If you park the machine on a slope, block or chock the wheels.

Before starting the machine

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.

   Note: If the machine is on any type of slope, it may move when the parking brake is released.
3. With the machine on a level surface after the engine is started, 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 linkage is adjusted incorrectly; therefore, shut off the engine and adjust the traction linkage until the machine does not move when the traction pedal is in the NEUTRAL position; refer to Traction Linkage Assembly (page 4–89).

⚠ **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.

⚠ **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 (or implement) completely, and then shutting off the engine.
- Use eye protection when working on the hydraulic system and its components.
- If major repairs are necessary, contact your Authorized Toro Distributor.
- 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 tachometer.
- Shut off the engine before checking or adding oil to the engine crankcase.
- Disconnect the battery before servicing the machine. Disconnect the negative battery 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.
- If welding on the machine is necessary, disconnect the battery cables to prevent damage to the electrical system. Disconnect the negative battery cable and then the positive cable. Disconnect the wire harness connector(s) from the machine controller and the terminal connector from the alternator. Also, disconnect and remove the engine ECU from the machine.

Maintenance and Service (continued)

- 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.
- 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).

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 or implement as a jacking point.**

Raising the Front of the Machine

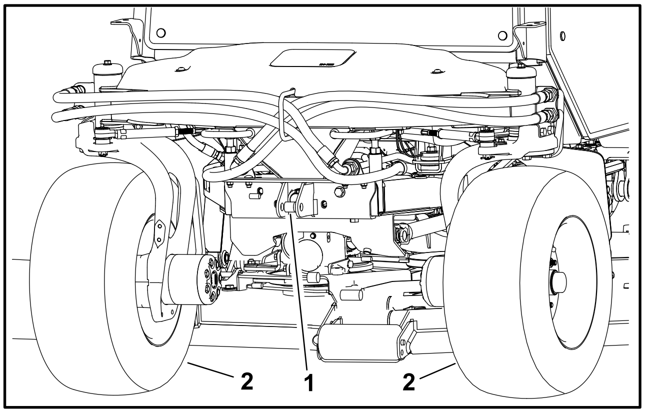

Figure 2

1. Front axle pivot
2. Front tire

1. Set the parking brake and block the 2 rear tires with chocks to prevent the machine from moving.
2. Position the jack securely under the front axle pivot.
3. Use a jack to raise the front of the machine.

IMPORTANT

Do not support the machine on the front steering fork or front wheel motors.

4. After raising the front of the machine, use appropriate jack stands under the frame to support the front of the machine.

Raising the Rear of the Machine

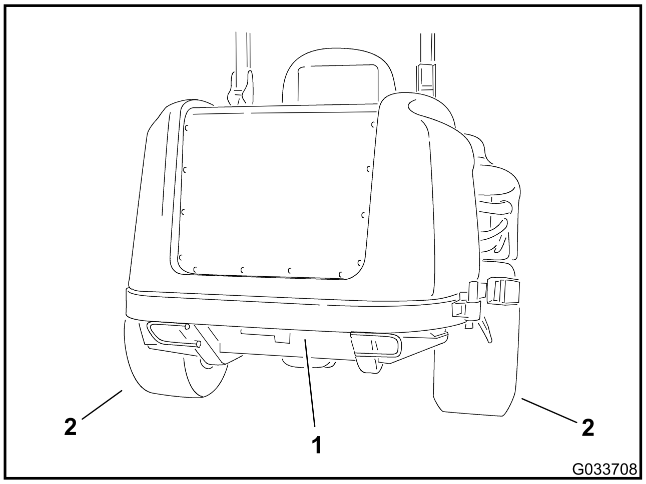

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Figure 3

1. Rear frame jacking point	2. Rear tire

IMPORTANT

Do not support the machine on the rear wheel hubs or wheel motors.

1. Block the 2 front wheels with chocks to prevent the machine from moving.
2. Position the jack securely under the rear frame.
3. Lift the rear wheels off the ground.
4. Use appropriate jack stands under the frame to support the rear of the machine.

Safety and Instructional Decals

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

Chapter 2

Specifications and Maintenance

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Specifications

Insert a copy of the *Operator’s Manuals* and *Parts Catalogs* for your machine at the end of this chapter. Additionally, if any optional equipment or accessories are installed to your machine, insert the *Installation Instructions*, *Operator’s Manuals*, and *Parts Catalogs* for those options at the end of this chapter.

The maintenance procedures and recommended service intervals for your machine are covered in the *Operator’s Manuals*. Refer to this publication when performing the regular equipment maintenance.

Decimal and Millimeter Equivalents

Fractions			Decimals	mm	Fractions			Decimals	mm
		1/64	0.015625	0.397			33/64	0.515625	13.097
	1/32		0.03125	0.794		17/32		0.53125	13.494
		3/64	0.046875	1.191			35/64	0.546875	13.891
1/16			0.0625	1.588	9/16			0.5625	14.288
		5/64	0.078125	1.984			37/64	0.578125	14.684
	3/32		0.09375	2.381		19/32		0.59375	15.081
		7/64	0.109275	2.778			39/64	0.609375	15.478
1/8			0.1250	3.175	5/8			0.6250	15.875
		9/64	0.140625	3.572			41/64	0.640625	16.272
	5/32		0.15625	3.969		21/32		0.65625	16.669
		11/64	0.171875	4.366			43/64	0.671875	17.066
3/16			0.1875	4.762	11/16			0.6875	17.462
		13/64	0.203125	5.159			45/64	0.703125	17.859
	7/32		0.21875	5.556		23/32		0.71875	18.256
		15/64	0.234375	5.953			47/64	0.734375	18.653
1/4			0.2500	6.350	3/4			0.7500	19.050
		17/64	0.265625	6.747			49/64	0.765625	19.447
	9/32		0.28125	7.144		25/32		0.78125	19.844
		19/64	0.296875	7.541			51/64	0.796875	20.241
5/16			0.3125	7.938	13/16			0.8125	20.638
		21/64	0.328125	8.334			53/64	0.828125	21.034
	11/32		0.34375	8.731		27/32		0.84375	21.431
		23/64	0.359375	9.128			55/64	0.859375	21.828
3/8			0.3750	9.525	7/8			0.8750	22.225
		25/64	0.390625	9.922			57/64	0.890625	22.622
	13/32		0.40625	10.319		29/32		0.90625	23.019
		27/64	0.421875	10.716			59/64	0.921875	23.416
7/16			0.4375	11.112	15/16			0.9375	23.812
		29/64	0.453125	11.509			61/64	0.953125	24.209
	15/32		0.46875	11.906		31/32		0.96875	24.606
		31/64	0.484375	12.303			63/64	0.984375	25.003
1/2			0.5000	12.700	1			1.000	25.400
1 mm = 0.03937 inch					**0.001 inch = 0.0254 mm**				

U.S. to Metric Conversions

	To Convert	Into	Multiply By
Linear Measurement	Miles	Kilometers	1.609
	Yards	Meters	0.914
	Feet	Meters	0.305
	Feet	Centimeters	30.48
	Inches	Meters	0.025
	Inches	Centimeters	2.54
	Inches	Millimeters	25.4
Area	Square Miles	Square Kilometers	2.59
	Square Feet	Square Meters	0.093
	Square Inches	Square Centimeters	6.452
	Acre	Hectare	0.405
Volume	Cubic Yards	Cubic Meters	0.765
	Cubic Feet	Cubic Meters	0.028
	Cubic Inches	Cubic Centimeters	16.39
Weight	Tons (Short)	Metric Tons	0.908
	Pounds	Kilograms	0.454
	Ounces (Avdp.)	Grams	28.349
Pressure	Pounds/Sq. In.	Kilopascal	6.895
	Pounds/Sq. In.	Bar	0.069
Work	Foot-pounds	Newton-Meters	1.356
	Foot-pounds	Kilogram-Meters	0.138
	Inch-pounds	Kilogram-Centimeters	1.152
Liquid Volume	Quarts	Liters	0.946
	Gallons	Liters	3.785
Liquid Flow	Gallons/Minute	Liters/Minute	3.785
Temperature	Fahrenheit	Celsius	1. Subtract 32° 2. Multiply by 5/9

Torque Specifications

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

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

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

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

Identifying the Fastener

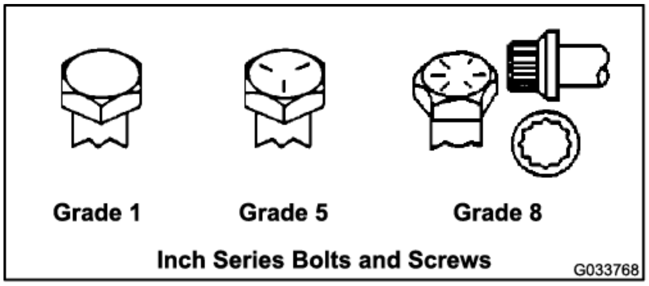

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Figure 4

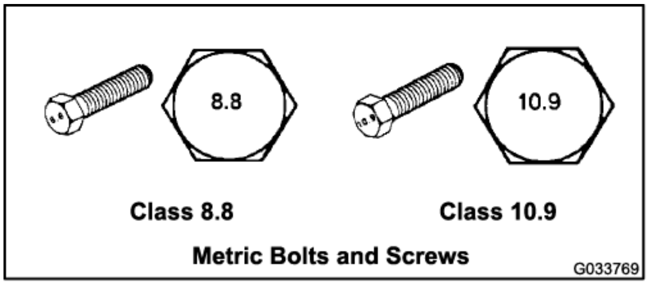

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Figure 5

Calculating the Torque Values When Using a Drive-Adapter Wrench

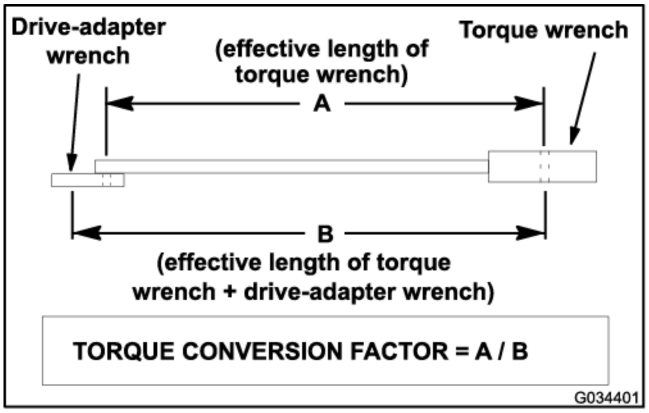

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Figure 6

Using a drive-adapter wrench (e.g., crowfoot wrench) in any position other than 90º and 270º 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 6) 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 Series)

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

Note: 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.

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.

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: 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.

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.

Other Torque Specifications

SAE Grade 8 Steel Set Screws

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

Thread Cutting Screws
(Zinc Plated Steel)

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

Wheel Bolts and Lug Nuts

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

*For steel wheels and non-lubricated fasteners

Thread Cutting Screws
(Zinc Plated Steel)

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

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

Conversion Factors

in-lb X 11.2985 = N·cm

ft-lb X 1.3558 = N·m

N·cm X 0.08851 = in-lb

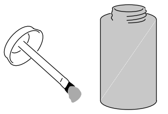
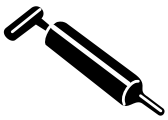
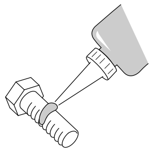
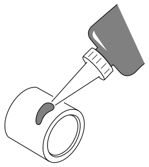
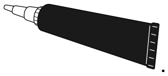
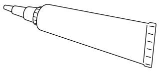
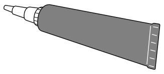
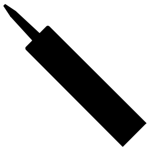
N·m X 0.7376 = ft-lb

Shop Supplies

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

IMPORTANT

Always follow manufacturers instructions when using or storing shop supplies.

Anti-seize lubricant Used to prevent corrosion, galling, and seizure between metal parts. Most often applied to shafts and bores during assembly. Unless otherwise specified, high viscosity regular grade lithium-graphite based anti-seize lubricant should be used.	
Grease Can be used to pre-fill (pack) bearings, boots, and seals 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).	

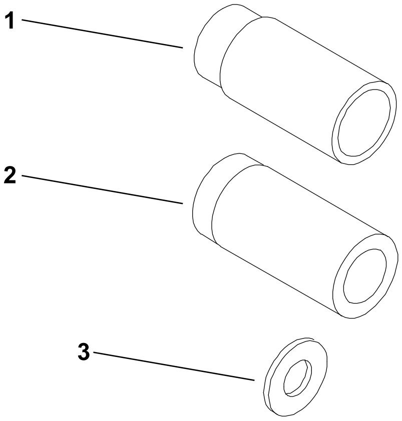
Special Tools

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

Toro 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.



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57 LPM (15 GPM) Hydraulic Tester Kit

Toro 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.

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150 LPM (40 GPM) Hydraulic Tester

Toro 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

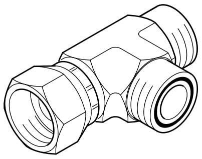
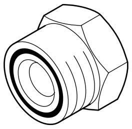
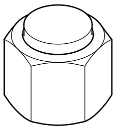
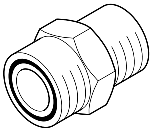
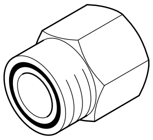
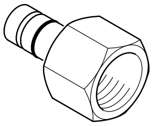
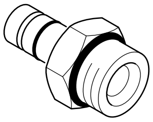
Toro Part No. TOR6007

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

Toro 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	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

Toro Part Number: TOR6011

The high flow hydraulic filter kit is designed with large flow (150 L/minute or 40 gallons/minute) 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 2–12).

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

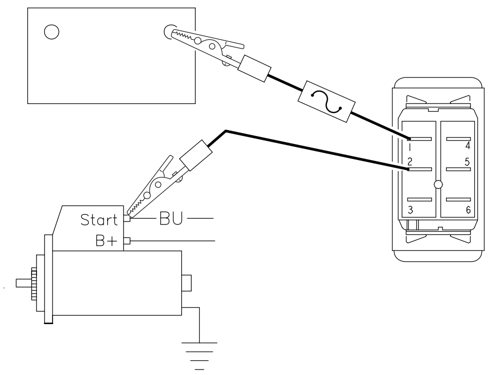
After flushing the hydraulic system or replacing a hydraulic component (e.g. gear pump, piston pump, drive motor), it is necessary to prime the hydraulic pumps. A remote starter switch can be used for this purpose. A remote starter switch can be purchased locally or fabricated as follows.

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.

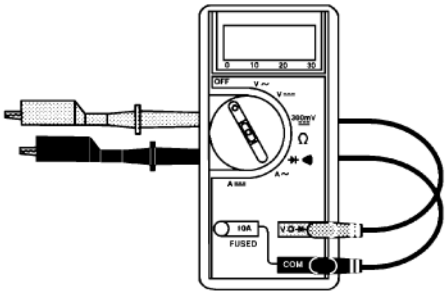
Remote Starter Switch (purchased)



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.

Chapter 3

Diesel Engine

Table of Contents

Additional Reference Materials

Yanmar TNV (Tier 4) Series Service Manual
Yanmar TNV (Tier 4) Series Troubleshooting Manual

Specifications

Engine

Item	Description
Make/Designation	Yanmar 3TNV88C-DTR3, 4-cycle, 3 cylinder common-rail water cooled diesel with EGR and diesel-particulate filter (DPF). EPA Tier 4 Final compliant.
Bore	88 mm (3.46 inches)
Stroke	90 mm (3.54 inches)
Total displacement	1642 cm^3 (100.2 in^3)
Firing order	1 (closest to the flywheel end) - 3 - 2
Direction of rotation	Counterclockwise (viewed from the flywheel)
Fuel	Diesel or Biodiesel fuel (up to B7) with ultra-low sulfur content
Fuel tank capacity	51.1 L (13.5 US gallons)
Fuel injection pump	Yanmar supply pump
Fuel injection type	Common rail system (EPA Tier 4 certified)
Governor	Electronic
Low idle (no load)	1,400 rpm
High idle (no load)	3,000 rpm
Engine oil	API CJ-4 or higher
Engine-oil viscosity	Refer to the *Operator's Manual*
Crankcase-oil capacity	5.2 L (5.5 US qt)
Oil pump	Yanmar trochoid pump
Coolant capacity	6.6 L (7 US qt)
Alternator/Regulator	12 VDC, 55 A
Engine weight (dry)	188 kg (414 lb)

General Information

This chapter gives information about specifications and repair of the Yanmar diesel engine used in the Groundsmaster 360 machine. The general maintenance procedures are described in the *Operator's Manual*. Detailed information on engine troubleshooting, testing, disassembly, and assembly is identified in the Yanmar Engine Service Manual and Troubleshooting 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 Engine 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.

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 Engine Service and Troubleshooting Manuals

The engine that powers your Groundsmaster machine is a Yanmar Model 3TNV88C-DTR3 (used on Groundsmaster 360 Models 31200 and 31202), a Tier 4F compliant engine. The Yanmar Engine Service and Troubleshooting Manual are available for these engines. Ensure that the correct engine manuals are used when servicing the engine on your machine.

Engine Electronic Control Unit (ECU)

The Yanmar engine used in the Groundsmaster 360 machine uses an electronic control unit (ECU) for engine management and to communicate with operator InfoCenter on the machine. The engine ECU is located inside the power center assembly behind the operator seat.

IMPORTANT

Do not plug or unplug the engine ECU for 30 seconds after the machine key switch is turned off. The engine ECU may remain energized even though the key switch is in the OFF position.

If you must disconnect the engine ECU for any reason, ensure that the key switch is in the OFF position with the key removed before disconnecting the engine ECU. Also, to prevent possible engine ECU damage when welding on the machine, disconnect and remove the engine ECU from the machine before welding.

The engine electrical components (e.g., engine ECU, fuel injectors, EGR, and exhaust DPF) are identified and matched in the engine ECU program. If the engine electrical components are replaced, the Yanmar electronic tool must be used to update the engine ECU program which will ensure correct engine operation.

If the engine ECU identifies that an engine problem exists, the engine speed may be reduced or the engine may shut off. The Yanmar troubleshooting manual and electronic diagnosis tool should be used to provide assistance in identifying the cause of the problem and the repairs that are necessary. Contact your Toro distributor for any assistance in the Yanmar engine troubleshooting.

Yanmar Engine

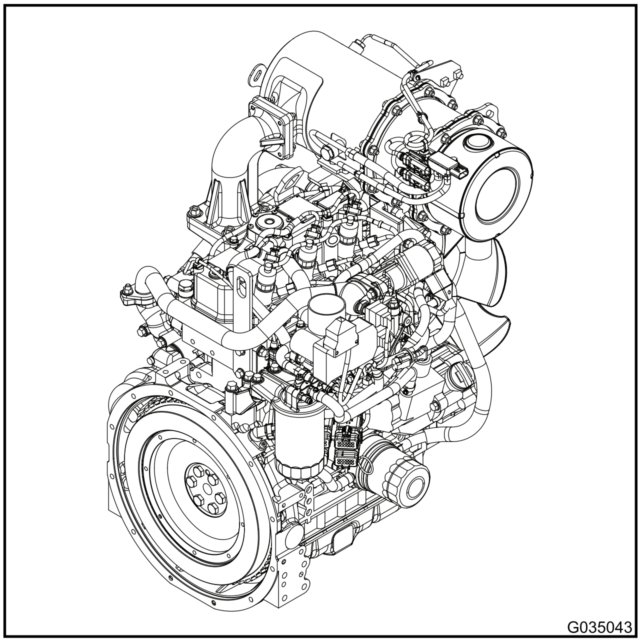


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Figure 7

The engine used on your Groundsmaster is a Yanmar TNV Series, diesel engine that complies with EPA Tier 4F emission regulations. The engine features include an electronic control unit (ECU) that controls a common rail fuel injection system with direct injection, water-cooled exhaust gas recirculation (EGR), an electronic governor, an exhaust system diesel oxidation catalyst (DOC), and an exhaust diesel-particulate filter (DPF) with active regeneration. Glow plugs are used to assist starting the engine. Numerous engine sensors are used to allow the engine ECU to monitor and control the engine operation for optimum engine performance.

The engine ECU, combined with numerous engine sensors, monitor and control the engine operation for optimum performance. During the operation of the engine, if conditions warrant, the engine ECU may generate an engine fault. Use the machine InfoCenter to identify the engine fault; refer to Starting Problems (page 5–37), the Yanmar Troubleshooting Manual, or contact an Authorized Toro Distributor for assistance.

Diesel Particulate Filter (DPF)

The diesel particulate filter (DPF) used on Yanmar Tier 4F compliant engines is designed to breakdown the hazardous elements in the exhaust and prevent the discharge of unburnt fuel or oil known as particulate matter or soot. The DPF includes a Diesel Oxidation Catalyst (DOC), a Soot Filter (SF), 2 temperature sensors, and a pressure differential sensor. Additional information regarding the Diesel Particulate Filter (DPF) can be found in the *Yanmar Operation Manual - Industrial Engines TNV* supplied with your machine.

Regeneration

The engine ECU monitors the exhaust pressure before and after the soot filter in the DPF to determine if soot is accumulating. If soot is accumulating during normal engine operation, the pressure differential will increase. The increase in pressure will signal the engine to begin a process called Regeneration. Regeneration increases the exhaust temperature and the length of time the engine operates at a higher than normal exhaust temperature, incinerating the built up soot and turning it into ash. The different types of regeneration used are listed in order based on the amount of particulate matter in the soot filter (least to most).

Note: The user interface and InfoCenter displays for DPF regeneration changed with machine software 121-8895R. Use the InfoCenter About screen to verify the software installed on the machine.

- For machines with software 121-8895A thru Q: Complete DPF regeneration instructions can be found in the updated traction unit *Operator's Manual* for the specific machine. Visit www.toro.com to download the updated traction unit *Operator's Manual* for the machine.
- For machines with software 121-8895R and up: Complete DPF regeneration instructions can be found in the traction unit *Operator's Manual*. Visit www.toro.com to download the traction unit *Operator's Manual* with the correct DPF regeneration instructions for the machine.

Types of regeneration that are performed automatically (while the machine is operating)

Type	Conditions	Description
Passive	Occurs during normal operation of the machine at high engine speed or high engine load	The DPF processes high heat exhaust gasses, oxidizing harmful emissions and incinerating soot to ash. The InfoCenter does not display an icon during passive regeneration.
Assist	Occurs because of prolonged operation at low engine speed, low engine load, or when the engine ECU detects the soot filter is becoming obstructed.	The engine ECU adjusts the exhaust intake throttle to raise the exhaust temperature. **For software 121-8895A thru Q only:** the InfoCenter displays the assist regeneration icon.
Reset	Occurs every 100 hours of engine operation Occurs after an assist regeneration if the engine ECU determines the assist regeneration did not sufficiently reduce the soot level **Note:** Reset regeneration may be temporarily delayed if high exhaust temperatures would create an unsafe condition (the machine is operating indoors or outdoors around trees, brush, tall grass, or other temperature-sensitive plants or materials). Refer to Setting the Inhibit Regen in the traction unit*Operators Manual* for additional information.	The engine ECU adjusts the exhaust intake throttle and the injector timing to raise the exhaust temperature. **For all software revisions:** the InfoCenter displays the high exhaust temperature icon.

Regeneration (continued)

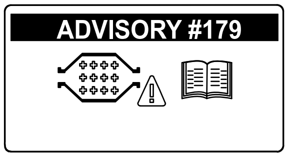
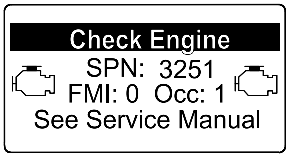
Types of regeneration that are performed manually (while the machine is stationary)

Type	Conditions	Description
Parked	Occurs when exhaust back pressure in the DPF increases due to continued soot buildup. May be caused by prolonged operation at low engine speed, low engine load, or the use of incorrect fuel or engine oil. May occur if the InfoCenter is set to inhibit regen (preventing a Reset Regeneration) and machine operation is continued. Can be initiated when prompted by the engine ECU or after a minimum of 50 hours of engine operation. **For software 121-8895R and up:** if a parked regeneration is ignored, the machine mow function (PTO) will be disabled approximately 2 hours after the first notification.	Manually initiate a parked regeneration as soon as possible. A parked regeneration will take approximately 30 to 60 minutes and should not be started with less than 1/4 tank of fuel. The machine must remain stationary (cannot be operated) during the entire parked regeneration process. **For all software revisions:** the InfoCenter displays advisory #188 and/or the stationary regeneration icon
Recovery	Occurs when exhaust back pressure in the DPF increases due to soot buildup reaching a critical level. Can only be initiated when prompted by the engine ECU. **For software 121-8895R and up:** the machine mow function (PTO) will be disabled at first notification.	Manually initiate a recovery regeneration as soon as possible. A recovery regeneration will take approximately 3 hours and should not be started with less than 1/2 tank of fuel. The machine must remain stationary (cannot be operated) during the entire recovery regeneration process. Use the InfoCenter About screen to verify the software installed on the machine. • Machines with software 121-8895A thru Q: Recovery regeneration must be initiated by an Authorized Toro Distributor service technician using Yanmar SMARTASSIST-Direct • Machines with software 121-8895R and up: Recovery regeneration can be initiated from the machine InfoCenter **For software 121-8895A thru Q only:** the InfoCenter displays the recovery regeneration icon. **For software 121-8895R and up:** the InfoCenter displays advisory #190 and/or the stationary regeneration icon. **Note:** Verify the model and serial number of the engine installed in the machine. 3TNV88C-DTR3 engines below serial number 02248 cannot run a recovery regeneration without first reprogramming the engine ECU. Contact an Authorized Toro Distributor for assistance.

Soot Accumulation

If the types of regeneration that are performed automatically (while the machine is operating) are bypassed or not allowed to complete before shutting off the engine, soot will continue to accumulate in the soot filter. When enough soot accumulates, the engine ECU will generate an engine fault to prompt a parked or recovery regeneration. In addition to an engine fault appearing on the InfoCenter, the engine output power will be reduced.

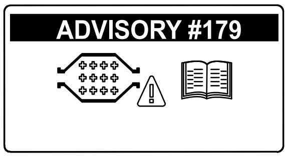
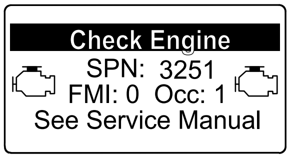
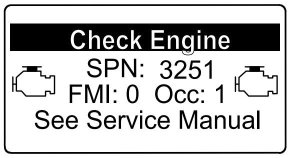
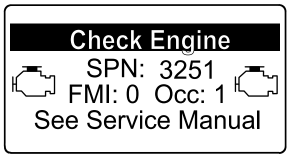
Soot Accumulation Engine Faults

Fault Level	Fault Code	Engine Power Rating	Recommended Action
Level 1: Engine Warning	 ADVISORY #179	De-rated to 85%	Perform a parked regeneration as soon as possible.
Level 2: Engine Warning	 Check Engine SPN: 3251 FMI: 0 Occ: 1 See Service Manual	De-rated to 50%	Perform a recovery regeneration as soon as possible

Ash Accumulation

Ash is a result of the regeneration processes. The lighter ash is discharged through the exhaust system, while the heavier ash collects in the soot filter. When enough ash accumulates in the soot filter, the engine ECU will generate an engine fault to prompt servicing the DPF. In addition to an engine fault appearing on the InfoCenter, the engine output power and speed will be reduced.

Ash Accumulation Advisories and Engine Faults

Fault Level	Fault Code	Engine Power Rating	Engine Speed Reduction	Recommended Action
System Advisory (machine software 121-8895A thru Q only)	 ADVISORY #179	100%	None	Plan to service the DPF in the near future
Level 1: Engine Warning	 Check Engine SPN: 3251 FMI: 0 Occ: 1 See Service Manual	De-rated to 85%	None	Service the DPF; refer to Exhaust System (page 3–10)
Level 2: Engine Warning	 Check Engine SPN: 3251 FMI: 0 Occ: 1 See Service Manual	De-rated to 50%	None	Service the DPF; refer to Exhaust System (page 3–10)
Level 3: Engine Warning	 Check Engine SPN: 3251 FMI: 0 Occ: 1 See Service Manual	De-rated to 50%	Maximum torque + 200 rpm	Service the DPF; refer to Exhaust System (page 3–10)

Service and Repairs

Air Cleaner System

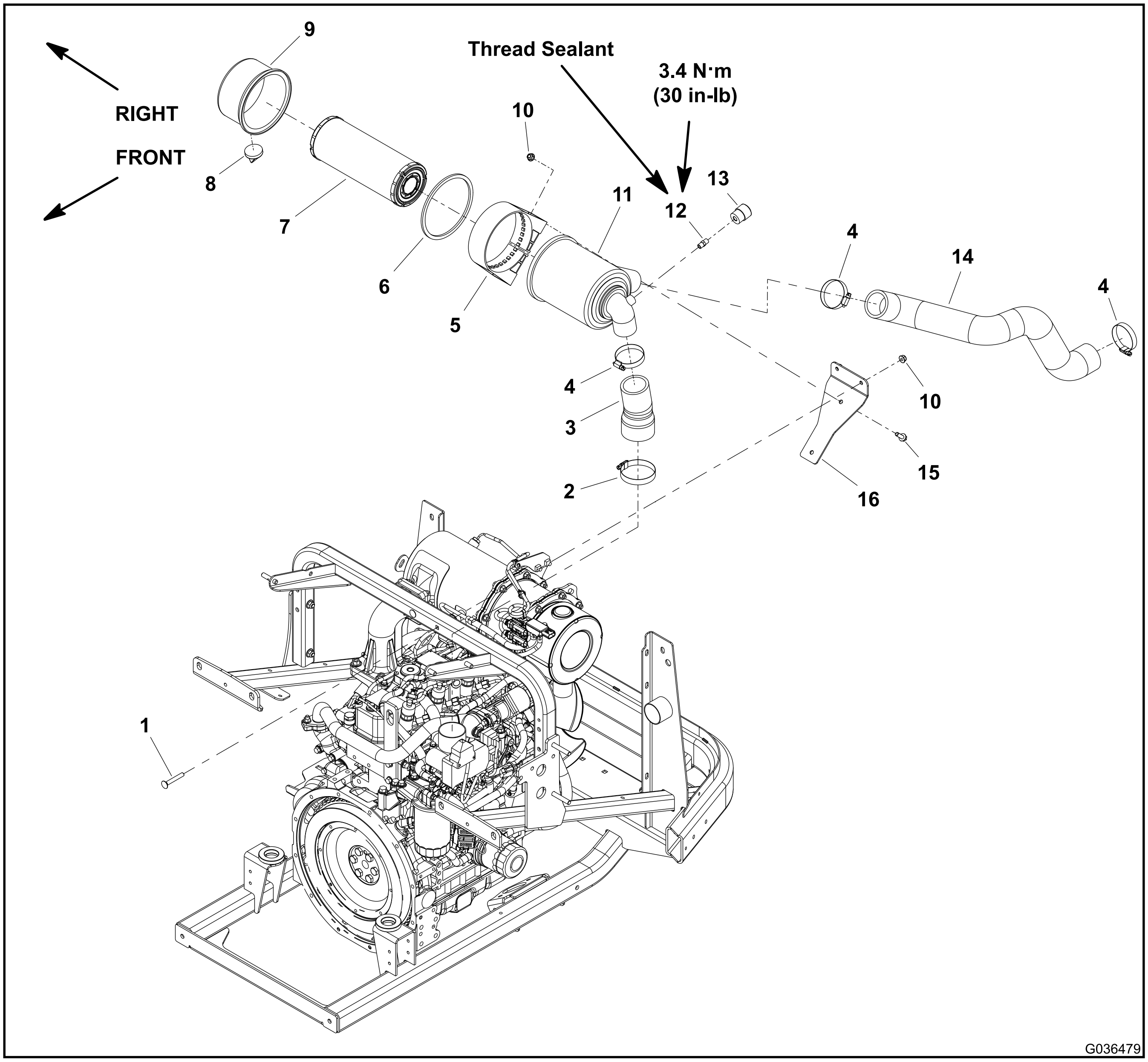


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Figure 8

1.	Carriage bolt (2 each)	7.	Air filter	13.	Service indicator
2.	Hose clamp	8.	Vacuator valve	14.	Air inlet hose
3.	Air inlet hose	9.	Air cleaner cover	15.	Flange-head screw (2 each)
4.	Hose clamp (3 each)	10.	Flange nut (4 each)	16.	Air cleaner bracket
5.	Air cleaner bracket	11.	Air cleaner housing		
6.	Gasket	12.	Pipe nipple		

Removing the Air Cleaner System

Note: Refer to the *Operator's Manual* for maintenance procedures and intervals of the air cleaner.

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. Unlatch the hood and raise it.
3. Remove the air cleaner components as shown in Figure 8.
4. Examine the air cleaner housing and cover (items 11 and 9 in Figure 8) for wear or damage that could cause possible air leaks.
5. Examine the air hoses for wear or damage and replace the hoses if necessary.
6. Examine the hood seals for wear or damage and replace the seals if necessary.

Installing the Air Cleaner System

IMPORTANT

Leaks in the air filter system will allow dirt to enter into the engine and can cause serious engine damage. Ensure that all the air cleaner components are in good condition and are properly secured during installation.

1. Assemble the air cleaner system as shown in Figure 8.
   A. Ensure that the vacuator valve (item 8 in Figure 8) is pointed down after installation.
   B. If the service indicator (item 13 in Figure 8) or pipe nipple were removed from the housing, apply sealant to the threads of the nipple, torque the nipple to **3.4 N·m (30 in-lb)**, and install the service indicator onto the nipple.
2. Lower the hood and secure it with the latches.

Exhaust System

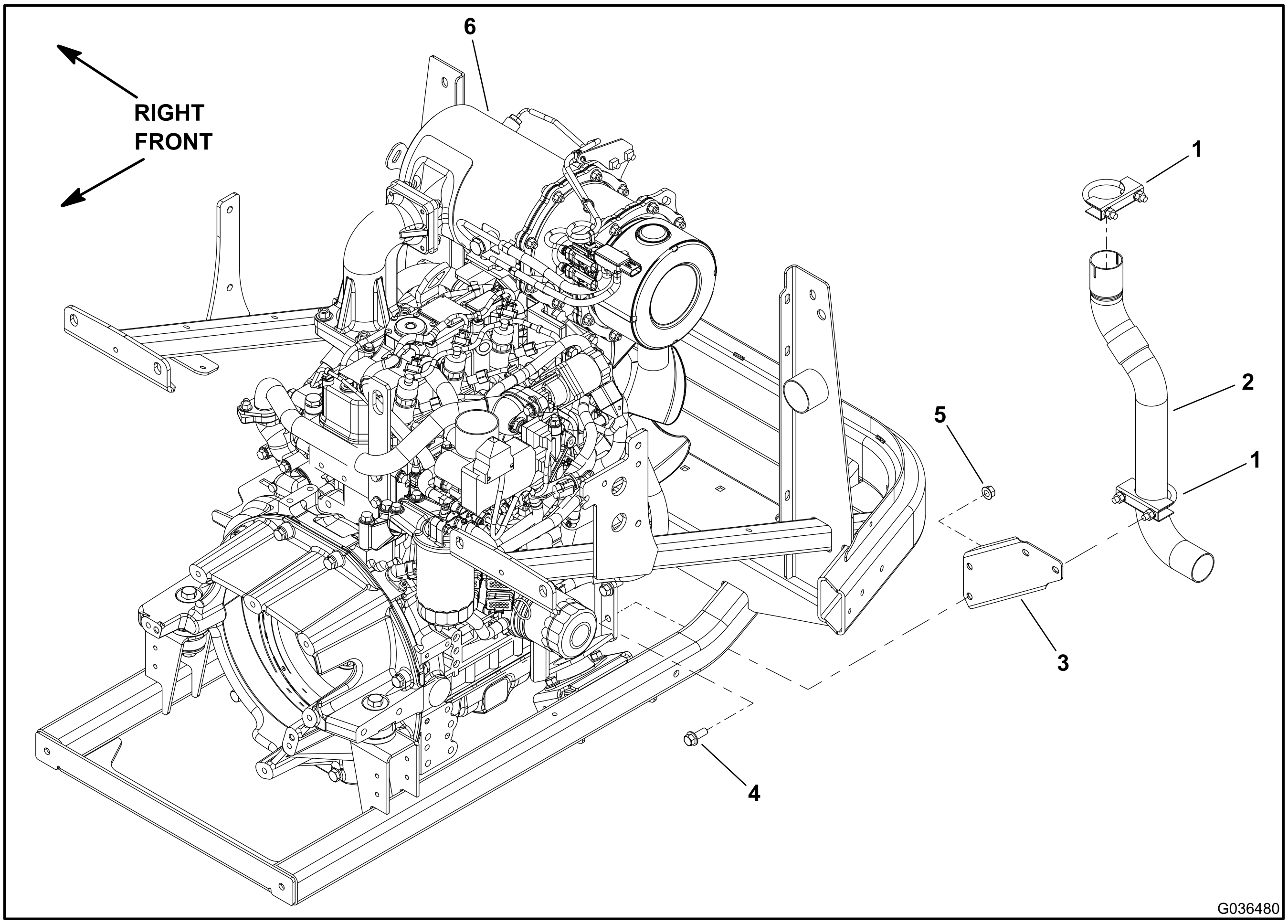

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Figure 9

1.	Exhaust clamp (2 each)	3.	Exhaust bracket	5.	Flange nut (2 each)
2.	Exhaust tube	4.	Flange-head screw (2 each)	6.	Diesel-particulate filter assembly (DPF includes DOC)

The engine that powers your Groundsmaster 360 machine is a Yanmar model 3TNV88C-DTR3 that complies with EPA Tier 4F emission regulations. The engine is equipped with an exhaust system that includes a diesel oxidation catalyst (DOC) and a diesel-particulate filter (DPF).

These exhaust components require service or component replacement at regular intervals; refer to the *Operator's Manual*.

At recommended intervals, DPF reconditioning is necessary which will require exhaust system disassembly. DPF reconditioning should be done by a company that has the necessary equipment. Once the DPF has gone through the reconditioning process, it can be re-installed in the exhaust system. Contact your Toro Distributor for information on reconditioning the DPF.

The diesel oxidation catalyst (DOC) has a service life expectancy and requires replacement at recommended intervals. Replacement of the DOC will require exhaust system disassembly, removal of the existing DOC and installation of the new DOC.

Information about the diesel-particulate filter (DPF) operation and maintenance can be found in the Yanmar Engine Service Manual and Troubleshooting Manual.

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. Unlatch the hood and raise it.
3. Remove the exhaust tube as shown in Figure 9.

   Note: The exhaust system DPF and DOC can be removed from the exhaust system without removing the entire exhaust system from the engine. Refer to the Yanmar Engine Service Manual for complete disassembly and assembly procedures.

Installing the Exhaust System

1. Install the exhaust tube as follows:
   A. Install all the fasteners finger tight.
   B. Starting at the bottom, tighten the flange nuts (item 5 in Figure 9).
   C. Tighten the lower exhaust clamp.
   D. Tighten the upper exhaust clamp.
2. Lower the hood and secure it with the latches.

Radiator

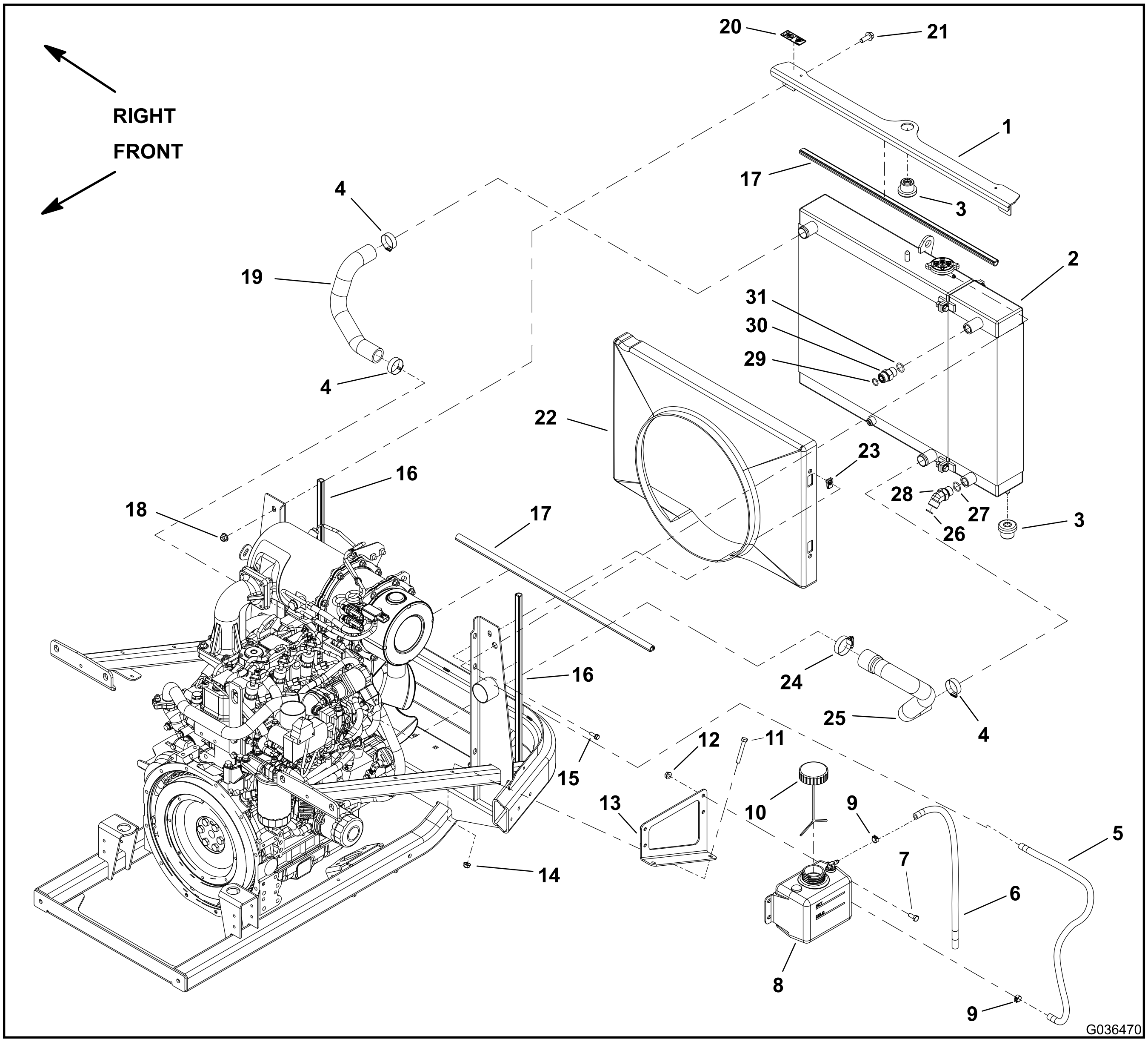

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Figure 10

1.	Radiator support	12.	Flange nut (4 each)	23.	Clip (4 each)
2.	Radiator and oil cooler assembly	13.	Reservoir bracket	24.	Hose clamp
3.	Isolator mount (3 each)	14.	Flange nut (2 each)	25.	Lower radiator hose
4.	Hose clamp (3 each)	15.	Washer-head screw (4 each)	26.	O-ring
5.	Coolant hose	16.	Bulb seal (2 each)	27.	O-ring
6.	Coolant hose	17.	Bulb seal (2 each)	28.	45° hydraulic fitting
7.	Screw (4 each)	18.	Flange nut (2 each)	29.	O-ring
8.	Coolant reservoir assembly	19.	Upper radiator hose	30.	Straight hydraulic fitting
9.	Hose clamp (2 each)	20.	Fan warning decal	31.	O-ring
10.	Reservoir cap	21.	Flange-head screw (2 each)		
11.	Screw (2 each)	22.	Fan shroud		

Removing the Radiator

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. Unlatch the hood and raise it.

⚠ WARNING ⚠

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 coolant away from children and pets.

Keep the coolant in a labeled container.

Discard the coolant in accordance with local hazardous waste ordinances.

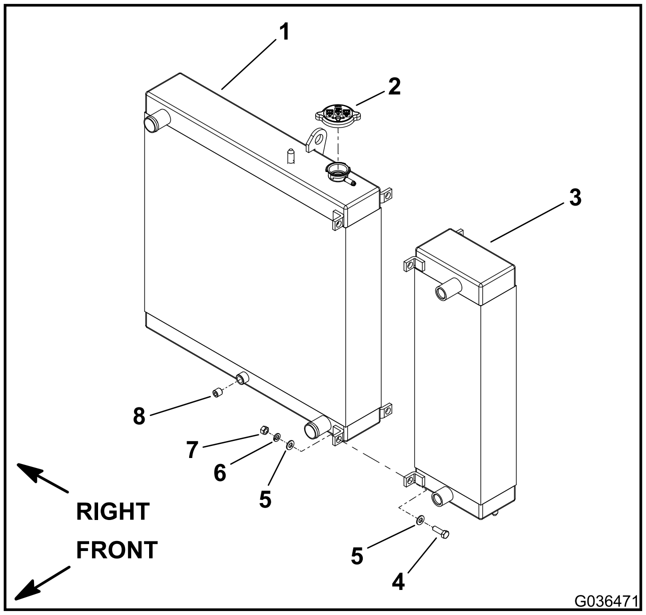

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Figure 11

1.	Radiator	5.	Flat washer (8 each)
2.	Radiator cap	6.	Lock washer (4 each)
3.	Oil cooler	7.	Hex nut (4 each)
4.	Screw (4 each)	8.	Pipe plug

3. Remove the radiator cap (item 2 in Figure 11) from the radiator.
4. Remove the pipe plug (item 8 in Figure 11) from the bottom of the radiator and completely drain the coolant from the radiator into a suitable container.
5. Disconnect the following hoses from the radiator:

Removing the Radiator (continued)

- The upper radiator hose (item 19 in Figure 10) that is connected to the water pump.
- The lower radiator hose (item 25 in Figure 10) that is connected to the engine block.
- The coolant hose (item 5 in Figure 10) that is connected to the coolant reservoir assembly.

6. Clean the hydraulic hose ends and oil cooler fittings to prevent hydraulic system contamination.
7. Disconnect the upper hydraulic tube from the straight hydraulic fitting (item 30 in Figure 10). Disconnect the lower hydraulic tube from the 45° hydraulic fitting in the oil cooler and completely drain the hydraulic fluid from the oil cooler into a suitable container.
8. Remove the fan shroud as shown in Figure 10. Carefully position the fan shroud away from the radiator and ensure that you do not damage the fan.
9. Remove the 2 flange-head screws (item 21 in Figure 10) and 2 flange nuts that attach the radiator support to the radiator frame, and remove the radiator support.
10. Carefully remove the oil cooler and radiator assembly from the machine.
11. Cover or plug the openings in oil cooler, radiator, and the disconnected coolant and hydraulic hoses to prevent contamination.
12. If necessary, separate the oil cooler from the radiator as follows:
    A. Remove the 4 screws (item 4 in Figure 11), 8 flat washers, 4 lock washers, and 4 hex nuts 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 purposes.
    D. Remove the fittings from the oil cooler as necessary (Figure 10) and discard the O-rings from the fittings.
    E. For inspection procedure of oil cooler; refer to Inspecting the Oil Cooler (page 4–178).

    Note: Remove any sealant found between the oil cooler and radiator.
13. Check the condition of the rubber isolator mounts (item 3 in Figure 10) and replace the mounts if damaged.
14. Check the condition of the bulb seals (items 16 and 17 in Figure 10) and replace the bulb seals if damaged.

Installing the Radiator

1. If removed, install the fan shroud and ensure that the equal clearance exists between the fan and the top and bottom of the fan shroud.
2. If separated, assemble the radiator to the oil cooler as follows:
   - A. If the hydraulic fittings were removed from the oil cooler, lubricate and install new O-rings to the fittings. Install the fittings into the oil cooler ports (Figure 10).
   - B. Attach the oil cooler to the radiator with the 4 screws (item 4 in Figure 11), 8 flat washers, 4 lock washers, and 4 hex nuts.
   - C. Install the radiator and oil cooler assembly to the machine.
   - D. Check that the gap between the oil cooler and radiator is less than 2.3 mm (0.090 inch). If the gap is more than 2.3 mm (0.090 inch), fill the gap with silicone sealer to ensure effective sealing.
3. Remove the covers and plugs from the opening in oil cooler, radiator, and the disconnected coolant and hydraulic hoses that were installed during removal.
4. Carefully align the oil cooler and radiator with the radiator frame.
5. Install the radiator support (item 1 in Figure 10) to the radiator frame, press the radiator support at the top with enough force to compress the bulb seal to a maximum thickness of 6.35 mm (0.25 inch) before tightening the fasteners.
6. Carefully position the fan shroud to the radiator. Secure the fan shroud to the frame as shown in Figure 10.
7. Connect the following hoses to the radiator:
   - The upper radiator hose that is connected to the water pump.
   - The lower radiator hose that is connected to the engine block. Ensure that the hose clamp on the lower radiator hose does not contact the alternator belt.
   - The coolant hose that is connected to the coolant reservoir assembly.
8. Use new O-rings and lubricate the O-rings before installing the hydraulic fittings to the oil cooler.
9. Connect the upper hydraulic hose to the straight hydraulic fitting and lower hydraulic hose to the 45° hydraulic fitting in the oil cooler.
10. Apply thread sealant to the threads of the pipe plug (item 8 in Figure 11). Install the plug into the radiator opening.
11. Check that no gaps exist between the radiator, the radiator frame, and the machine frame.
12. Fill the radiator with the appropriate coolant; refer to the *Operator’s Manual* for coolant specifications.

    Note: Ensure that the coolant level in the coolant reservoir is correct.
13. Install the radiator cap (item 2 in Figure 11) to the radiator.
14. Add hydraulic fluid to the hydraulic reservoir as needed to raise the hydraulic-fluid level to the operating range; refer to the *Operator’s Manual*.
15. Start the engine and check for coolant and hydraulic fluid leaks. Repair any leaks as required before returning the machine to service.
16. Continue to run the engine to obtain the operating temperature. Check the coolant and hydraulic fluid levels and adjust as necessary.
17. Lower the hood and secure it with the latches.

Fuel System

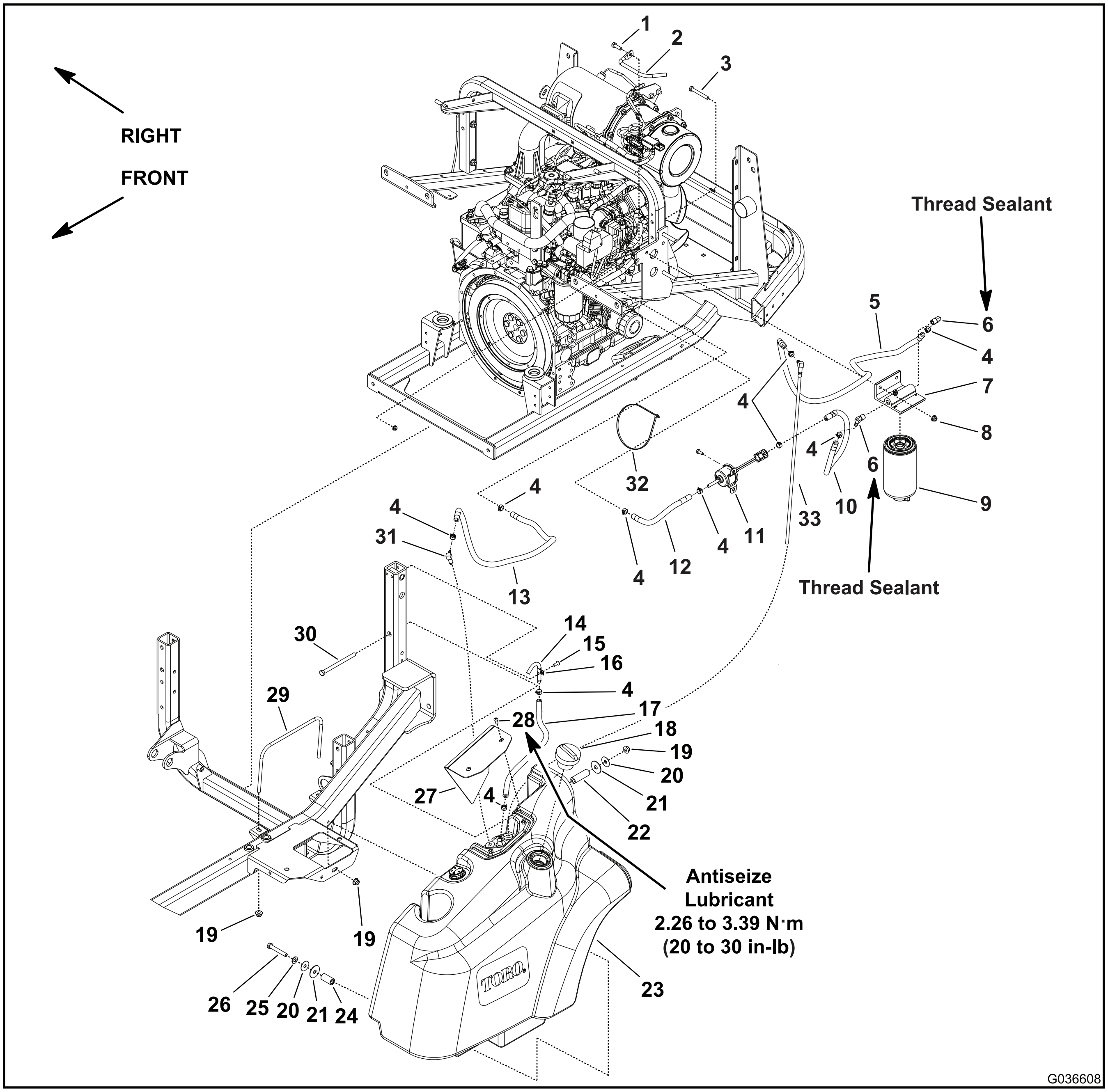

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Figure 12

1.	Screw	12.	Fuel hose	23.	Fuel tank assembly
2.	Brake guide cable	13.	Fuel return hose	24.	Spacer
3.	Screw	14.	Vent tube	25.	Flat washer
4.	Hose clamp (10 each)	15.	Rivet	26.	Screw
5.	Fuel supply hose	16.	R-clamp	27.	Cover plate
6.	Elbow fitting (2 each)	17.	Vent hose	28.	Button-head screw (2 each)
7.	Fuel/water separator bracket	18.	Fuel cap	29.	Tank bracket
8.	Flange nut (2 each)	19.	Flange nut (4 each)	30.	Screw
9.	Fuel/water separator	20.	Plain washer (2 each)	31.	Elbow fitting (return)
10.	Fuel hose	21.	Rubber washer (2 each)	32.	Cable tie
11.	Fuel pump	22.	Tube spacer	33.	Stand pipe (fuel supply)

⚠ 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.**

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.

Priming the Fuel System

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 a fuel hose). To prime the fuel system, ensure that the fuel tank has fuel in it. Then, turn the key switch to the RUN position for 10 to 15 seconds which allows the fuel pump to prime the fuel system. Do not turn the key switch to the START position to prime the fuel system.

Removing the 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. Unlatch the hood and raise it.
3. Remove the negative battery cable from the negative post of the battery.
4. Allow the engine to completely cool.
5. Raise the operator seat.
6. Use a fuel transfer pump to remove the fuel from the fuel tank.

Removing the Fuel Tank (continued)

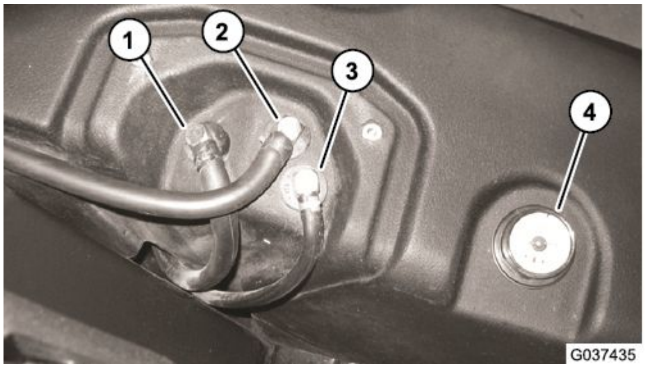

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Figure 13

1. Fuel supply hose
2. Vent hose
3. Fuel return hose
4. Fuel gauge

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7. Remove the 2 button-head screws (item 28 in Figure 12) that secure the cover plate to the fuel tank, and remove the cover plate.

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

8. Disconnect the fuel supply hose (item 1 in Figure 13), vent hose, and fuel return hose from fittings in the top of the fuel tank.
9. Cover or plug the fuel hoses and fuel filter fittings openings to prevent contamination.
10. Remove the 2 flange nuts from threaded ends of the tank bracket (item 29 in Figure 12), and remove the tank bracket.
11. Loosen and remove the screw (item 30 in Figure 12), rubber washer, plain washer, and flange nut that secure the rear of the fuel tank to the frame.
12. Loosen and remove the screw (item 26 in Figure 12), flat washer, plain washer, rubber washer, and flange nut that secure the front of the fuel tank to the frame.
13. Locate and retain the spacer and tube spacer (items 24 and 22 in Figure 12) from the fuel tank.
14. Lift the fuel tank from the machine.

Note: For information regarding the fuel pump testing; refer to Fuel Pump (page 5–94).

Note: Refer to the *Operator's Manual* for the fuel/water separator and fuel filter service information.

Installing the Fuel Tank

1. If the elbow fittings (item 6 in Figure 12) were removed from the fuel/water separator, apply thread sealant to the fittings before installing.
2. Align the fuel tank to the machine.
3. Secure the fuel tank to the frame as follows:
   A. Secure the rear of the fuel tank with the tube spacer (item 22 in Figure 12), screw, rubber washer, plain washer, and flange nut.

   B. Secure the front of the fuel tank with the spacer (item 24 in Figure 12), screw, flat washer, plain washer, rubber washer, and flange nut.

   Note: Do not overtighten the flange nuts on the tank bracket.

Installing the Fuel Tank (continued)

   C. Position the tank bracket (item 29 in Figure 12) to the fuel tank and frame. Secure the bracket with the 2 flange nuts. Tighten the flange nuts evenly and only sufficient so that the tank is snug to the frame.

4. Use the labels that you attached during fuel tank removal to correctly connect the hoses to the stand pipe (item 33 in Figure 12), return elbow fitting, and 90° elbow fitting on the top of the fuel tank. Secure the hoses with the hose clamps.

5. Apply anti-seize lubricant to the threads of the 2 button-head screws (item 28 in Figure 12) that secure the cover plate to the fuel tank. Install the cover plate and tighten the screws to **2.3 to 3.3 N·m (20 to 30 in-lb)**.

6. Connect the negative battery cable to the negative battery post.

7. Add fuel to the tank and prime the fuel system; refer to Priming the Fuel System (page 3–17).

8. Check the fuel hoses and fittings for leaks.

   Note: Repair all fuel leaks before operating the machine.

9. Lower the hood and secure it with the latches.

10. Lower the operator seat.

Engine

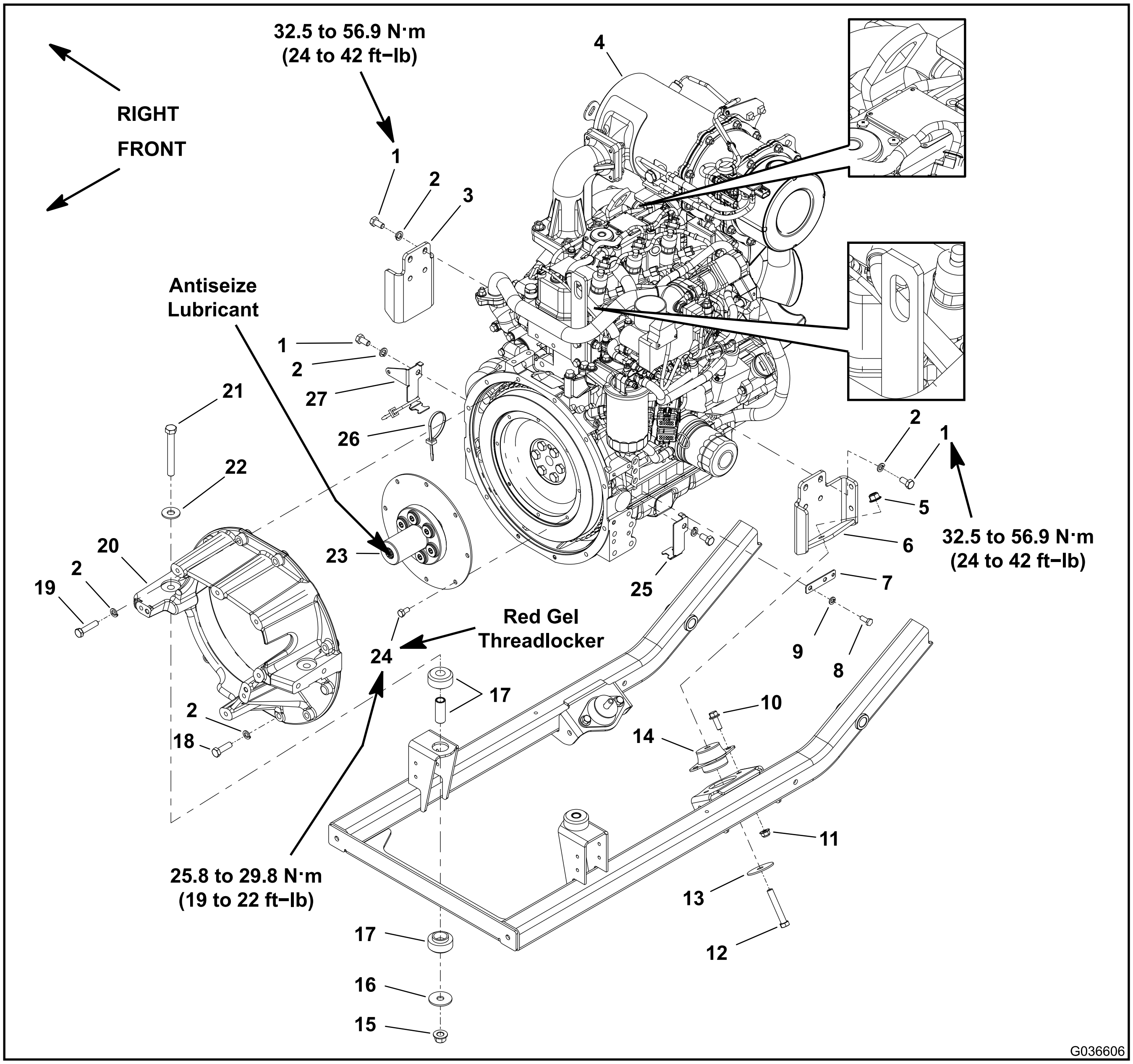

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Figure 14

1. Bolt (10 each)	10. Screw (4 each)	19. Screw (7 each)
2. Lock washer (19 each)	11. Flange nut (4 each)	20. Flywheel housing
3. Right mount (machines without cab)	12. Bolt (2 each)	21. Screw (2 each)
4. Yanmar engine	13. Snubbing washer (2 each)	22. Flat washer (2 each)
5. Flange nut (2 each)	14. Engine mount (2 each)	23. Flywheel coupling
6. Left mount	15. Locknut (2 each)	24. Bolt (8 each)
7. Harness tab	16. Thrust washer (2 each)	25. Left harness bracket
8. Screw (2 each)	17. Rubber mount assembly (2 each)	26. Cable tie (4 each)
9. Lock washer (2 each)	18. Screw (2 each)	27. Right harness bracket

Removing the Engine

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 hood; refer to Removing the Hood (page 6–68).

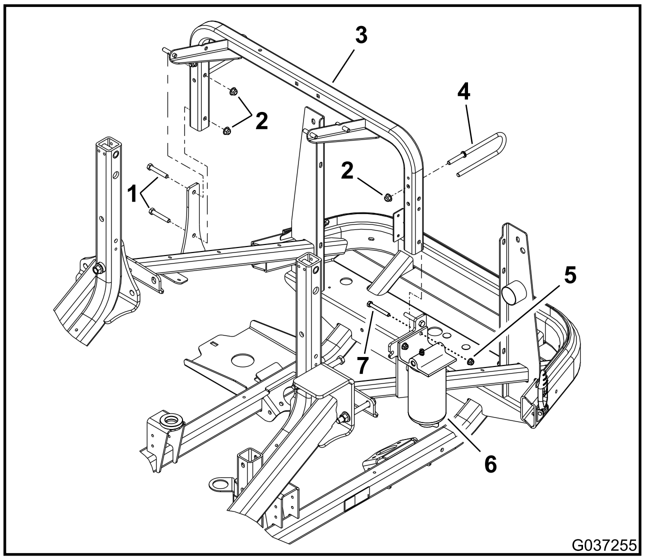

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Figure 15

1. Screw (4 each)	5. Flange nut
2. Flange nut (6 each)	6. Fuel/water separator
3. Cross tube	7. Screw
4. Hose guide (2 each)	

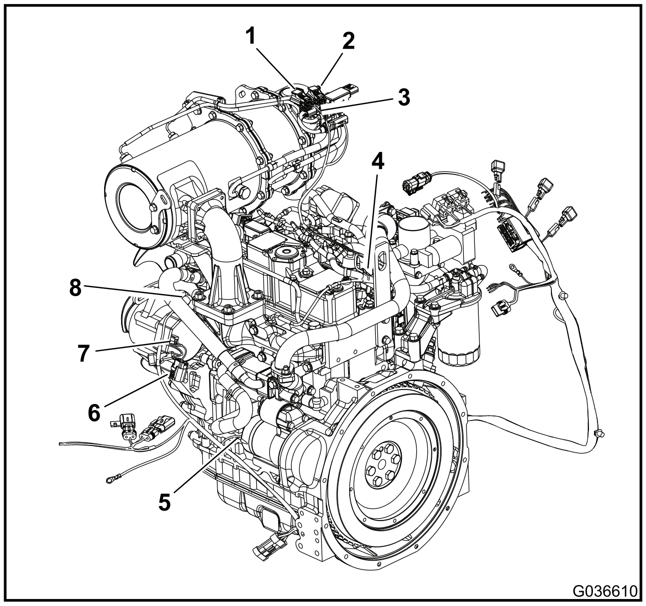

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Figure 16

1. Middle temperature sensor	5. “S” starter
2. Inlet temperature sensor	6. Ring terminal
3. DPF pressure sensor	7. Connector
4. Glow plugs	8. Connector

Removing the Engine (continued)

3. Disconnect both the battery cables at the battery. Disconnect the negative battery cable and then the positive battery cable; refer to Servicing the Battery (page 5–111).
4. Remove both the hydraulic hose guides (item 4 in Figure 15) from the cross tube assembly.
5. Disconnect the air inlet hose from the radiator frame.
6. Disconnect the air inlet hose from the engine intake manifold.
7. Remove the cross tube with air cleaner assembly attached as shown in Figure 15.
8. Remove the radiator and oil cooler assembly; refer to Removing the Radiator (page 3–13).
9. Remove the fan shroud.
10. Disconnect the upper and lower radiator hoses from the engine.
11. Remove the clamp securing the oil cooler hydraulic tube to the machine frame rail.
12. Remove the exhaust tube (Figure 9).
13. Label all the electrical connectors to assure correct assembly. Note the location of cable ties, anchors, and wire routing to assure correct assembly.
    - Disconnect the negative battery cable from the engine block.
    - Disconnect the Toro engine harness from Yanmar engine harness (4 multipin connectors on the left side of the engine).
    - Disconnect the wire harness connector at the oil pressure switch.
    - Disconnect the wire harness from the starter "S" terminal (item 5 in Figure 16).
    - Disconnect the wire harness from the alternator (items 6,7, and 8 in Figure 16).
    - Disconnect the wire harness from the DPF pressure sensor (item 3 in Figure 16) and temperature sensors (items 1 and 2 in Figure 16).
    - Disconnect the wire harness from the glow plug bus (item 4 in Figure 16).
    - Disconnect the battery positive cable and fusible link harness from the starter solenoid post.
14. For assembly purposes, label the fuel hoses. Disconnect the fuel supply hose (item 1 in Figure 18) and return hose from the fuel filter on the engine.

Removing the Engine (continued)

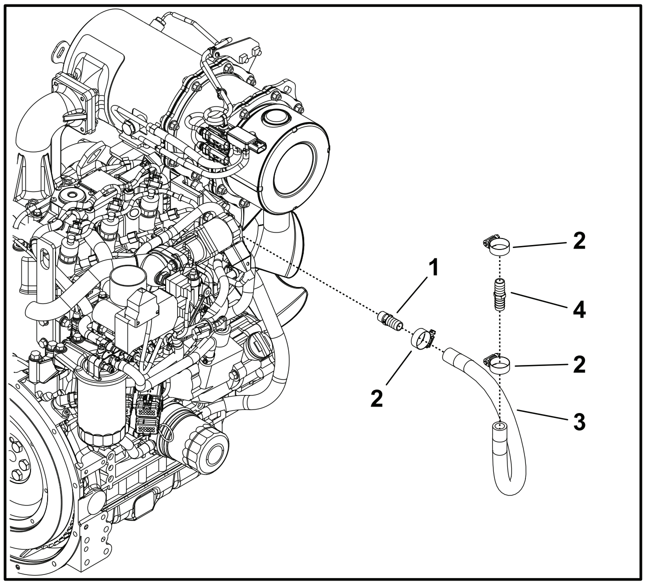

Figure 17

1.	Straight fitting	3.	Heater hose
2.	Hose clamp (3 each)	4.	Straight fitting

15. Cover or plug the fuel hoses and fuel filter fittings openings to prevent contamination.
16. On the machines with an operator cab:
    A. Remove the air conditioning compressor from the compressor bracket; refer to Removing the Air Conditioning Compressor (page 8–6). Position the compressor away from engine and ensure that you do not damage the compressor or hoses. Ensure that the compressor remains in a horizontal position. Support the compressor to ensure that it does not fall during engine removal.

    B. Disconnect the cab heater hose from the engine thermostat housing (Figure 17).

    Note: When lifting the engine using the following procedure, the flywheel housing and transmission will remain in the machine.

⚠ 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 188 kg (414 lb).

IMPORTANT

Do not lift the engine with the lift eyes on the DPF.

17. 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.

Removing the Engine (continued)

18. Remove the 9 screws (items 18 and 19 in Figure 14) and 9 lock washers that secure the flywheel housing to the engine.
19. Remove the flange nuts (item 5 in Figure 14), snubbing washers, and bolts that secure the engine and flywheel housing to the 4 engine mounts.

IMPORTANT

When removing the engine ensure that you do not damage the engine, flywheel housing, fuel hoses, hydraulic lines, electrical harness or other parts. Also, ensure that the transmission does not shift during engine removal.

20. Support the transmission to prevent it from moving during engine removal.

⚠ CAUTION ⚠

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

21. Slide the engine rearward to separate it from the transmission input shaft. Carefully raise the engine from the machine.
22. Inspect the 4 rubber engine mounts for the wear or damage. Replace if necessary.
23. If necessary, remove the 8 bolts (item 24 in Figure 14) that secure the flywheel coupling to the engine, and remove the flywheel coupling from the engine.
24. Plug and cap all the engine openings.

Installing the Engine

IMPORTANT

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

1. Apply anti-seize lubricant to the splines of the transmission input shaft.
2. If removed, install the flywheel coupling to the engine with the 8 bolts (item 24 in Figure 14), apply red gel threadlocker to the bolts, and torque the bolts to **25.8 to 29.8 N·m (19 to 22 ft-lb)**.
3. If the 2 mounts (items 3 and 6 in Figure 14) were removed, install the 2 mounts to the engine with the 8 bolts and 8 lock washers; torque the bolts to **32.5 to 56.9 N·m (24 to 42 ft-lb)**.

⚠ 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 188 kg (414 lb).

4. Support the transmission to prevent it from moving during the engine installation.

IMPORTANT

Do not lift the engine with the lift eyes on the DPF.

5. 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.
6. Carefully lower the engine into the machine, align the engine with the transmission input shaft, and move the engine toward the flywheel housing.

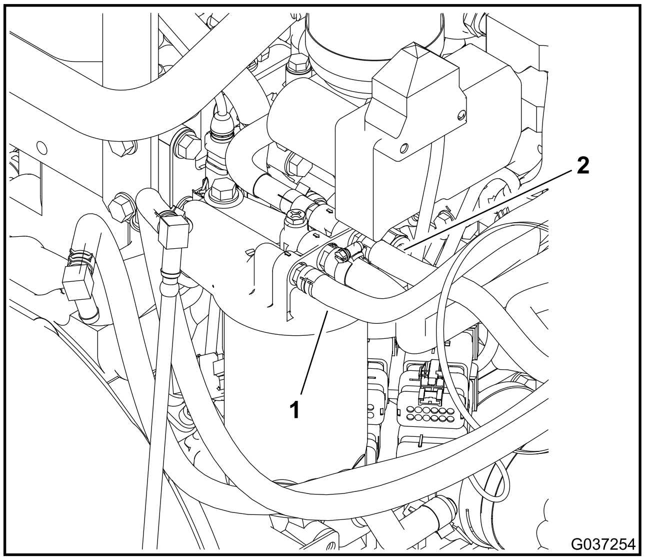

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Figure 18

1. Fuel supply hose
2. Return hose

IMPORTANT

When installing the engine ensure that you do not damage the engine, flywheel housing, fuel hoses, hydraulic lines, electrical harness or other parts. Also, ensure that transmission does not shift during engine installation.

7. Align the engine with the engine mounts and install a flange nut, snubbing washer, and bolt through each of the 4 engine mounts but do not fully tighten the flange nuts.
8. Align the flywheel housing with the engine and install the 9 screws (items 18 and 19 in Figure 14) and 9 lock washers Once all screws have been installed, tighten the screws to secure the flywheel housing to the engine.
9. Tighten the bolt at each of the 4 engine mounts.
10. Remove all of the covers and plugs from the engine openings that you placed while removing the engine.
11. Use the labels that you attached during removal to correctly connect the fuel supply hose (item 1 in Figure 18) and return hose to the fuel filter.

12. On the machines with an operator cab:
    A. Install the air conditioning compressor to the compressor bracket; refer to Installing the Air Conditioning Compressor (page 8–8). Ensure that the compressor drive belt is properly tensioned.
    B. Connect the cab heater hose to the engine thermostat housing (Figure 17).
13. Use the notes that you recorded during removal and connect all the electrical connectors.
    - Connect the Toro engine harness to Yanmar engine harness (4 multipin connectors on the left side of the engine).
    - Connect the wire harness connector to the oil pressure switch.
    - Connect the wire harness to the starter "S" terminal.
    - Connect the wire harness to the alternator (items 6,7, and 8 in Figure 16).
    - Connect the wire harness to the DPF pressure sensor (item 3 in Figure 16) and temperature sensors (items 1 and 2 in Figure 16).
    - Connect the wire harness to the glow plug bus.
    - Connect the battery positive cable and fusible link harness to the starter solenoid post.
    - Connect the negative battery cable to the engine block.

    Note: When securing the negative battery cable (ground) to the engine, ensure that the lock washer is between the ground cable and engine flange. Torque the flange nut to **20 to 25 N·m (175 to 225 in-lb)** and apply a layer of terminal protector (Toro Part No. 107-0392) to prevent corrosion.
14. Install the exhaust tube to the engine (Figure 9).
15. Install the radiator and oil cooler assembly to the machine; refer to Installing the Radiator (page 3–15).
16. Install the cross tube and air cleaner assembly as shown in Figure 15.
17. Connect both the battery cables to the battery. First, connect the positive battery cable and then the negative battery cable; refer to Servicing the Battery (page 5–111).
18. Check the engine-oil level and adjust as necessary.
19. Install the hood; refer to Installing the Hood (page 6–68).
20. Ensure that all the hoses, tubes, and wires are clear of moving parts and secured to their original locations.
21. Prime the fuel system; refer to Priming the Fuel System (page 3–17).
22. Operate the machine checking for coolant, hydraulic fluid or fuel leaks.
23. Check the engine coolant and hydraulic fluid levels before returning the machine to service.

Chapter 4

Hydraulic System

Table of Contents

Additional Reference Materials

Parker Torqmotor™ Service Procedure (TC, TB, TE, TJ, TF, TG, TH and TL Series)

Eaton Parts and Repair Information: 5 Series Steering Control Units

Specifications

Hydraulic System

Item	Description
Transmission	Kanzaki dual, variable displacement traction piston pumps with integral charge pump and multi-disc PTO clutch
Maximum traction pump displacement (per revolution)	18 cm^3 (1.1 in^3)
Traction circuit relief pressure (forward and reverse)	27,600 kPa (4,000 psi)
Charge pump displacement (per revolution)	6 cm^3 (0.37 in^3)
Charge pressure	810 to 850 kPa (117 to 123 psi)
Gear pump	Casappa single section, positive displacement gear type pump
Displacement (per revolution)	6.7 cm^3 (0.41 in^3)
Implement relief pressure	12,500 kPa (1,800 psi)
Wheel motors	Parker geroller motor, LSHT Series
Displacement (per revolution)	280 cm^3 (17.1 in^3)
Steering control valve	Eaton steering unit, Series 5
Displacement (per revolution)	100 cm^3 (6.1 in^3)
Hydraulic filter	Spin-on cartridge type
Hydraulic reservoir in-line suction strainer	100 mesh (in reservoir)
Hydraulic fluid capacities (approximate)	
Hydraulic fluid change (hydraulic tank and transmission)	17 L (18 US qt)
Hydraulic system (all components and lines)	21.3 L (22.5 US qt)
Hydraulic fluid	Refer to the *Operator's Manual*

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.

Pushing the Traction Unit

In case of emergency, the machine can be pushed for a very short distance. However, Toro does not recommend this as a standard procedure.

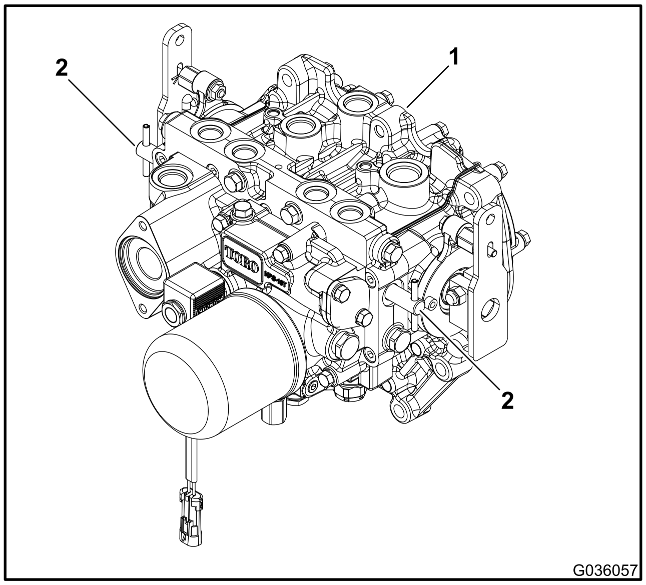

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Figure 19

1. Transmission	2. Bypass valve

1. Ensure that the engine is not running.
2. Find the 2 bypass valves on the transmission (Figure 19). Loosen the 2 valves (rotate them counterclockwise) 1 to 2 turns.

IMPORTANT

Pushing the machine faster than 2 mph can damage the drive system. If you must move the machine a considerable distance (more than a few feet), transport it on a truck or trailer.

3. Slowly push the machine.

IMPORTANT

Do not start the engine when the bypass valves are open or transmission damage will occur.

4. Before you start the engine, tighten the 2 bypass valves to close them; torque the valves to **7 to 9 N·m (62 to 79 in-lb)**.

Releasing Pressure from the Hydraulic System

Release all the pressure in the hydraulic system before you work on the hydraulic system.

- Release the hydraulic pressure from the traction circuit as follows:

  Note: If you park the machine on an incline or slope, the pressure in the traction circuit does 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.
- Release the hydraulic pressure from the lift circuit as follows:
  1. Fully lower the cutting deck onto the solid blocks.
  2. Turn the key switch to the OFF position and allow the engine to stop.
  3. After lowering the cutting deck, ensure that the lift cylinder does not support the cutting deck.
- Release the hydraulic pressure from the steering circuit as follows:
  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 in both directions.
- Turn the key switch to the OFF position to release the hydraulic pressure from the PTO circuit.
- If the machine is equipped with optional hydraulic kits (e.g., Quick Attach System), release the hydraulic pressure from the kits as follows:
  1. Fully lower and support the attachments.
  2. With the engine stopped, turn the key switch to the RUN position and move the hydraulic kit switches to ON position.
  3. As the hydraulic solenoids are energized, the circuit pressure will be released.

Traction Circuit Component Failure

The traction circuit of the Groundsmaster 360 machines is a closed loop system that includes the dual piston (traction) pump and 4 wheel motors. If a component failure occurs in the traction circuit (e.g., traction (piston) pump or wheel motor), 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 High Flow Hydraulic Filter Kit (page 4–30). 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., traction (piston) pump or wheel motor). Using a high flow hydraulic-fluid filter will remove contaminates 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 direction. When you are certain that the filter has removed the contaminates from the hydraulic fluid of the traction circuit, remove the filter. Refer to Filtering the Closed-Loop Traction Circuit (page 4–72) 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 in the traction circuit. 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 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.

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 Hose and Tube (O-Ring Face Seal Fitting) (page 4–8).

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.

⚠ **WARNING** ⚠

Release all pressure in the hydraulic system before performing any work on the system; refer to Releasing Pressure from the Hydraulic System (page 4–5).

- **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.**

Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting)

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.

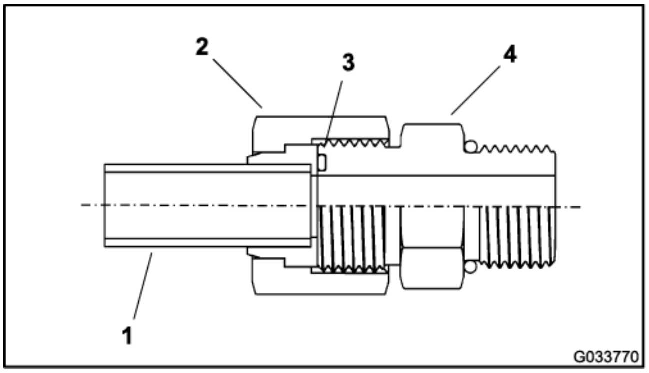

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Figure 20

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

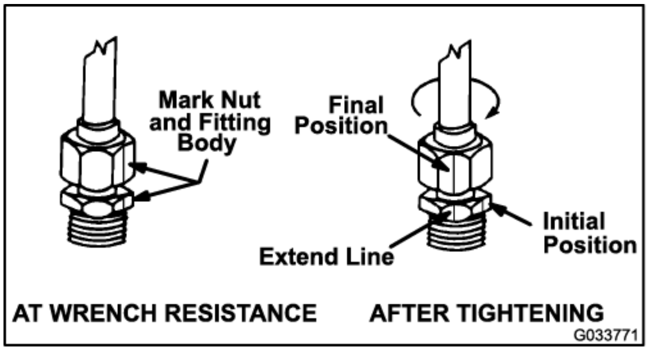

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Figure 21

2. To help prevent a hydraulic leak, replace the face seal O-ring when you open the connection. Ensure that the O-ring is installed and correctly seated in the groove of the fitting. Lightly lubricate the O-ring with clean hydraulic fluid.
3. Align the hose/tube against the body of the fitting so that the flat face of the hose/tube sleeve fully touches the O-ring in the fitting (Figure 20).
4. 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 4–9). This procedure to tighten the swivel nut requires a drive-adapter wrench (e.g., crowfoot wrench).

   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 2–5).
5. 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 (Figure 21).

   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)**.

Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (continued)

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.

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 4–9).

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

Hose/Tube Installation Torque Table

Fitting Dash Size	Hose/Tube Side Thread Size (inch(es)—threads per inch)	Installation Torque
4	9/16—18	25 to 29 N·m (18 to 22 ft-lb)
6	11/16—16	37 to 44 N·m (27 to 33 ft-lb)
8	13/16—16	51 to 63 N·m (37 to 47 ft-lb)
10	1—14	82 to 100 N·m (60 to 74 ft-lb)
12	1–3/16—12	116 to 142 N·m (85 to 105 ft-lb)
16	1–7/16—12	150 to 184 N·m (110 to 136 ft-lb)
20	1–11/16—12	190 to 233 N·m (140 to 172 ft-lb)

Flats From Wrench Resistance Table

Size	FFWR
4 (1/4 inch nominal hose or tubing)	1/2 to 3/4
6 (3/8 inch)	1/2 to 3/4
8 (1/2 inch)	1/2 to 3/4
10 (5/8 inch)	1/2 to 3/4
12 (3/4 inch)	1/3 to 1/2
16 (1 inch)	1/3 to 1/2

Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fitting into the Component Port)

Installing the Non-Adjustable Fittings

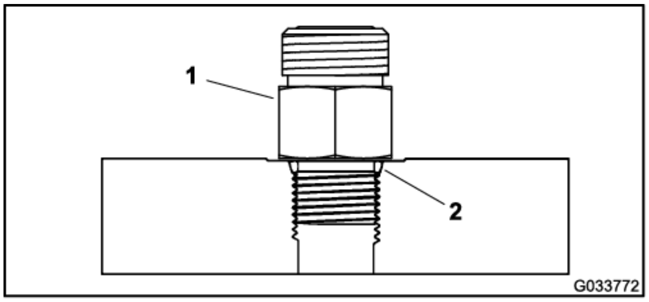

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Figure 22

1. Fitting
2. O-ring

Installing the Non-Adjustable Fittings (continued)

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 installing the fitting into the port, determine the material of which the port is made. Installing a fitting into an aluminum port requires a reduced 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 4–10).

   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 2–5).

5. If a torque wrench is not available or if space at the port prevents the use of a torque wrench, use the alternative procedure Flat From Finger Tight Table (page 4–10) 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 FFFT. If the port material is aluminum, tighten the fitting to 60% of the listed FFFT.

Fitting Installation Torque Table

Fitting Dash Size	Fitting Port Side Thread Size (inch(es)—threads per inch)	Installation Torque Into Steel Port	Installation Torque Into Aluminum Port
4	7/16—20	21 to 25 N·m (15 to 19 ft-lb)	13 to 15 N·m (9 to 11 ft-lb)
5	1/2—20	25 to 29 N·m (18 to 22 ft-lb)	15 to 20 N·m (11 to 15 ft-lb)
6	9/16—18	47 to 56 N·m (34 to 42 ft-lb)	28 to 35 N·m (20 to 26 ft-lb)
8	3/4—16	79 to 97 N·m (58 to 72 ft-lb)	48 to 58 N·m (35 to 43 ft-lb)
10	7/8—14	135 to 164 N·m (99 to 121 ft-lb)	82 to 100 N·m (60 to 74 ft-lb)
12	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	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	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	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 Table

Size	FFFT
4 (1/4 inch nominal hose or tubing)	1.00 ± 0.25
6 (3/8 inch)	1.50 ± 0.25
8 (1/2 inch)	1.50 ± 0.25
10 (5/8 inch)	1.50 ± 0.25

Installing the Non-Adjustable Fittings (continued)

Flat From Finger Tight Table (continued)

Size	FFFT
12 (3/4 inch)	1.50 ± 0.25
16 (1 inch)	1.50 ± 0.25

Installing an Adjustable Fitting

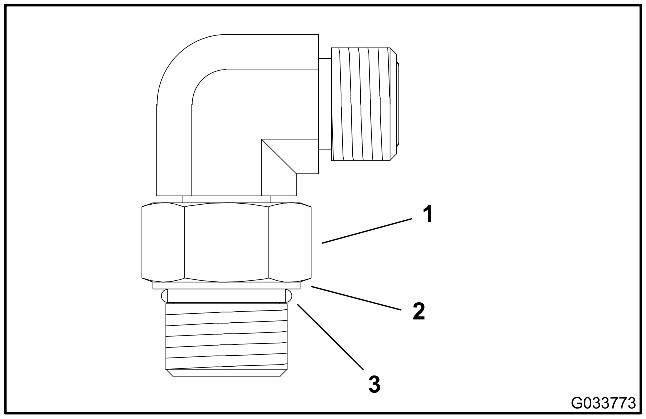

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Figure 23

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

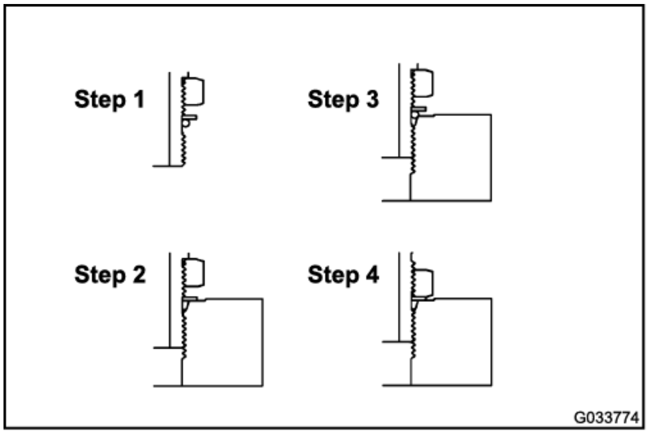

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Figure 24

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 24).

Installing an Adjustable Fitting (continued)

IMPORTANT

Before installing the fitting into the port, determine the material of which the port is made. Installing a fitting into an aluminum port requires a reduced installation torque.

5. Install the adjustable fitting into the port by hand until the washer contacts the face of the port (Step 2 in Figure 24).
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 24). Do not rotate the adjustable fitting more than 1 turn counterclockwise.
7. 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 4–10). This tightening procedure requires a drive-adapter wrench (e.g., crowfoot wrench).

   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 2–5).
8. If a torque wrench is not available or if space at the port prevents the use of a torque wrench, use the alternative procedure Flat From Finger Tight Table (page 4–12) given below;
   - A. Hold the fitting in the correct alignment with a wrench and, if the port material is steel, tighten the locknut with a second wrench to the listed FFFT (Step 4 in Figure 24).
   - B. If the port material is aluminum, tighten the fitting to 60% of the listed FFFT; refer to the Flat From Finger Tight Table (page 4–12).

Flat From Finger Tight Table

Size	FFFT
4 (1/4 inch nominal hose or tubing)	1.00 ± 0.25
6 (3/8 inch)	1.50 ± 0.25
8 (1/2 inch)	1.50 ± 0.25
10 (5/8 inch)	1.50 ± 0.25
12 (3/4 inch)	1.50 ± 0.25
16 (1 inch)	1.50 ± 0.25

Hydraulic Schematics

Note: Refer to the Hydraulic Schematic in Appendix A (page A–1) - Foldout Drawings.

Hydraulic Flow Diagrams

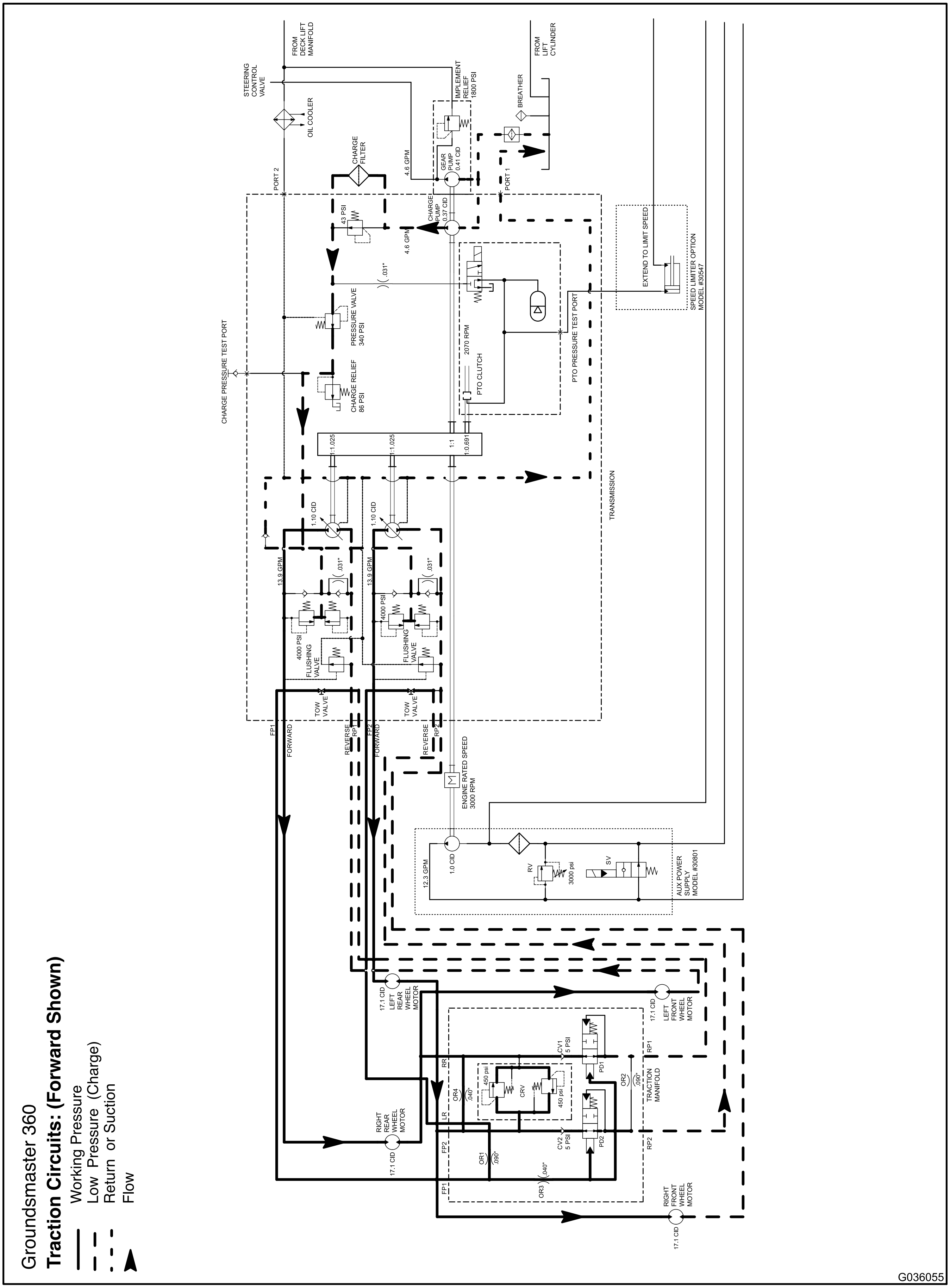

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Figure 25

Traction Circuits

The traction system of the Groundsmaster 360 machines consists of a transmission that is directly connected to, and driven by a coupler attached to the engine flywheel. The traction components include a transmission with 2 independent closed loop circuits, 2 rear wheel motors, 2 front wheel motors, and CrossTrax™ traction manifold assembly. Each of the closed loop circuits includes a variable displacement, slipper foot design piston pump which provides hydraulic flow for 2 wheel motors. One piston pump provides flow to the right rear and left front wheel motor, and the other piston pump supplies flow to the left rear and right front wheel motor. The swash plate in each of these piston pumps is controlled by the operator traction pedal through a linkage system.

The angle of the swash plate determines the pump flow and ultimately traction speed. When a traction pedal is moved a small amount, a small swash plate rotation results in low pump output and lower traction speed. When the traction pedal is moved fully, the pump swash plate rotates fully to provide maximum pump output flow and traction speed.

With the engine running and the traction pedal in the NEUTRAL position, the swash plates of the piston pump are held in the vertical position, providing no flow to either of the wheel motors and the machine remains stationary. The transmission reverse check valves include an orifice which makes it easier to locate the transmission neutral position.

Forward Direction

When the traction pedal is pushed forward, the rod connected to the traction linkage positions the swash plates in the piston pumps to provide hydraulic fluid flow from the transmission (port A and C). This fluid flows to the rear wheel motors and then to the opposite front wheel motor (e.g., right rear then left front) and turns the motors in the forward direction. The fluid flow from the front wheel motor returns to the transmission (port B or D) and is continuously pumped while the traction pedal is pushed forward. As the traction load increases, the forward traction circuit pressure can increase to the relief-valve setting of 27,600 kPa (4,000 psi). If the circuit pressure is more than the relief-valve setting, fluid flows through the forward relief valve in the transmission to the low-pressure side of the closed loop traction circuit.

The piston pumps use a small amount of hydraulic fluid for internal lubrication. The fluid is designed to leak across the pump parts into the transmission case drain. This leakage results in the loss of hydraulic fluid from the closed loop traction circuits that must be replaced. A charge pump in the transmission supplies hydraulic flow for maintaining 810 to 850 kPa (117 to 123 psi) to the low-pressure side of the 2 traction circuits. The charge pump also provides pressure for the transmission PTO drive system. The charge pump replenishes the closed loop traction circuits with fluid from the hydraulic tank. The charge-relief valve in the transmission maintains sufficient pressure so that the charge-pump flow is guided past check valves to the low-pressure side of each traction circuit. The charge-pump flow in excess of system requirements is released through the charge-relief valve back to the hydraulic tank.

When operating the machine in a forward, straight direction (not turning), transmission fluid flow to the 2 traction circuits routes from a rear wheel motor to the opposite front wheel motor. Both the traction circuits require similar flow to drive the wheel motors so minimal circuit flow change is provided through the traction manifold assembly and balancing fluid lines.

When turning the machine in a forward direction, the 4 wheel motors require different flows due to different wheel distances traveled going around the corner. The balancing lines and the traction manifold assembly allow the 2 traction circuits to be connected so differences in the wheel motor flows can be achieved.

Forward Direction (continued)

In the forward direction, pilot directional valves PD1 and PD2 in the traction manifold assembly are shifted. These shifted valves along with the check valves (CV1 and CV2) help to provide fluid where needed in the traction circuits for optimal traction operation when turning.

The 2 transmission traction circuits include flushing valves (one for each traction circuit) in the piston pump that bleed off a small amount of hydraulic fluid for cooling of the closed loop traction circuits. The flushing valves are opened only during forward direction operation. When the flushing valves are unseated, some fluid from the low-pressure side of the traction loop is returned to the hydraulic tank. The fluid loss from the closed loops through the flushing valves is replaced by the charge pump.

The traction manifold assembly includes a bi-directional relief valve (CRV) and orifice fittings to prevent pressure differences in the 2 circuits reducing tire scuffing when turning.

To provide 4-wheel dynamic braking when the traction pedal is released, the pilot directional valves PD1 and PD2 in the traction manifold assembly shift to their normally closed position. This disables the check valves (CV1 and CV2) ensuring 4-wheel hydrostatic braking.

Reverse Direction

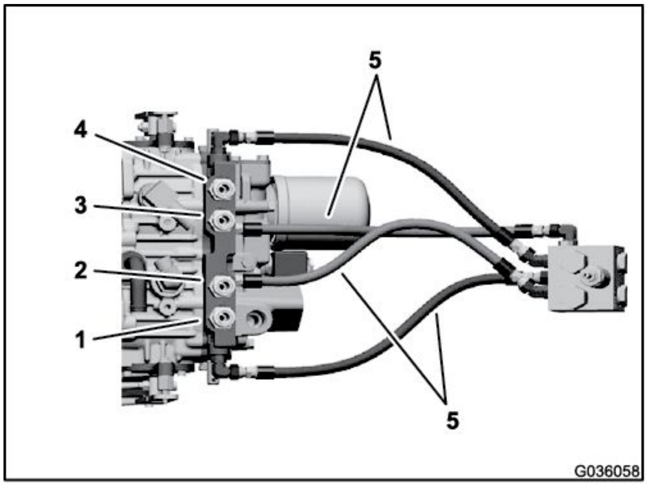

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Figure 26

1. Port A
2. Port B
3. Port C
4. Port D
5. Balancing hose

The traction circuit operates essentially the same in reverse as it does in the forward direction.

When a traction pedal is pushed for reverse, the linkage connected to the pedal positions the swash plates in both transmission-piston pumps to provide hydraulic fluid flow from the transmission (port B and D). This fluid flows to the front wheel motors and then on to the rear wheel motors turning the motors in the reverse direction. The fluid flow from the rear wheel motors return to the transmission (port A and port C) and is continuously pumped while the traction pedal is pushed for reverse.

In the reverse direction, transmission pump flow is routed to a front wheel motor and then to the opposite rear wheel motor (e.g., the right front and then to the left rear). The reverse traction circuit relief valve setting is 27,600 kPa (4,000 psi).

Reverse Direction (continued)

In the reverse direction, the pilot directional valves PD1 and PD2 in the traction manifold assembly are not shifted. This disables the check valves (CV1 and CV2) ensuring optimal 4-wheel drive traction while in reverse.

Because the vehicle speed in the reverse direction is typically reduced, there is less hydraulic flow through the traction circuit. This lower flow results in less circuit flow change necessary through the traction manifold assembly and balancing fluid lines.

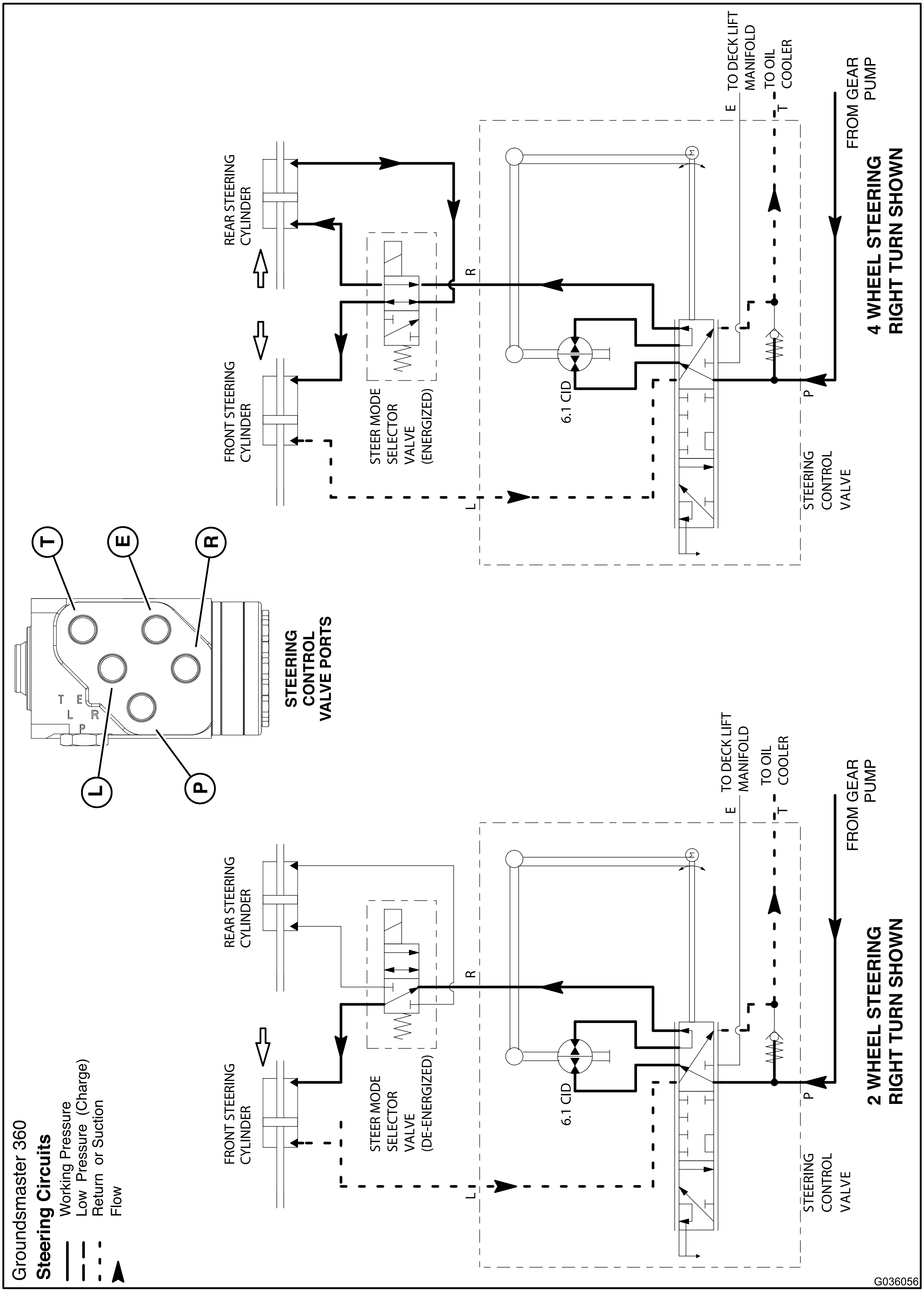

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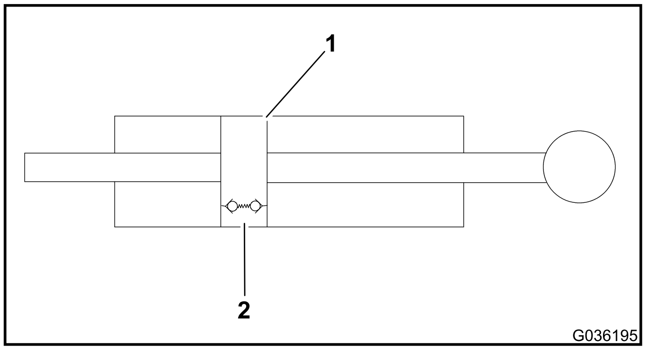
Figure 27

Steering Circuit

The Groundsmaster 360 Quad Steer™ all wheel steering system uses Ackermann four wheel steering. Ackermann steering enables the inside and outside wheels to turn around a common pivot point. This results in reduced turf damage and greater operator response when turning.

A single-section gear pump is directly coupled to the transmission which is driven by the engine. This gear pump supplies hydraulic flow for both the steering and lift/lower circuits. The hydraulic pump flow from the gear pump is routed to the steering control valve first so that the steering circuit has priority. The pump takes its suction from the hydraulic tank. The steering circuit pressure is limited to 12,500 kPa (1,800 psi) by a relief valve located in the gear pump. Two steering cylinders are used to provide 4 wheel steering: one cylinder turns the front wheels and the second cylinder turns the rear wheels.



g036195

Figure 28

1. Cylinder piston
2. Check valve assembly

The steering control valve includes a check valve that allows steering operation when the engine is not running. The steering wheel rotation with the engine shut off causes the fluid flow from the steering control gerotor. The check valve opens in this situation to allow the fluid flow from the steering control to the steering cylinder in a closed loop.

To allow for synchronization of the front and rear steering cylinders, both the steering cylinders include an internal re-phasing check valve assembly in the cylinder piston (Figure 28). While rotating the steering wheel for a turn when in 4 wheel steer (either right or left), the cylinder check valve will open when the cylinder is fully extended or retracted. After both cylinders have moved fully, the 4 wheel steering system has been synchronized. If the steering wheel continues to be turned, the check valves will stay open and will allow flow through the circuit.

With the steering wheel in the neutral position and the engine running, gear pump flow enters the steering control valve at the P port and goes through the steering control spool valve, bypassing the rotary meter and steering cylinders. The flow leaves the control valve through the E port and is routed to the lift/lower circuit, oil cooler, and transmission case. The transmission case drain allows fluid to return to the hydraulic tank.

The Groundsmaster 360 machine includes the feature of allowing the operator to choose between 2 or 4 wheel steering. The steering selector switch on the control panel is used to control the hydraulic steering system for this feature.

2 Wheel Steering

When the front of the steering selector switch is pressed with the wheels directed straight forward, the steering will only be active on the front wheels. This position

2 Wheel Steering (continued)

is recommended for transporting the machine. The switch indicator light will be illuminated when the machine is in the 2 wheel steering operation.

In this switch position, the steering control manifold solenoid valve is not energized. The flow from the steering control valve in either steering direction is directed only to the front steering cylinder. The rear steering cylinder remains in the centered, straight forward position.

4 Wheel Steering

When the rear of the steering selector switch is pressed with the wheels directed straight forward, the 4 wheel steering will be active. The switch indicator light will not be illuminated when the 4 wheel steering is active.

In this switch position, the steering control manifold solenoid valve is energized. The flow from the steering control valve in either steering direction is directed to both the front and rear steering cylinders.

Right Turn

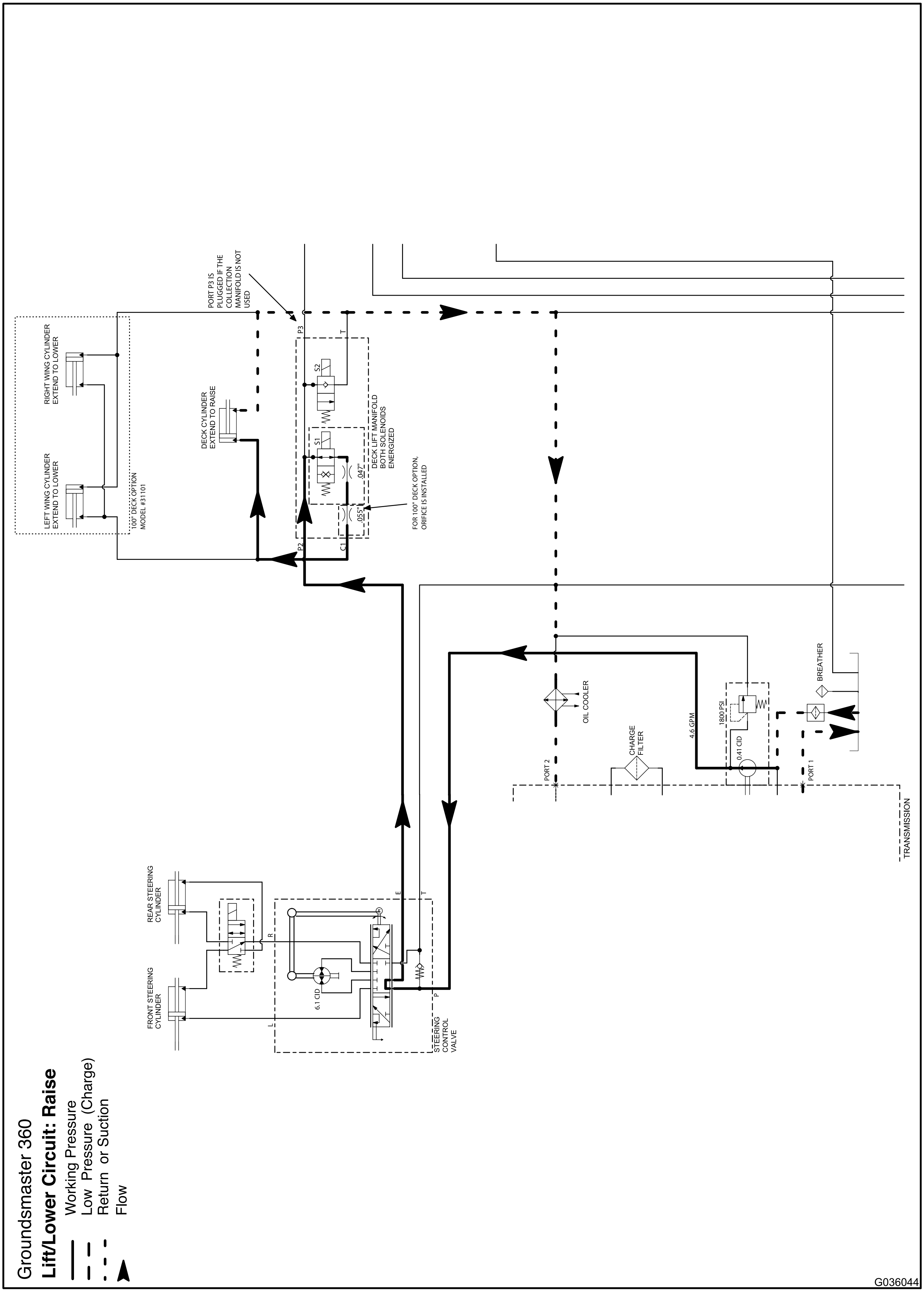
When a right turn is made with the engine running, the turning of the steering wheel positions the steering control spool valve so that the gear pump flow is directed through the bottom of the spool. The flow entering the steering control valve at the P port goes through the spool, is routed through rotary meter and out the control valve R port. This flow moves to the steer mode selector valve and then to the rear steering cylinder to retract the cylinder and turn the rear wheels in the direction for a right turn. The hydraulic fluid displaced from the retracting rear cylinder is directed to the front steering cylinder to retract that cylinder and turn the front wheels in the direction for a right turn. The rotary meter ensures that the fluid flow to the steering cylinders is proportional to the amount of turning on the steering wheel. The fluid leaving the front steering cylinder flows back through the steer mode selector valve, steering control spool valve, and then out of the steering control valve through the T port and is routed to the oil cooler and transmission case.

The steering control valve returns to the NEUTRAL position when turning is completed.

Left Turn

When a left turn is made with the engine running, the turning of the steering wheel positions the steering control spool valve so that the gear pump flow is directed through the top of the spool. The flow entering the steering control valve at the P port goes through the spool, is routed through rotary meter and out the control valve L port. This flow moves to the steer mode selector valve and then to the front steering cylinder to extend the cylinder and turn the front wheels in the direction for a left turn. The hydraulic fluid displaced from the extending front cylinder is directed to the rear steering cylinder to extend that cylinder and turn the rear wheels in the direction for a left turn. The rotary meter ensures that the fluid flow to the steering cylinders is proportional to the amount of turning on the steering wheel. The fluid leaving the rear steering cylinder flows back through the steering control spool valve and then out of the steering control valve through the T port and is routed to the oil cooler and transmission case.

The steering control valve returns to the neutral position when turning is completed.



g036044

Figure 29

Lift/Lower Circuit: Raise

A single-section gear pump is directly coupled to the transmission which is driven by the engine. This gear pump supplies hydraulic flow for both the steering and lift/lower circuits. The gear pump flow is routed to the steering control valve first so that the steering circuit has priority. The pump takes its suction from the hydraulic tank.

When the deck lift switch is in its neutral state, flow from the gear pump bypasses the lift cylinder and is routed through the deck lift manifold directly to the oil cooler and then to the transmission. The transmission case drain allows the hydraulic fluid to return to the hydraulic tank.

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

When the deck lift switch is pressed to the RAISE position and held, the solenoid valves (S1 and S2) in the deck lift manifold are energized to cause the valves to shift. The energized solenoid valve S2 prevents the gear pump flow from bypassing the lift cylinder. The energized solenoid valve S1 allows hydraulic fluid flow from the gear pump to the barrel end of the lift cylinder. The lift cylinder extends, causing the cutting deck to raise. The fluid displaced from the rod end of the lift cylinder is routed to the oil cooler, transmission, and then to the hydraulic tank. An orifice fitting in the deck lift manifold controls the speed of the lift cylinder while raising the cutting deck.

The load on the lift cylinder causes lift circuit pressure to increase. If lift circuit pressure reaches 12,500 kPa (1,800 psi), the relief valve in the gear pump shifts to allow pump flow to return to the hydraulic tank.

When the deck lift switch is released from the RAISE position, both the solenoid valves (S1 and S2) in the deck lift manifold are de-energized. The de-energized solenoid valve S2 allows the gear pump flow to bypass the lift cylinder, returning to the oil cooler, transmission, and then to the hydraulic tank. The de-energized solenoid valve S1 prevents the hydraulic flow to and from the lift cylinder to keep the cutting deck in the raised position.

Lift/Lower Circuit: Raise (continued)

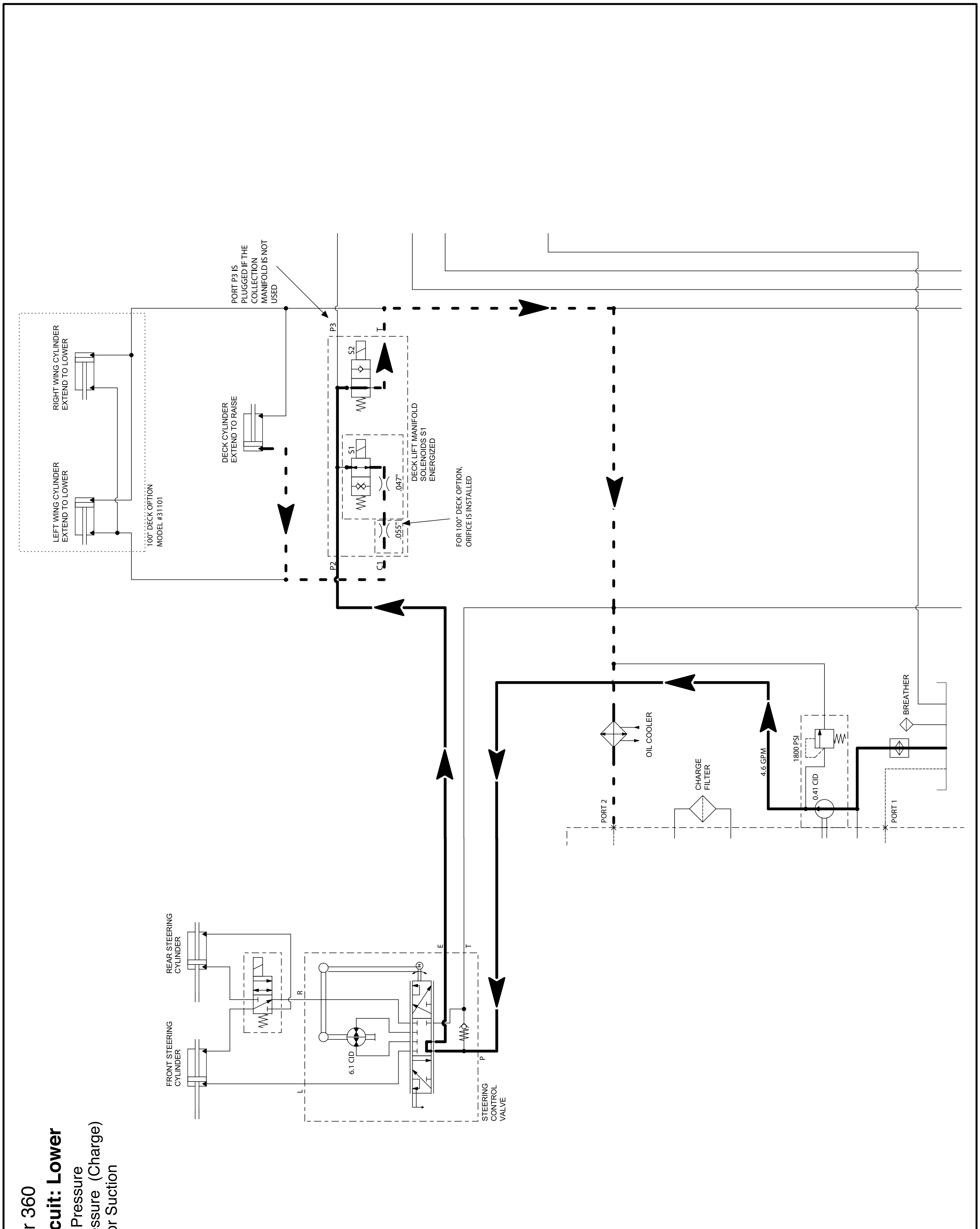


Figure 30

Lift/Lower Circuit: Lower

A single-section gear pump is directly coupled to the transmission which is driven by the engine. This gear pump supplies hydraulic flow for both the steering and lift/lower circuits. The gear pump flow is routed to the steering control valve first so that the steering circuit has priority. The pump takes its suction from the hydraulic tank.

When the deck lift switch is in its neutral state, flow from the gear pump bypasses the lift cylinder and is routed through the deck lift manifold directly to the oil cooler and then to the transmission. The transmission case drain allows the hydraulic fluid to return to the hydraulic tank.

Note: Ensure that the key switch is in the RUN position to allow the cutting deck to be lowered. When the front of the deck lift switch is pressed, the deck will lower fully and enter the float position. The switch has momentary contacts in the lower position so that the switch returns to the center position after being pressed to lower the cutting deck.

When the deck lift switch is pressed to the LOWER position, the solenoid valve S1 in the deck lift manifold is energized to cause the valve to shift. The energized solenoid valve S1 allows a path for fluid flow from the barrel end of the lift cylinder. The weight of the cutting deck causes the lift cylinder to retract, allowing the cutting deck to lower to the ground. An orifice fitting in the deck lift manifold controls the speed of the lift cylinder while lowering the cutting deck.

The circuit operation for lowering the cutting deck is similar to raising it. However, the hydraulic flow is used to retract the lift cylinder and this action allows the cutting deck to lower.

Cutting Deck Float

The cutting deck float allows the fully lowered cutting deck to follow ground surface contours. On the Groundsmaster 360 machines, the deck lift manifold solenoid valve S1 stays energized for the deck float when the deck is fully lowered. This energized solenoid provides an oil passage to and from the lift cylinder to allow cylinder and cutting deck movement while mowing.

Cutting Deck Float (continued)

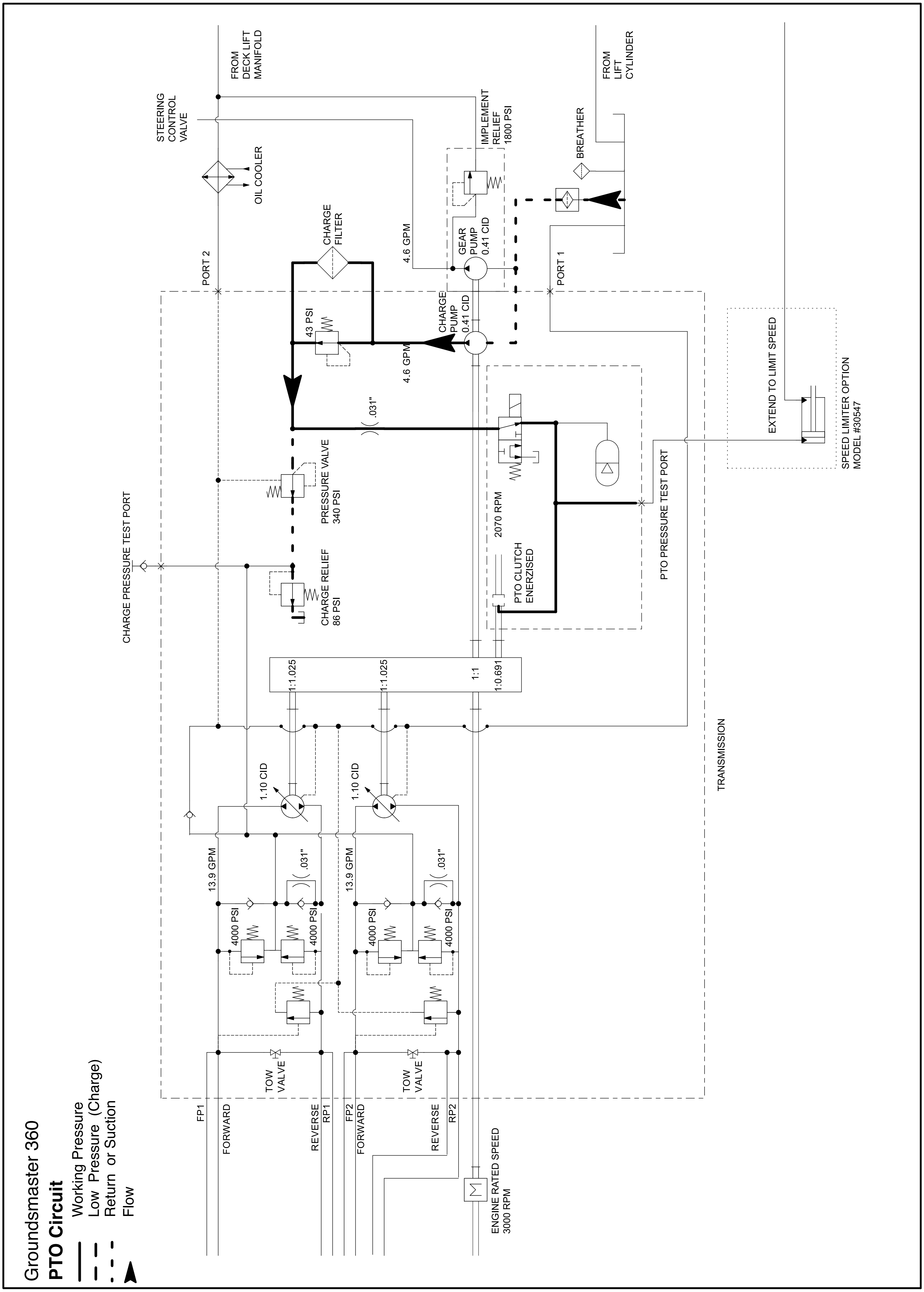


Figure 31

PTO Circuit

The transmission of the Groundsmaster 360 machine consists of a hydraulic, multi-plate clutch that is used to engage the PTO. The hydraulic flow for the PTO clutch engagement is provided by the transmission-charge pump.

When the PTO switch is turned on (pulled up), the transmission solenoid valve is energized to allow the hydraulic flow to engage the PTO clutch. As the PTO clutch engages, an integral PTO brake is released at the same time to allow the rotation of the PTO driveshaft and the cutting deck. An orifice and accumulator in the transmission prevent sudden engagement of the PTO.

⚠ WARNING ⚠

The Groundsmaster 360 machine has a hydraulic accumulator built into the transmission that stores energy by compressing a spring.

This pressure must be released before disconnecting or doing any work on the hydraulic system; refer to Releasing Pressure from the Hydraulic System (page 4–5).

The pressure to the PTO clutch is limited by the pressure valve in the transmission. The pressure valve setting is 1,951 to 2,351 kPa (283 to 341 psi).

When the PTO switch is turned off (pushed down), the transmission solenoid valve is de-energized and the PTO clutch is disengaged. The integral PTO brake is applied to control the stopping rate of the driveshaft and cutting deck. When the transmission solenoid valve is de-energized, the hydraulic accumulator is allowed to discharge stored hydraulic fluid back to the hydraulic tank.

Special Tools

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

Hydraulic Pressure Testing Kit

g031764

Figure 32

Toro 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; refer to Testing the Hydraulic System (page 4–39).

15 GPM Hydraulic Tester Kit (Pressure and Flow)

g031765

Figure 33

Toro Part No. TOR214678

Use this tester to test the hydraulic circuits and components for flow and pressure capacities as recommended in Testing the Hydraulic System (page 4–39). This tester includes the following:

1. Inlet Hose: This hose connects the system circuit to the inlet side of the hydraulic tester.
2. Load Valve: Turn the valve to restrict the flow to create a simulated working load in the circuit.

15 GPM Hydraulic Tester Kit (Pressure and Flow) (continued)

3. Pressure Gauge: A glycerine filled pressure gauge 0 to 34,500 kPa (0 to 5,000 psi) to provide operating circuit pressure.
4. Flow Meter: This meter measures the actual fluid flow in the operating circuit with a gauge rated at 5 to 55 L/minute (1 to 15 gallons/minute).
5. Outlet Hose: A hose from the outlet side of the hydraulic tester that connects to the hydraulic system circuit.
6. Fittings: An assortment of hydraulic fittings are included with this kit.

40 GPM Hydraulic Tester (Pressure and Flow)

g035151

Figure 34

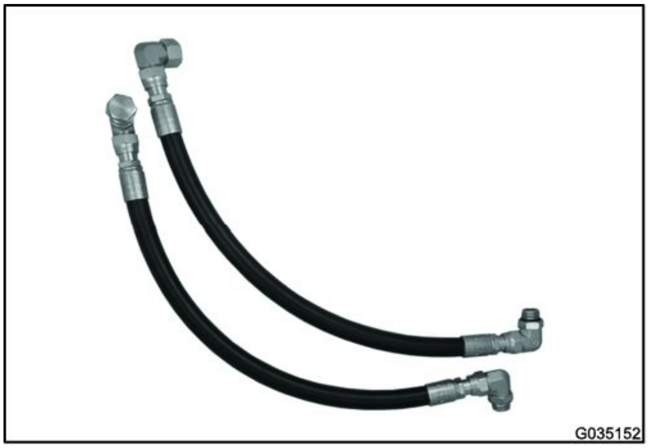
Toro Part No. AT40002

Use this tester to test the hydraulic circuits and components for flow and pressure capacities as recommended in Testing the Hydraulic System (page 4–39). This tester includes the following:

1. Load Valve: Turn the valve to restrict the flow to create a simulated working load in the circuit.
2. Pressure Gauge: A glycerine filled pressure gauge 0 to 35,000 kPa (0 to 5,000 psi) to provide operating circuit pressure.
3. Flow Meter: This meter measures the actual fluid flow in the operating circuit with a gauge rated at 20 to 150 L/minute (4 to 40 gallons/minute).

Note: This tester does not include the hoses; refer to Hydraulic Hose Kit (page 4–29).

Hydraulic Hose Kit



g035152

Figure 35

Toro Part No. TOR6007

This kit includes the fittings and hoses that are used to connect the 40 GPM hydraulic tester (AT40002) or high flow hydraulic filter kit (TOR6011) to the machine hydraulic traction system components.

O-Ring Kit

g033395

Figure 36

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.

High Flow Hydraulic Filter Kit

g035050

Figure 37

Toro Part No. TOR6011

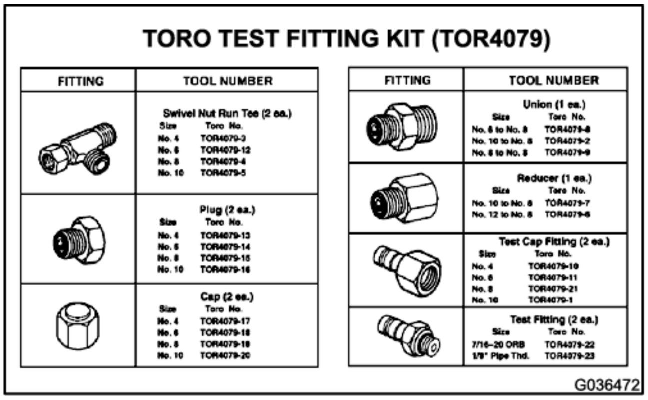
The high flow hydraulic filter kit is designed with large flow (150 L/minute or 40 gallons/minute) and high pressure (34,500 kPa or 5,000 psi) capabilities. This kit provides for bi-directional filtration which prevents filtered unwanted material from entering into the circuit regardless of flow direction.

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 hoses; refer to Hydraulic Hose Kit (page 4–29).

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

Hydraulic Test Fitting Kit



TORO TEST FITTING KIT (TOR4079)

FITTING	TOOL NUMBER
	Swivel Nut Run Tee (2 ea.) Size Toro No. No. 4 TOR4079-3 No. 6 TOR4079-12 No. 8 TOR4079-4 No. 10 TOR4079-5
	Plug (2 ea.) Size Toro No. No. 4 TOR4079-13 No. 6 TOR4079-14 No. 8 TOR4079-15 No. 10 TOR4079-16
	Cap (2 ea.) Size Toro No. No. 4 TOR4079-17 No. 6 TOR4079-18 No. 8 TOR4079-19 No. 10 TOR4079-20

FITTING	TOOL NUMBER
	Union (1 ea.) Size Toro No. No. 6 to No. 8 TOR4079-8 No. 10 to No. 8 TOR4079-2 No. 6 to No. 6 TOR4079-9
	Reducer (1 ea.) Size Toro No. No. 10 to No. 8 TOR4079-7 No. 12 to No. 8 TOR4079-6
	Test Cap Fitting (2 ea.) Size Toro No. No. 4 TOR4079-10 No. 6 TOR4079-11 No. 8 TOR4079-21 No. 10 TOR4079-1
	Test Fitting (2 ea.) Size Toro No. 7/16–20 ORB TOR4079-22 1/8" Pipe Thd. TOR4079-23

g036472

Figure 38

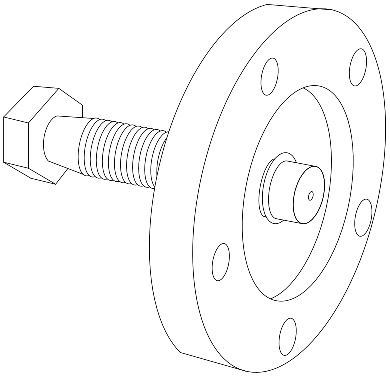
Toro Part No. TOR4079

Hydraulic Test Fitting Kit (continued)

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

The kit includes: tees, unions, reducers, plugs, caps, and male test fittings.

Wheel Hub Puller



g185941

Figure 39

Toro Part No. TOR6004

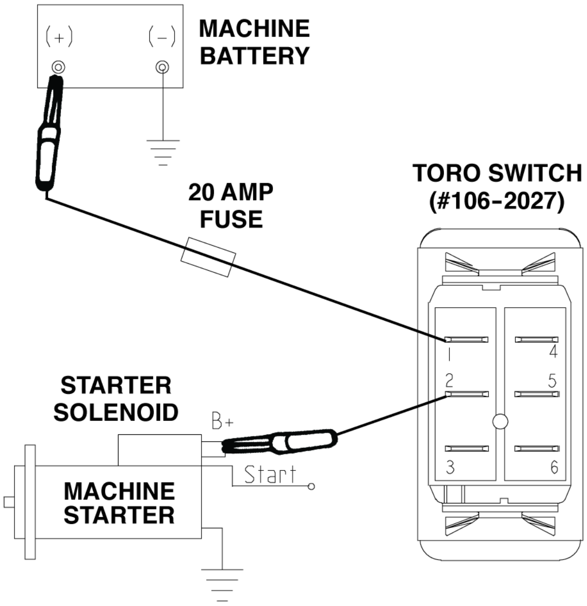
The wheel hub puller allows you to safely remove the wheel hub from the wheel motor shaft.

Remote Starter Switch

g036604

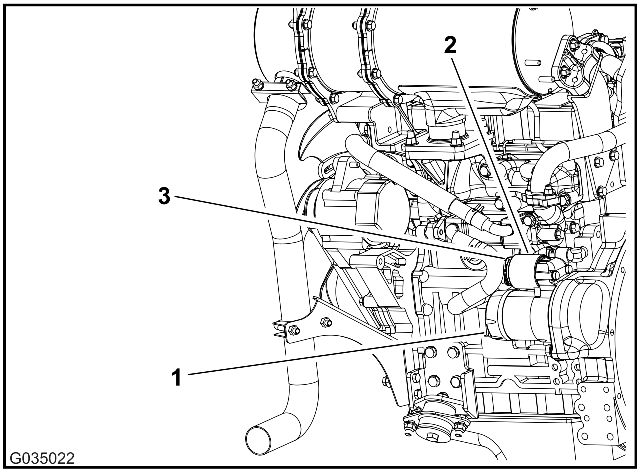
Figure 40

Remote Starter Switch (continued)



g186163

Figure 41



g035022

Figure 42

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

After flushing the hydraulic system or replacing a hydraulic component (e.g., gear pump, piston pump, or wheel motor), it is necessary to prime the hydraulic pumps. A remote starter switch (Figure 40) can be used for priming the hydraulic pumps. You can get this switch locally.

IMPORTANT

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

Remote Starter Switch (continued)

A remote stater switch can also be constructed using the Toro switch #106-2027, a length of 14 gauge wire, a 20 A in-line fuse, 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 (Figure 41).

Note: For information on using the remote starter switch to prime the hydraulic pumps; refer to Priming the Hydraulic Pumps (page 4–69).

Troubleshooting

The following chart contains suggestions that can be used to solve performance issues specific to the hydraulic system. The suggestions are not all-inclusive. There can be more than 1 cause for a machine malfunction.

Review the hydraulic schematic in Appendix A (page A–1)—Foldout Drawings and information on the hydraulic system operation in the Hydraulic Flow Diagrams (page 4–14). This information will be useful during the hydraulic troubleshooting process.

Refer to Testing the Hydraulic System (page 4–39) for precautions and specific hydraulic test procedures.

General Hydraulic System Problems

Problem	Possible Causes
The hydraulic fluid is leaking from the system.	• The fitting(s), hose(s), or tube(s) are loose or damaged. • The O-ring(s) or seal(s) are missing or damaged.
The hydraulic fluid foams excessively causing fluid leakage from the hydraulic tank breather. **Note:** Some aeration of the hydraulic fluid on this machine is normal. This aeration (foaming) may be more noticeable after initial filling of hydraulic tank.	• The hydraulic-fluid level in the hydraulic tank is low. • The hydraulic system has a wrong type of fluid. • One of the pump suction lines has an air leak. • Incompatible hydraulic fluids are mixed in the system. • There is water in the hydraulic system.
The hydraulic system operates hot.	• The transmission pressure is high due to load or dragging brakes. • The hydraulic-fluid level in the hydraulic tank is low or the inlet filter is loose or clogged. • The hydraulic fluid is contaminated or the fluid viscosity is too light. • The oil cooler is damaged or plugged. • The oil cooler air flow is obstructed. • The transmission bypass valve(s) is open or damaged. • The gear pump relief valve is stuck open. • The deck lift switch is held in the RAISE position for too long causing hydraulic fluid to be at relief pressures. An electrical problem could exist with the deck lift switch or circuit wiring that could cause excessive hydraulic temperatures. • The transmission check valve is not seating or is damaged. • The charge pressure is low. • The transmission or wheel motor(s) is worn or damaged. **Note:** If 1 traction circuit component has internal wear or damage, it is possible that the other traction components are also damaged.

Traction Circuit Problems

Problem	Possible Causes
The traction response is sluggish.	• The transmission bypass valve(s) is open or damaged. • The brake is dragging or binding. • The transmission-check valve, relief valve, and/or flushing valve is leaking. • The charge pressure is low. • The hydraulic fluid is very cold. • The transmission or wheel motor(s) is worn or damaged. **Note:** If 1 traction circuit component has internal wear or damage, it is possible that the other traction components are also damaged.
Neutral is difficult to find.	• The external control linkage is incorrectly adjusted, disconnected, binding, or damaged. • The orifice in the transmission-check valve(s) is plugged. • The transmission is worn or damaged.
No traction exists in either direction and the engine speed remains constant.	• The hydraulic-fluid level in the hydraulic tank is low. • The transmission bypass valves are open. • The charge pressure is low. • The engine flywheel coupling is damaged. • The transmission or wheel motor(s) is worn or damaged. **Note:** If 1 traction circuit component has internal wear or damage, it is possible that the other traction components are also damaged.
The wheel motor does not turn and the engine speed reduces when the traction pedal is pressed.	• The transmission bypass valve(s) is open. • The transmission or wheel motor is worn or damaged. **Note:** If 1 traction circuit component has internal wear or damage, it is possible that the other traction components are also damaged.
The wheel motor does not hold load in the NEUTRAL position. **Note:** The machine may not be completely stationary if parked on an incline without the parking brake engaged.	• The make-up fluid from the charge pump is not available. • The check valves in the transmission are damaged. • The valve plate(s) in the transmission is worn or damaged. • The wheel motor is worn or damaged. • The PD1 or PD2 cartridge in the traction manifold is leaking or damaged. • The cylinder block assembly in the transmission is worn or damaged. • The external neutral linkages are out of adjustment.

Traction Circuit Problems (continued)

Problem	Possible Causes
A single-wheel motor turns while unloaded, but slows down or stops when the load is applied.	• The transmission bypass valve(s) is open or leaking. • The wheel motor is worn or damaged. • The transmission components (e.g., piston pump, relief valve, and check valve) for the problem wheel motor are worn or damaged. **Note:** If 1 traction circuit component has internal wear or damage, it is possible that the other traction components are also damaged.
The machine does not track straight.	• The external traction control linkage is incorrectly adjusted, disconnected, binding, or damaged. • The steering cylinders are not synchronized preventing front and rear wheel alignment (synchronize the steering cylinders by turning in 1 direction and holding until all wheels stop turning). • The steering components are out of adjustment or damaged. • The steering home sensor may be out of adjustment. • The transmission bypass valve(s) is open. • The brake is dragging or binding. • The transmission-check valve is not seating or damaged. • The transmission or wheel motor(s) is worn or damaged.

PTO Circuit Problems

Problem	Possible Causes
The cutting deck blades do not turn.	• There is a mechanical problem with the cutting deck; refer to Chapter 7: Cutting Deck (page 7–1). • An electrical problem exists that prevents the PTO from engaging; refer to Chapter 5: Electrical System (page 5–1). • The engine coolant temperature is high. • The PTO solenoid valve is stuck or damaged (not shifting). • The charge pump is damaged (the traction charge circuit is also affected). • The PTO relief valve is damaged.
The cutting deck blade(s) turn too slowly.	• The engine speed is too low. • There is a mechanical problem with the cutting deck; refer to Chapter 7: Cutting Deck (page 7–1). • The transmission PTO clutch is worn or damaged. • The PTO relief valve is damaged.
The PTO does not stop when disengaged.	• An electrical problem exists that prevents the PTO from disengaging; refer to Chapter 5: Electrical System (page 5–1). • The transmission solenoid valve is stuck or damaged. • The transmission PTO brake friction plates are worn or damaged. • The machine is equipped with attachment that includes an over-running clutch.

Steering and Lift/Lower Circuit Problems

Problem	Possible Causes
The gear pump is noisy (cavitation).	• The hydraulic-fluid level in the hydraulic tank is low. • The hydraulic fluid is very cold. • The suction line is restricted. • There is an air leak in the suction line.
Steering is sluggish or does not operate.	• The steering components (e.g., steering forks, steering arms, tie rods, steering cylinder ends) are binding and need to be greased. • The steering components (e.g., steering forks, steering arms, tie rods, steering cylinder ends) are worn or damaged. • The steering cylinder is binding (e.g., bent rod on the steering cylinder). • The hydraulic-fluid level in the hydraulic reservoir is low (other hydraulic systems are affected as well). • The implement relief valve in the gear pump is stuck or damaged. • The steering cylinder is leaking internally. • The steering cylinder internal re-phasing valve is stuck, worn, or damaged. • The steering control valve is worn or damaged. • The gear pump is worn or damaged. **Note:** A worn or damaged gear pump will also affect the lift/lower circuit
The cutting deck does not lift or lifts slowly.	• The engine speed is too low. • The cutting deck being raised during steering input (steering has priority). • The lift cylinder linkage is binding or broken. • The lift arm bushings are binding. • The hydraulic-fluid level in the hydraulic tank is low. • The implement-relief valve (in the gear pump) is stuck or damaged. • The lift cylinder is leaking internally. • The deck lift manifold valves are worn or damaged. • The gear pump is worn or damaged. **Note:** A worn or damaged gear pump will also affect the steering circuit.
The cutting deck raises, but does not stay up. **Note:** The lift cylinder and solenoid valve S1 in the deck lift manifold cannot provide an absolutely perfect seal. The cutting deck will eventually lower if left in the raised position.	• The lift cylinder is leaking internally. • Solenoid valve S1 in the deck lift manifold is leaking.

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 4–27).

⚠ **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 4–5).

⚠ **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. Clean the machine fully before you disconnect or disassemble the hydraulic components.

   Note: Cleanliness is required whenever you work on the hydraulic equipment. Contamination causes too much wear on hydraulic components.
2. When you perform tests on the hydraulic system, wear eye protection.
3. Before you perform a test, check the traction control lever linkages for improper adjustment, binding, or broken parts.
4. Perform all the hydraulic tests with the hydraulic fluid at normal operating temperature.
5. Install clean metal caps or plugs on the hydraulic lines that are left open or exposed during the testing or component removal.
6. 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.
7. Install the hydraulic fittings by hand and ensure that they are not cross-threaded before you tighten them with a wrench.
8. Position the tester hoses to prevent the rotating machine parts from contacting and damaging the hoses or tester.
9. After you connect the test equipment, check the hydraulic-fluid level in the hydraulic tank and ensure that the tank has the correct fluid level.
10. 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.
11. Ensure that the engine is in good operating condition before performing any hydraulic test.

    Note: Use a phototac when you perform a hydraulic test. The engine speed can affect the accuracy of the tester readings.
12. If there is a traction circuit problem, perform 1 or more of the following tests: charge relief valve pressure, transmission piston pump flow, traction relief valve pressure, and/or wheel motor efficiency.
13. If there is a lift circuit problem, perform 1 or more of the following tests: implement relief pressure, gear pump flow, and/or lift cylinder internal leakage.
14. If there is a PTO circuit problem, perform the PTO pressure valve test.
15. If there is a steering circuit problem, perform 1 or more of the following tests: implement relief pressure and/or gear pump flow.

Testing the Traction System Operation

Because the traction system of the Groundsmaster 360 machine uses 2 different but interconnected circuits, it is difficult to identify which circuit is causing a problem and what hydraulic tests should be performed. Use the following operation tests and suggestions before you perform the hydraulic tests described in this section.

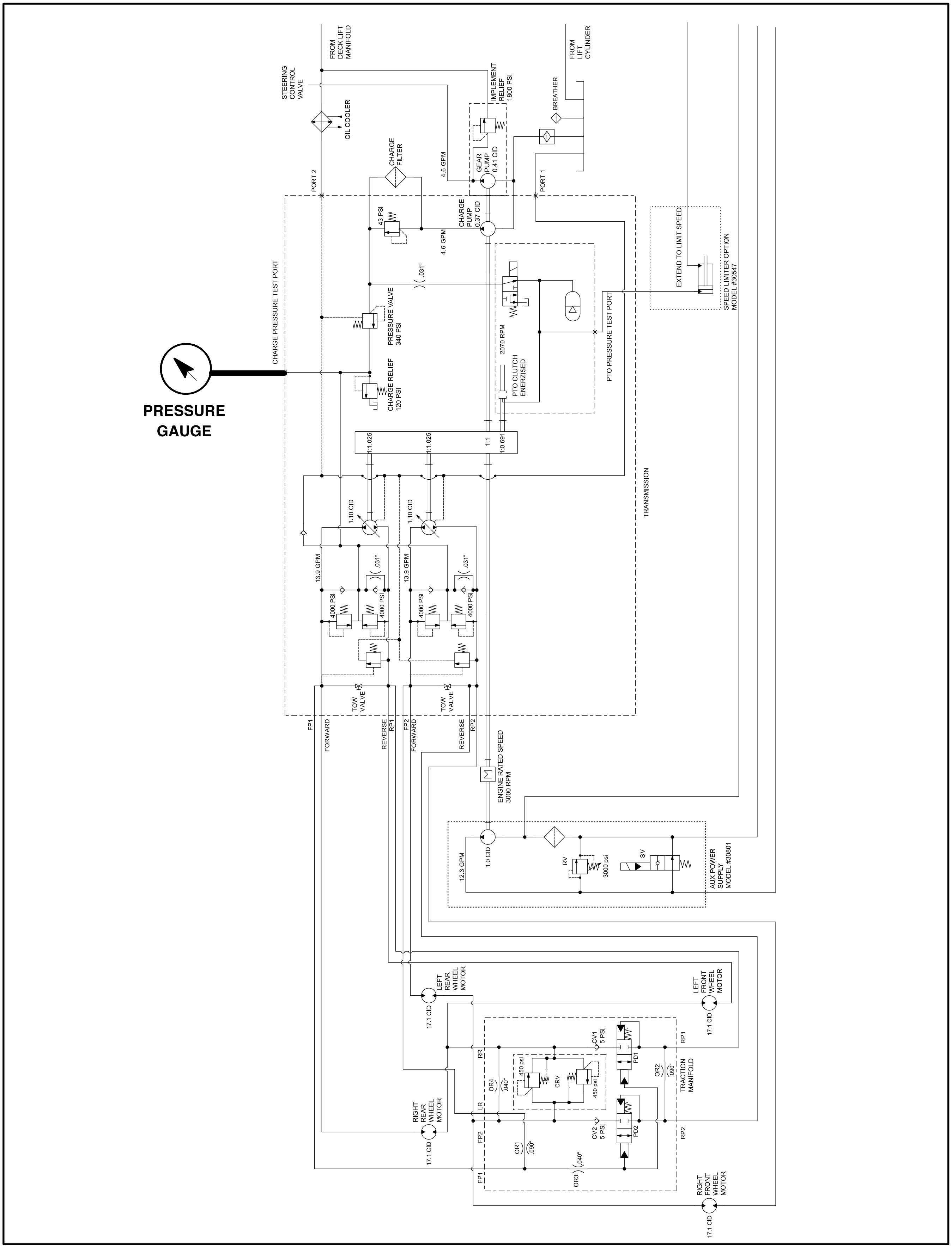
1. The wheel speed should be the same on the 2 rear wheels. Ensure that the hydraulic fluid is at normal operating temperature. With the machine drive

Testing the Traction System Operation (continued)

wheels raised up off the ground and the machine correctly supported with jack stands, have an operator in the seat move the traction control pedal to the full forward speed. Check the rotational speed of the 2 rear wheels. The wheel speed of both the rear wheels should be approximately the same.

2. If the operation tests suggest a traction system problem, check the following before you perform the hydraulic tests.
   A. Check the hydraulic-fluid level in the hydraulic tank to ensure that the fluid level is correct.
   B. Check the brake adjustment to ensure that the brakes are not dragging.
   C. Check that the 2 transmission bypass valves are seated.
   D. Check that the traction pedal is rotating the swash plates of the transmission pump equally.
   E. Check for free movement of all the traction linkage control components.

Testing the Charge Relief Valve Pressure (Using Pressure Gauge)



g187996

Figure 43

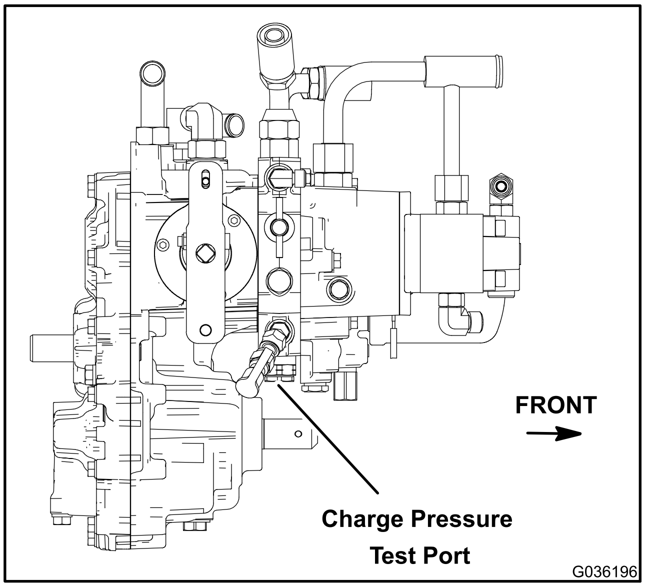
Perform the charge relief valve pressure test if you identify a traction circuit problem. This test determines if the traction charge circuit operates correctly.

Test Procedure

1. Ensure that the hydraulic fluid is at normal operating temperature.
2. Ensure that the traction drive is correctly adjusted for the NEUTRAL position.

⚠ 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 4–5).



g036196

Figure 44

3. Park the machine on a level surface, lower the cutting deck, shut off the engine, and set the parking brake.
4. Read all Warning, Cautions, and precautions listed at the beginning of this section.
5. Clean the charge-pressure test port on the right side of the transmission (Figure 44).
6. Connect a 6,900 kPa (1,000 psi) hydraulic-pressure gauge with an attached hydraulic hose to the transmission charge-pressure port.
7. Start the engine and run it at low-idle speed **(1,400 rpm)**. Check for hydraulic-fluid leaks from the test connections and correct before continuing the test.
8. With engine running, press the engine speed switch to full speed **(3,000 rpm)** position. The pressure gauge reading should be **720 to 930 kPa (105 to 135 psi)**. Record the test result.
9. If the charge relief pressure specification is not met, consider the following transmission issues (refer to Servicing the Transmission (page 4–98)):
   A. The transmission charge relief valve is damaged. Repair or replace the charge-relief valve.

Test Procedure (continued)

   B. A transmission traction relief valve or flushing valve is leaking or damaged.

   C. The charge pump in the transmission is damaged (the PTO operation may also be affected).

10. Next, determine the charge pressure under traction load by operating the machine in a direct forward and reverse direction. Ensure that the engine is running at full speed **(3,000 rpm)**.

    Note: When applying brakes, ensure that the parking brake latch is not pressed. The engine will stop if the parking brake latch is pressed.

11. Firmly apply the brakes and press the traction pedal in the forward direction and then to reverse while you monitor the pressure gauge. Release the traction pedal to NEUTRAL, shut off the engine, and record the test results.

    A. The charge pressure should not drop more than 15% from the initial test reading (8) as the machine is moving (e.g., if the initial charge pressure is **830 kPa (120 psi)**, charge pressure while the machine is moving should be above **700 kPa (102 psi)**.

    B. A pressure drop of more than 15% indicates a traction circuit leak (e.g., a leaking transmission check valve, a worn/damaged transmission piston pump). If charge pressure is good under no load, but the pressure drops below specification when under a traction load, the transmission piston pump(s) are probably worn or damaged.

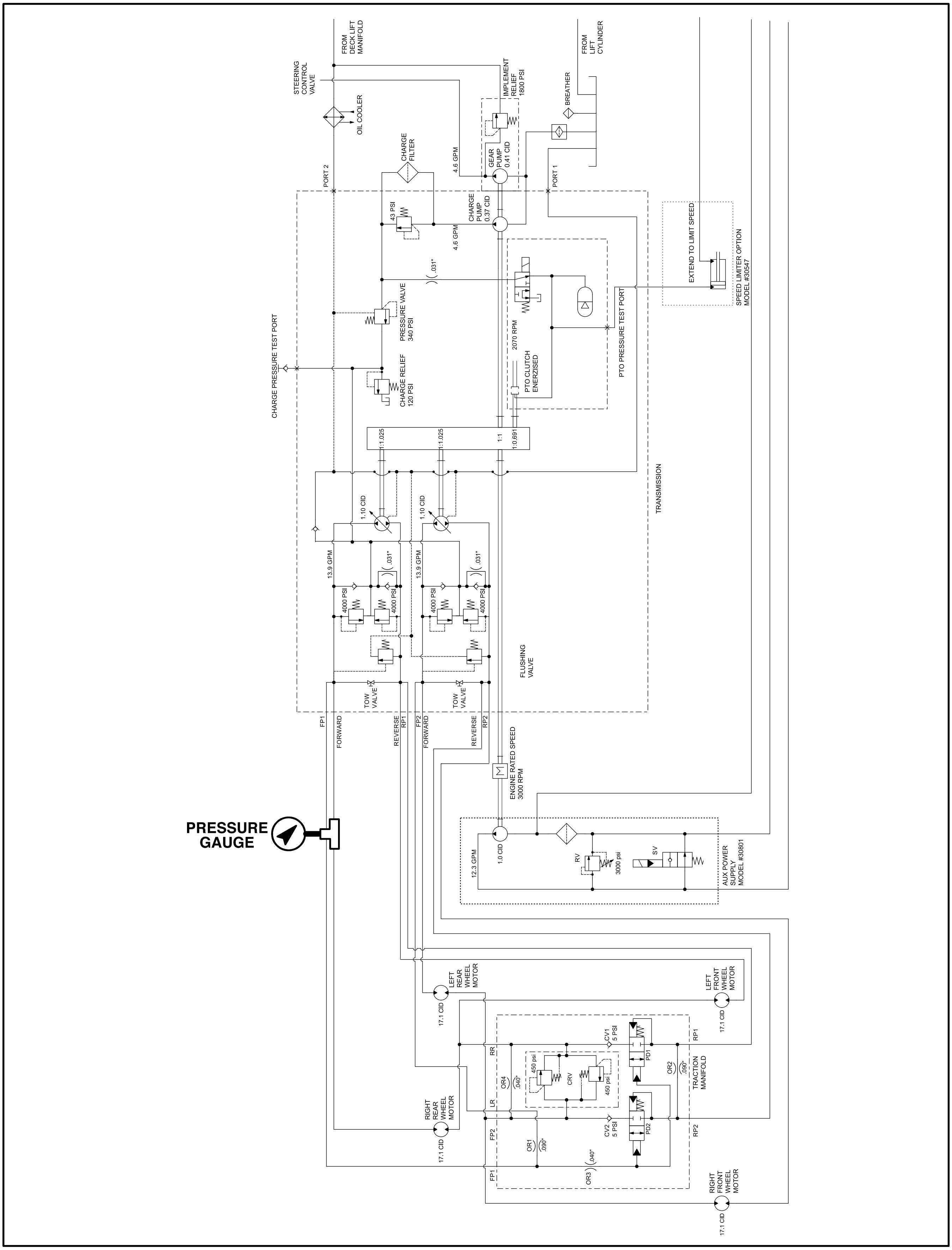
    Note: When a piston pump is worn or damaged, the charge pump cannot keep up with internal leakage in the traction circuit.

12. Stop the machine and shut off the engine.

13. Release pressure from the hydraulic system; refer to Releasing Pressure from the Hydraulic System (page 4–5).

14. Remove the pressure gauge from the transmission charge-pressure test port.

Testing the Traction Relief Valve Pressure (Using Pressure Gauge)



g187997

Figure 45

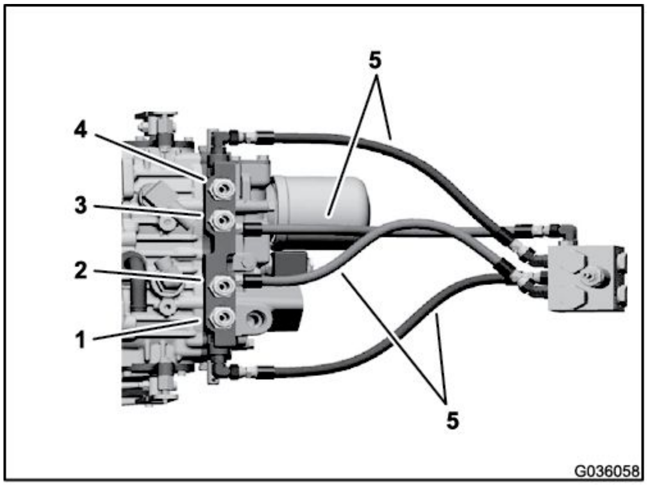
Perform the traction relief valve pressure test if you identify a traction circuit problem. This test determines if a transmission relief valve operates correctly.

Test Procedure

1. Ensure that the hydraulic fluid is at normal operating temperature.
2. Ensure that the traction drive is correctly adjusted for the NEUTRAL position.

⚠ 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 4–5).



g036058

Figure 46

1. Port A
2. Port B
3. Port C
4. Port D
5. Balancing hose

3. Park the machine on a level surface, lower the cutting deck, shut off the engine, and do not set the parking brake.
4. Read all Warning, Cautions, and precautions listed at the beginning of this section.
5. Clean the transmission area around the traction circuit hoses on the top of the transmission (Figure 46).
6. Determine which traction relief valve is to be tested. Disconnect the hydraulic hose from the transmission pump outlet fitting to test the relief valve (Figure 45 or Figure 46):

Relief Valve to be Tested	Pump Outlet
Right side forward	Port A
Right side reverse	Port B
Left side forward	Port C
Left side reverse	Port D

Note: The pump outlet ports are not identified on the pump housing. Refer to Figure 46 to identify the pump ports.

Test Procedure (continued)

7. Install a tee fitting between the disconnected hydraulic hose and the transmission fitting. Install a 34,500 kPa (5,000 psi) pressure gauge to the tee fitting.
8. Disconnect the balancing hose from the transmission fitting closest to transmission pump outlet fitting for the relief valve to be tested (Figure 45 or Figure 46). Install a steel cap on the fitting and steel plug in the balancing hose.
9. Start the engine and run it at low-idle speed **(1,400 rpm)**. Check for hydraulic-fluid leaks from the test connections and correct before continuing the test.
10. Press the engine speed switch to full speed **(3,000 rpm)** position.
11. Sit on the seat and move the machine against an immovable object (e.g., wall) to prevent movement of the machine.

⚠ CAUTION ⚠

Use extreme caution when performing the test. The drive wheels will be trying to move the machine during test.

Note: When applying brakes, ensure that the parking brake latch is not pressed. The engine will stop if the parking brake latch is pressed.

12. Firmly apply brakes to prevent the rear wheels from rotating and then slowly press the traction pedal in the direction to be tested (forward or reverse). While pressing the traction pedal, carefully monitor the pressure gauge needle. As the traction relief valve lifts, the gauge needle will momentarily stop. Traction system pressure as the relief valve opens should be **26,900 to 28,200 kPa (3,900 to 4,100 psi)** in either forward or reverse.

    Note: It may be difficult to achieve the traction circuit relief pressure. If the traction pedal is pressed slowly, it is more likely that the relief pressure can be obtained.

13. Release the traction pedal to the NEUTRAL position, shut off the engine, and record the test results.

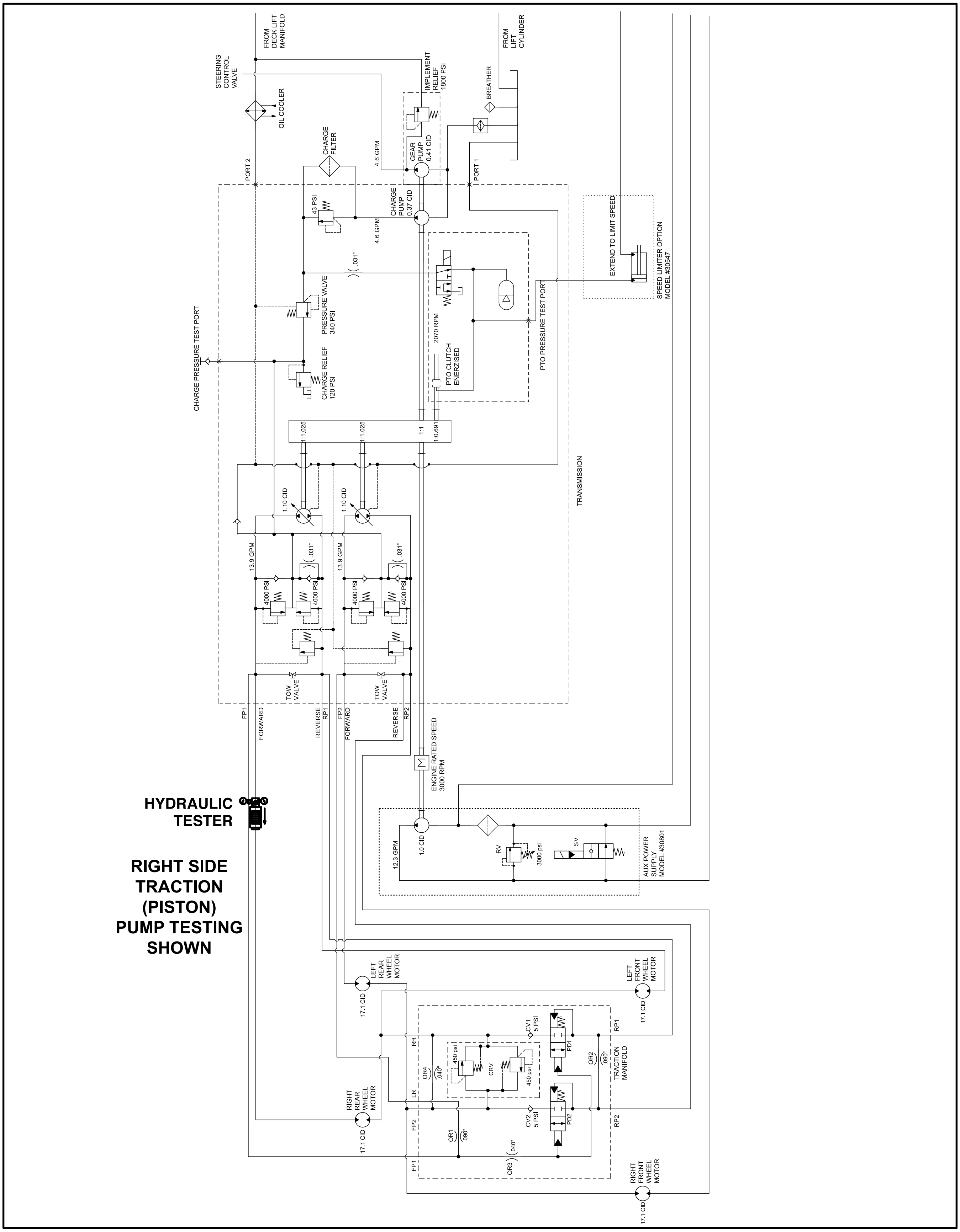
    Note: The forward relief valves for the 2 transmission pump circuits are identical and thus you can interchange them. The reverse relief valves are also identical. The forward relief valves, however, are different than the reverse relief valves so do not interchange the forward and reverse relief valves.

14. If the traction relief valve pressure is not met, release pressure from the hydraulic system; refer to Releasing Pressure from the Hydraulic System (page 4–5). Remove and inspect the relief valve(s) from the transmission; refer to Servicing the Transmission (page 4–98). Clean or replace the relief valve(s).

    Note: The traction relief valves are not adjustable.

15. After you complete the testing, ensure that the engine is shut off and then release pressure from the hydraulic system; refer to Releasing Pressure from the Hydraulic System (page 4–5). Remove the pressure gauge and tee fitting from the machine. Connect the pump outlet and balancing hoses to the transmission fittings.
16. If necessary, repeat the pressure test for other traction-relief valves.

Testing the Transmission Piston Pump Flow (Using Tester with Pressure Gauges and Flow Meter)



g187998

Figure 47

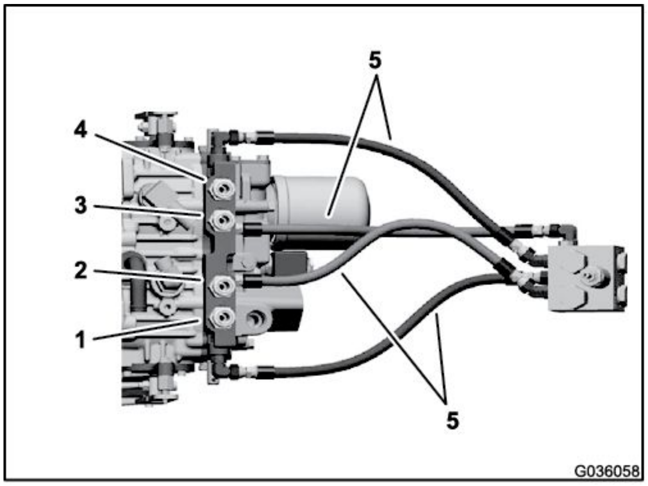


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Figure 48

1.	Port A	4.	Port D
2.	Port B	5.	Balancing hose
3.	Port C		

Perform the transmission piston pump flow test if you identify a traction circuit problem. This test determines if hydraulic flow from a transmission piston pump is correct.

Test Procedure

IMPORTANT

The traction circuit flow for the Groundsmaster 360 is approximately 57 L/minute (15 gallons/minute). Use a 40 GPM hydraulic tester #AT40002 (pressure and flow) for this test; refer to Special Tools (page 4–27).

1. Ensure that the hydraulic fluid is at normal operating temperature.
2. Ensure that the traction drive is correctly adjusted for the NEUTRAL position and that the hydraulic tank is full.

⚠ 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 4–5).

3. Park the machine on a level surface, lower the cutting deck, and shut off the engine.
4. Read all Warning, Cautions, and precautions listed at the beginning of this section.

IMPORTANT

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

5. Lift and support the machine with jack stands so that all the drive wheels are off the ground. In this test, the drive wheels need to spin freely to allow hydraulic flow through the traction circuit.

   Note: Ensure that the parking brake is not applied.

6. Clean the transmission area around the traction circuit hoses on the top of the transmission (Figure 48).
7. Determine which piston pump is to be tested. Disconnect the hydraulic hose from the transmission pump outlet fitting to test the piston pump (Figure 47 or Figure 48):

Piston Pump to be Tested	Pump Outlet
Right side pump	Port A
Left side pump	Port C

8. Install a 40 GPM hydraulic tester (pressure and flow) in series between the pump outlet fitting and disconnected hose. Ensure that the tester flow arrow points from the pump outlet and toward the hose. Ensure that the flow-control valve on the tester is fully open.
9. Disconnect the balancing hose from the transmission fitting closest to the transmission pump outlet fitting for the pump to be tested (Figure 47 or Figure 48). Install a steel cap on the fitting and steel plug in the balancing hose.
10. Sit in the operator seat, start the engine and run it at low-idle speed **(1,400 rpm)**. Check for any hydraulic-fluid leaks from the test connections and correct before continuing the test.
11. With the engine running, press the engine speed switch to full speed **(3,000 rpm)** position. Use a phototac to measure the engine speed.
12. Have an operator slowly push the traction pedal to the full FORWARD position.
13. Slowly close the tester flow control valve until the pressure gauge reading is **6,900 kPa (1,000 psi)**.
14. Check the engine speed with a phototac and ensure that the engine speed is still **3,000 rpm**.
15. Observe the flow gauge on the tester.

    Note: The tester reading should be approximately **53 L/minute (14 gallons/minute)** for a traction pump in good condition.

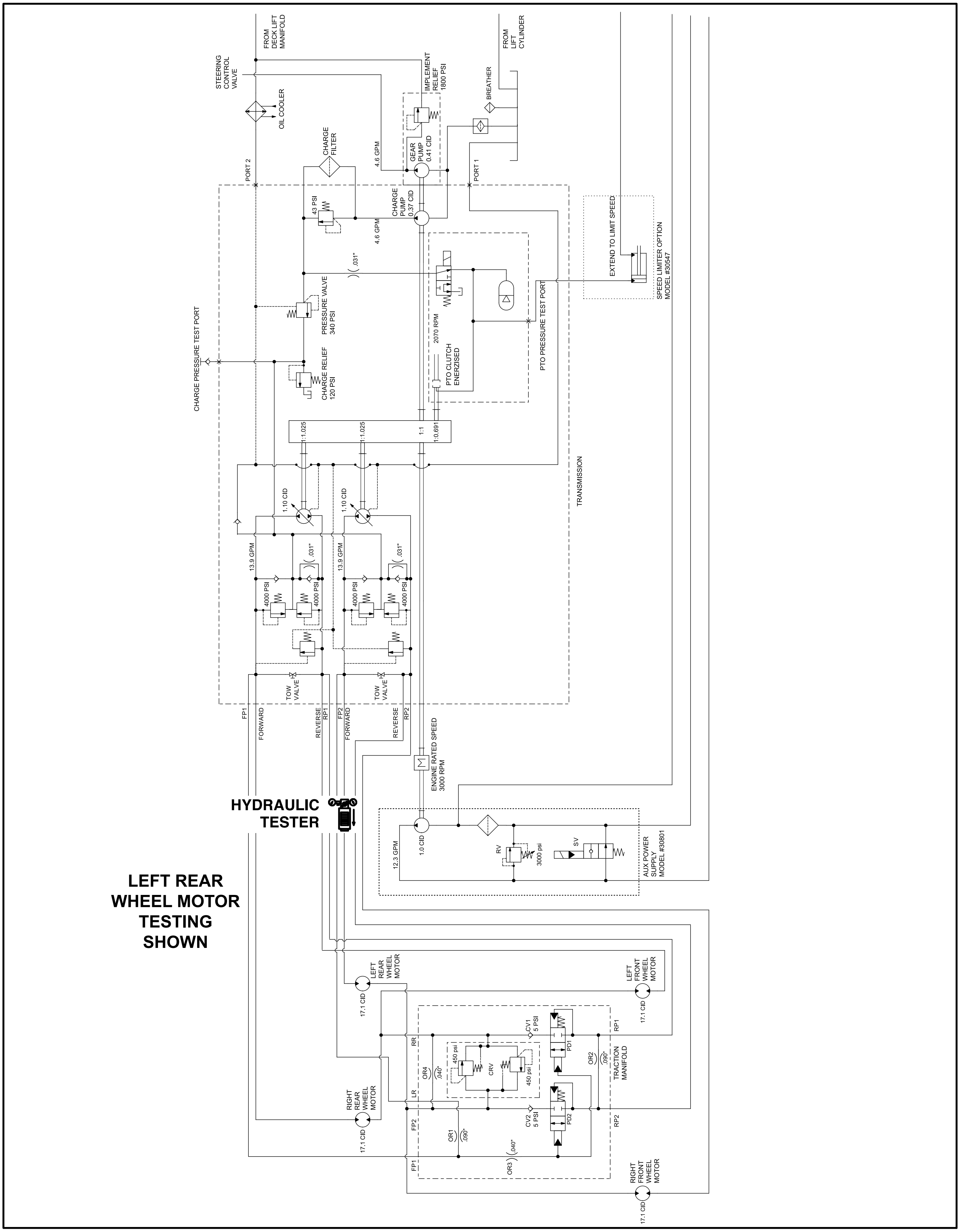
16. Open the tester flow control valve, release the traction pedal to the NEUTRAL position and shut off the engine. Record the test results.
17. A lower pump flow may result in reduced traction circuit performance. If the flow is less than **47.4 L/minute (12.5 gallons/minute)** or a pressure of **6,900 kPa (1,000 psi)** cannot be obtained:
    A. The transmission bypass valve(s) may be open or damaged.
    B. The traction control assembly may need adjustment (e.g., traction pedal not rotating the pump swash plate fully).
    C. If the engine speed drops excessively as the tester flow control valve is closed, the engine performance should be evaluated.

Test Procedure (continued)

D. If the engine speed does not drop, the pressure and flow specifications are not met, the tested transmission piston pump needs to be inspected, repaired, or replaced as necessary.

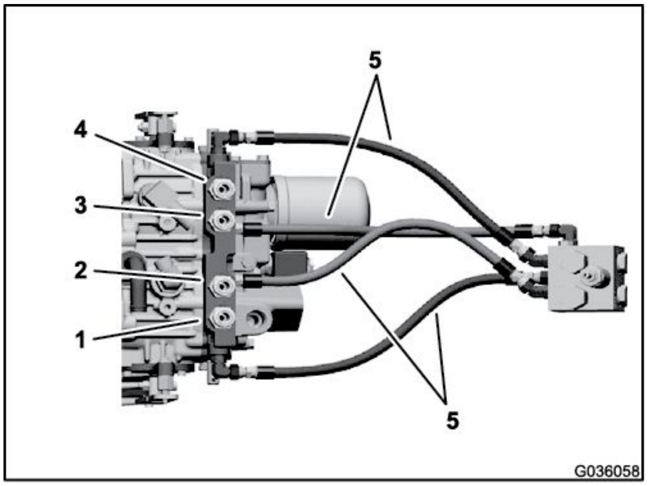
18. If the transmission piston pump flow specification is met, and you identify a traction circuit problem, consider that a wheel motor is worn or damaged; refer to Testing the Rear Wheel Motor Efficiency (Using Tester with Pressure Gauges and Flow Meter) (page 4–52).
19. Release pressure from the hydraulic system; refer to Releasing Pressure from the Hydraulic System (page 4–5).
20. Disconnect the tester from the transmission fitting and hose, and connect the pump outlet and balancing hoses to the transmission fittings.
21. If necessary, repeat the flow test for other transmission piston pump.

Testing the Rear Wheel Motor Efficiency (Using Tester with Pressure Gauges and Flow Meter)



g187995

Figure 49



g036058

Figure 50

1.	Port A	4.	Port D
2.	Port B	5.	Balancing hose
3.	Port C		

Perform the rear wheel motor efficiency test if you identify a traction circuit problem. This test determines if a wheel motor has excessive internal leakage and wear.

Note: Over a period of time, a wheel motor can wear internally. A worn motor may bypass the hydraulic fluid internally that reduces the motor efficiency. After sometime, sufficient fluid loss causes the wheel motor to stall under heavy load conditions. Continued operation with a worn, inefficient motor can generate excessive heat, cause damage to the seals and other components in the hydraulic system and affect overall machine performance.

Test Procedure

IMPORTANT

The traction circuit flow for the Groundsmaster 360 is approximately 57 L/minute (15 gallons/minute). Use a 40 GPM hydraulic tester #AT40002 (pressure and flow) for this test; refer to Special Tools (page 4–27).

1. Ensure that the hydraulic fluid is at normal operating temperature.
2. Ensure that the traction drive is correctly adjusted for the NEUTRAL position.

⚠ 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 4–5).

3. Park the machine on a level surface, lower the cutting deck, shut off the engine, and set the parking brake.
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.

IMPORTANT

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

6. Lift and support the front wheels off the ground to allow flow through the front wheel motors.
7. Block the rear wheels with chocks to prevent wheel rotation.
8. Clean the transmission area around the traction circuit hoses on the top of the transmission (Figure 50).
9. Determine which rear wheel motor is to be tested. Disconnect the hydraulic hose from the transmission pump outlet fitting for the rear wheel motor to be tested (Figure 49 or Figure 50):

Wheel Motor to be Tested	Pump Outlet
Right side rear motor	Port A
Left side rear motor	Port C

10. Install a 40 GPM hydraulic tester (pressure and flow) in series between the pump outlet fitting and disconnected hose. Ensure that the tester flow arrow points from the pump outlet and toward the hose. Ensure that the flow control valve on the tester is fully open.
11. Disconnect the balancing hose from the transmission fitting closest to the transmission pump outlet fitting for the rear wheel to be tested (Fig. Figure 49 or Figure 50). Install a steel cap on the fitting and steel plug in the balancing hose.
12. Start the engine and run it at low-idle speed **(1,400 rpm)**. Check for hydraulic-fluid leaks from test connections and correct before continuing the test.
13. With the engine running, press the engine speed switch to full speed **(3,000 rpm)** position. Use a phototac to measure the engine speed.

⚠ **CAUTION** ⚠

The rear wheel that you are testing will try to move the machine forward.

Use extreme caution when performing the test.

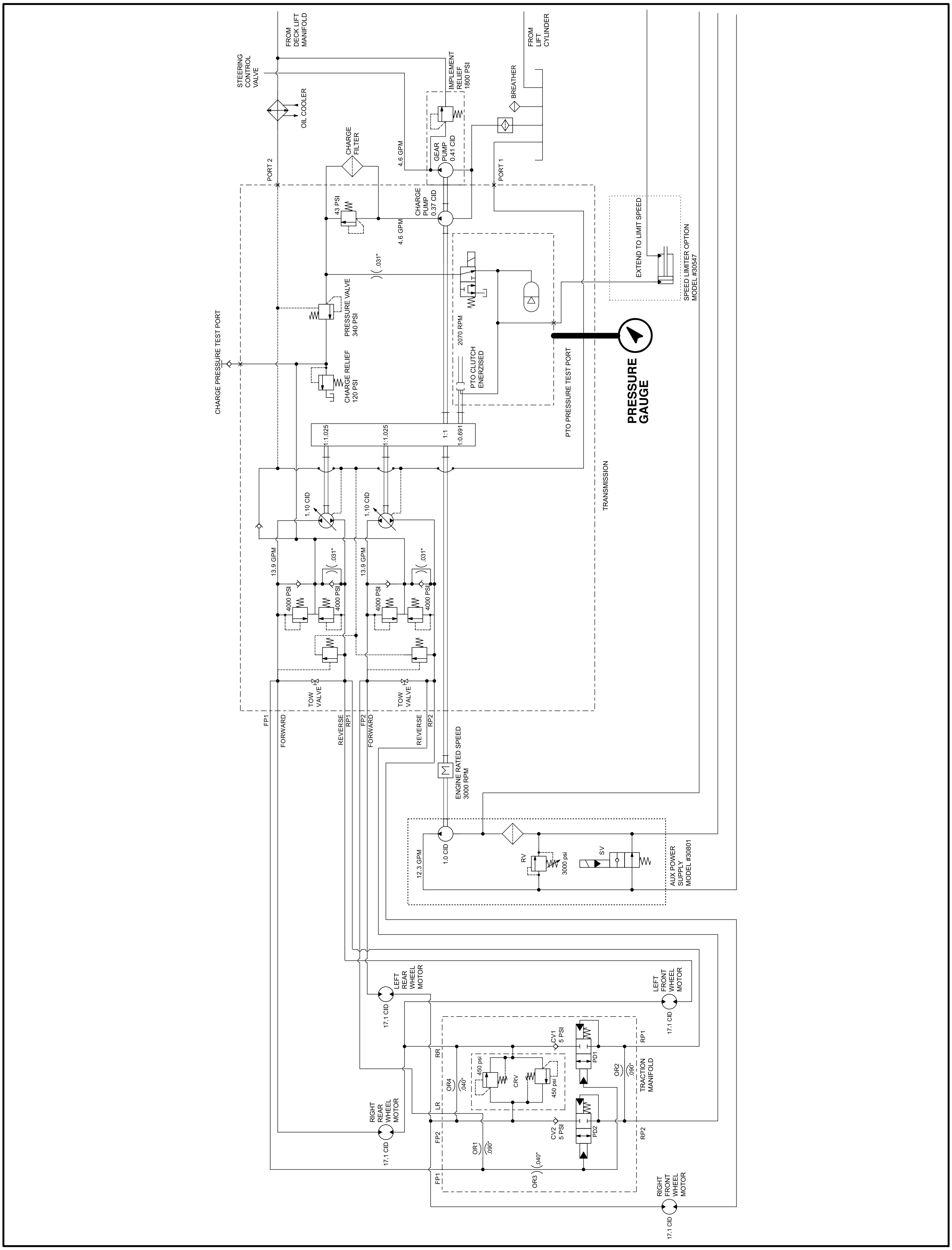
14. While sitting in the operator seat, and with the brakes firmly applied to prevent the rear wheels from rotating, slowly press the traction pedal in the forward direction until the tester pressure gauge displays **6,900 kPa (1,000 psi)**.
15. The rear wheel motor internal leakage is shown on the tester flow meter in L/minute (gallons/minute).
16. Return the traction pedal to the NEUTRAL position. Release the brakes, shut off the engine, and record the test results. Rotate the wheel and test it again.

    Note: Testing the wheel motor leakage in 3 different wheel positions will give the most accurate test results.

Test Procedure (continued)

17. The flow should be less than **5.7 L/minute (1.5 gallons/minute)** for the tested wheel motor. If the specification is not met, repair or replace the wheel motor.
18. Release pressure from the hydraulic system; refer to Releasing Pressure from the Hydraulic System (page 4–5).
19. Disconnect the tester from the pump outlet fitting and hydraulic hose, and connect the pump outlet and balancing hoses to the transmission fittings.
20. If other wheel motor requires testing, complete the steps 8 to 19 for the other motor.

Testing the PTO Pressure Valve (Using Pressure Gauge)



g187994

Figure 51

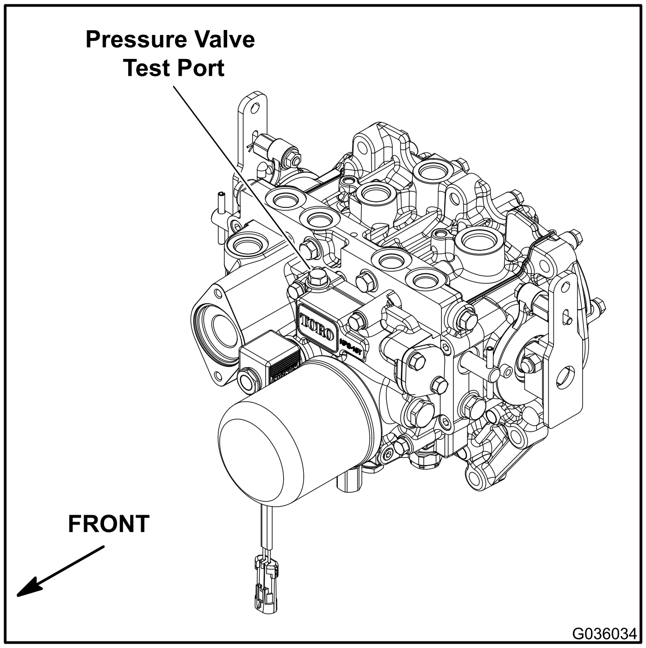
Perform the PTO pressure valve test if you identify a PTO engagement problem. This test determines if the PTO pressure valve in the transmission is operating correctly.

Test Procedure

1. Ensure that the hydraulic fluid is at normal operating temperature.

⚠ 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 4–5).



g036034

Figure 52

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. Clean the transmission area around the pressure valve test port (Figure 52).

   Note: If the machine is equipped with optional speed reduction kit, a hydraulic fitting and hose for the kit is connected to the transmission pressure valve test port. For testing the PTO pressure valve, disconnect the hydraulic hose and remove the fitting from the transmission port. Install a cap in the speed reduction kit hose. Then, install the pressure gauge and proceed with remaining steps of test. When the PTO pressure valve testing is completed, install the fitting to the transmission port, remove the cap from the hydraulic hose, and connect the hose to the fitting.

5. Remove the plug from the pressure valve test port (Figure 52). Connect a 6,900 kPa (1,000 psi) hydraulic-pressure gauge with an attached hydraulic hose to the test port.

Test Procedure (continued)

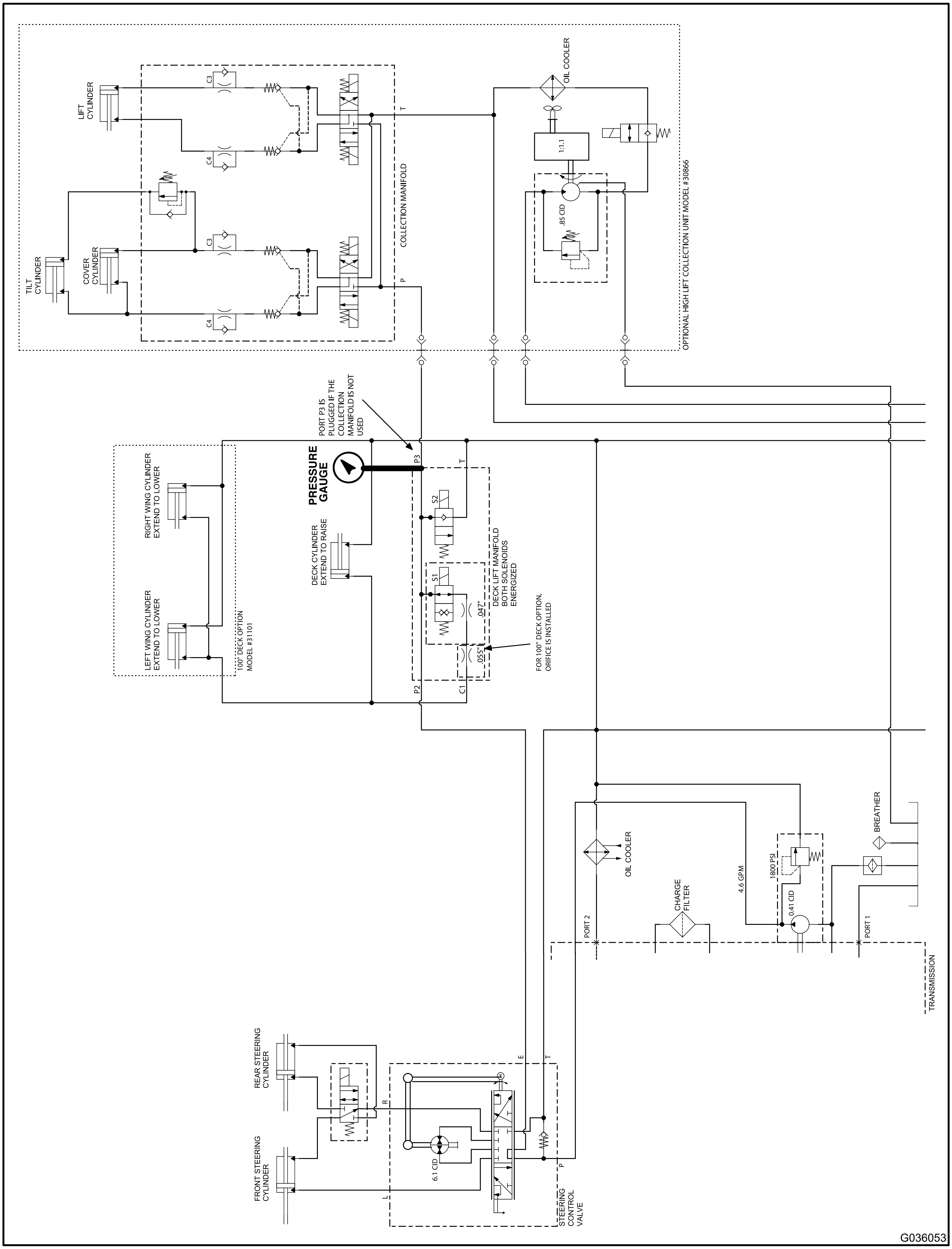
6. Start the engine and run it at low-idle speed **(1,400 rpm)**. Check for hydraulic-fluid leaks from the test connections and correct before continuing the test.
7. With the engine running, press the engine speed switch to full speed **(3,000 rpm)** position.

⚠ **WARNING** ⚠

Keep away from the deck during the test to prevent personal injury.

8. Have an operator engage the PTO and monitor the pressure gauge.
9. With the engine running at full speed and PTO engaged, the pressure should be **1,930 to 2,340 kPa (280 to 340 psi)**.
10. Disengage the PTO and then shut off the engine. Record the test results.
11. If specification is not met, repair or replace the pressure valve in the transmission; refer to Servicing the Transmission (page 4–98). Also consider a worn or damaged charge pump in the transmission (the traction charge circuit will be affected as well).
12. Release pressure from the hydraulic system; refer to Releasing Pressure from the Hydraulic System (page 4–5).
13. Disconnect the test gauge from the pressure valve test port. Install the plug into the port and torque the plug to **19 to 20 N·m (14 to 15 ft-lb)**.

Testing the Implement Relief Pressure (Using Pressure Gauge)



g036053

Figure 53

Perform the implement relief pressure test if you identify a steering or cutting deck raise and lower problem. This test determines if the implement relief valve is operating correctly.

Test Procedure

1. Ensure that the hydraulic fluid is at normal operating temperature.
2. Ensure that the traction drive is correctly adjusted for the NEUTRAL position.

⚠ 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 4–5).

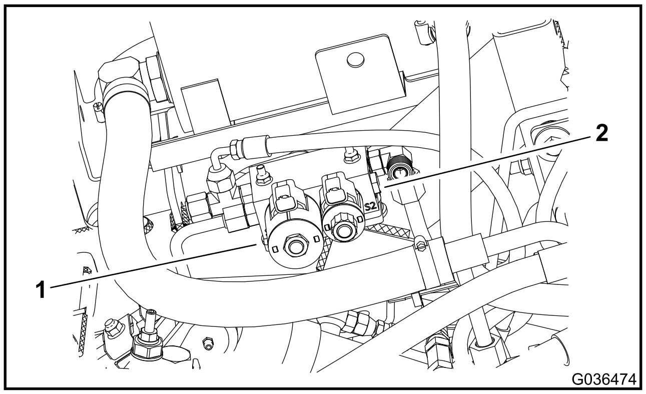


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Figure 54

1. Deck lift manifold
2. Location of port 3

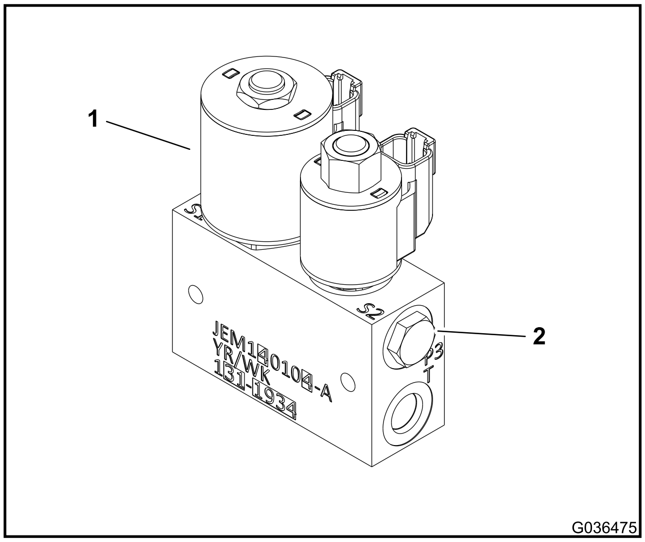

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Figure 55

1. Deck lift manifold
2. Port 3 plug

3. Park the machine on a level surface, lower the cutting deck, shut off the engine, and set the parking brake.

Test Procedure (continued)

4. Read all Warning, Cautions, and precautions listed at the beginning of this section.
5. Clean the deck lift manifold around the plug in port 3 on the rear of the deck lift manifold (Figure 55). Remove the plug from the deck lift manifold port 3.
6. Install a 34,500 kPa (5,000 psi) pressure gauge into the deck lift manifold port 3.
7. Start the engine and run it at low-idle speed **(1,400 rpm)**. Check for hydraulic-fluid leaks from the test connections and correct before continuing the test.
8. With the engine running, press the engine speed switch to full speed **(3,000 rpm)** position.

IMPORTANT

Press the lift switch to the Raise position only until you get a system relief pressure reading. Holding the lift switch in the Raise position for an extended period may damage the circuit components.

9. Monitor the pressure gauge carefully while you press the lift switch to the Raise position.
10. When the lift cylinder is fully extended (deck raised) and the implement relief valve lifts, the pressure gauge needle will momentarily stop. The system pressure should be approximately **12,400 kPa (1,800 psi)** as the implement relief valve opens.
11. After you monitor the relief valve pressure, return the lift switch to the Neutral position.

    Note: If the lift switch continues to be pressed after the relief valve has opened, the system pressure can increase higher than the relief pressure.

12. Shut off the engine and record the test results.
13. If specification is not met, repair or replace the implement relief valve in the gear pump; refer to Servicing the Gear Pump (page 4–139). Also, consider a leaking lift cylinder, leaks in the deck lift manifold, a leaking check valve in the steering control valve or a worn gear pump.

    Note: The implement relief valve pressure can also be tested with a hydraulic tester (pressure and flow) in series with the gear pump fitting and disconnected hose; refer to Testing the Gear Pump Flow (Using Tester with Pressure Gauges and Flow Meter) (page 4–62). Use the pressure gauges on the hydraulic tester and follow Testing the Implement Relief Pressure (Using Pressure Gauge) (page 4–59).

14. Release pressure from the hydraulic system; refer to Releasing Pressure from the Hydraulic System (page 4–5).
15. Remove the pressure gauge from the deck lift manifold port. Install the plug into the deck lift manifold port 3 and torque the plug to **34 N·m (25 ft-lb)**.

Testing the Gear Pump Flow (Using Tester with Pressure Gauges and Flow Meter)

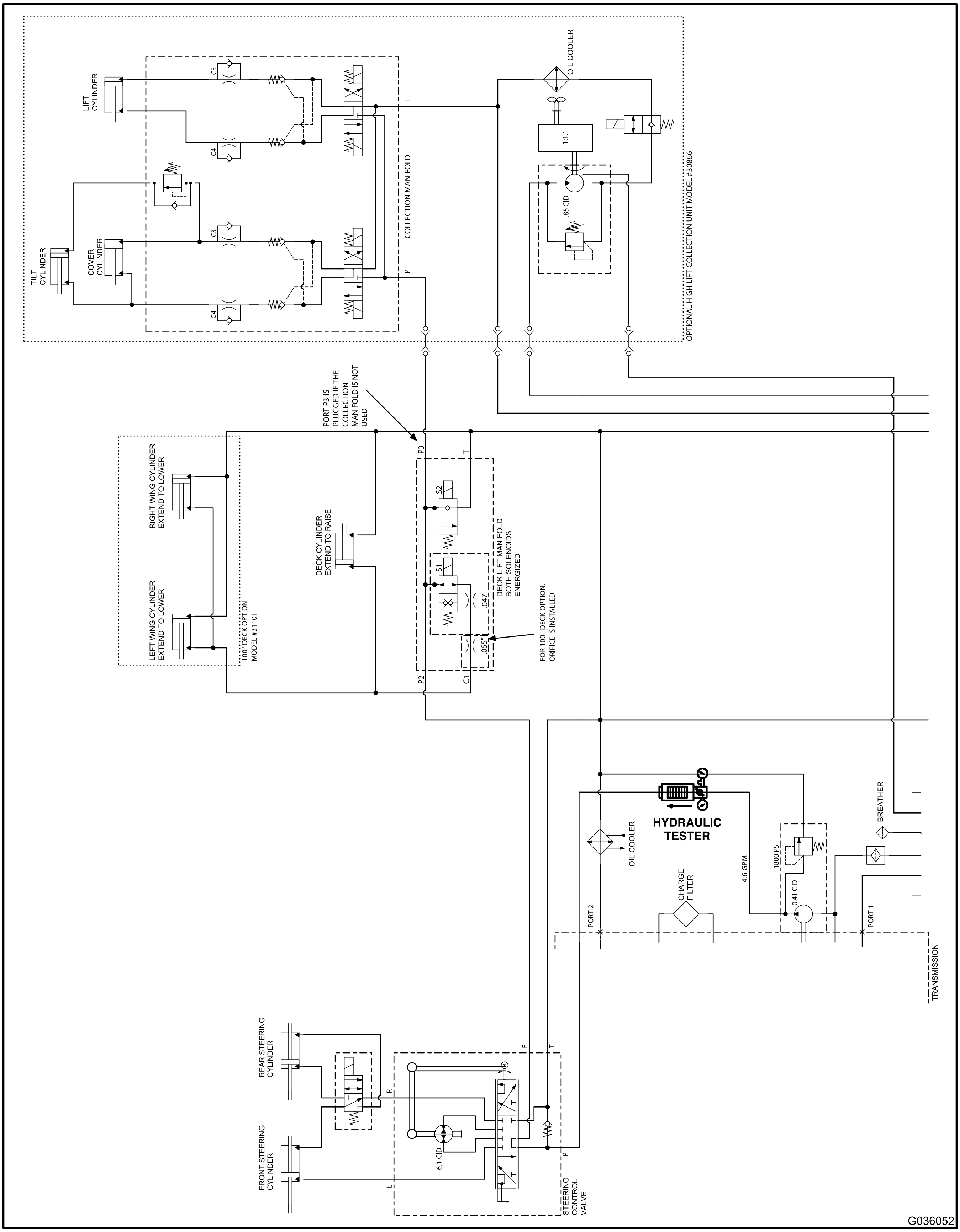

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Figure 56

Perform the gear pump flow test if you identify a steering or cutting deck raise and lower problem. This test determines if the hydraulic flow from the gear pump is correct.

Test Procedure

Note: Over a period of time, the gears and wear plates in the gear pump can wear. A worn pump may bypass the hydraulic fluid and make the pump less efficient. After sometime, sufficient fluid loss will occur and cause the cutting unit motors to stall under heavy cutting conditions. Continued operation with a worn, inefficient pump can generate excessive heat, cause damage to the seals and other components in the hydraulic system.

1. Ensure that the hydraulic fluid is at normal operating temperature.
2. Ensure that the traction drive is correctly adjusted for the NEUTRAL position.

⚠ 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 4–5).

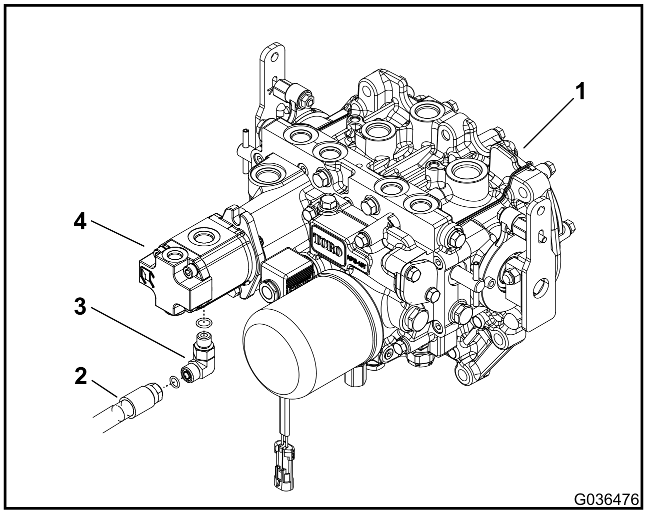

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Figure 57

1. Transmission
2. Hydraulic hose
3. Lower fitting
4. Gear pump

3. Park the machine on a level surface, lower the cutting deck, shut off the engine, and set the parking brake.
4. Read all Warning, Cautions, and precautions listed at the beginning of this section.
5. Clean the junction of the hydraulic hose and lower fitting on the gear pump.
6. Disconnect the hydraulic hose from the lower fitting on the gear pump (Figure 57).
7. Install a hydraulic tester (pressure and flow) in series with the gear pump fitting and disconnected hose. Ensure that the tester flow arrow points from the pump outlet port and toward the disconnected hose. Ensure that the flow-control valve on the tester is fully open.

Test Procedure (continued)

8. Start the engine and run it at low-idle speed **(1,400 rpm)**. Check for hydraulic-fluid leaks from the test connections and correct before continuing the test.
9. With the engine running, press the engine speed switch to full speed **(3,000 rpm)** position.
10. Monitor the tester pressure gauge carefully while you slowly close the flow control valve until you get **6,900 kPa (1,000 psi)**. Do not close the tester load valve fully.
11. Check with a phototac that the engine speed remains **3,000 rpm** while maintaining **6,900 kPa (1000 psi)** on the tester pressure gauge.
12. Monitor the flow gauge. The flow indication for a pump in good condition is **19.7 L/minute (5.2 gallons/minute)**.
13. Open the tester load valve and then shut off the engine. Record the test results.
14. A lower pump flow may result in reduced steering and lift/lower circuit performance. If the measured flow is less than **16.6 L/minute (4.4 gallons/minute)** or a pressure of **6,900 kPa (1,000 psi)** cannot be obtained, check for restriction in the pump inlet line. If the inlet line is not restricted, remove the gear pump and repair or replace as necessary.

    Note: The implement relief valve pressure can also be tested with a hydraulic tester (pressure and flow) in series with the gear pump fitting and disconnected hose. Use the pressure gauges on the hydraulic tester and follow Testing the Implement Relief Pressure (Using Pressure Gauge) (page 4–59).

15. Release pressure from the hydraulic system; refer to Releasing Pressure from the Hydraulic System (page 4–5).
16. Disconnect the tester from the deck lift manifold fitting and hydraulic hose, and connect the hose to the control valve fitting.

Testing the Lift Cylinder for Internal Leakage

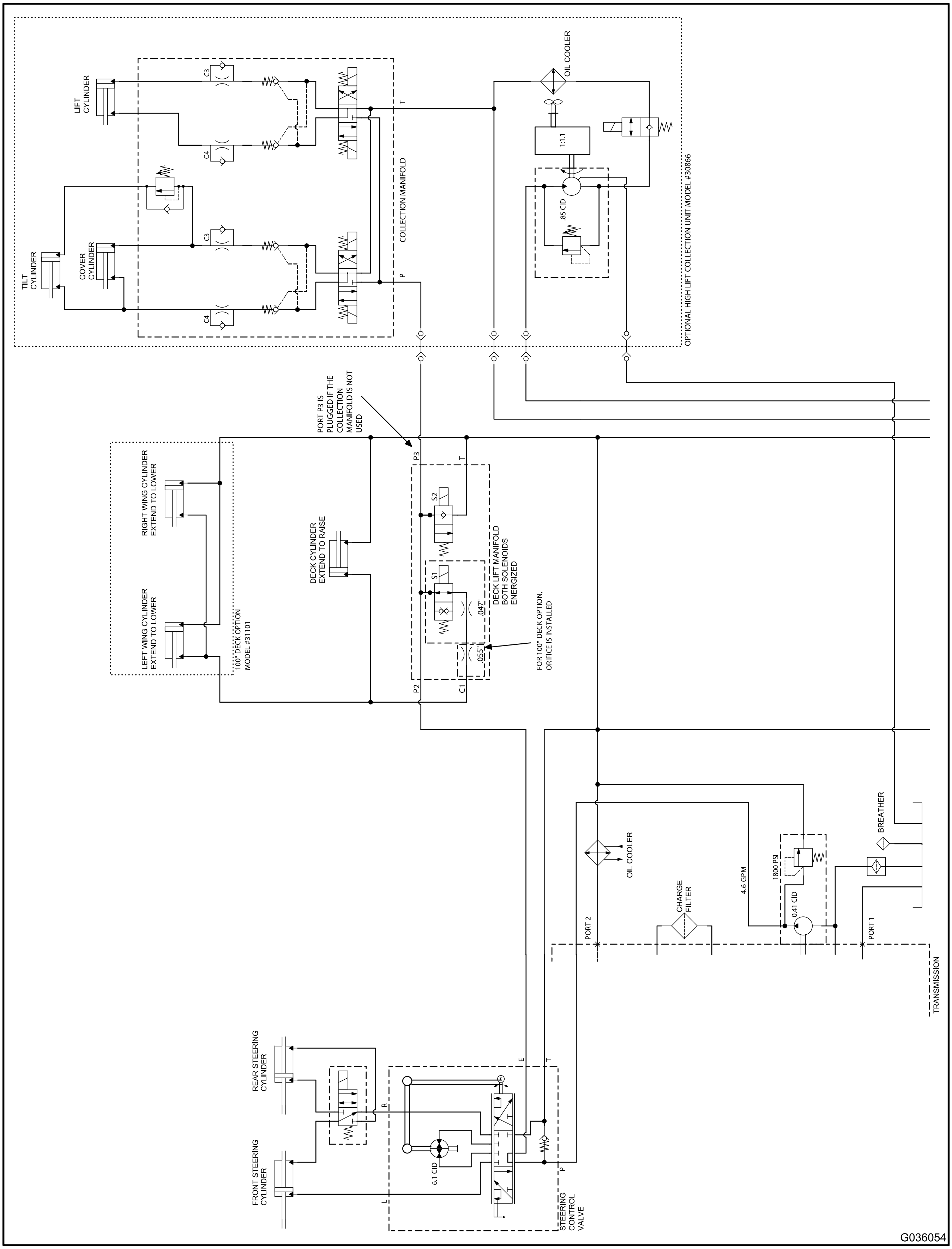

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Figure 58

Perform the lift cylinder internal leakage test if you identify a cutting deck raise and lower problem. This test determines if the lift cylinder is damaged.

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

Test Procedure

1. Park the machine on a level surface with the PTO switch off, position the cutting deck in a partially raised position, shut off the engine, and set the parking brake.
2. Under both sides of the cutting deck, use a jack to raise the cutting deck slightly. This removes the load from the lift cylinder and releases the lift cylinder hydraulic pressure.
3. Support both sides of the cutting deck with jack stands to prevent the lift cylinder from retracting.
4. Clean the area around the hydraulic hose end at the barrel end of the lift cylinder. Disconnect the hydraulic hose from the lift cylinder barrel end fitting.

IMPORTANT

When capping the 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 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.

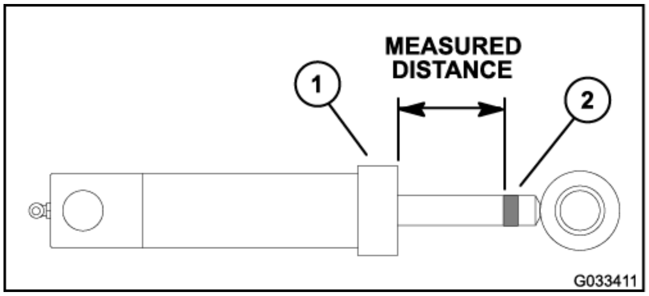

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Figure 59

1. Lift cylinder collar
2. Tape

6. Remove the jack stands from under the cutting deck.

   Note: The cutting deck should settle slightly and then be supported by the capped lift cylinder.

7. Place a piece of tape on the lift cylinder rod near the rod end (Figure 59). Measure and record the distance from the lift cylinder collar to the tape location.
8. Keep the machine parked for 2 hours and monitor the lift cylinder. The weight of the cutting deck can cause the lift cylinder to gradually retract. Use the change in distance from the lift cylinder collar to the location of the tape to determine the lift cylinder rod movement.

   A. If the cutting deck is still suspended after 2 hours and lift cylinder rod movement is less than **31.7 mm (1.25 inch)**, consider that the lift cylinder is in good condition.

      Note: A lift cylinder in good, usable condition will show minimal rod movement.

   B. If the rod movement is more than **31.7 mm (1.25 inch)** after 2 hours, indicates a lift cylinder with internal seal damage or excessive internal wear. Replace or repair the lift cylinder; refer to Lift Cylinder (page 4–165) and Servicing the Lift Cylinder (page 4–168).

9. Once the lift cylinder condition is determined, use a jack to raise both sides of the cutting deck slightly which removes the load from the lift cylinder.
10. Support both sides of the cutting deck with jack stands.
11. Remove the cap from the cylinder fitting and the plug from the hydraulic hose.
12. Connect the hydraulic hose to the lift cylinder fitting.
13. Remove the tape from the lift cylinder rod.
14. Remove the jack stands from the cutting deck.
15. Start the engine and operate the lift cylinder through several raise and lower cycles. Shut off the engine and check for any leakage.
16. Check the hydraulic-fluid level in the hydraulic reservoir.

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, shut off the engine, 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.

⚠ **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 4–5).

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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 reservoir and add correct quantity of fluid if necessary. Use the hydraulic fluids that are specified in the *Operator's Manual*.

IMPORTANT

Drain and fill the hydraulic-system reservoir and change the oil filter if the component failure is severe or the system is contaminated; refer to Flushing the Hydraulic System (page 4–70).

---

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.
4. Use proper tightening procedures when installing the hydraulic hoses and fittings; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal

Fitting) (page 4–8) and Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fitting into the Component Port) (page 4–9).

5. After you complete the repairs, check the control linkages or cables for proper adjustment, binding, or broken parts.
6. After you disconnect or replace any hydraulic components, operate the machine functions slowly until the air is out of the system; refer to Charging the Hydraulic System (page 4–74).
7. 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, and hose deterioration. Repair the damaged hydraulic lines and hoses before operating the machine.

Priming the Hydraulic Pumps

When the hydraulic system is flushed, the hydraulic system is charged, or the hydraulic components are installed, it is important to properly prime the hydraulic pumps. The hydraulic pump priming ensures that the gear pump and piston (traction) pump have sufficient fluid during initial start-up and running. The pumps can be primed by using a remote starter switch (refer to Special Tools (page 4–27)) to crank the engine which allows the pumps 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 reservoir and add correct quantity of fluid if necessary; refer to the *Operator’s Manual*.

Priming the Hydraulic Pumps (continued)

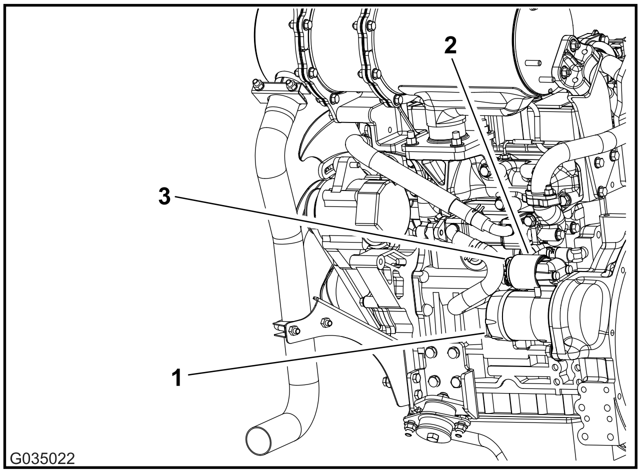

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Figure 60

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

Note: A blue wire connects to the starter motor solenoid B+ terminal (Figure 60). It is not necessary to remove this blue wire from the solenoid terminal for hydraulic pump priming.

3. Connect the remote starter switch electrical leads to the starter motor solenoid B+ terminal and positive post of the battery.
4. 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.
5. Disconnect the remote starter switch leads from the starter motor solenoid terminal and positive post of the battery.

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 4–6) 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 20 minutes.

Flushing the Hydraulic System (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 4–5).

2. Park 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.

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

3. Drain the hydraulic fluid from the hydraulic tank and transmission.
4. Drain the complete hydraulic system. Drain all the hoses, tubes, and components while the system is warm.
5. Remove and replace the hydraulic-fluid filter.
6. Inspect and clean the hydraulic-fluid tank; refer to Inspecting the Hydraulic Tank (page 4–77).
7. Connect all the hydraulic hoses, tubes, and components that were disconnected while draining the system; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–8).

IMPORTANT

Using other hydraulic fluids could damage the hydraulic system. Use the hydraulic fluids that are specified in the *Operator's Manual*. Use of biodegradable hydraulic fluid in the Groundsmaster 360 machines is not recommended.

8. Fill the hydraulic tank with the correct quantity of new hydraulic fluid.
9. Prime the hydraulic pumps; refer to Priming the Hydraulic Pumps (page 4–69).
10. Start the engine and operate it at low-idle speed **(1,400 rpm)** for a minimum of 2 minutes. Increase the engine speed to high idle **(3,000 rpm)** for a minimum of 1 minute under no load.
11. Raise and lower the cutting deck several times.
12. 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*.

13. Operate the machine for 2 hours under normal operating conditions.
14. Check the condition of hydraulic fluid. If new fluid shows any signs of contamination, repeat steps 1 through 13 again until the fluid is clean.
15. When the hydraulic fluid is free from contamination, assume normal operation and follow the recommended maintenance intervals.

Filtering the Closed-Loop Traction Circuit

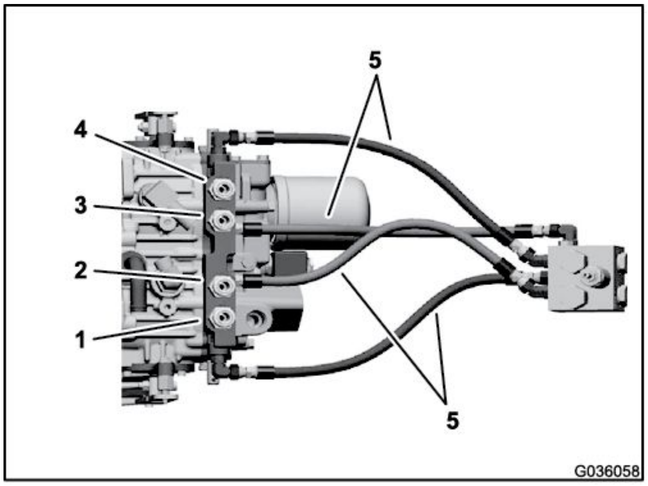

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Figure 61

1. Port A
2. Port B
3. Port C
4. Port D
5. Balancing hose

Filtering a closed-loop hydraulic system after a major component failure (e.g., transmission piston pump or wheel 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 traction circuit, use the Toro high flow hydraulic filter and hydraulic hose kits (refer to Special Tools (page 4–27)).

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

IMPORTANT

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

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

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

3. Clean the area around the traction circuit hoses on the top of the transmission (Figure 61). Determine which piston pump circuit is to be filtered.
4. Disconnect the hydraulic hose from the transmission pump inlet fitting for the piston pump to be filtered (Figure 61).

Piston Pump to be Filtered	Pump Inlet
Right side pump	Port B
Left side pump	Port D

5. Connect the Toro high flow hydraulic filter in series between the pump inlet fitting and disconnected hose. Use the hydraulic hose kit (refer to Special Tools (page 4–27)) to connect the filter to the machine. Ensure that the hose connections are properly tightened.

Filtering the Closed-Loop Traction Circuit (continued)

6. Disconnect the balancing hose from the transmission fitting closest to the transmission pump inlet for the pump to be filtered (Figure 61). Install a steel cap on the fitting and steel plug in the balancing hose.

IMPORTANT

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

7. After you install the high-flow filter to the machine, check and fill the reservoir with the correct quantity of new hydraulic fluid.
8. Start the engine and run it at low-idle speed **(1,400 rpm)**. 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.

9. 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.

   Note: When applying brakes to increase the traction system pressure, ensure that the parking brake latch is not pressed. If the parking brake latch is pressed, the engine will stop running.

10. With the engine running at high-idle speed **(3,000 rpm)** 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.

Filtering the Closed-Loop Traction Circuit (continued)

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.

11. 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.
12. Shut off the engine and remove the key from the key switch.
13. Remove the high flow hydraulic filter and hydraulic hose kit from the machine. Connect the pump inlet and balancing hoses to transmission fittings. Ensure that you properly tighten the hoses; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–8).
14. Repeat steps 4 through 13 to filter the remaining piston pump circuit.
15. After filtering is completed, lower the machine to the ground.
16. Check the hydraulic-fluid level in the hydraulic reservoir and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.

Charging the Hydraulic System

Note: When initially starting the hydraulic system with new or rebuilt components such as wheel motors, gear pump, or lift cylinder, 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. Ensure that all of the hydraulic connections, lines, and components are secured tightly.

   Note: Flush and fill the hydraulic system and tank whenever there is a severe component failure or the system is contaminated; refer to Flushing the Hydraulic System (page 4–70).
3. Ensure that the hydraulic tank is full. Add correct quantity of hydraulic fluid if necessary; refer to the *Operator's Manual*.
4. Check the traction control components for proper adjustment, binding, or damaged parts.
5. Prime the hydraulic pumps; refer to Priming the Hydraulic Pumps (page 4–69).

IMPORTANT

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

6. Lift and support the machine with jack stands so that all the drive wheels are off the ground.

⚠ CAUTION ⚠

Ensure that the machine is safely supported so that it does not move or accidentally fall and prevent injuring anyone under the machine.

7. Ensure that the traction pedal is in the NEUTRAL position. Start the engine and run it at low-idle speed **(1,400 rpm)**.

   Note: The piston and gear pumps 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.

8. After the hydraulic system starts to show the signs of fill, actuate a deck lift switch until the lift cylinder rod moves in and out several times.
9. If the lift cylinder 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 implement relief valve that is damaged.
   E. The gear pump that is damaged.
10. After the lift cylinder moves normally, proceed to step 11.
11. Turn the steering wheel in both directions so that the steering cylinders move in and out several times.
12. 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 wheel motor location and hydraulic lines to the wheel motors; refer to Installing the Transmission (page 4–95).
13. Adjust the traction pedal to the NEUTRAL position; refer to the *Operator's Manual*.
14. Lower the machine to the ground.
15. If the transmission or a wheel motor was replaced or rebuilt, operate the traction circuit on a level ground so that all the drive wheels rotate slowly for 10 minutes.
16. Operate the machine by gradually increasing its work load to full over a 10 minute period.

    Note: Some aeration of hydraulic fluid on this machine is normal. This aeration (foaming) may be more noticeable after initial filling of the hydraulic tank.

17. Stop the machine. Check the hydraulic-fluid level in the hydraulic reservoir and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
18. Check the hydraulic components for leaks and tighten any loose connections.

Hydraulic Tank

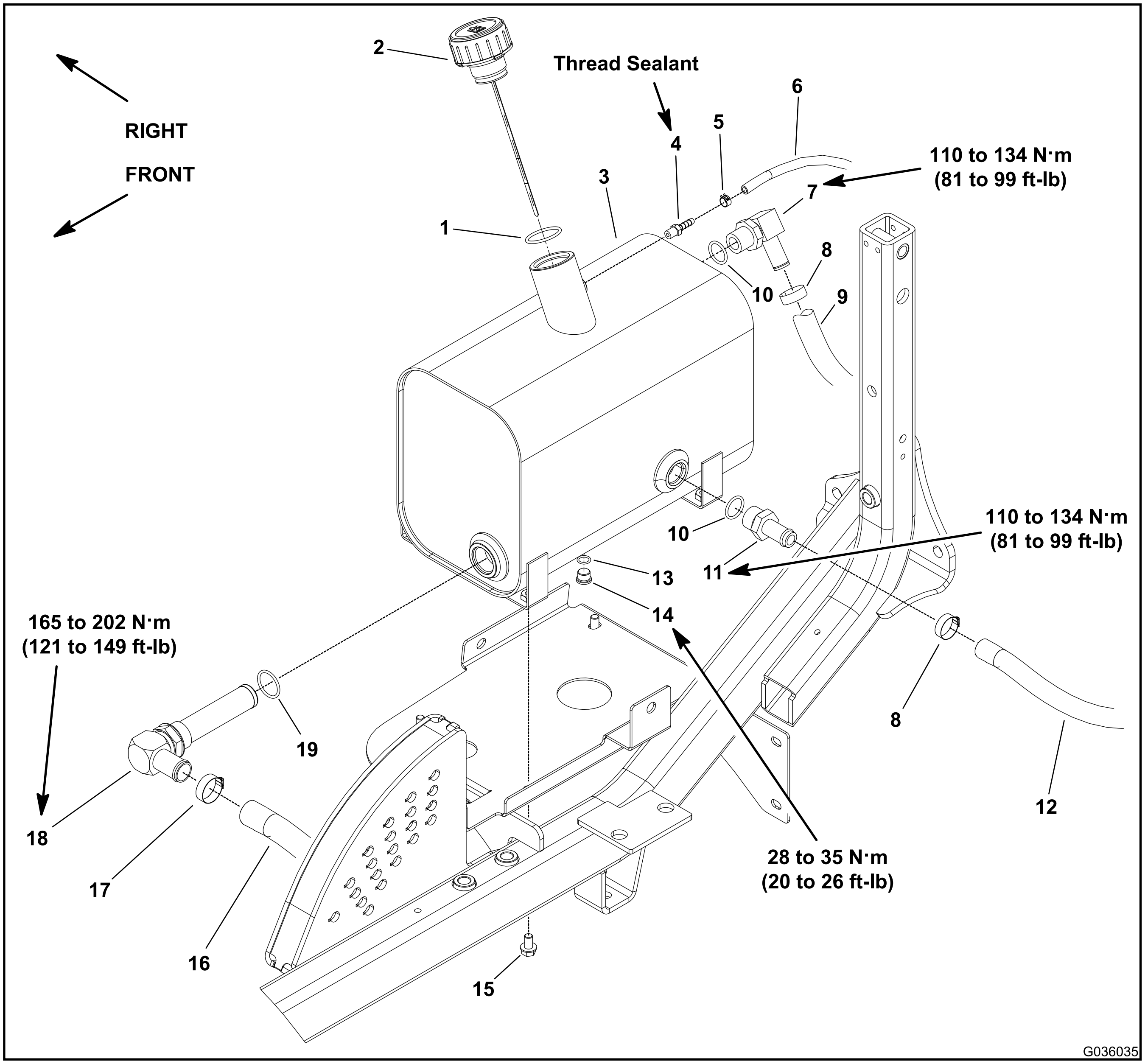

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Figure 62

1. O-ring
2. Tank cap
3. Hydraulic tank
4. Barbed fitting
5. Hose clamp
6. Hose
7. 90° hydraulic fitting
8. Hose clamp (2 each)
9. Drain hose
10. O-ring (2 each)
11. Straight fitting
12. Drain hose
13. O-ring
14. Plug
15. Flange-head screw (4 each)
16. Suction hose
17. Hose clamp
18. Strainer fitting assembly
19. O-ring

Removing 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. Raise the operator seat.
3. Drain the hydraulic fluid from the hydraulic tank into a suitable container.
4. Remove the hydraulic tank cover from the machine; refer to Control Console (page 6–53).
5. Clean the hydraulic hose ends and fittings on the hydraulic tank to prevent contaminants from entering into the hydraulic system.
6. For assembly purposes, label all the hydraulic hoses and fittings. Remove the hydraulic hoses from the fittings on the hydraulic tank (Figure 63) and drain the hoses into a suitable container.
7. Install clean caps or plugs on the hydraulic hoses and fittings to prevent system contamination.
8. Remove the 4 flange-head screws (item 15 in Figure 62) that secure the hydraulic tank to the frame.
9. Remove the hydraulic tank from the machine.
10. Remove the hydraulic fittings from the hydraulic tank as necessary (Figure 62).
11. Remove and discard the O-rings from the fittings.

Inspecting the Hydraulic Tank

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

Installing the Hydraulic Tank

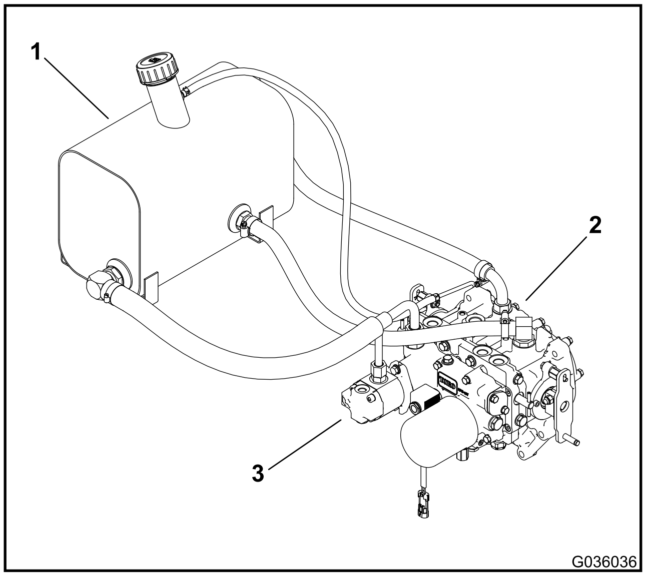

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Figure 63

1. Hydraulic tank
2. Transmission
3. Gear pump

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1. Install the strainer fitting assembly and fittings with new lubricated O-rings to the hydraulic tank; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fitting into the Component Port) (page 4–9). Torque the fittings to the values identified in Figure 62.

Installing the Hydraulic Tank (continued)

2. Install the hydraulic tank to the machine and secure the tank to the frame with the 4 flange-head screws.
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 hydraulic tank; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–8).
5. Fill the hydraulic tank with the correct quantity of new hydraulic fluid.
6. Install the hydraulic tank cover to the machine; refer to Control Console (page 6–53).
7. Lower and secure the operator seat.
8. Operate the machine. Check the hydraulic-fluid level and adjust if necessary.
9. Check the hydraulic components for leaks. Tighten any loose connections.

Rear Wheel Motors

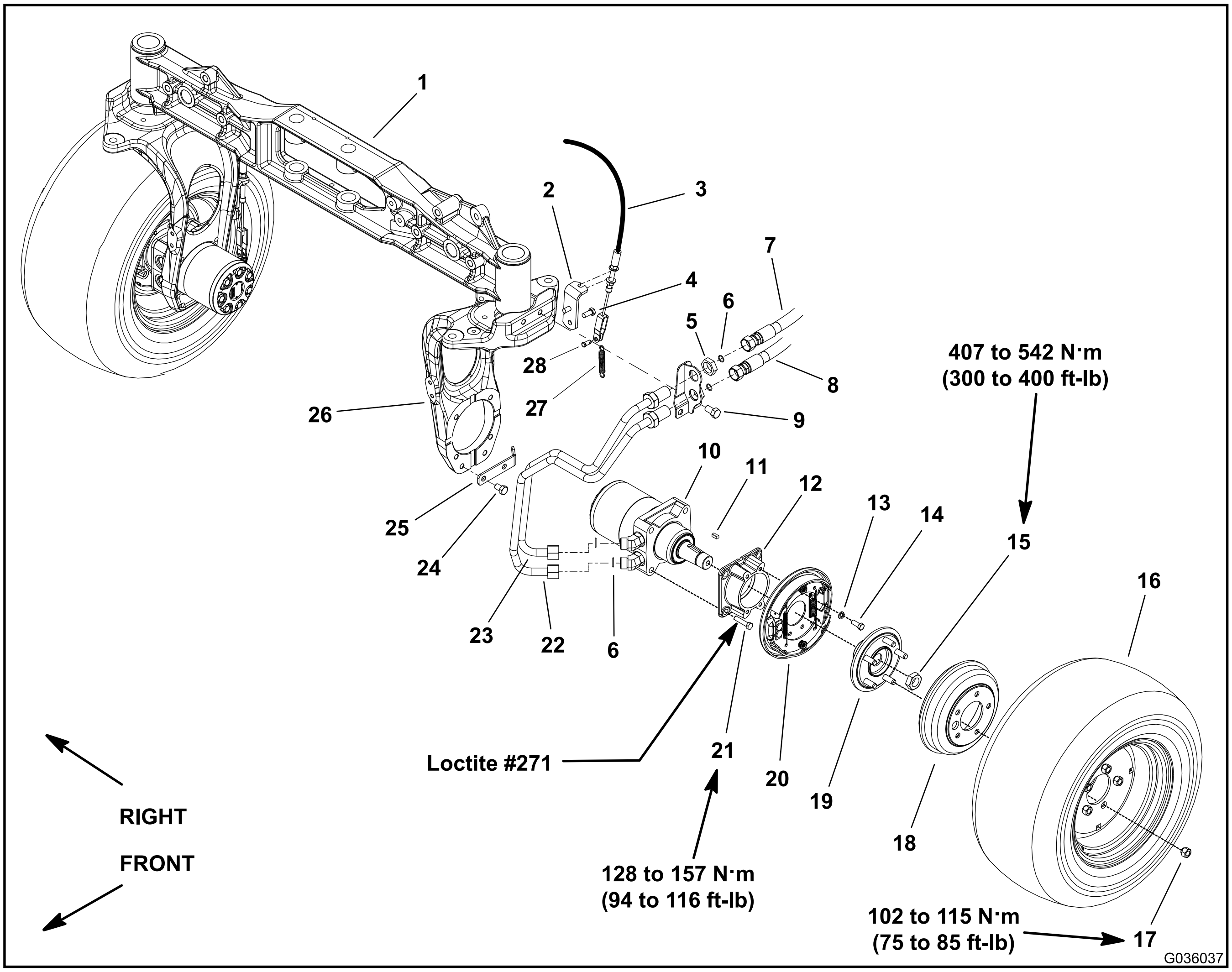

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Figure 64

1. Rear axle
2. Brake cable bracket (left)
3. Brake cable
4. Bolt (2 each per bracket)
5. Bulkhead locknut (2 each per bracket)
6. O-ring
7. Hydraulic hose
8. Hydraulic hose
9. Bolt (2 each per bracket)
10. Wheel motor (left)
11. Square key
12. Brake adapter
13. Lock washer (2 each per brake assembly)
14. Bolt (2 each per brake assembly)
15. Locknut
16. Rear wheel assembly (left)
17. Wheel-lug nut (5 each per wheel)
18. Brake drum
19. Wheel hub
20. Brake assembly (left)
21. Bolt (4 each per motor)
22. Hydraulic tube
23. Hydraulic tube
24. Bolt (2 each per bracket)
25. Return spring bracket
26. Steering fork assembly
27. Brake return spring
28. Clevis pin

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 4–5).

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. Loosen, but do not remove the locknut (item 15 in Figure 64) that secures the wheel hub to the wheel motor. Also, loosen the wheel-lug nuts.

IMPORTANT

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

3. Lift the machine with a jack to remove the rear wheel, support the machine with jack stands.
4. Remove the rear wheel assembly (item 16 in Figure 64), brake drum, wheel hub, and brake assembly from the machine; refer to Servicing the Brake (page 6–15).

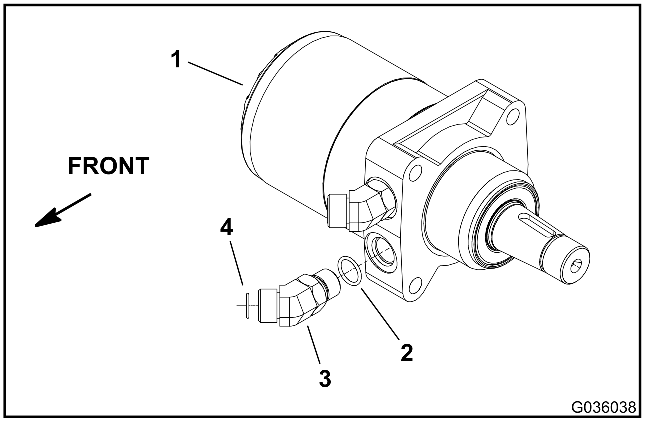

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Figure 65

1.	Wheel motor	3.	45° hydraulic fitting (2 each)
2.	O-ring	4.	O-ring

5. Clean the hydraulic hose ends and fittings on the wheel motor to prevent contaminants from entering into the hydraulic system.
6. Loosen and remove the hydraulic tubes from the fittings on the wheel motor. Allow the tubes to drain into a suitable container.
7. Install clean caps or plugs on the hydraulic tubes and fittings to prevent system contamination.
8. Support the wheel motor to prevent it from falling during removal.
9. Remove the 4 bolts (item 21 in Figure 64) that secure the wheel motor to the steering fork.
10. Remove the wheel motor from the steering fork.

Removing the Rear Wheel Motor (continued)

11. 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

IMPORTANT

Because of the internal differences in the wheel motors, do not interchange the wheel motors on the machine (e.g., do not put the right motor on the left side of the machine). If necessary, use the *Parts Catalog* and Part Number on the wheel motor to identify the right and left motors, there is also a yellow dot on the left motor.

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1. If the hydraulic fittings were removed from the wheel motor, lubricate and install new O-rings to the fittings. Install the fittings into the wheel motor ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fitting into the Component Port) (page 4–9). Ensure that the fittings are orientated correctly (Figure 65).
2. Clean the threads in the steering fork and on the bolts that secure the wheel motor to the machine.
3. Position the rear wheel motor to the steering fork with ports facing forward.
4. Apply the Loctite #271 (or equivalent) to the threads of the bolts. Secure the rear wheel motor to the steering fork with the 4 bolts; torque the bolts to **128 to 157 N·m (94 to 116 ft-lb)**.

IMPORTANT

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

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5. Remove the caps or plugs from the hydraulic tubes and wheel fittings.
6. Connect the hydraulic tubes to the wheel motor fittings; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–8).
7. Install the brake assembly (item 20 in Figure 64), wheel hub, brake drum, and rear wheel assembly to the machine; refer to Servicing the Brake (page 6–15).
8. Lower the machine to the ground.

⚠ 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.

Installing the Rear Wheel Motor (continued)

9. Torque the locknut (item 15 in Figure 64) to **407 to 542 N·m (300 to 400 ft-lb)**. Also, ensure to torque all the wheel-lug nuts to **102 to 115 N·m (75 to 85 ft-lb)** in a crossing pattern.

10. Fill the reservoir with the correct quantity of new hydraulic fluid.

Front Wheel Motors

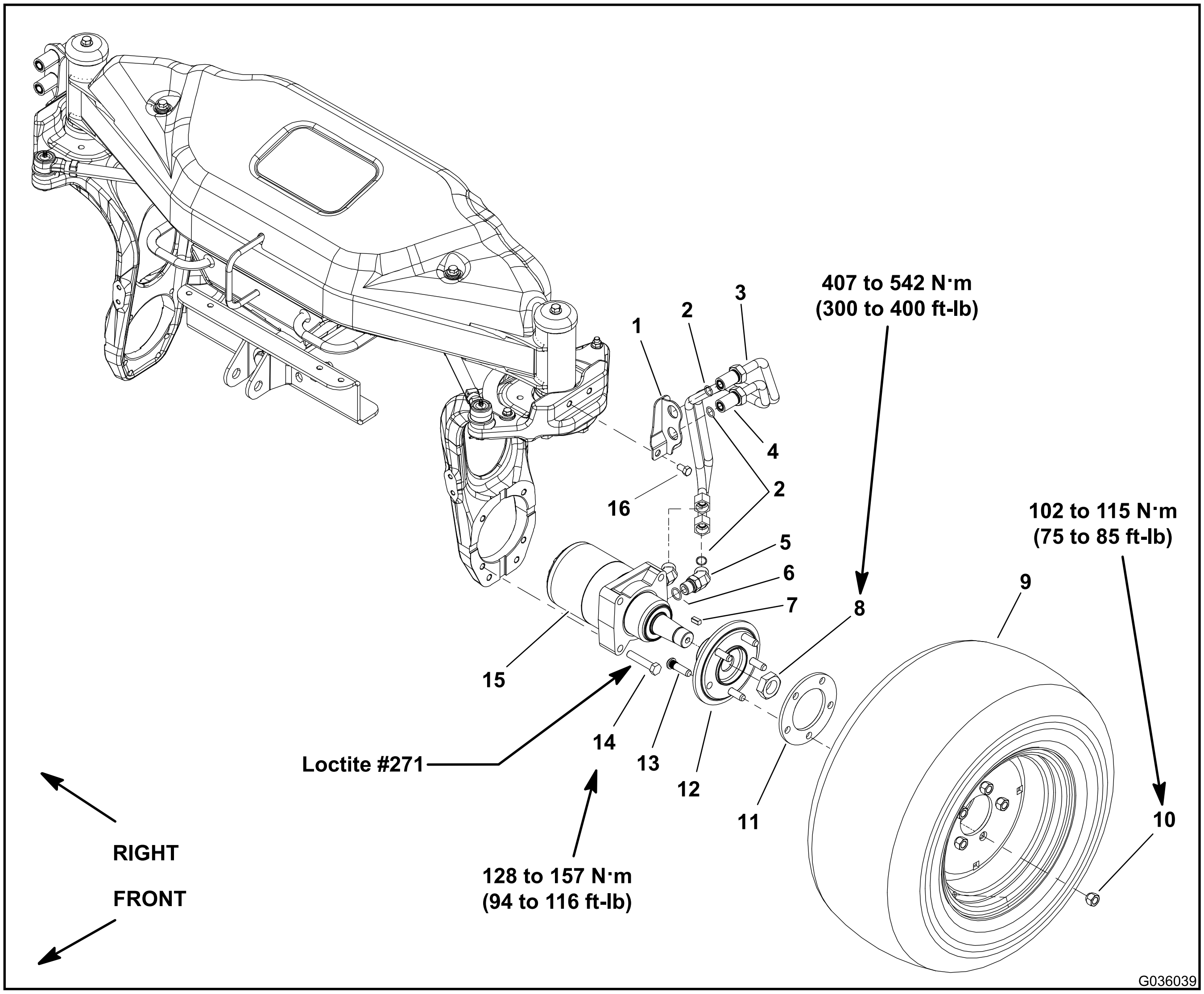

Figure 66

1.	Bulkhead bracket	7.	Square key	13.	Wheel stud (5 each per wheel)
2.	O-ring	8.	Locknut	14.	Bolt (4 each per motor)
3.	Hydraulic tube	9.	Front wheel assembly	15.	Front wheel motor (left)
4.	Hydraulic tube	10.	Wheel-lug nut (5 each per wheel)	16.	Bolt (4 each per bracket)
5.	45° hydraulic fitting (2 each per motor)	11.	Wheel spacer		
6.	O-ring	12.	Wheel hub		

Removing the Front 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 4–5).

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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. Loosen, but do not remove the locknut (item 8 in Figure 66) that secures the wheel hub to the wheel motor. Also, loosen the wheel-lug nuts.

IMPORTANT

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

3. Lift the machine with a jack to remove the front wheel, support the machine with jack stands.
4. Remove the front wheel from the machine; refer to Removing the Wheel (page 6–14). Remove the wheel spacer (item 11 in Figure 66).

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.

5. Ensure that the locknut (item 8 in Figure 66) on the wheel motor shaft is loosened at least 2 turns. Use a hub puller (refer to Special Tools (page 4–27)) to loosen the wheel hub from the wheel motor.
6. Remove the locknut and wheel hub from the motor shaft. Discard the locknut.
7. Locate and retrieve the square key (item 7 in Figure 66).
8. Clean the hydraulic tube ends and fittings on the wheel motor to prevent contaminants from entering into the hydraulic system.
9. Loosen and remove the hydraulic tubes from the fittings on the wheel motor. Allow the tubes to drain into a suitable container.
10. Install 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.
12. Remove the 4 bolts (item 14 in Figure 66) that secure the wheel motor to the steering fork.
13. Remove the wheel motor from the steering fork.
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

IMPORTANT

Because of the internal differences in the wheel motors, do not interchange the wheel motors on the machine (e.g., do not put the right motor on the left side of the machine). If necessary, use the *Parts Catalog* and Part Number on the wheel motor to identify the right and left motors, there is also a yellow dot on the left motor.

1. If the hydraulic fittings were removed from the wheel motor, lubricate and install new O-rings to the fittings. Install the fittings into the wheel motor ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fitting into the Component Port) (page 4–9). Ensure that the fittings are orientated correctly.
2. Clean the threads in the steering fork and on the 4 bolts that secure the wheel motor to the machine.
3. Position the front wheel motor to the steering fork with ports facing toward rear of the machine.
4. Apply the Loctite #271 (or equivalent) to the threads of the bolts. Secure the front wheel motor to the steering fork with the 4 bolts; torque the bolts to **128 to 157 N·m (94 to 116 ft-lb)**.

IMPORTANT

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

5. Insert the square key (item 7 in Figure 66) in the wheel motor shaft, then install the wheel hub onto the wheel motor shaft.

IMPORTANT

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

6. Install new locknut (item 8 in Figure 66) onto the wheel motor shaft to secure the wheel hub to the motor shaft.
7. Remove the caps or plugs from the hydraulic tubes and wheel fittings.
8. Connect the hydraulic tubes to the wheel motor fittings; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–8).
9. Install the wheel spacer (item 11 in Figure 64), wheel assembly to the machine; refer to Installing the Wheel (page 6–14).
10. Lower the machine to the ground.

Installing the Front Wheel Motor (continued)

⚠ WARNING ⚠

Failure to maintain proper torque could result in failure or loss of the wheel and may result in personal injury.

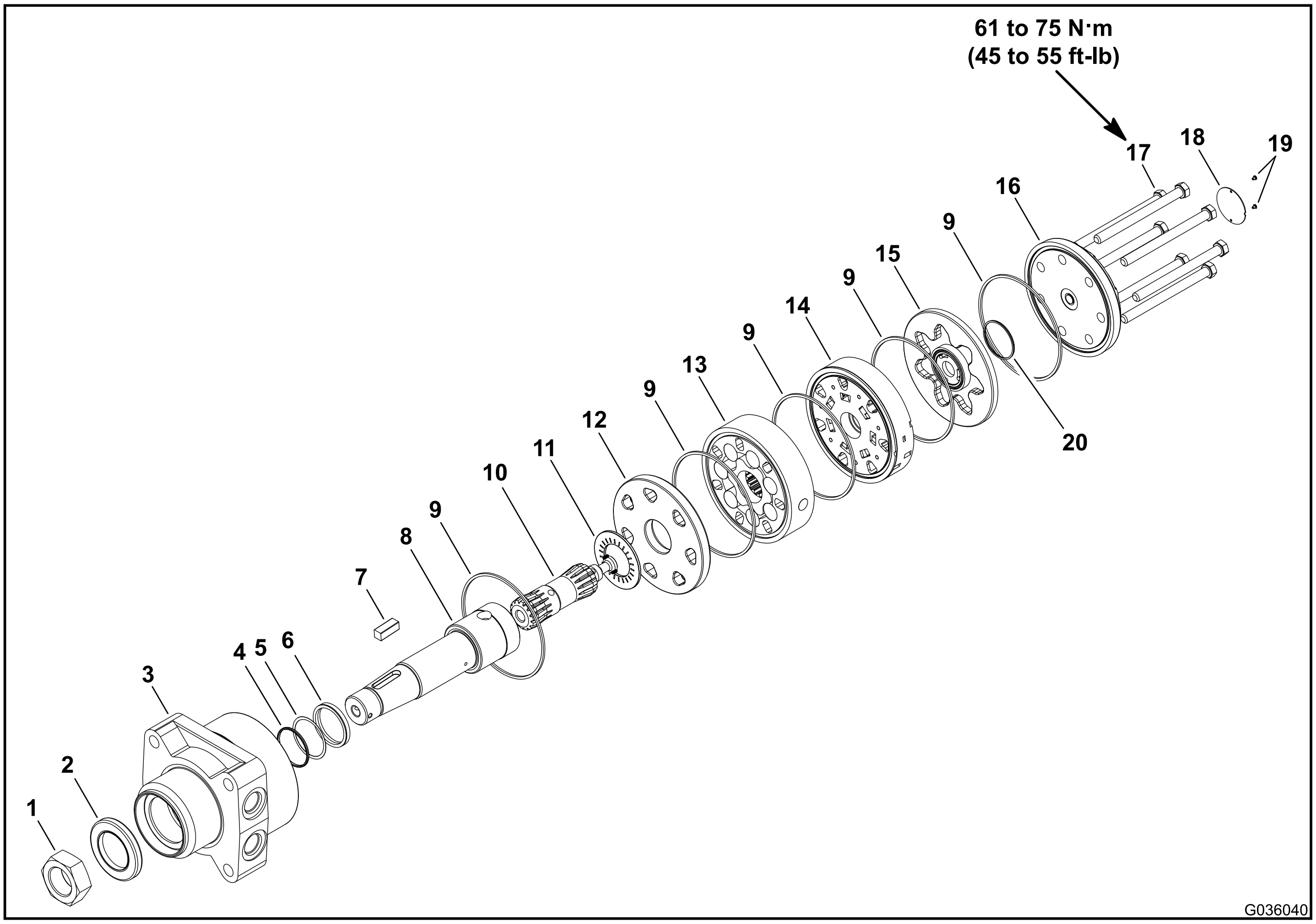
Maintain the proper torque of the wheel lug nuts.

---

11. Torque the locknut (item 8 in Figure 64) to **407 to 542 N·m (300 to 400 ft-lb)**. Also, ensure to torque all the wheel-lug nuts to **102 to 115 N·m (75 to 85 ft-lb)** in a crossing pattern.

12. Fill the reservoir with the correct quantity of new hydraulic fluid.

Servicing the Wheel Motor



g036040

Figure 67

1.	Locknut	8.	Coupling shaft	15.	Commutator assembly
2.	Dirt and water seal	9.	Square ring seal (5 each)	16.	End cover
3.	Housing assembly	10.	Drive link	17.	Bolt (7 each)
4.	Back-up ring	11.	Thrust bearing	18.	Identification tag
5.	Back-up washer	12.	Wear plate	19.	Drive screw (2 each)
6.	Shaft seal	13.	Rotor assembly	20.	Commutator seal
7.	Square key	14.	Manifold assembly		

Note: The wheel motors of the Groundsmaster 360 machine have the same basic construction. The left wheel motor(s) has a yellow dot on the port side of the motor housing. The right wheel motor(s) has a reverse timed manifold.

IMPORTANT

Do not interchange the wheel motors on the machine (e.g., do not put the right motor on the left side of the machine). If necessary, use the *Parts Catalog* and Part Number on the wheel motor to identify the right and left motors.

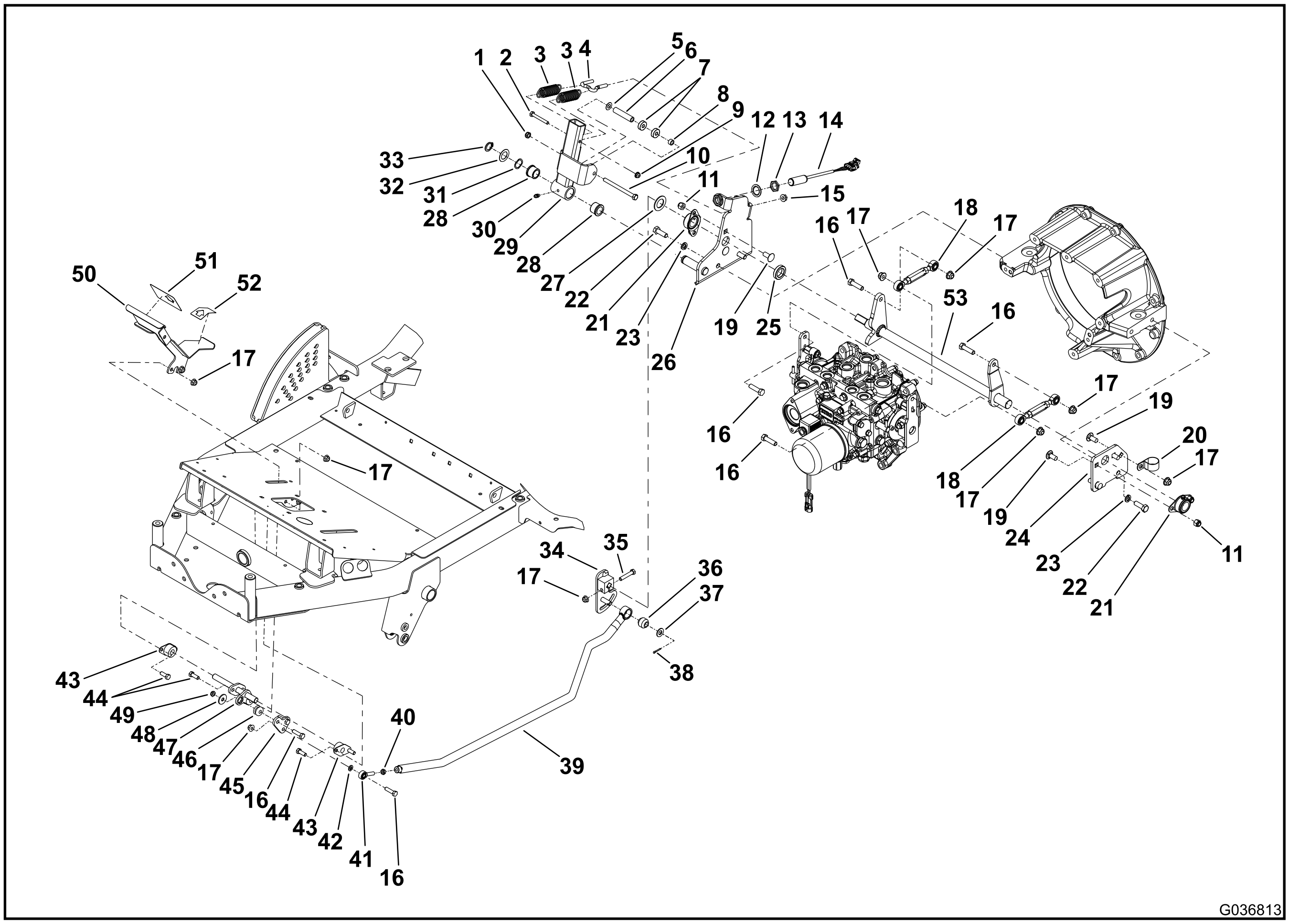
Note: For the wheel motor repair procedures; refer to the Parker Torqmotor™ Service Procedure (TC, TB, TE, TJ, TF, TG, TH, and TL Series) at the end of this chapter.

Servicing the Wheel Motor (continued)

IMPORTANT

If a wheel motor fails; refer to the Traction Circuit Component Failure (page 4–6) for information regarding the importance of removing contamination from the traction circuit.

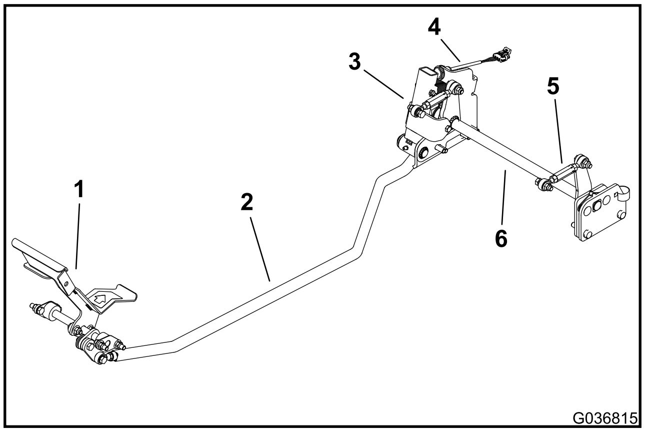
Traction Linkage Assembly



g036813

Figure 68

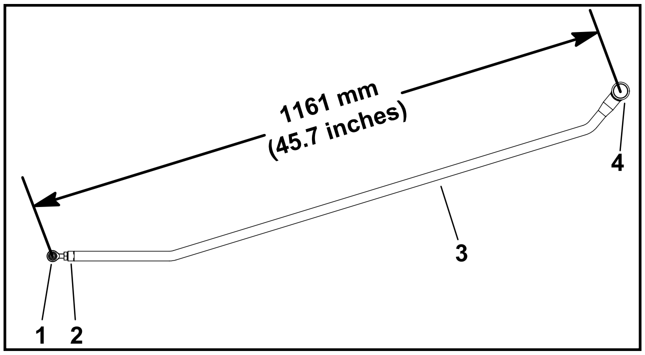
1. Locknut
2. Screw
3. Extension spring (2 each)
4. Dual spring hook
5. Thrust washer
6. Spacer
7. Ball bearing (2 each)
8. Tilt pivot spacer
9. Flange nut
10. Screw
11. Locknut (4 each)
12. Internal tooth lock washer (2 each)
13. Hex nut (2 each)
14. Traction neutral sensor
15. Flange nut
16. Screw (7 each)
17. Flange nut (13 each)
18. Link assembly (2 each)
19. Carriage screw (5 each)
20. R-clamp
21. Side flange bearing (2 each)
22. Screw (4 each)
23. Lock washer (4 each)
24. Neutral end plate
25. Neutral shaft spacer
26. Neutral end plate
27. Flat washer
28. Flange bushing (2 each)
29. Neutral arm assembly
30. Grease fitting
31. Wave washer
32. Thrust washer
33. Retaining ring
34. Traction lever assembly
35. Screw
36. Rubber bushing
37. Flat washer
38. Cotter pin
39. Traction rod assembly
40. Jam nut
41. Rod end
42. Lock washer
43. Flange mount bearing (2 each)
44. Screw (6 each)
45. Traction linkage plate
46. Rubber mount (2 each)
47. Isolated pedal pivot
48. Hardened washer (2 each)
49. Locknut (2 each)
50. Pedal
51. Traction pedal pad
52. Traction pedal pad
53. Neutral shaft assembly



g036815

Figure 69

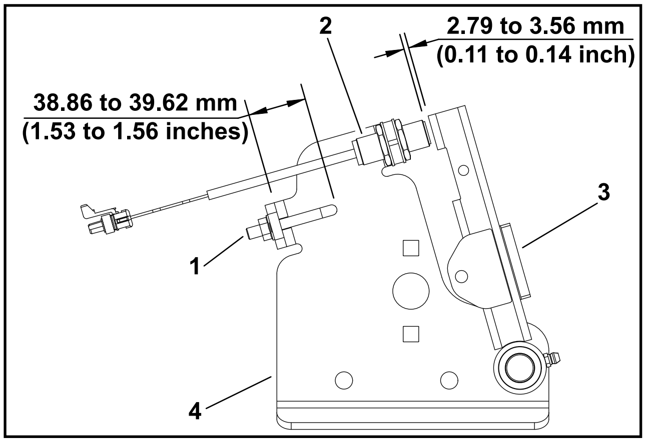
1. Traction pedal	4. Traction neutral sensor
2. Traction rod assembly	5. Link assembly (2 each)
3. Neutral arm assembly	6. Neutral shaft assembly



g185811

Figure 70

1. Rod end	3. Traction rod assembly
2. Threaded hub	4. Control rod hub



g185810

Figure 71

1. Dual spring hook	3. Neutral arm assembly
2. Traction neutral sensor	4. Neutral end plate

Traction Linkage Assembly (continued)

The transmission of the Groundsmaster 360 machine consists of 2 piston pumps. The swash plate in each of the piston pumps is controlled by the operator traction pedal through the traction linkage assembly. Correct assembly of the traction linkage assembly (Figure 69) is required for proper traction circuit operation.

When servicing the traction linkage on your Groundsmaster 360 machine, use the following information:

Note: Refer to the *Operator's Manual* for information on adjusting traction pedal stops, mow speed limiter lever, and traction pedal neutral position.

1. The center distance between the two rod ends (item 41 in Figure 68) should be 1161 mm (45.7 inches). This is the distance between the center of the rod end and the center of the rubber bushing (Figure 70). Tomah has a tool that sets it at 1168.4 mm (46 inches) to begin and then it is adjusted on each machine.
2. If the dual spring hook that locates behind the neutral arm spring is removed, install the dual spring hook so that the threads extend after the flange nut from 8.7 to 9.5 mm (0.34 to 0.37 inch) (Figure 71). If quicker return to the traction neutral position is necessary, adjustment can made to increase amount of thread extension. This adjustment will also result in higher pressure required to press the traction pedal.
3. Adjust the control arms; refer to the *Operator's Manual*.

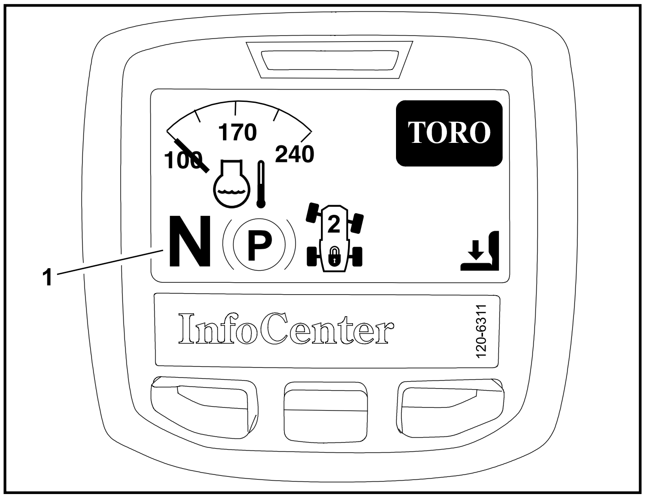


Figure 72

1. Traction neutral position

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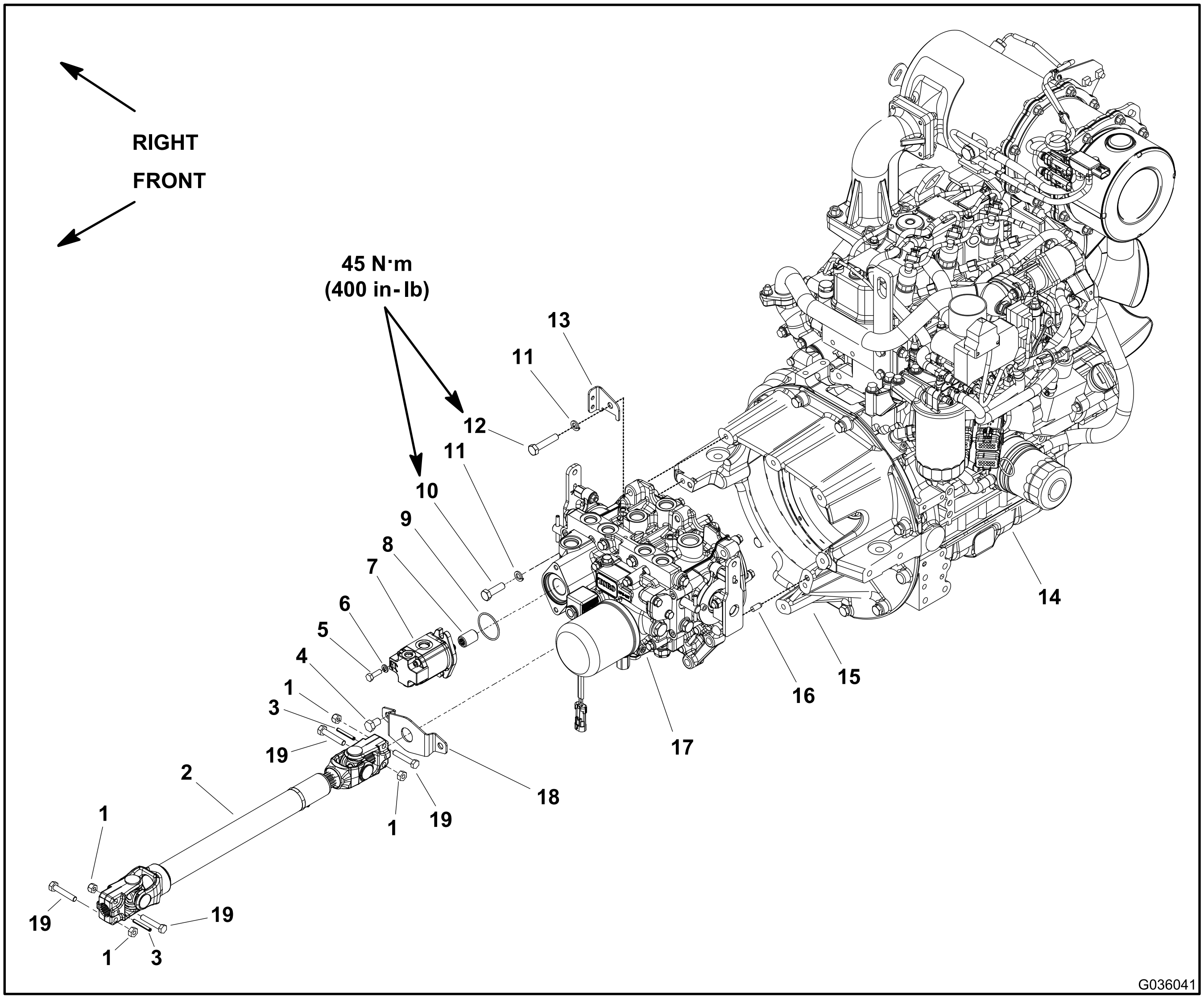
4. Ensure that the traction neutral sensor is closed when the traction pedal is in the NEUTRAL position:
   A. Use InfoCenter display to check the traction neutral sensor operation (Figure 72) .
   B. The traction neutral sensor LED should be illuminated when the traction pedal is in the NEUTRAL position; refer to Traction Neutral Sensor (page 5–44).
5. After adjustments have been made and all the traction linkage fasteners are tightened, ensure that there is no binding as the traction pedal is pressed. The traction pedal should freely return to the NEUTRAL position after it is released from either forward or reverse. Also, ensure that the traction rod does not contact anything through both forward and reverse directions.

Transmission



g036041

Figure 73

1. Locknut (4 each)
2. Driveshaft assembly
3. Roll pin (2 each)
4. Bolt (2 each)
5. Bolt (2 each)
6. Lock washer (2 each)
7. Gear pump assembly
8. Spline coupler
9. O-ring
10. Bolt (35 mm long)
11. Lock washer (7 each)
12. Bolt (50 mm long) (6 each)
13. Tube support
14. Engine
15. Flywheel housing
16. Dowel pin (2 each)
17. Transmission assembly
18. Seal shield
19. Bolt (4 each)

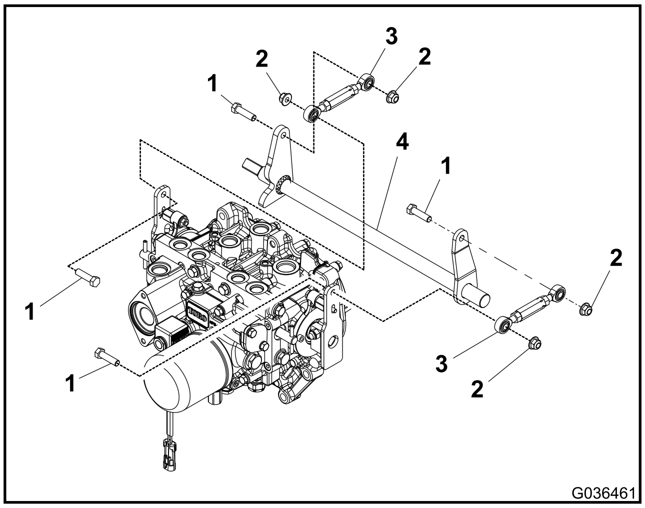
Removing the Transmission

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 4–5).

Removing the Transmission (continued)

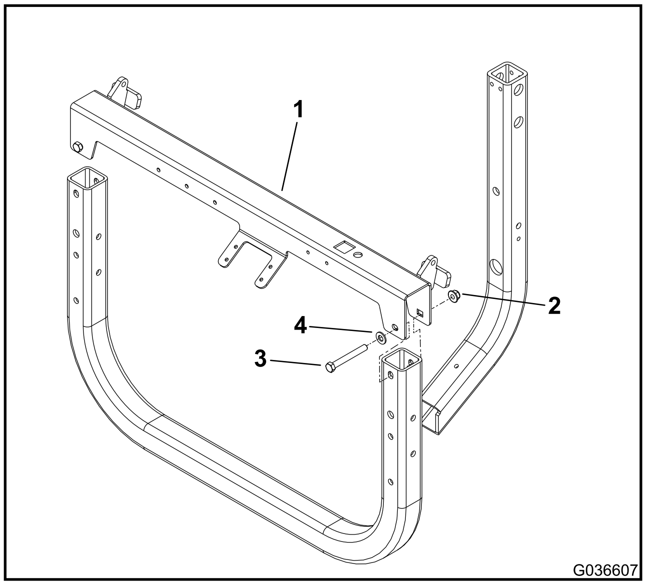
1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Remove the cutting deck; refer to the *Cutting Deck Operator's Manual*.
3. On the machines with operator cab, remove the cab doors from the cab.
4. Remove the operator seat and seat plate; refer to Removing the Operator Seat (page 6–60).



g036461

Figure 74

1.	Screw (4 each)	3.	Link assembly (2 each)
2.	Flange nut (4 each)	4.	Neutral shaft assembly



g036607

Figure 75

1.	Seat channel	3.	Screw (2 each)
2.	Flange nut (2 each)	4.	Flat washer (2 each)

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5. Remove the power center assembly; refer to Removing the Power Center Assembly (page 6–56) or, if the machine is equipped with operator cab; refer to Removing the Power Center Assembly (page 6–58).

Removing the Transmission (continued)

6. On both sides of the transmission, remove the screw and flange nut that secures the link assembly to the transmission control arm (Figure 74).

   Note: The bolt is installed from the inner side of the control arm.

7. Remove the 2 screws, 2 flat washers, and 2 flange nuts that secure the seat channel to the frame (Figure 75). Separate the channel from the frame and carefully position the channel away from the frame to allow easier transmission removal.
8. Drain the hydraulic fluid from the hydraulic tank and transmission.
9. Clean the hydraulic hose ends and fittings on the transmission, gear pump, and hydraulic tank to prevent contaminants from entering into the hydraulic system.
10. For assembly purposes, label all the hydraulic hoses and fittings. Remove the hydraulic hoses from the fittings on the transmission, gear pump, and hydraulic tank. Allow the hoses to drain into a suitable container.
11. Install clean caps or plugs in the hose and fitting openings to prevent system contamination.
12. Remove the 2 bolts (item 19 in Figure 73), 2 locknuts, and roll pin that secures the driveshaft to the transmission, and disengage the driveshaft from the transmission.

    Note: Two 8 mm eyebolts can be installed into the threaded bosses in the top of the transmission to allow the use of a lift or hoist to remove the transmission.

⚠ CAUTION ⚠

The weight of the transmission is approximately 41 kg (90 lb).

Support the transmission assembly when you remove it from the flywheel housing to prevent it from falling and causing personal injury.

13. Remove the 7 bolts (items 10 and 12 in Figure 73) and 7 lock washers that secure the transmission to the flywheel housing. Note the location of the shorter bolt (35 mm) for assembly purposes.

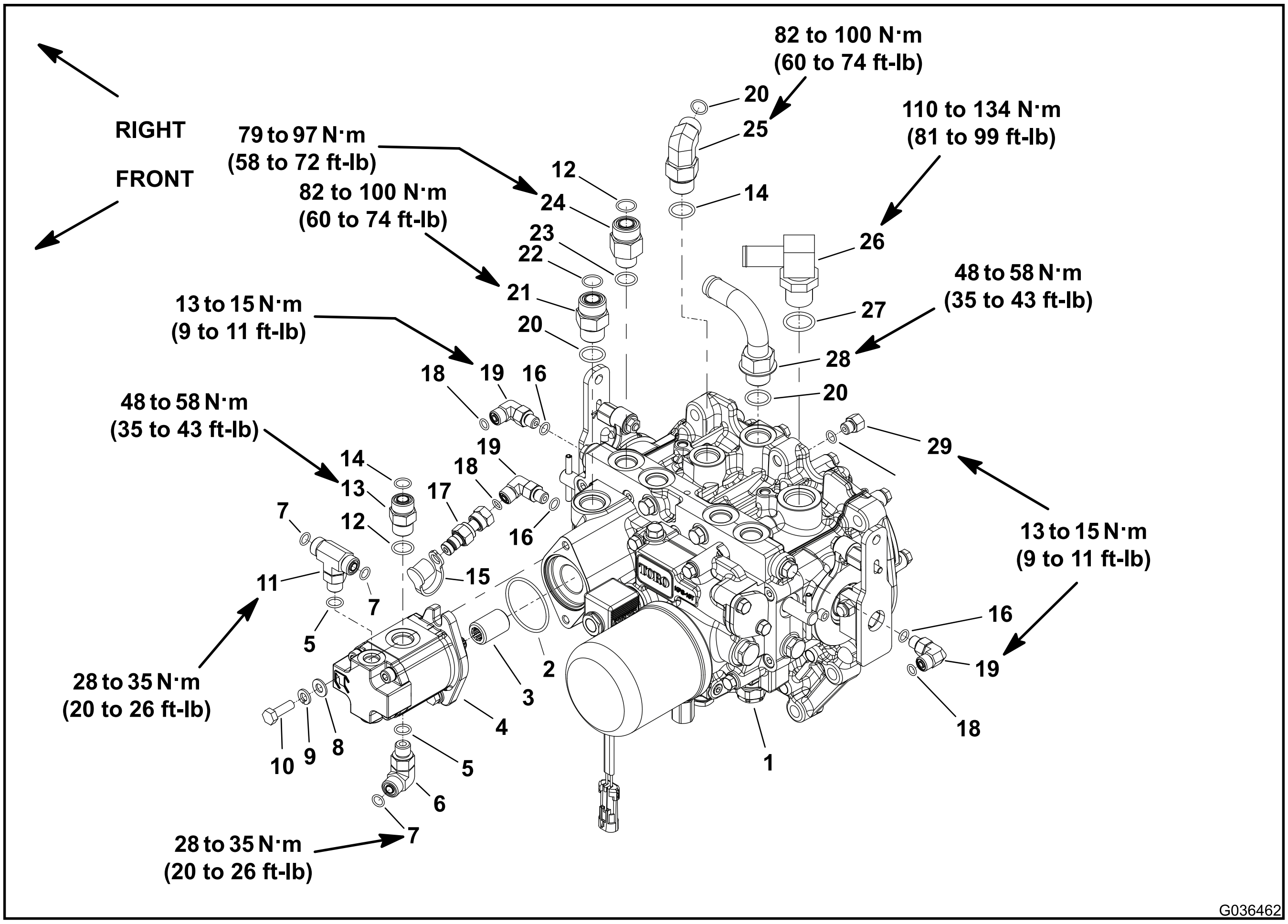
IMPORTANT

Ensure that you do not damage the transmission, flywheel housing, hydraulic lines, electrical harness, or other parts while removing the transmission.

14. Move the transmission assembly toward the front of the machine and away from the flywheel housing and coupler on the engine flywheel. Lift the transmission from the machine.
15. Locate and note the location of the 2 dowel pins (item 16 in Figure 73) from the transmission and flywheel housing.
16. If the hydraulic fittings are to be removed from the transmission, mark the fitting orientation for assembly purposes. Remove the fittings from the transmission (Figure 76) and discard the O-rings from the fittings.

Removing the Transmission (continued)

17. Inspect the flywheel housing and coupler on the engine flywheel for wear or damage.
18. If necessary, remove the gear pump from the transmission; refer to Removing the Gear Pump (page 4–137).
19. Remove the oil filter from the transmission and discard the filter.



g036462

Figure 76

1. Transmission
2. O-ring
3. Spline coupler
4. Gear pump assembly
5. O-ring
6. 90° hydraulic fitting
7. O-ring (3 each)
8. Flat washer (2 each)
9. Lock washer (2 each)
10. Bolt (2 each)
11. Tee fitting
12. O-ring (2 each)
13. Straight hydraulic fitting
14. O-ring (2 each)
15. Dust cap
16. O-ring (3 each)
17. Test nipple
18. O-ring (4 each)
19. 90° hydraulic fitting (3 each)
20. O-ring (3 each)
21. Straight fitting
22. O-ring
23. O-ring
24. Straight hydraulic fitting
25. 90° hydraulic fitting
26. 90° hydraulic fitting
27. O-ring
28. 90° elbow fitting
29. Adapter hydraulic fitting

Installing the Transmission

1. Ensure that the flywheel coupler and flywheel housing are secure on the engine; refer to Installing the Engine (page 3–24).
2. If the hydraulic fittings were removed from the transmission, lubricate and install new O-rings to the fittings. Install the fittings into the transmission

Installing the Transmission (continued)

ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fitting into the Component Port) (page 4–9). Tighten the fittings to the torque values identified in Figure 76.

3. If removed, install the gear pump to the transmission; refer to Installing the Gear Pump (page 4–137).
4. Lubricate the gasket of new oil filter and install the filter on the transmission.
5. Apply a thick layer of anti-seize lubricant to the splines of the transmission input shaft and flywheel coupler.
6. Carefully place the 2 dowel pins (item 16 in Figure 73) in the flywheel housing. Ensure that the dowel pins are perpendicular to the face of housing during installation.

IMPORTANT

Ensure that you do not damage the transmission, flywheel housing, hydraulic lines, electrical harness, or other parts while installing the transmission.

⚠ CAUTION ⚠

The weight of the transmission is approximately 41 kg (90 lb).

Support the transmission assembly when you install it to the flywheel housing to prevent it from falling and causing personal injury.

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7. Support the transmission to prevent it from shifting.
8. Lower the transmission into the machine. Align the transmission input shaft with the flywheel coupler and slide the transmission to the flywheel housing. It may be necessary to turn the engine crankshaft to help align the splines of the transmission shaft and coupler.
9. Assemble the transmission to the flywheel housing with the 7 bolts (items 10 and 12 in Figure 73) and 7 lock washers. Ensure that the shorter (35 mm) bolt (item 10 in Figure 73) is properly positioned. Torque the bolts to **45 N·m (400 in-lb)**.
10. Install the 2 bolts (item 19 in Figure 73), 2 locknuts, and roll pin that secures the driveshaft to the transmission.
11. On both sides of the machine, attach the screw and flange nut that secures the link assembly to the transmission control arm (Figure 74).

    Note: The bolt is installed from the inner side of the control arm.
12. Carefully position the seat channel to the frame (Figure 75). Secure the seat channel to the frame with 2 screws, 2 flat washers, and 2 flange nuts.
13. Remove the caps or plugs that were installed to the hydraulic hoses and fittings during the removal process.
14. Use the labels that you attached during the removal process to correctly connect the hydraulic hoses to the transmission, gear pump, and hydraulic tank fittings; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–8).

Installing the Transmission (continued)

15. Ensure that the drain plugs are properly installed in the hydraulic tank and transmission. Fill the hydraulic tank with the correct quantity of new hydraulic fluid.
16. Install the power center assembly; refer to Installing the Power Center Assembly (page 6–56) or, if the machine is equipped with operator cab; refer to Installing the Power Center Assembly (page 6–58).
17. Connect all the electrical connectors and platform harness.
18. Install the operator seat and seat base; refer to Installing the Operator Seat (page 6–61).
19. Adjust the traction linkage as necessary; refer to Traction Linkage Assembly (page 4–89).
20. On the machines with operator cab, install the cab doors to the cab.
21. Install the cutting deck; refer to *Cutting Deck Operator's Manual*.

Servicing the Transmission

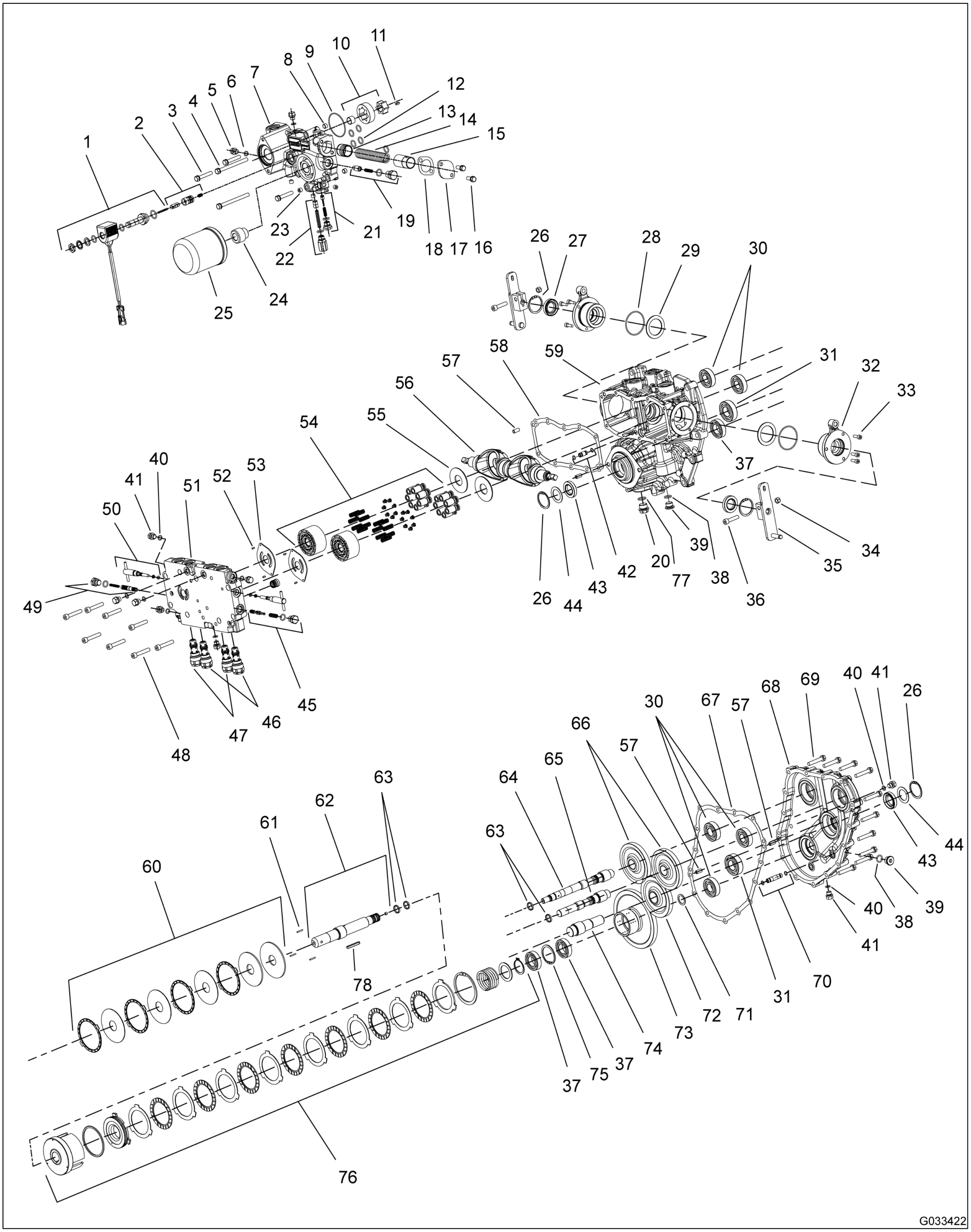

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Figure 77

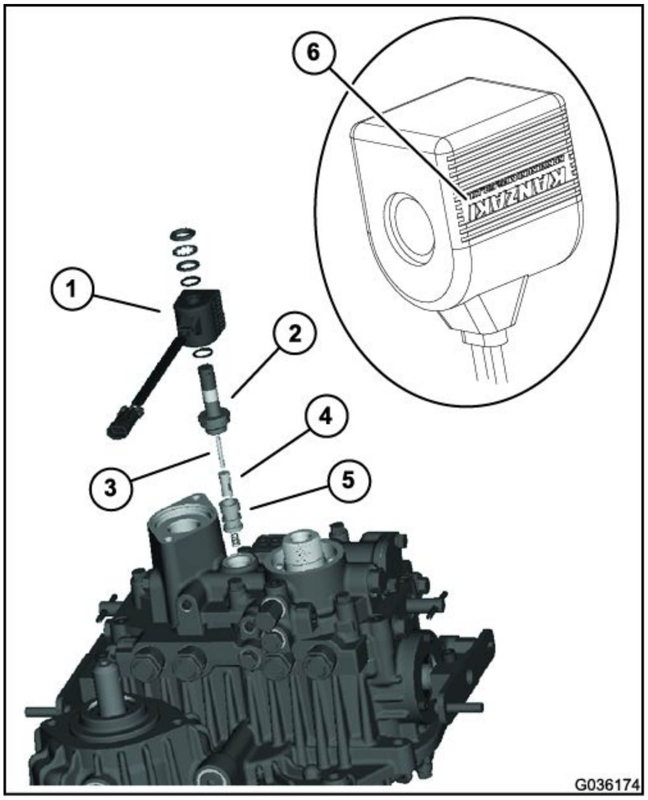
Figure 77 (continued)

1. Solenoid assembly
2. Solenoid valve assembly
3. Bolt (3 each)
4. Bolt (2 each)
5. Hex plug (2 each)
6. O-ring
7. Pump body
8. Pin (2 each)
9. O-ring
10. Charge pump assembly
11. Key
12. O-ring (5 each)
13. Piston
14. Spring
15. Collar
16. Bolt and washer (2 each)
17. Accumulator cover
18. Gasket
19. Filter bypass valve assembly
20. Hex drain plug
21. Charge relief valve assembly
22. Pressure valve assembly
23. Socket-head plug (4 each)
24. Filter adapter
25. Oil filter
26. Retaining ring (4 each)
27. Seal (4 each)
28. O-ring (2 each)
29. Washer (2 each)
30. Bearing (5 each)
31. Bearing (2 each)
32. Side cover (2 each)
33. Socket-head screw (3 each per cover)
34. Nut (2 each)
35. Control arm (2 each)
36. Socket-head screw (2 each)
37. Bearing (3 each)
38. O-ring (2 each)
39. Socket-head plug (2 each)
40. O-ring (8 each)
41. Hex plug (8 each)
42. Pipe assembly
43. Seal (2 each)
44. Washer (2 each)
45. Left flushing valve
46. Reverse relief valve (2 each)
47. Forward relief valve (2 each)
48. Socket-head screw (8 each)
49. Right flushing valve
50. Bypass valve (2 each)
51. Center case
52. Pin (4 each)
53. Valve plate (2 each)
54. Cylinder block assembly (2 each)
55. Thrust plate (2 each)
56. Swash plate (2 each)
57. Pin (4 each)
58. Gasket
59. Pump housing
60. PTO brake assembly
61. Push rod (3 each)
62. PTO shaft
63. Seal ring (4 each)
64. Right pump shaft
65. Left pump shaft
66. Pump gear (2 each)
67. Gasket
68. Gear case housing
69. Flange-head screw (13 each)
70. Pipe assembly
71. Spacer
72. Input gear
73. PTO gear
74. Input shaft
75. Retaining ring
76. Clutch assembly
77. O-ring
78. Key

IMPORTANT

If a transmission fails; refer to the Traction Circuit Component Failure (page 4–6) for information regarding the importance of removing contamination from the traction circuit.

Disassembling the Transmission



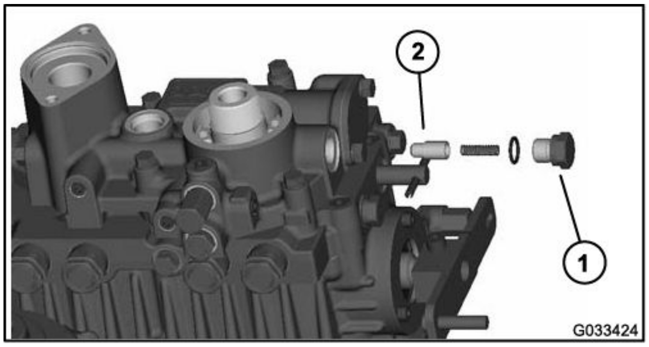
g036174

Figure 78

1.	Solenoid coil	4.	Spool
2.	Solenoid valve stem	5.	Sleeve
3.	Pin	6.	Letter I

1. Clean the exterior of the transmission.
2. Remove the nut, lock washer, washer, O-ring, solenoid coil, and O-ring from the solenoid valve stem.
3. For assembly purposes, note that the "KANZAKI" molded into the coil has the "I" nearest the location of the nut as coil direction is important for proper solenoid operation.
4. Remove the solenoid valve stem from the transmission pump body.
5. Remove the pin from the spool, and remove the spool, sleeve, and solenoid valve spring from the transmission pump body.
6. For assembly purposes, note that the step in the spool is toward the spring location and that the sleeve is installed so that the holes are closest to the spring location.

Disassembling the Transmission (continued)



g033424

Figure 79

1.	Filter bypass plug	2.	Bypass valve

7. Remove the filter bypass plug, spring, and valve from the transmission pump body.
8. Remove and discard the O-ring from the plug.

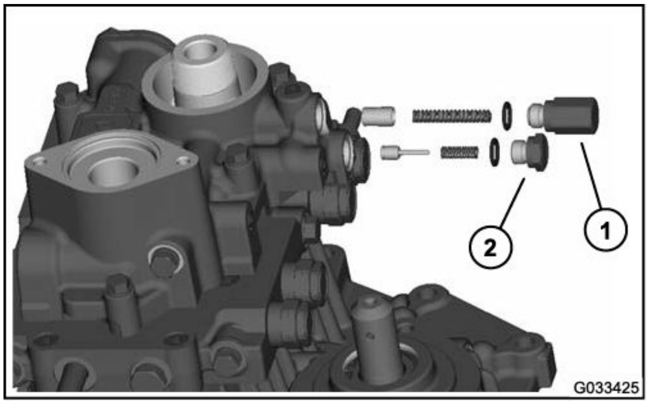


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Figure 80

1.	Pressure valve plug	2.	Charge relief plug

9. Remove the pressure valve plug, spring, and valve from the transmission pump body.
10. Remove and discard the O-ring from the pressure valve plug.
11. Remove the charge relief plug, spring, and valve from the transmission pump body.
12. Remove and discard the O-ring from the charge relief plug.

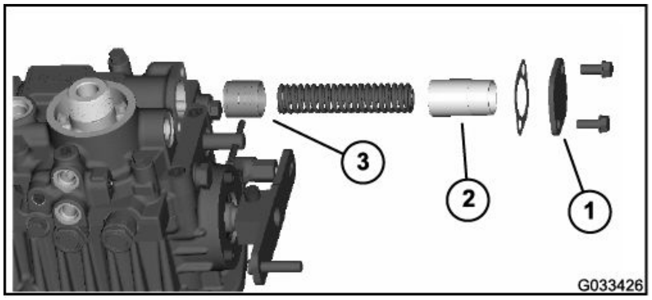

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Figure 81

1.	Accumulator cover	3.	Piston
2.	Collar		

13. Remove the 2 bolts that attach the accumulator cover to the transmission pump body.
14. Remove the cover, gasket, collar, spring, and piston from the pump body. For assembly purposes, note that the hole in the collar is toward the outside of the pump body. Discard the gasket.

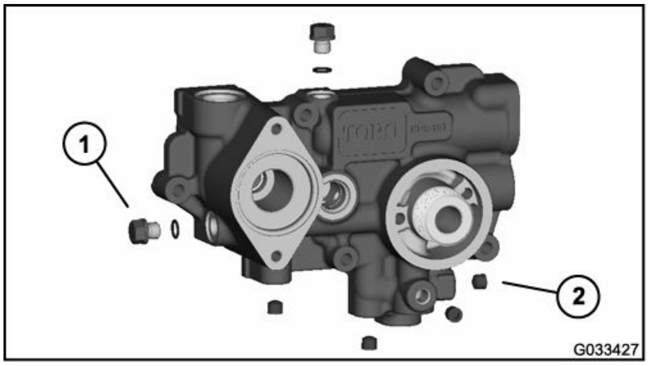

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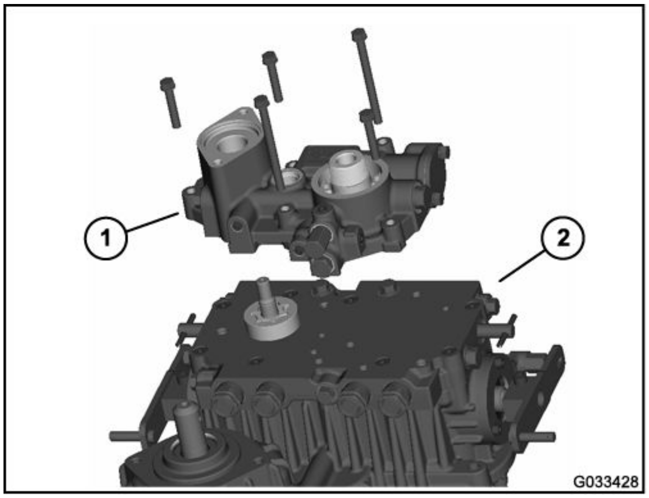
Figure 82

1. Hex plug (2 each)
2. Socket-head plug (4 each)

15. Remove the 2 hex plugs from the pump body.
16. Remove and discard the O-rings from the plugs.
17. Remove the 4 socket-head plugs from the pump body.

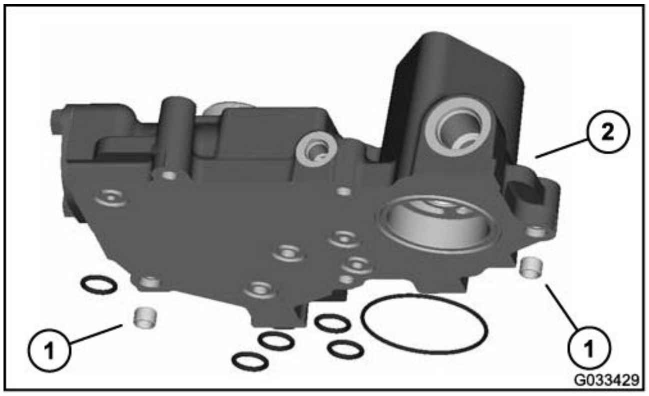


g033428

Figure 83

1. Pump body
2. Center case

18. Remove the 3 shorter (45 mm) and 2 longer (95 mm) flange-head screws that attach the pump body to the center case, and remove the pump body from the center case.

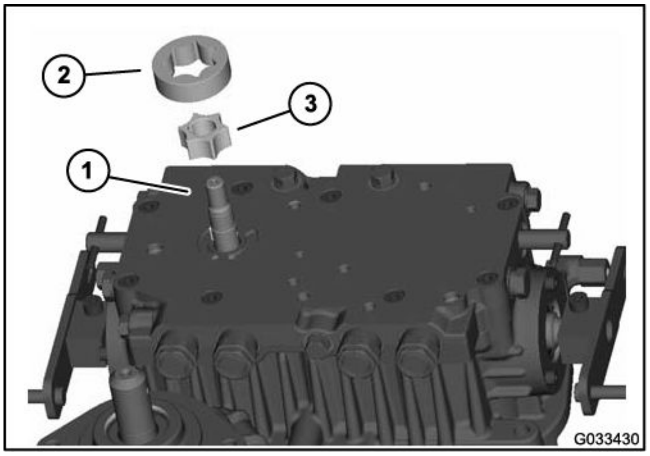


g033429

Figure 84

1. Pin	2. Pump body

19. Remove the 2 pins that locate the pump body.
20. Remove and discard the O-rings.

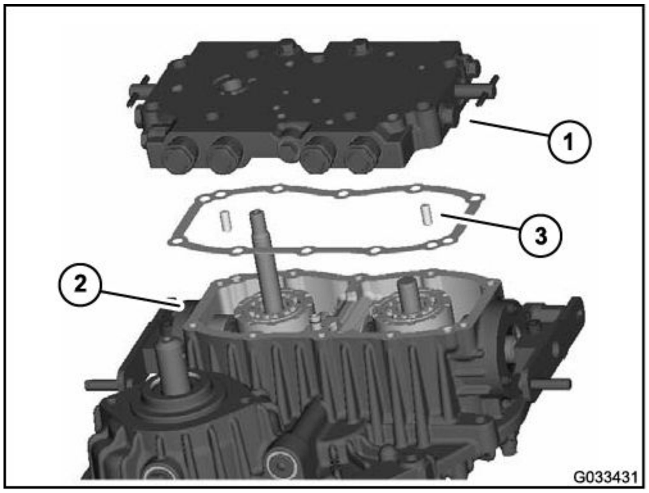


g033430

Figure 85

1. Right pump shaft	3. Inner pump rotor
2. Outer pump rotor	

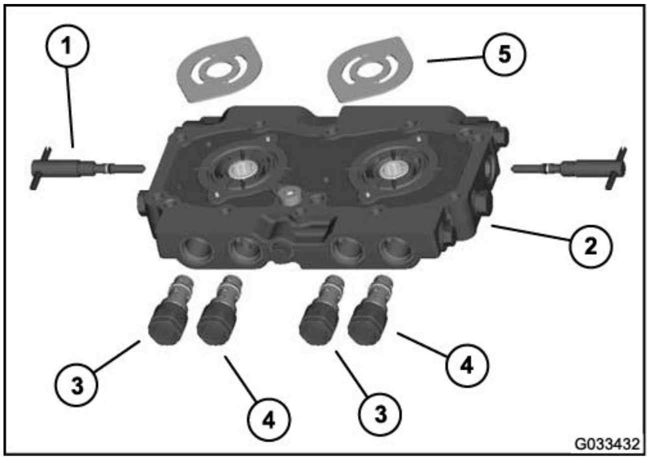
21. Slide the outer and inner charge pump rotors from the right pump shaft, and remove the key from the key slot in the pump shaft.



g033431

Figure 86

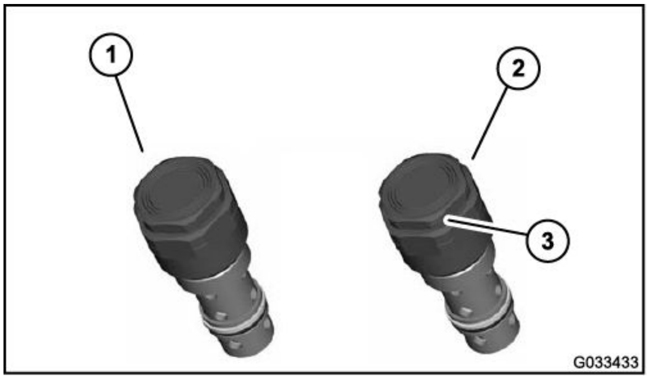
1. Center case	3. Pin (2 each)
2. Pump housing	



g033432

Figure 87

1. Bypass valve	4. Forward relief cartridge
2. Center case	5. Valve plate
3. Reverse relief cartridge	



g033433

Figure 88

1. Forward relief cartridge
2. Reverse relief cartridge
3. Hex head groove

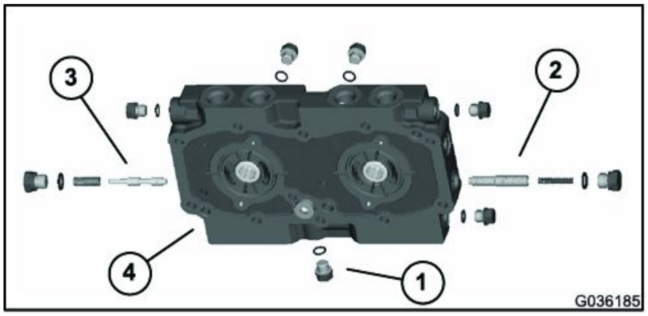
22. Remove the 8 socket-head screws that attach the center case to the transmission pump housing.
23. Carefully remove the center case assembly from the transmission pump housing.
24. Remove the 2 pins from the transmission pump housing bores.
25. Remove and discard the gasket.
26. Remove the bypass valves from the center case.
27. Remove and discard the O-rings and back-up rings from the bypass valves.

IMPORTANT

The forward and reverse relief cartridges are different. For assembly purposes, label all the relief cartridges.

28. Remove the forward and reverse relief valve cartridges from the center case and note the location of the relief cartridge for assembly purposes.

    Note: You can identify the reverse relief valve cartridges by the groove in the hex head (Figure 88).
29. Remove the valve plates (item 5 in Figure 87) from the center case. Mark the positions of the valve plates so that you can assemble them in the same position.

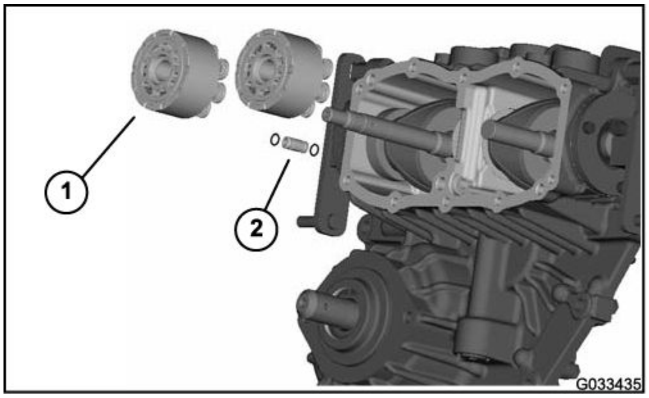


g036185

Figure 89

1. Hex plug (6 each)
2. Right flushing valve
3. Left flushing valve
4. Center case

30. Remove the 6 hex plugs from the center case.
31. Remove and discard the O-rings from the plugs.
32. Remove the right and left flushing valve plugs, springs, and valves from the center case. Note the differences in the flushing valves and their locations for assembly purposes.
33. Remove and discard the O-rings from the plugs.



g033435

Figure 90

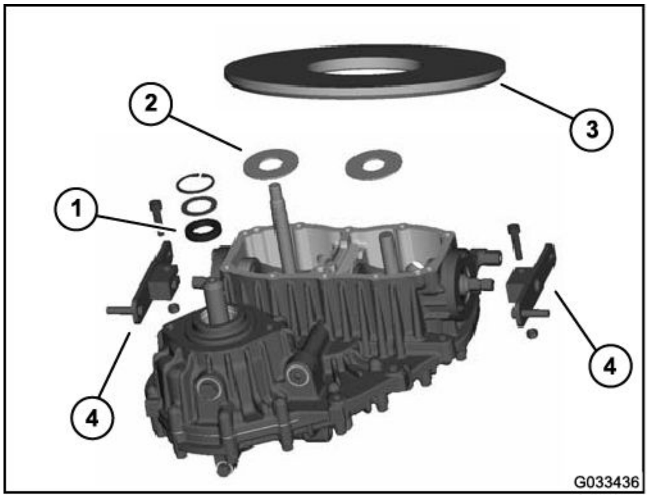
1. Cylinder block assembly	2. Pipe

---

34. Slide the 2 cylinder block assemblies from the pump shafts. Mark the positions of the cylinder blocks so that you can assemble them in the same position.

    Note: Ensure that you do not drop the pistons from the cylinder block.

35. Slide the pipe assembly from the bore of the transmission pump housing.
36. Remove and discard the O-rings from the grooves in the pipe.



g033436

Figure 91

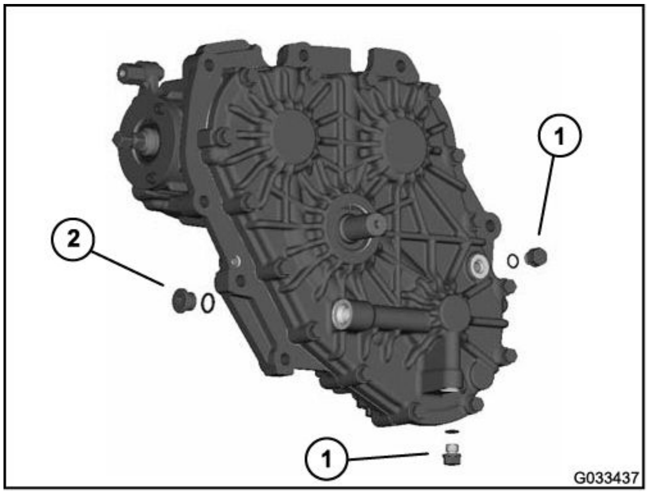
1. Oil seal	3. Thrust plate bevel
2. Thrust plate	4. Control arm

---

37. Remove the retaining ring that secures the PTO shaft oil seal into the housing bore, and remove the spacer and oil seal from the housing.

    Note: Ensure that you do not damage the housing bore.

38. Remove the thrust plate from each swash plate. For assembly purposes, note that the beveled sides of the thrust plates are against the swash plate surfaces.
39. Remove the socket-head screw and nut that secures the control arm onto each trunnion shaft. Slide the control arm from each trunnion shaft.

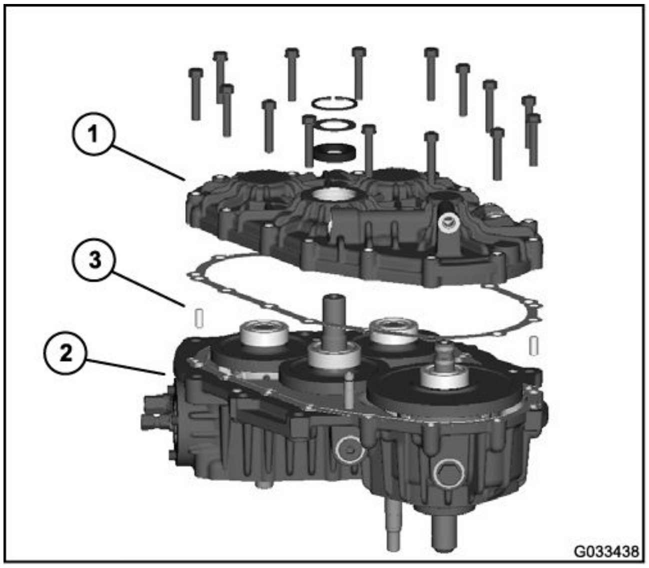


g033437

Figure 92

1. Hex plug
2. Socket-head plug

40. Remove the 2 hex plugs and 1 socket-head plug from the gear case housing.
41. Remove and discard the O-rings from the plugs.



g033438

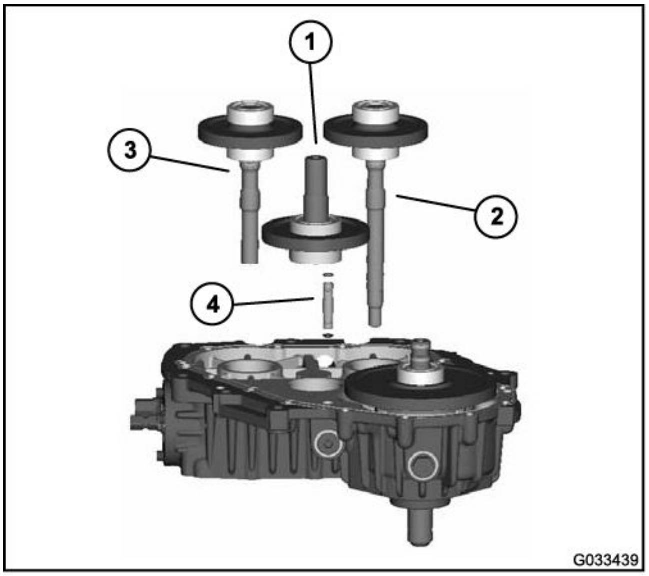
Figure 93

1. Gear case housing
2. Pump housing
3. Pin (2 each)

42. Remove the 15 flange-head screws that attach the gear case housing to the transmission pump housing.
43. Carefully remove the gear case housing from the pump housing.
44. Locate and retrieve the 2 pins from the gear case housing holes.
45. Remove and discard the gasket.

46. Remove the retaining ring that secures the input shaft oil seal into the gear case housing bore, and remove the spacer and oil seal from the housing. Discard the seal.

    Note: Ensure that you do not damage the seal bore in the housing.

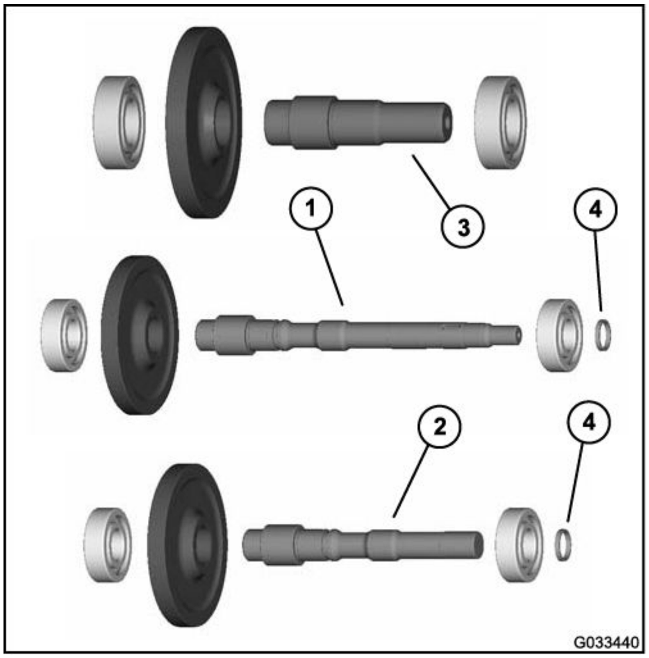


g033439

Figure 94

1. Input shaft
2. Right pump shaft
3. Left pump shaft
4. Pipe

47. Remove the input shaft, right pump shaft, and left pump shaft assemblies from transmission pump housing.
48. Slide the pipe assembly from the bore of the pump housing.
49. Remove and discard the 2 O-rings from the grooves in the pipe.

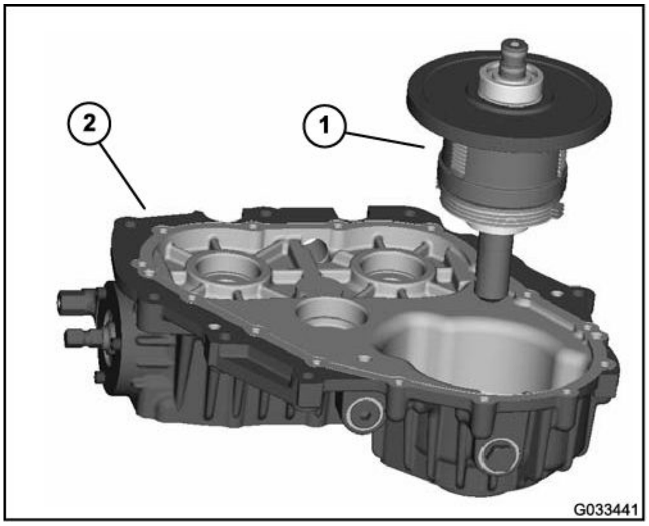


g033440

Figure 95

1. Right pump shaft	3. Input shaft
2. Left pump shaft	4. Seal ring

50. If the pump shaft bearing replacement is necessary, remove and discard the seal ring from the right and left pump shafts.
51. Use a bearing puller to remove the bearings from the pump shaft.
52. Discard the bearings that were removed, and remove the gear from the pump shaft.
53. If the input shaft bearing replacement is necessary, use a bearing puller to remove the bearings from the input shaft.
54. Discard the bearings that were removed, and remove the gear from the input shaft.

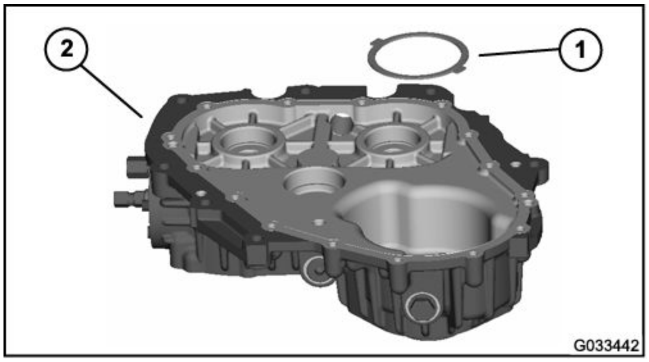


g033441

Figure 96

1. PTO shaft assembly	2. Pump housing

55. Remove the PTO shaft assembly from the transmission pump housing.



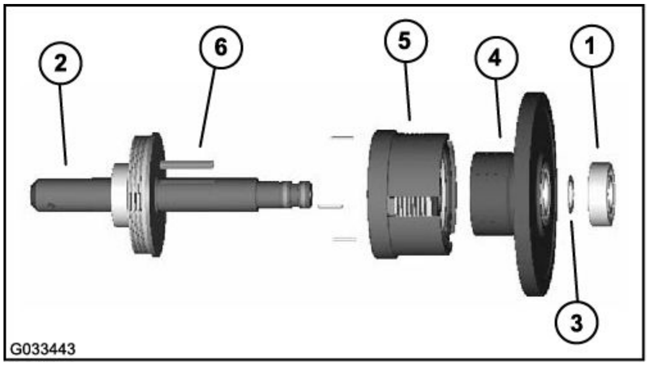
g033442

Figure 97

1. Friction plate	2. Pump housing

56. Remove the final friction plate from the transmission pump housing.

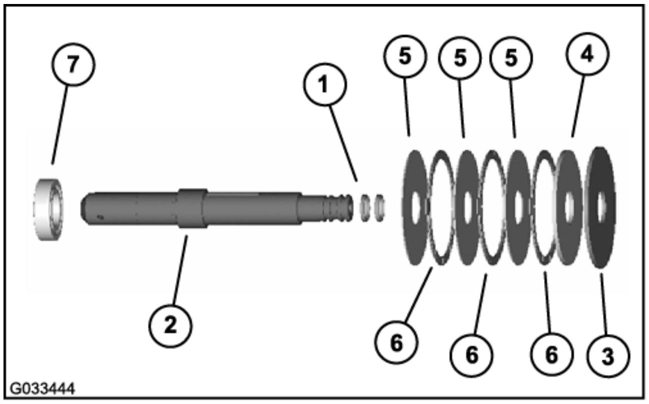
Note: This friction plate may have been removed with the PTO shaft assembly.



g033443

Figure 98

1. Bearing	4. Gear
2. PTO shaft	5. Clutch assembly
3. Spacer	6. Key



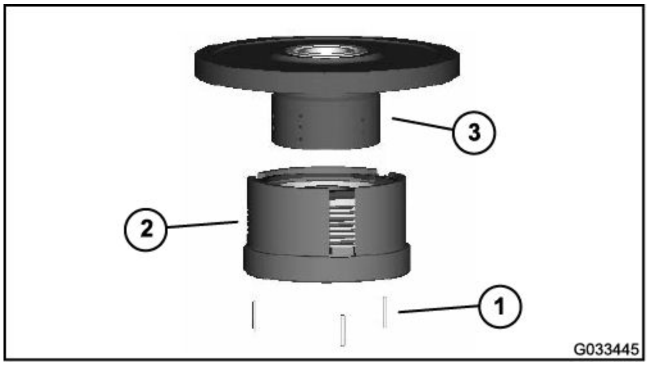
g033444

Figure 99

1. Seal ring (2 each)	5. A-plate (3 each)
2. PTO shaft	6. Friction plate (3 each)
3. B-plate	7. Bearing
4. C-plate	

---

57. Disassemble the PTO shaft assembly as follows:
    A. Use a bearing puller to remove the bearing from the PTO shaft. Discard the bearing.
    B. Remove the spacer from the PTO shaft.
    C. Slide the gear and clutch assembly from the PTO shaft.
    D. Remove the key from the PTO shaft slot.
    E. Remove the 2 seal rings from the PTO shaft grooves. Discard the seal rings.
    F. Remove the B-plate, C-plate, 3 A-plates, and 3 friction plates from the PTO shaft.
    G. Use a bearing puller to remove the bearing from the PTO shaft. Discard the bearing.



g033445

Figure 100

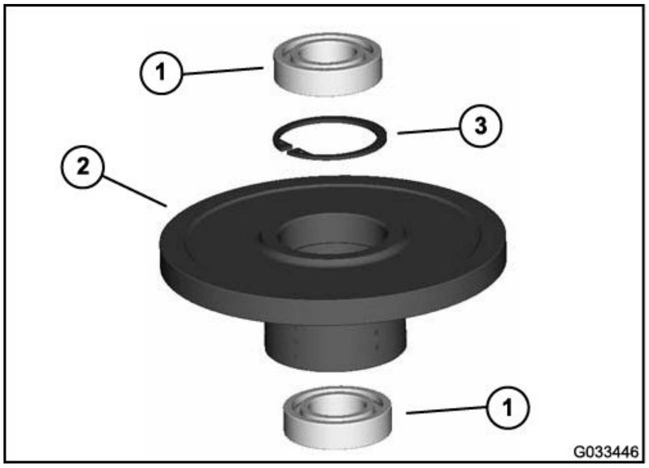
1. Rod (3 each)	3. PTO gear assembly
2. Clutch assembly	

---

58. Slide the 3 rods from the holes in the clutch assembly.
59. Slide the PTO gear assembly from the clutch assembly.

    Note: Because the individual clutch components are not available, disassembly of the clutch assembly is not necessary.

Disassembling the Transmission (continued)



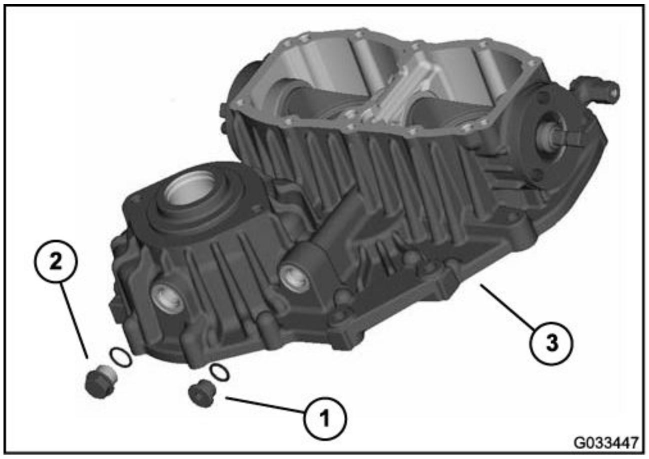
g033446

Figure 101

1. Bearing
2. PTO gear
3. Retaining ring

---

60. If necessary, remove the 2 bearings from the PTO gear and discard the bearings that were removed.
61. Remove the retaining ring from the groove in the PTO gear bore.



g033447

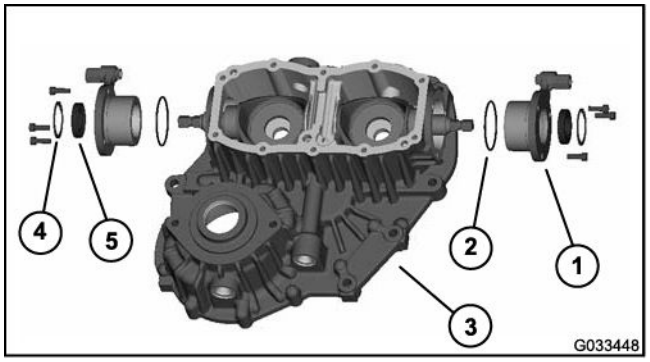
Figure 102

1. Socket-head plug
2. Hex plug
3. Pump housing

---

62. Remove the socket-head plug and hex plug from the transmission pump housing.
63. Remove and discard the O-rings from the plugs.

Disassembling the Transmission (continued)

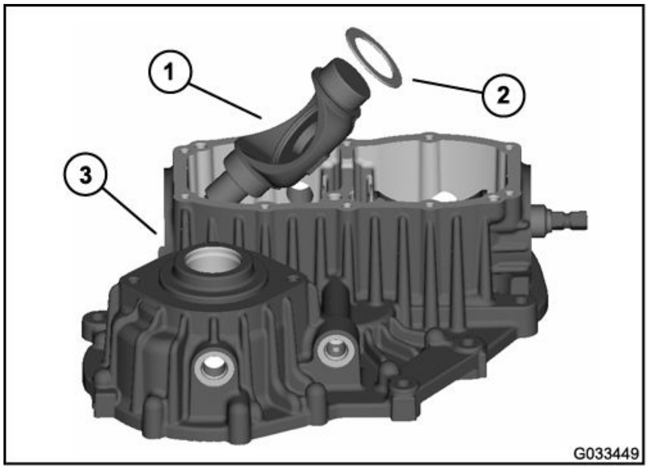


g033448

Figure 103

1. Side cover	4. Retaining ring
2. O-ring	5. Oil seal
3. Pump housing	

64. Remove the 3 socket-head screws that attach the 2 side covers to the transmission pump housing.
65. Carefully slide the side covers from the trunnion shafts and housing.
66. Remove and discard the O-rings from the side covers.
67. Remove the retaining rings that attach the oil seals into the 2 side covers.
68. Remove and discard the oil seals from the side covers.



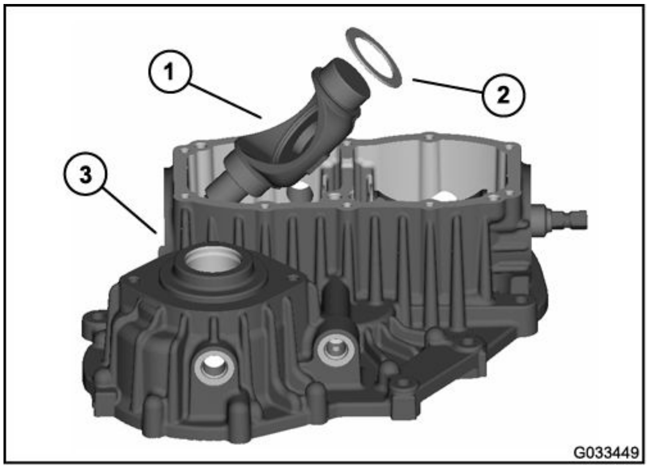
g033449

Figure 104

1. Swash plate (2 each)	3. Pump housing
2. Washer	

69. Carefully remove the swash plates from the transmission pump housing, and remove the washer from each swash plate.
70. Clean and inspect all the transmission components.

Assembling the Transmission



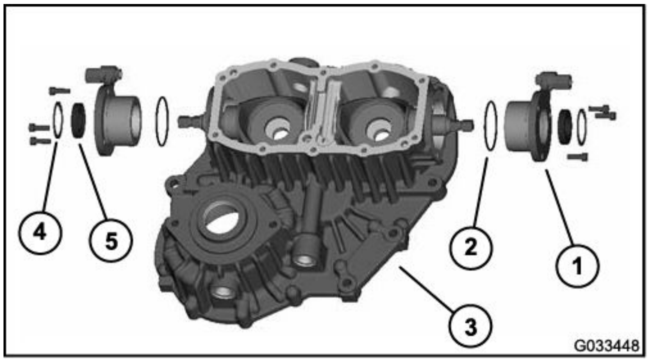
g033449

Figure 105

1. Swash plate (2 each)
2. Washer
3. Pump housing

Note: When assembling the transmission, lubricate all the transmission components with clean hydraulic fluid.

1. Ensure that all the transmission components are clean before you assemble the transmission.
2. Apply clean hydraulic fluid to the washers and surfaces of the swash plate. Install the washer onto each swash plate and carefully install the swash plates into the transmission pump housing.



g033448

Figure 106

1. Side cover
2. O-ring
3. Pump housing
4. Retaining ring
5. Oil seal

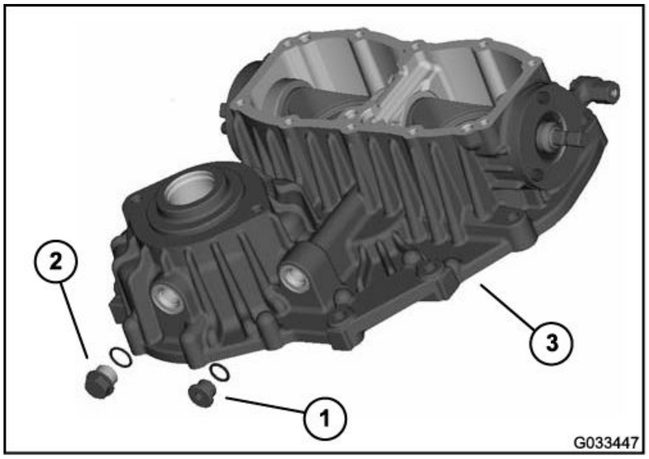
---

3. Press the oil seal into the 2 side covers and secure the seal with the retaining ring. Lubricate new O-rings and install them onto the side covers.
4. Carefully slide the side covers over the trunnion shaft.

   Note: Ensure that you do not damage the seals.

5. Install the 2 side covers to the transmission pump housing with the 3 socket-head screws; torque the screws to **8.8 to 10.8 N·m (78 to 95 in-lb)**.

Assembling the Transmission (continued)



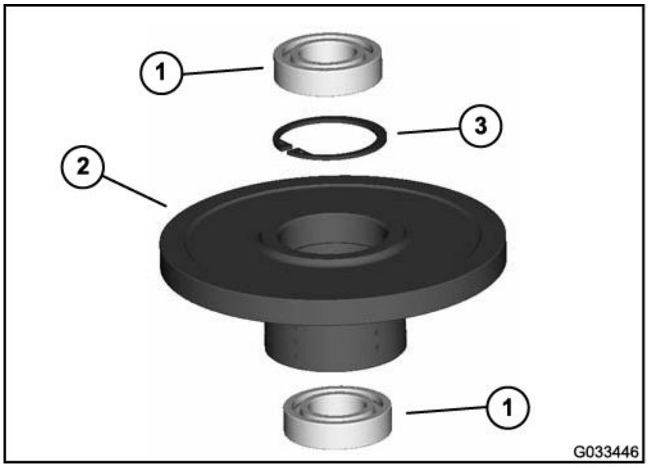
g033447

Figure 107

1. Socket-head plug	3. Pump housing
2. Hex plug	

---

6. Lubricate new O-rings and install the O-rings onto the socket-head plug and hex plug. Install both the plugs into the transmission pump housing; torque the plugs to **23 to 26 N·m (17 to 19 ft-lb)**.



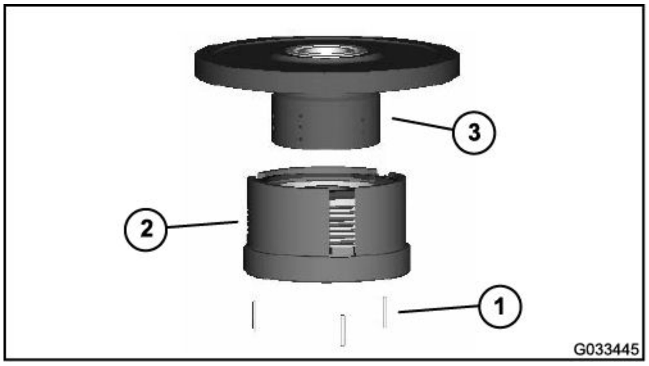
g033446

Figure 108

1. Bearing	3. Retaining ring
2. PTO gear	

---

7. Install the retaining ring into the groove in the PTO gear bore. Press both the bearings into the PTO gear until each bearing contacts the retaining ring that is installed.



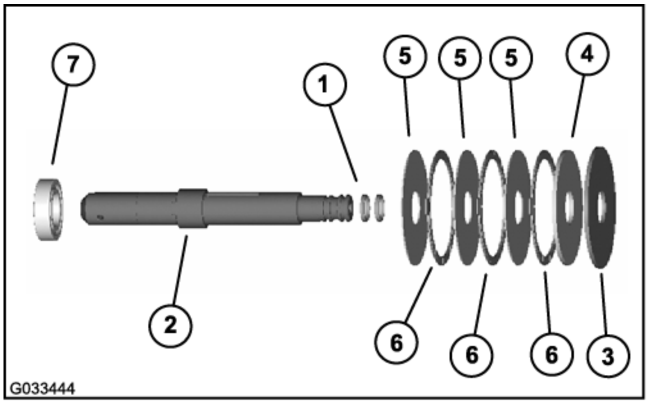
g033445

Figure 109

1. Rod (3 each)
2. Clutch assembly
3. PTO gear assembly

---

8. Slide the 3 rods into the holes in the clutch assembly.
9. Slide the PTO gear assembly into the clutch assembly.



g033444

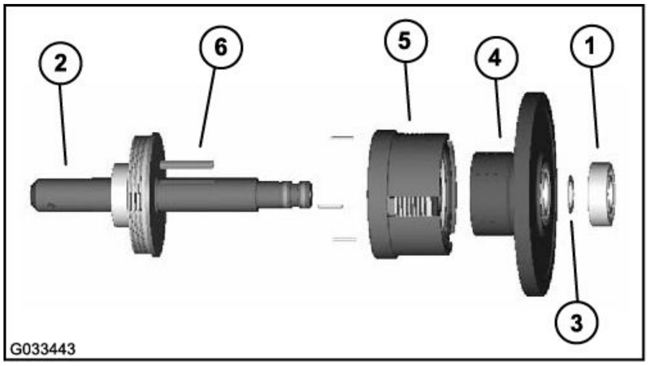
Figure 110

1. Seal ring (2 each)
2. PTO shaft
3. B-plate
4. C-plate
5. A-plate (3 each)
6. Friction plate (3 each)
7. Bearing

---

10. Assemble the PTO shaft assembly as follows:
    A. Press new bearing onto the PTO shaft so that the bearing is flush with the shaft shoulder.
    B. Alternately place the 3 A-plates and 3 friction plates onto the PTO shaft.
    C. Place the C-plate and then the B-plate onto the shaft.
    D. Carefully install the 2 seal rings into the grooves of the PTO shaft.

Assembling the Transmission (continued)



g033443

Figure 111

1. Bearing	4. Gear
2. PTO shaft	5. Clutch assembly
3. Spacer	6. Key

11. Install the clutch assembly and gear onto the PTO shaft:
    A. Install the key into the PTO shaft slot.

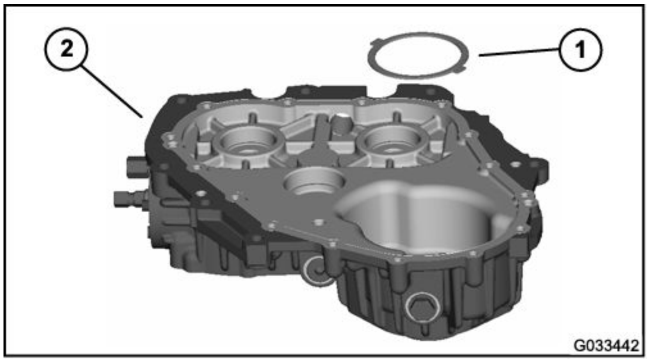
    Note: Ensure that the rounded ends of the key are aligned with the rounded ends of the shaft slot.

    B. Slide the clutch assembly and gear onto the PTO shaft. Also, align the rods in the clutch with the holes in the B-plate.

    Note: Ensure that the slot in the clutch is aligned with the key in the shaft.

    C. Place the spacer onto the PTO shaft.

    D. Press the bearing onto the PTO shaft so that the bearing is flush with the shaft shoulder.



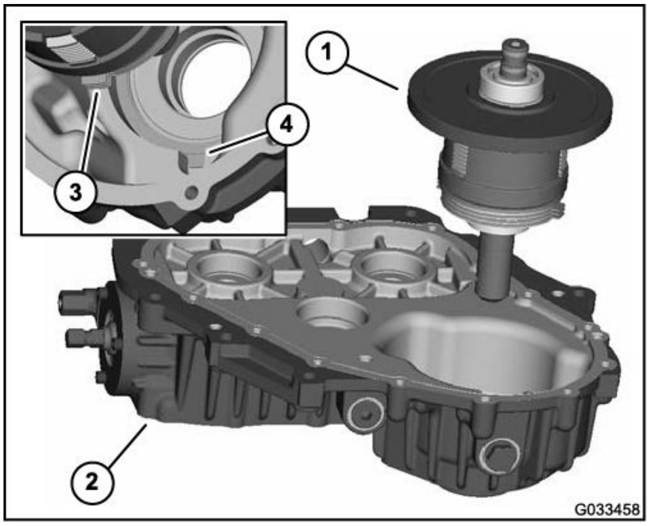
g033442

Figure 112

1. Friction plate	2. Pump housing

12. Apply clean hydraulic fluid to the friction plate and place it in the transmission pump housing.

    Note: Ensure that the tabs on the friction plates are placed in the housing grooves.



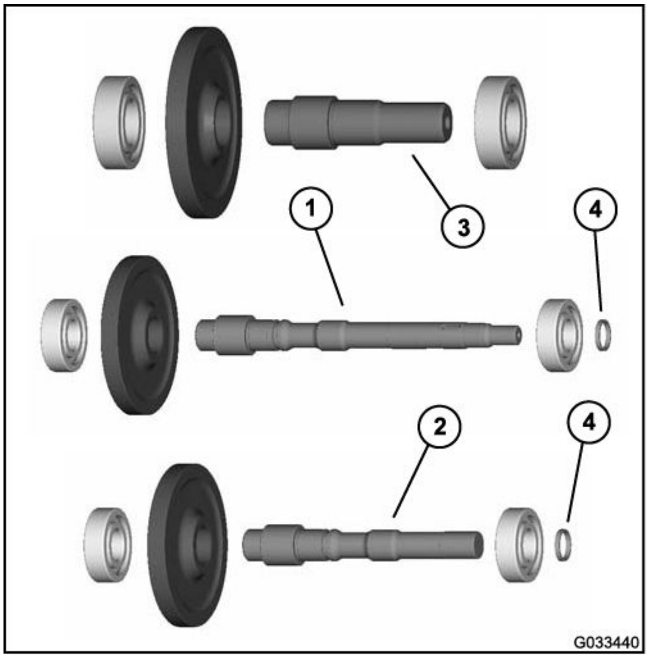
g033458

Figure 113

1. PTO shaft assembly	3. Friction plate tabs
2. Pump housing	4. Housing groove

13. Install the PTO shaft assembly into the transmission pump housing.

    Note: Ensure that the tabs on the friction plates are placed in the housing grooves.



g033440

Figure 114

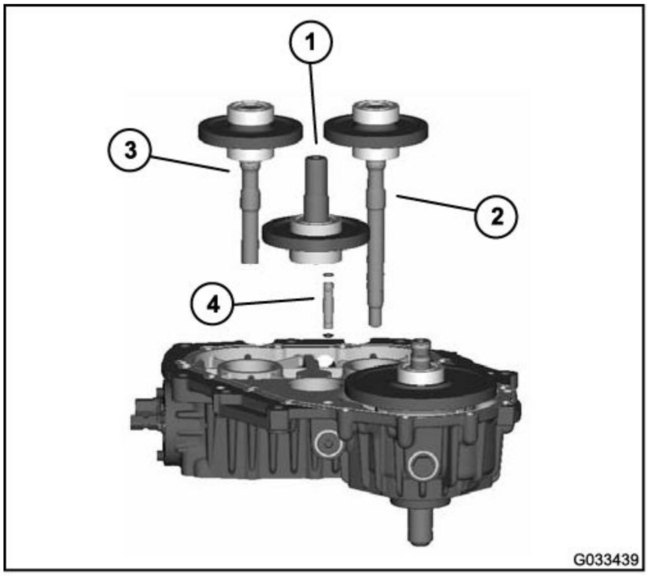
1. Right pump shaft	3. Input shaft
2. Left pump shaft	4. Seal ring

14. If the shafts were disassembled, install the gear and 2 bearings onto the input shaft, right pump shaft and/or left pump shaft.

    Note: Ensure that the bearings are pressed fully to the shaft shoulder.

15. Lubricate the seal rings and install the seal ring onto the right and left pump shafts.

Assembling the Transmission (continued)



g033439

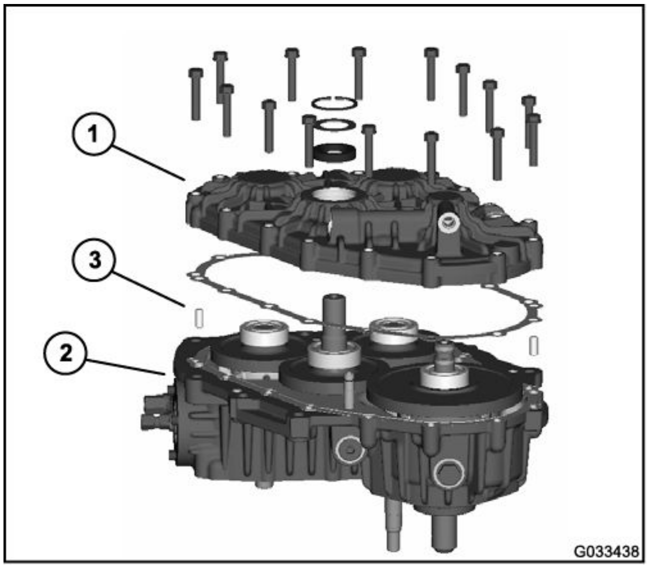
Figure 115

1.	Input shaft	3.	Left pump shaft
2.	Right pump shaft	4.	Pipe assembly

16. Install the right and left pump shaft assemblies into the transmission pump housing, and install the input shaft into the pump housing.

    Note: Ensure that the gear teeth of the input shaft is aligned with the gears on the PTO and pump shafts.

17. Lubricate the 2 new O-rings and install the O-rings into the grooves in the pipe. Slide the pipe assembly into the bore of the transmission pump housing.



g033438

Figure 116

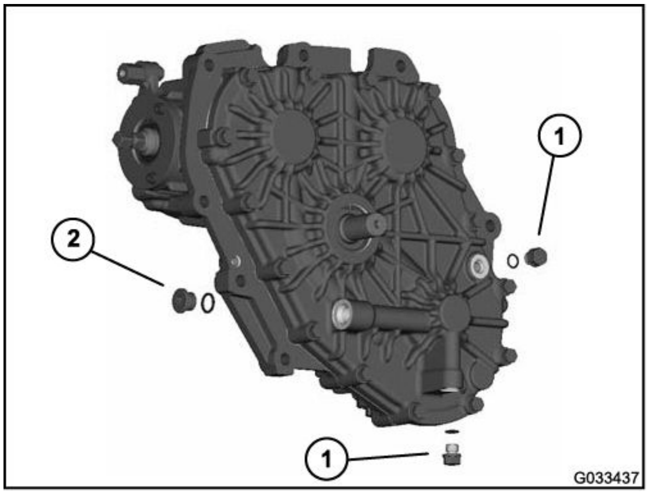
1.	Gear case housing	3.	Pin (2 each)
2.	Pump housing		

18. Install the 2 pins into the transmission pump housing holes. Align new gasket to the housing.

Assembling the Transmission (continued)

19. Carefully place the gear case housing onto the pump housing and align the pins, pipe, and shaft bearings.
20. Assemble the gear case housing to the pump housing with the 15 flange-head screws. Tighten the screws evenly in a crossing pattern and then torque the screws to **23 to 26 N·m (17 to 19 ft-lb)**.
21. Install the oil seal into the gear case housing bore.

    Note: Ensure that you do not damage the input shaft oil seal.
22. Place the spacer on the oil seal and secure the seal with the retaining ring.



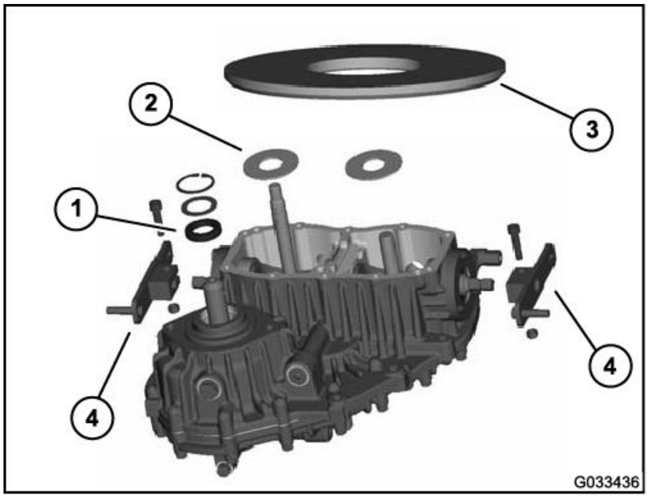
g033437

Figure 117

1. Hex plug	2. Socket-head plug

---

23. Lubricate new O-rings and install the O-rings onto the 3 plugs. Install the plugs into the transmission assembly; torque the hex plugs to **19 to 20 N·m (14 to 15 ft-lb)** and socket-head plug to **23 to 26 N·m (17 to 19 ft-lb)**.



g033436

Figure 118

1. Oil seal	3. Thrust plate bevel
2. Thrust plate	4. Control arm

---

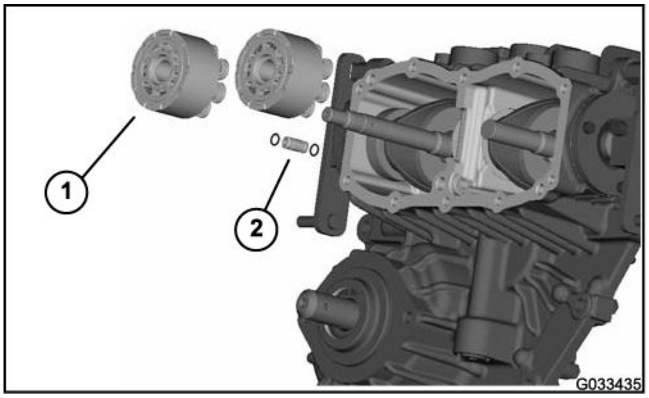
24. Install the oil seal into the bore of the pump housing at the PTO shaft.

Note: Ensure that you do not damage the PTO oil seal.

25. Place the spacer on the oil seal and secure the seal with the retaining ring.
26. Lubricate the both sides of the thrust plates with clean hydraulic fluid. Place the thrust plate onto each swash plate.

Note: Ensure that you position the beveled side of the thrust plates against the swash plate surface.

27. Slide the control arm onto each trunnion shaft and secure the control arm with the socket-head screw and nut; torque the nut to **27 to 31 N·m (20 to 23 ft-lb)**.



g033435

Figure 119

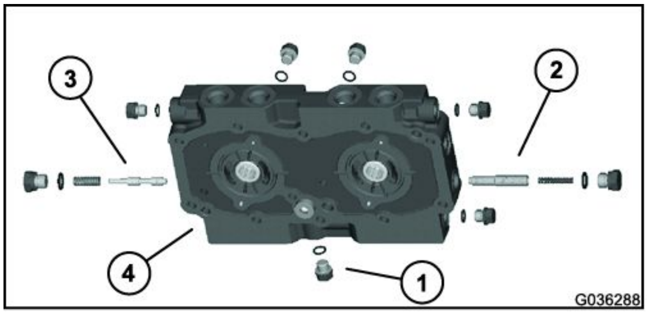
1.	Cylinder block assembly	2.	Pipe

---

28. Lubricate all components of the cylinder blocks with a thick layer of clean hydraulic fluid.

Note: Ensure that all the pistons are placed in the cylinder blocks. Ensure that you do not drop the pistons from the cylinder block.

29. Slide the 2 cylinder block assemblies onto the pump shafts.
30. Lubricate the 2 new O-rings and install the O-rings into the grooves in the pipe. Slide the pipe assembly into the bore of the transmission pump housing.



g036288

Figure 120

1.	Hex plug (6 each)	3.	Left flushing valve
2.	Right flushing valve	4.	Center case

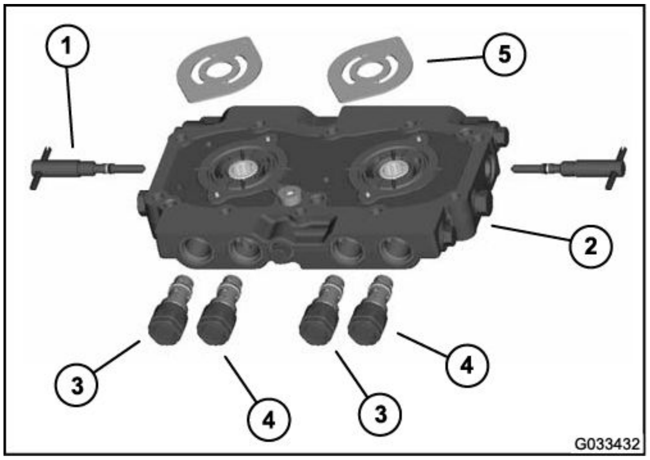
---

31. Lubricate new O-rings and install the O-rings onto the 6 hex plugs. Install the plugs into the center case; torque the plugs to **19 to 20 N·m (14 to 15 ft-lb)**.

32. Lubricate the flushing valves with clean hydraulic fluid and place them in the center case bores.

    Note: Ensure that you place the right and left flushing valves in the correct location.

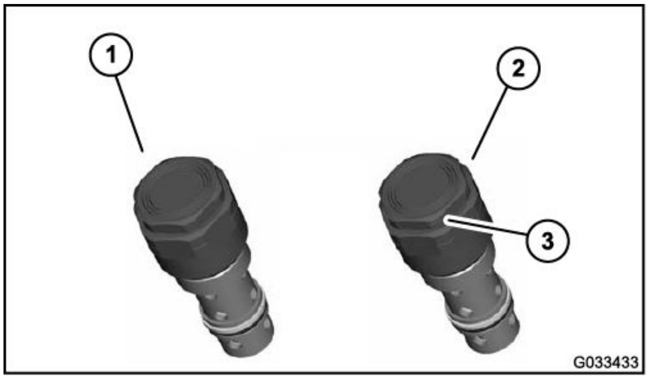
33. Lubricate new O-rings and install the O-rings onto the 2 flushing valve plugs. Install the springs and plugs to secure the flushing valves; torque the plugs to **23 to 26 N·m (17 to 19 ft-lb)**.



g033432

Figure 121

1. Bypass valve
2. Center case
3. Reverse relief cartridge
4. Forward relief cartridge
5. Valve plate



g033433

Figure 122

1. Forward relief cartridge
2. Reverse relief cartridge
3. Hex head groove

---

34. Lubricate the O-rings and back-up rings for bypass valves. Position the rings on the bypass valves and install the valves into the center case; torque the valves to **7 to 9 N·m (62 to 79 in-lb)**.

35. Lubricate the sealing washers and install them onto the forward and reverse relief valve cartridges.

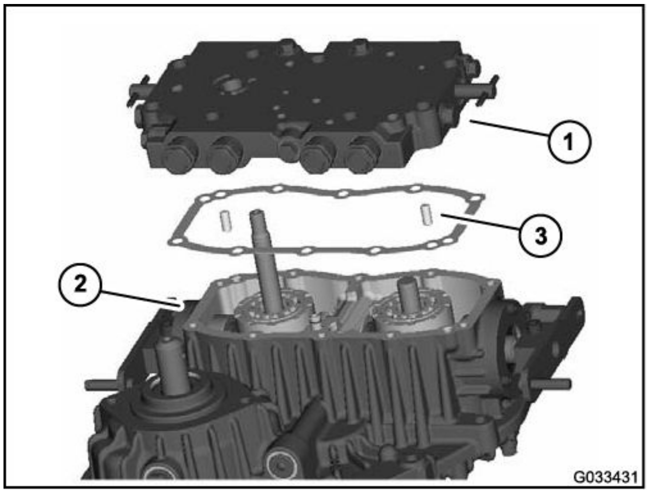
IMPORTANT

The forward and reverse relief cartridges are different. Use the labels that you attached during disassembly to correctly install the relief cartridges.

36. Thread the relief cartridges into the correct center case ports and torque the cartridges to **32 to 37 N·m (24 to 27 ft-lb)**.

    Note: You can identify the reverse relief valve cartridges by the groove in the hex head (Figure 122).

37. Apply clean grease to the mating surfaces of the center case and valve plates to hold the valve plates in position during assembly. Install the valve plates to the dowel pins in the center plate.

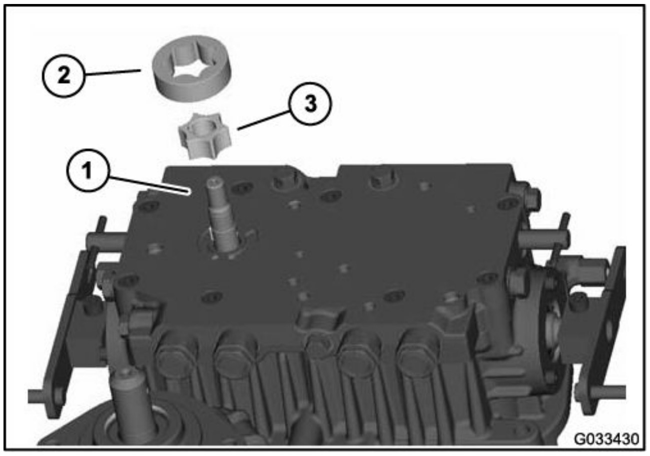


g033431

Figure 123

1. Center case
2. Pump housing
3. Pin (2 each)

38. Install the 2 pins into the transmission pump housing bores. Align new gasket to the pump housing.
39. Position the center case assembly to the transmission pump housing and ensure that the valve plates remain in position.
40. Assemble the center case to the transmission pump housing with the 8 socket-head screws. Tighten the screws evenly in a crossing pattern and then torque the screws to **23 to 26 N·m (17 to 19 ft-lb)**.

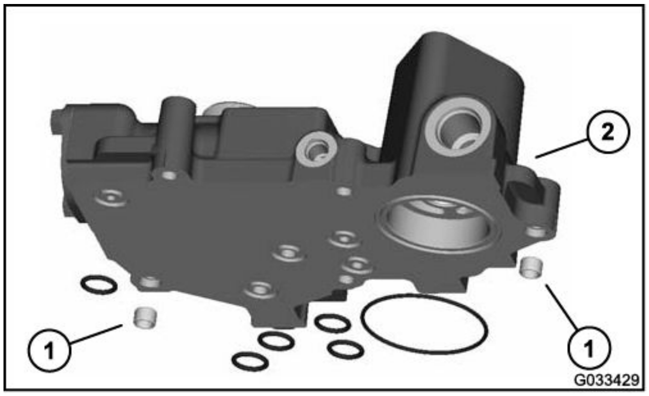


g033430

Figure 124

1. Right pump shaft	3. Inner pump rotor
2. Outer pump rotor	

41. Install the key into the key slot in the right pump shaft. Lubricate the inner and outer charge pump rotors with clean hydraulic fluid. Slide the inner pump rotor onto the pump shaft and align the pump rotor with the key. Place the outer pump rotor onto the inner pump rotor.



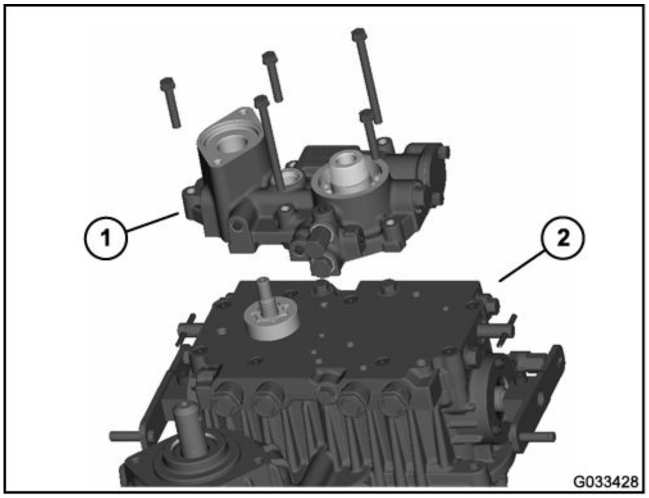
g033429

Figure 125

1. Pin	2. Pump body

42. Install the 2 pins into the bores of the pump body.
43. Apply clean grease to the pump body O-rings to hold them in position during assembly. Place the O-rings in the pump body locations.

Assembling the Transmission (continued)



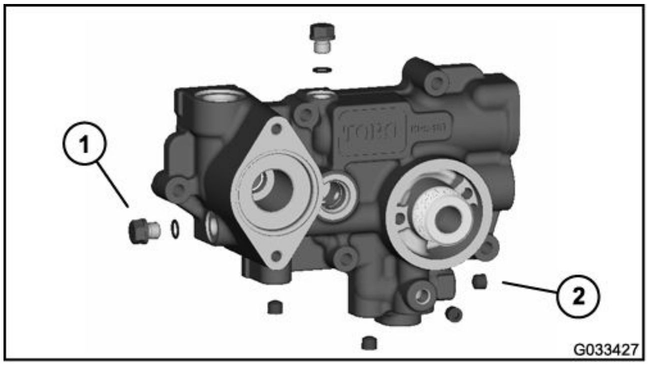
g033428

Figure 126

1. Pump body
2. Center case

---

44. Place the pump body onto the center case and ensure that the O-rings remain in position. Install the 3 shorter and 2 longer flange-head screws to attach the pump body to the center case; torque the screws to **23 to 26 N·m (17 to 19 ft-lb)** in a crossing pattern.



g033427

Figure 127

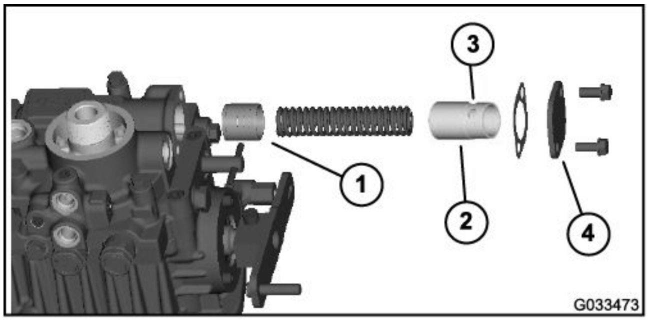
1. Hex plug (2 each)
2. Socket-head plug (4 each)

---

45. Lubricate new O-rings and install the O-rings onto the 2 hex plugs. Install the plugs into the pump body; torque the plugs to **19 to 20 N·m (14 to 15 ft-lb)**.

46. Apply sealant to the threads of the 4 socket-head plugs and install them into the pump body; torque the plugs to **8.8 to 10.8 N·m (78 to 95 in-lb)**.

Assembling the Transmission (continued)



g033473

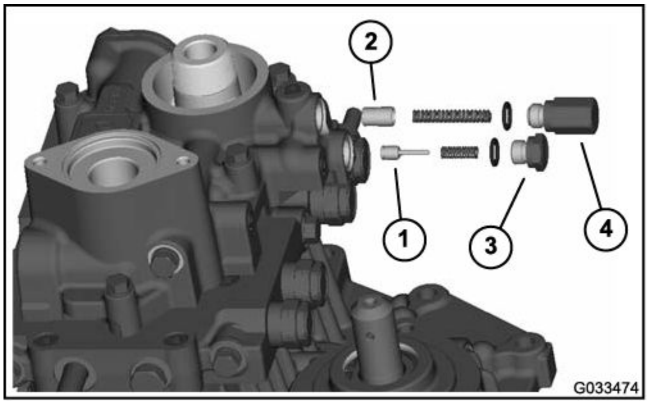
Figure 128

1. Accumulator piston	3. Collar hole
2. Accumulator collar	4. Accumulator cover

47. Lubricate the accumulator components with clean hydraulic fluid. Install the piston, spring, and collar into the pump body.

    Note: Ensure that the hole in the collar is toward the outside of the pump body.

48. Align new gasket to the accumulator cover and secure the cover to the pump body with the 2 bolts; torque the bolts to **23 to 26 N·m (17 to 19 ft-lb)**.



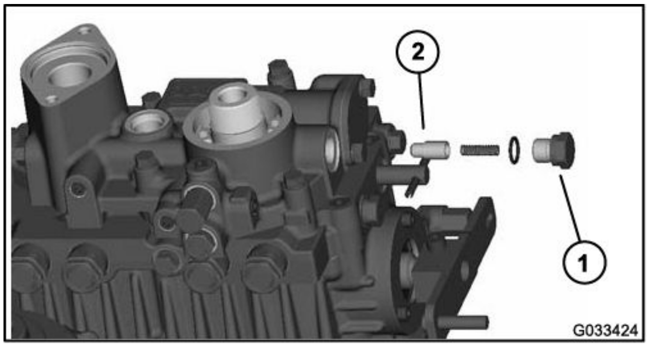
g033474

Figure 129

1. Charge relief valve	3. Charge relief plug
2. Pressure valve	4. Pressure valve plug

49. Lubricate the charge relief valve and spring with clean hydraulic fluid and install them into the pump body.
50. Lubricate the pressure valve and spring with clean hydraulic fluid and install them into the pump body.
51. Lubricate new O-rings and install the O-rings onto the charge relief plug and pressure valve plug. Install the plugs into the pump body; torque the plugs to **23 to 26 N·m (17 to 19 ft-lb)**.

Assembling the Transmission (continued)



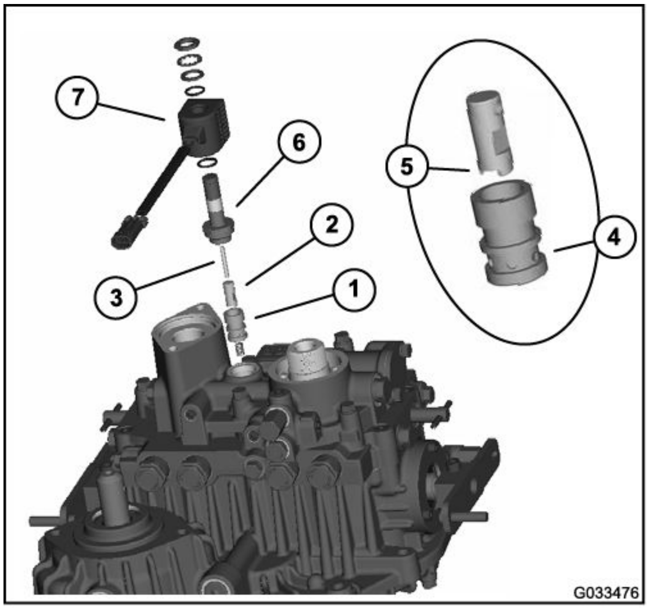
g033424

Figure 130

1. Filter bypass plug	2. Filter bypass valve

52. Lubricate the filter bypass valve and spring with clean hydraulic fluid and install them into the pump body.

53. Lubricate new O-ring and install the O-ring onto the plug. Install the plug into the pump body; torque the plug to **23 to 26 N·m (17 to 19 ft-lb)**.

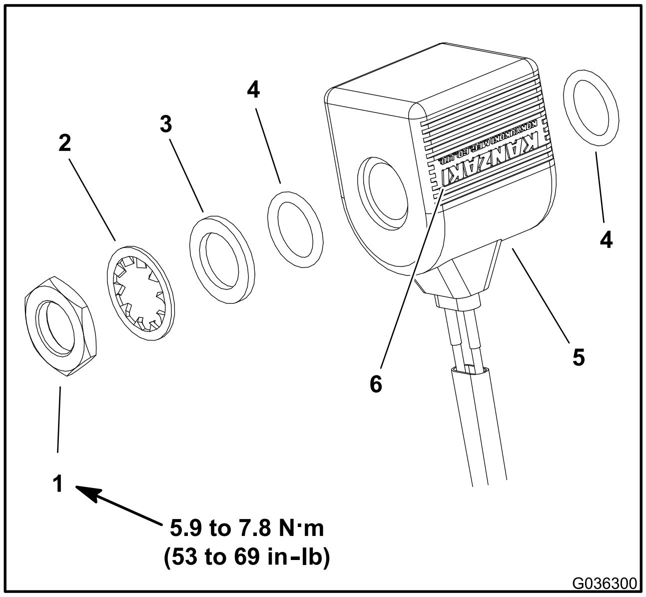


g033476

Figure 131

1. Sleeve	5. Spool step
2. Spool	6. Solenoid valve stem
3. Pin	7. Solenoid coil
4. Sleeve holes	

Assembling the Transmission (continued)



g036300

Figure 132

1. Hex nut	4. Seal
2. Lock washer	5. Solenoid valve coil
3. Washer	6. Letter I

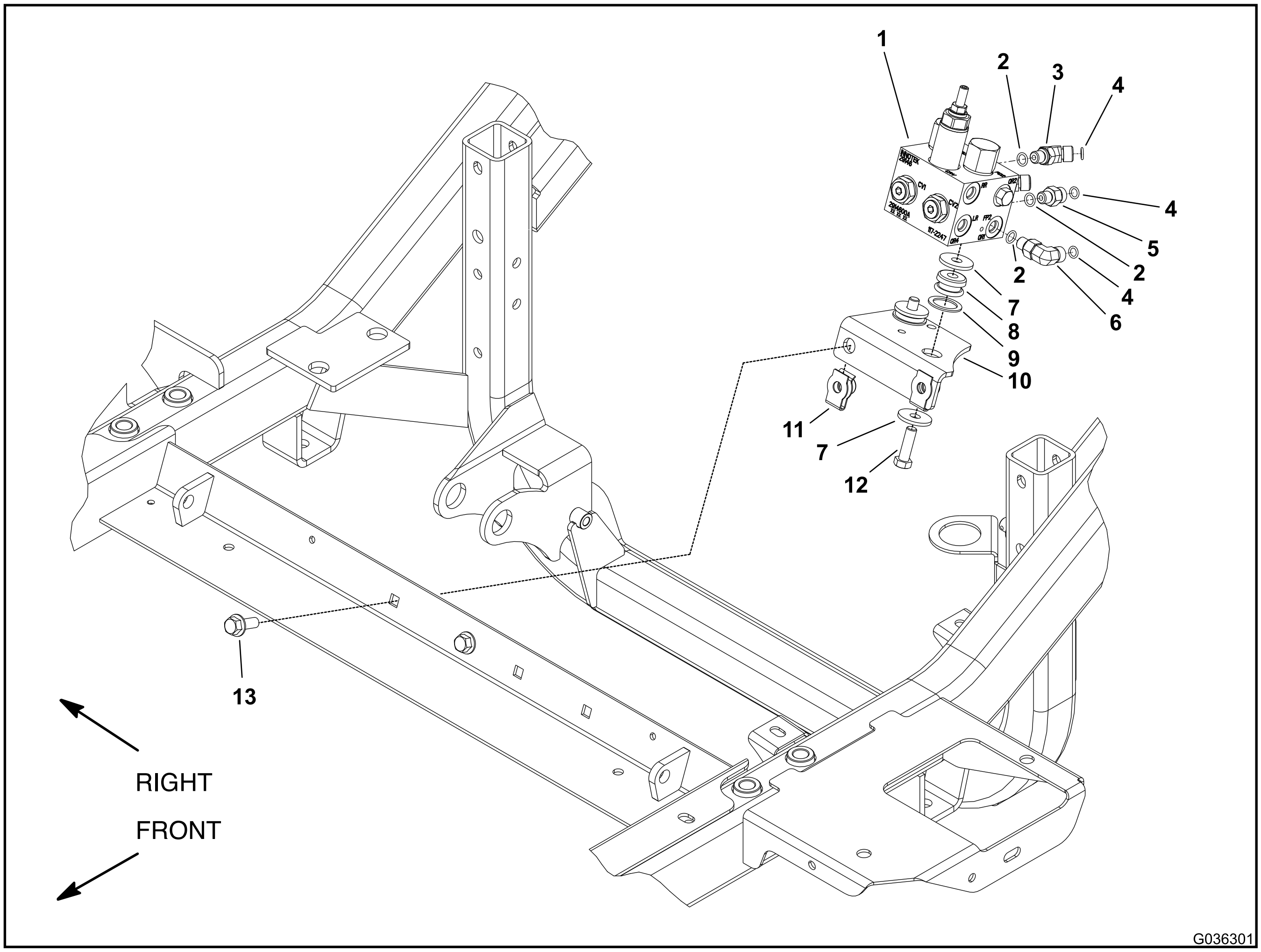
54. Lubricate the solenoid valve spring, sleeve, and spool with clean hydraulic fluid and install the solenoid valve spring, sleeve, and spool into the pump body.

    Note: Ensure that the sleeve is installed so that the holes are closest to the spring location and that the step in the spool is also toward the spring location.

55. Place the pin in the spool.
56. Install the solenoid valve stem into the pump body and torque the solenoid valve stem to **21 to 22 N·m (186 to 195 in-lb)**.
57. Install the O-ring, solenoid coil, O-ring, washer, lock washer, and nut onto the solenoid valve stem; torque the nut to **5.9 to 7.8 N·m (52 to 69 in-lb)**.

    Note: The coil should be installed so that the "KANZAKI" molded into the coil has the "I" nearest the nut location.

CrossTrax Traction Manifold Assembly



g036301

Figure 133

1. Traction manifold assembly
2. O-ring
3. 45° hydraulic fitting (2 each)
4. O-ring
5. Straight fitting
6. 90° hydraulic fitting
7. Washer (4 each)
8. Mount (2 each)
9. Washer (2 each)
10. Mount plate
11. Tinnerman nut (2 each)
12. Bolt (2 each)
13. Flange-head screw (2 each)

Removing the CrossTrax Traction Manifold 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.

⚠ 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 4–5).

2. Read the General Precautions for Removing and Installing the Hydraulic System Components (page 4–68).

Removing the CrossTrax Traction Manifold Assembly (continued)

3. Raise and support the operator seat. Locate the traction manifold assembly.
4. Clean the hydraulic hose ends and fittings on the traction manifold assembly to prevent contaminants from entering into the hydraulic system.
5. For assembly purposes, label all the hydraulic hoses that are connected to the traction manifold fittings and ports.
6. Disconnect the hydraulic hoses that are connected to the hydraulic fittings and ports on the traction manifold assembly (Figure 134).

   Note: The hoses at the traction manifold assembly ports LR and RR should be disconnected at the hydraulic tubes before removal from the traction manifold assembly shown in Figure 134.

7. Install clean caps or plugs in the hose and fitting openings to prevent system contamination.
8. Support the traction manifold assembly to prevent it from falling.
9. Remove the 2 bolts (item 12 in Figure 133) and 4 washers (item 7 in Figure 133) that secure the traction manifold assembly to the mount plate, and remove the traction manifold assembly from the machine.
10. If the mounts (item 8 in Figure 133) are worn or damaged, note the location of the washer (item 9 in Figure 133) for assembly purposes. Remove and replace damaged mounts and ensure that the washer is installed between new mounts and top of the mount plate.
11. If the hydraulic fittings are to be removed from the traction manifold assembly, mark the fitting orientation for assembly purposes. Remove the fittings from the traction manifold assembly and discard the O-rings from the fittings.

IMPORTANT

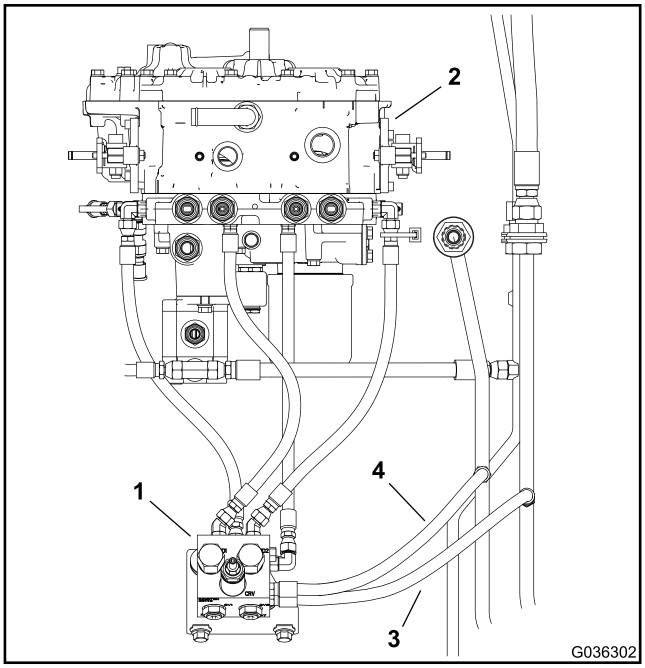
An orifice is threaded into the traction manifold assembly ports OR1, OR2, OR3, and OR4. If any orifice is removed from the traction manifold assembly, ensure to label its position for assembly purposes.

Installing the CrossTrax Traction Manifold Assembly

IMPORTANT

If any orifice was removed from the traction manifold assembly, ensure to secure the orifice into correct port before installing the fittings.

Installing the CrossTrax Traction Manifold Assembly (continued)



g036302

Figure 134

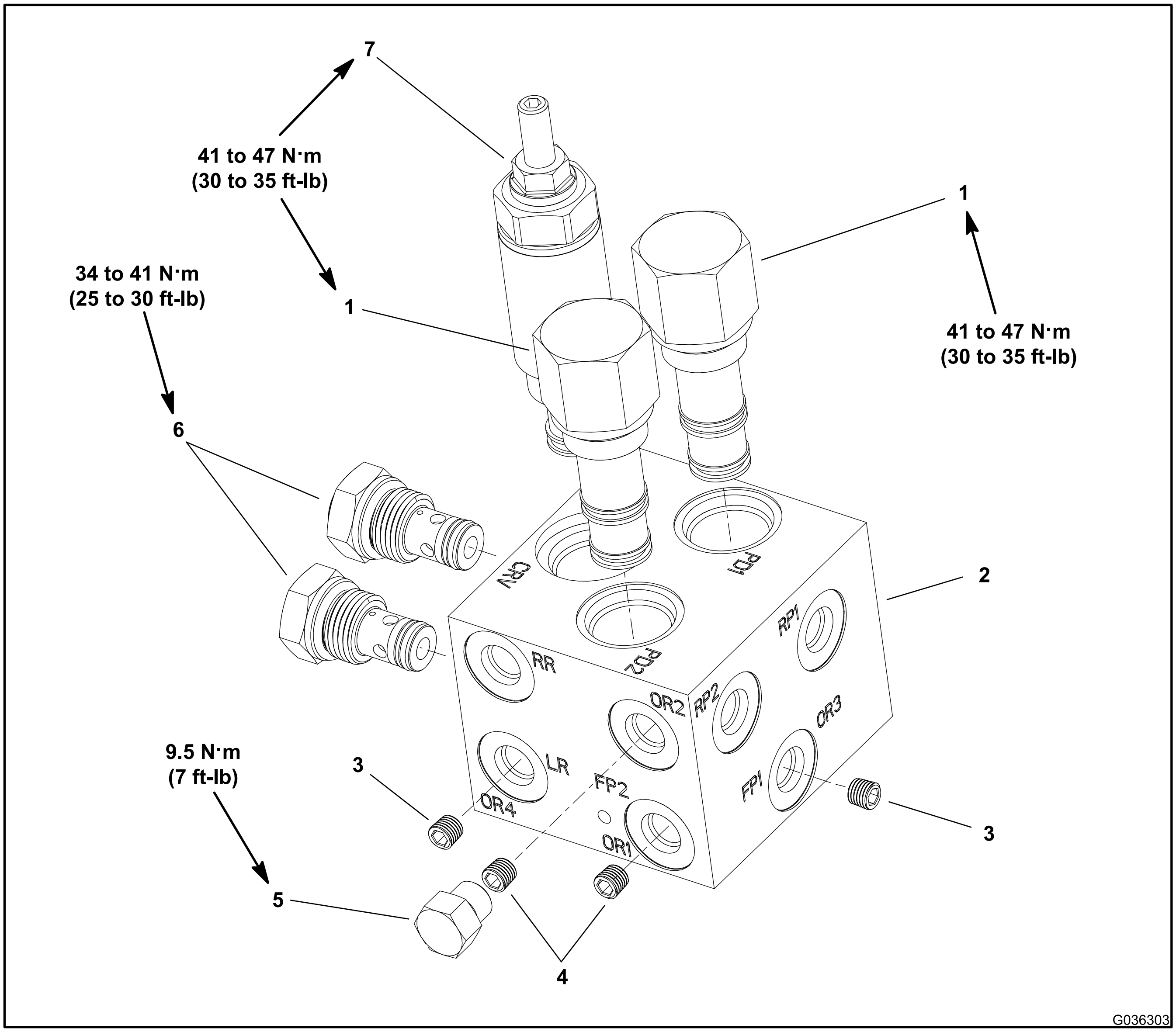
1. Traction manifold assembly
2. Transmission
3. Hose to port LR
4. Hose to port RR

---

1. If an orifice was removed from any port, ensure that the orifice is in the port before you install the fitting; refer to Servicing the CrossTrax Traction Manifold Assembly (page 4–132).
2. If the hydraulic fittings were removed from the traction manifold assembly, lubricate new O-rings with clean hydraulic fluid, position the O-rings to the fittings, and install the fittings into the ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fitting into the Component Port) (page 4–9).
3. Position the traction manifold assembly to the machine.
4. Position the 2 washers (item 9 in Figure 133) to the top of the mounts. Secure the traction manifold assembly to the machine with 2 bolts and 2 washers (item 7 in Figure 133).
5. Remove the caps and plugs from the hydraulic hoses and fittings.

   Note: The hoses in ports LR and RR should be installed in the traction manifold ports before they are installed to the hydraulic tubes.
6. Use the labels that you attached during traction manifold assembly removal, correctly connect the hydraulic hoses to the traction manifold assembly and hydraulic tubes (Figure 134); refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–8).
7. Check the hydraulic-fluid level in the hydraulic reservoir and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
8. Lower and secure the operator seat.

Servicing the CrossTrax Traction Manifold Assembly



g036303

Figure 135

1. Pilot directional valve (PD1 and PD2)
2. Manifold block
3. Orifice (0.040) (OR3 and OR4)
4. Orifice (0.090) (OR1 and OR2)
5. Zero-leak hex plug
6. Check valve (CV1 and CV2)
7. Relief valve (CRV)

Note: The ports on the CrossTrax traction manifold assembly are marked for easy identification of the components. Example: PD1 is the location for the pilot directional valve PD1 and OR1 is the location for a 0.090 orifice. Refer to the Hydraulic Schematic in Appendix A (page A–1)—Foldout Drawings.

Servicing the Cartridge Valves

⚠ 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 4–5).

IMPORTANT

An orifice is threaded into the traction manifold assembly ports OR1, OR2, OR3, and OR4. If any orifice is removed from the ports, ensure to label its position for assembly purposes. While assembling, ensure that the orifice is correctly installed.

For the cartridge valve service procedures; refer to Servicing the Cartridge Valves in a Control Manifold (page 4–134). Refer to Figure 135 for CrossTrax traction manifold assembly cartridge valve and plug installation torque.

Servicing the Cartridge Valves in a Control Manifold

⚠ 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 4–5).

1. Ensure that the control manifold is clean before you remove the cartridge valve from the assembly.
2. If the cartridge valve is solenoid operated, remove the nut that secures the solenoid coil to the cartridge valve. Carefully slide the coil off the valve.

IMPORTANT

Label the cartridge valves before removal so that the valves can be correctly installed into the control manifold.

IMPORTANT

Carefully handle the cartridge valve. Slight bending or distortion of the stem tube can cause binding and malfunction. When removing the cartridge valve from the control manifold, ensure that the deep well socket fully engages the valve base.

3. Use a deep socket wrench to remove the cartridge valve from the control manifold. Note the correct location of the O-rings, sealing rings, and back-up rings.
4. Remove and discard the seal kit from the cartridge valve.
5. Visually examine the port in the control manifold for damaged sealing surfaces, damaged threads, and contamination.
6. Visually inspect the cartridge valve for damaged sealing surfaces and contamination.
    A. Contamination can cause the valves to stick or hang up. Contamination can accumulate in small valve orifices or seal areas and cause malfunction.
    B. If the sealing surfaces of the valve are pitted or damaged, the hydraulic system may be overheating or there can be water in the system.

⚠ CAUTION ⚠

Use eye protection such as goggles when using compressed air.

⚠ CAUTION ⚠

Sudden movement of the internal valve spools can release the stored fluid suddenly.

Servicing the Cartridge Valves in a Control Manifold (continued)

7. Use clean mineral spirits to clean the cartridge valve. Put the valve in clean mineral spirits to flush out contamination.

IMPORTANT

Particles as fine as talcum powder can affect the operation of high-pressure hydraulic valves.

If the cartridge design allows, use a wood or plastic probe to press the internal spool in and out for 20 to 30 times to flush out contamination.

Ensure that you do not damage the cartridge. Use compressed air for cleaning.

8. Install the cartridge valve into the control manifold as follows:
   A. Lubricate the new seal kit components with clean hydraulic fluid and install the components onto the valve.
   B. Install the O-rings, sealing rings, and back-up rings correctly on the cartridge valve for proper operation and sealing.
   C. Put the assembled cartridge into the clean hydraulic fluid.

   IMPORTANT

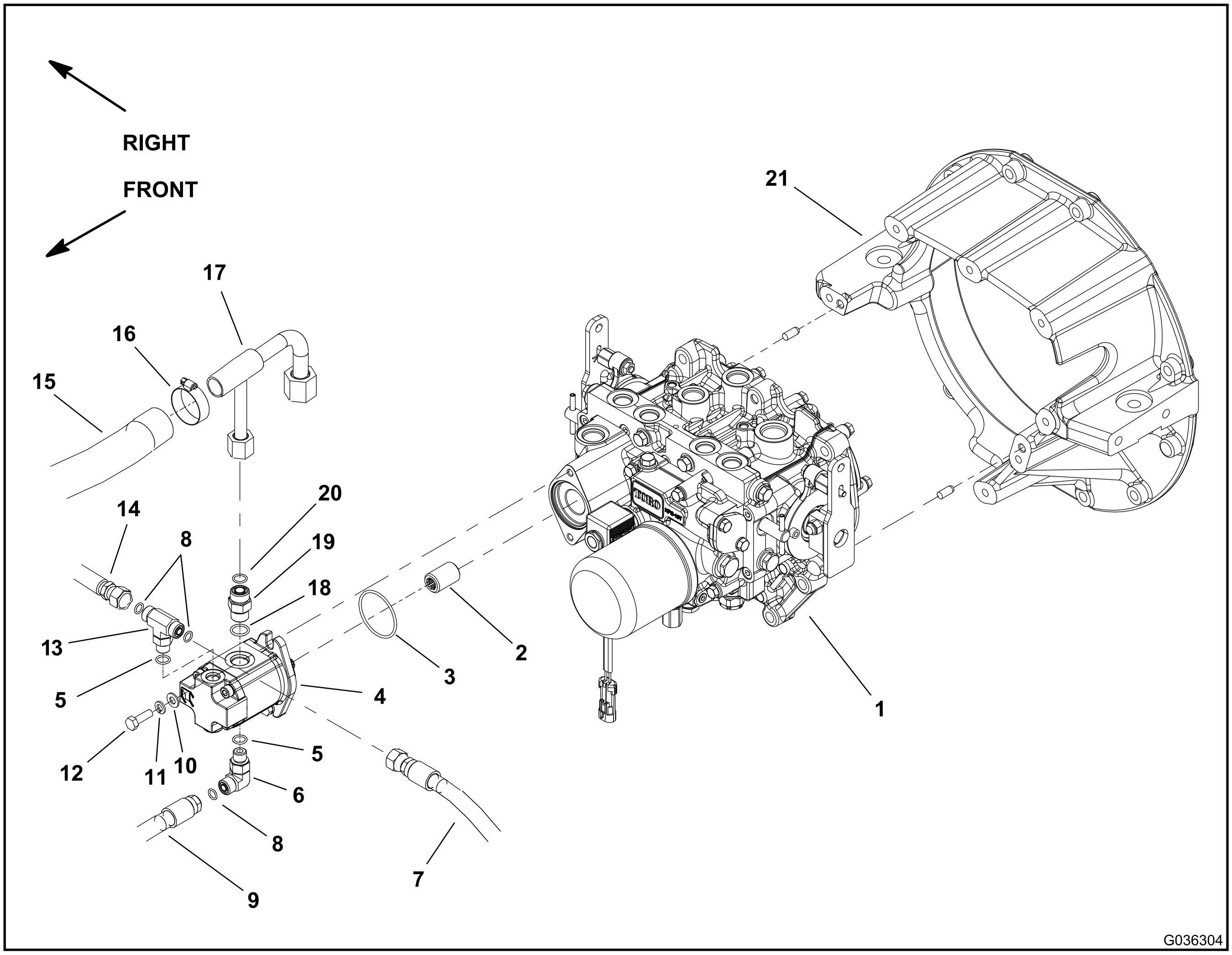
   Carefully handle the cartridge valve. Slight bending or distortion of the stem tube can cause binding and malfunction. When installing the cartridge valve into the control manifold, ensure that the deep well socket fully engages the valve base.

   D. Turn the cartridge valve carefully into the control manifold port until it contacts the top of the O-ring. The valve should go into the port easily without binding.
   E. Use a deep socket wrench and torque the cartridge valve to torque specification included in the control manifold illustration found in this section.

9. If the cartridge valve is solenoid operated, carefully install the solenoid coil into the cartridge valve and secure the coil to the valve with the nut; torque the nut to **6.7 N·m (60 in-lb)**.

10. If circuit problems still exist after assembly, remove the cartridge valve and clean the valve again or replace the cartridge valve.

Gear Pump



g036304

Figure 136

1.	Transmission assembly	8.	O-ring	15.	Hydraulic hose (suction)
2.	Spline coupler	9.	Hydraulic hose (output)	16.	Hose clamp
3.	O-ring	10.	Flat washer (2 each)	17.	Suction tube assembly
4.	Gear pump	11.	Lock washer (2 each)	18.	O-ring
5.	O-ring	12.	Bolt (2 each)	19.	Straight hydraulic fitting
6.	90° hydraulic fitting	13.	Hydraulic tee fitting	20.	O-ring
7.	Hydraulic hose	14.	Hydraulic hose	21.	Flywheel housing

Removing the Gear Pump

⚠ 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 4–5).

---

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. Raise and support the operator seat.
3. Drain the hydraulic fluid from the hydraulic tank.
4. Clean the hydraulic hose ends and fittings on the gear pump and hydraulic tank to prevent contaminants from entering into the system.
5. For assembly purposes, label the hydraulic hoses and tubes that are connected to the fittings on the gear pump.
6. Disconnect the hydraulic hoses from the fittings on the gear pump. Allow the hoses to drain into a suitable container.
7. Install clean caps or plugs in the hose and fitting openings to prevent system contamination.
8. Support the gear pump to prevent it from falling during removal.
9. Remove the 2 bolts (item 12 in Figure 136), 2 lock washers, and 2 flat washers that secure the gear pump to the transmission, and remove the gear pump from the transmission.
10. Remove and discard the O-ring (item 3 in Figure 136).
11. Locate and remove the spline coupler from the transmission or gear pump shaft.
12. If the hydraulic fittings are to be removed from the gear pump, mark the fitting orientation for assembly purposes. Remove the fittings from the gear pump as necessary and discard the O-rings from the fittings.

Installing the Gear Pump

1. If the hydraulic fittings were removed from the pump, lubricate and install new O-rings to the fittings. Install the fittings into the gear pump ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fitting into the Component Port) (page 4–9).
2. Slide the spline coupler onto the transmission shaft. Lubricate the O-ring (item 3 in Figure 136) with grease and install the O-ring onto the flange of the gear pump.

IMPORTANT

Position the gear pump to the transmission so that the gear pump suction port is facing up.

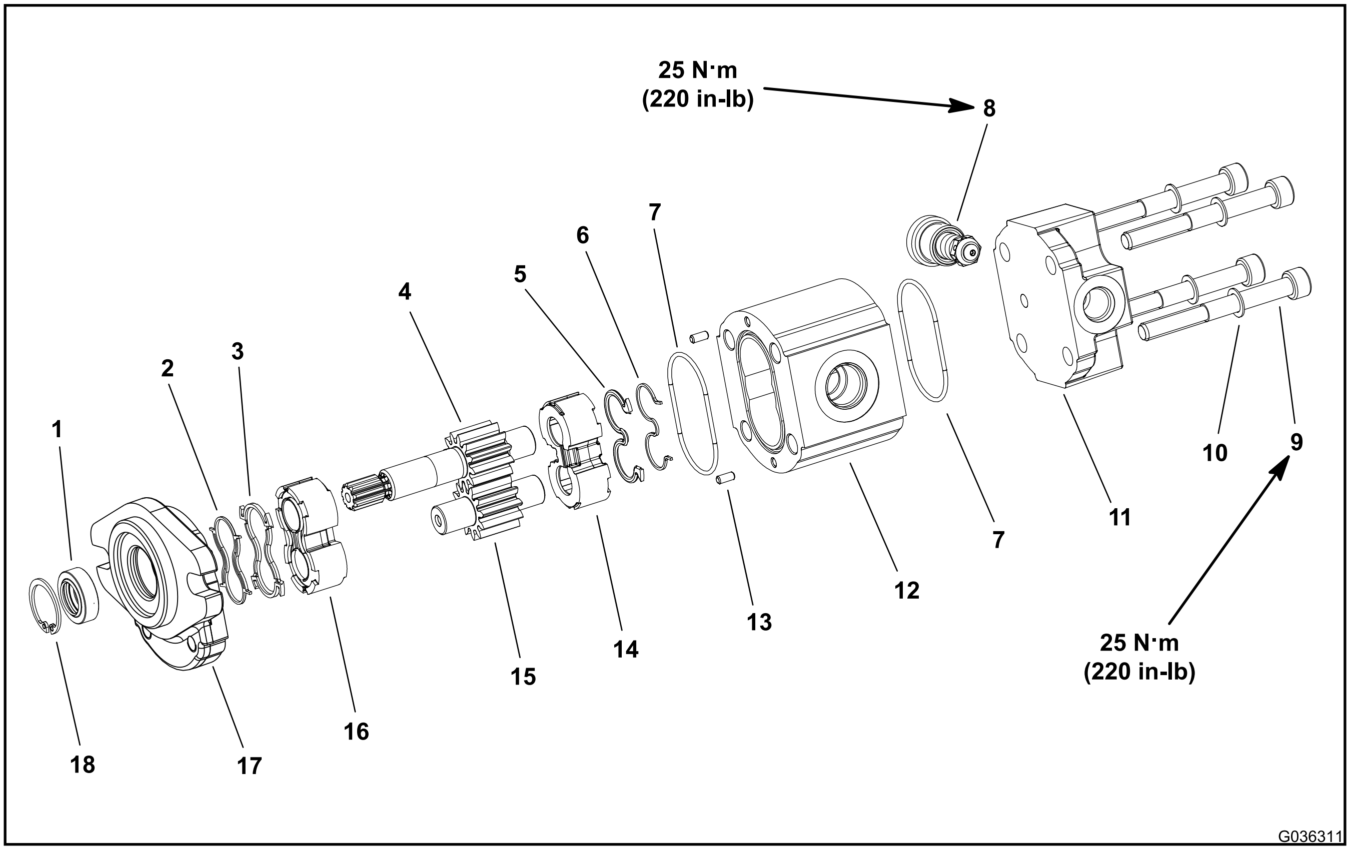
---

3. Position the gear pump to the transmission and secure the pump with the 2 bolts, 2 lock washers, and 2 flat washers.
4. Remove the caps or plugs that were installed to the hydraulic hoses and fittings during the removal process.

Installing the Gear Pump (continued)

5. Use the labels that you attached during the removal process to correctly connect the hydraulic hoses to the fittings on the gear pump and hydraulic tank; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–8).
6. Fill the hydraulic tank with the correct quantity of new hydraulic fluid.
7. Lower and secure the operator seat.

Servicing the Gear Pump

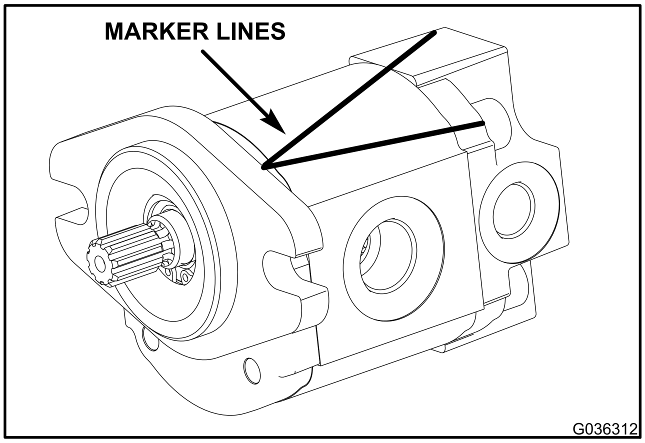


g036311

Figure 137

1. Shaft seal	7. O-ring	13. Dowel pin (2 each)
2. Front back-up seal	8. Implement relief valve	14. Rear bearing block
3. Front pressure seal	9. Socket-head screw (4 each)	15. Idler gear
4. Drive gear	10. Lock washer (4 each)	16. Front bearing block
5. Rear pressure seal	11. Back plate	17. Front plate
6. Rear back-up seal	12. Body	18. Retaining ring

Disassembling the Gear Pump



g036312

Figure 138

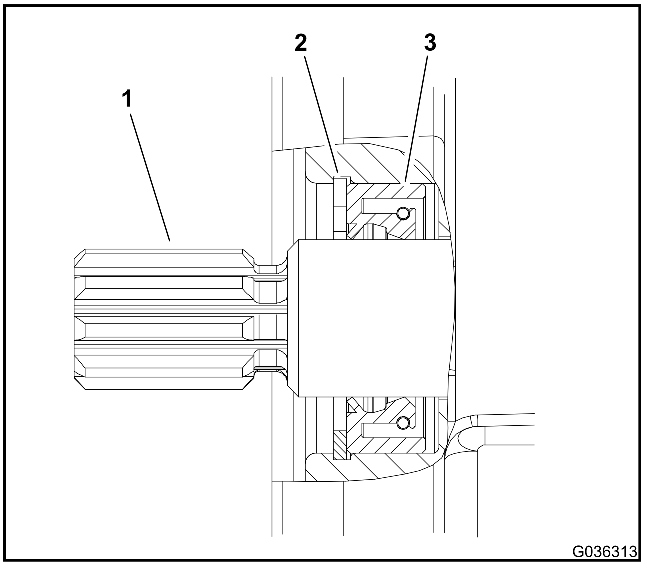
1. Install clean plugs in the pump ports and clean the outer surface of the pump. After cleaning, remove the plugs and drain the hydraulic fluid out of the pump.
2. Use a marker to make a "V" across the front plate, body, and back plate for assembly purposes (Figure 138).

IMPORTANT

Clamping the pump body in a vise could damage the pump. When you clamp the pump in a vise, clamp the mounting flange only.

---

3. Clamp the mounting flange of the pump in a vise with the shaft end down.
4. Loosen the 4 socket-head screws that attach the back plate and front plate together.



g036313

Figure 139

1. Drive gear shaft
2. Retaining ring
3. Shaft seal

5. Remove the pump from the vise, and remove the 4 socket-head screws (item 9 in Figure 137) and 4 lock washers.

Disassembling the Gear Pump (continued)

6. Remove the front plate from the body and then remove the back plate.
7. Locate and remove the 2 dowel pins (item 13 in Figure 137) from the body.

IMPORTANT

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

8. Place the pump on its side and push on the rear bearing block to remove the bearing blocks and gear set from the pump body.

   Note: The pressure seals and back-up seals fit in the grooves machined into the bearing blocks. The O-rings fit in the grooves machined in the pump body.
9. Carefully remove and discard the O-rings, pressure seals, and back-up seals from the pump body and bearing blocks.

   Note: Do not damage the machined grooves during the removal process.
10. Turn the front plate over, with seal side up, and remove the retaining ring.

IMPORTANT

Ensure that you do not damage the counterbore when removing the shaft seal from the front plate.

11. Carefully remove the shaft seal from the front plate (Figure 139). Note the orientation of seal lips during removal. Discard the seal.
12. If necessary, remove the implement relief valve from the back plate. Remove and discard the sealing washers.

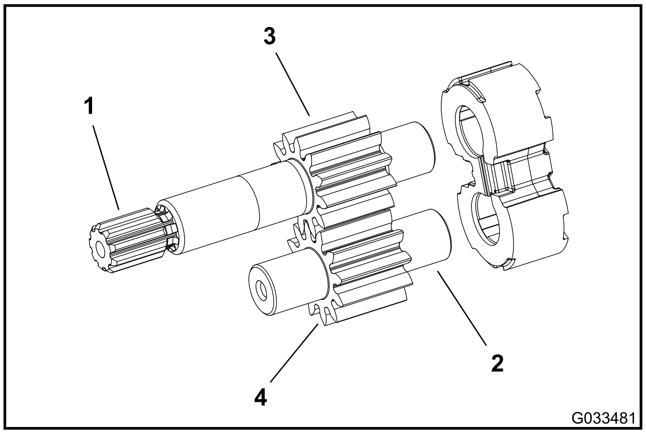
Inspecting the Gear Pump

⚠ CAUTION ⚠

Use eye protection such as goggles when using compressed air.

1. Clean all the pump parts with solvent and dry them with compressed air.
2. Inspect the drive gear, idler gear, and bearing blocks for the following. If damage is found, replacement of the gear pump is necessary.
   A. Gear shafts must be free of rough surfaces and excessive wear at the bushing points and sealing areas. Replace the gear pump if you find any scoring, rough surfaces, or wear on the gear shafts.
   B. Gear teeth must be free from excessive scoring and wear. Replace the gear pump if you find broken or nicked gear teeth.

Inspecting the Gear Pump (continued)



g033481

Figure 140

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

C. Gear face edge must be free from sharpness. The sharp edges of gears will mill into the bearing blocks. Replace the gear pump if you find any sharp gear face edge.

D. Bearing areas of the bearing blocks must not have excessive wear or scoring.

E. Face of the bearing blocks that are in contact with the gears must be free of wear, roughness, or scoring.

3. Inspect the front plate and back plate for damage or wear. If the plates are damaged or worn, replace the pump.

Assembling the Gear Pump

Note: When assembling the pump, check the V-shaped marker line made during disassembly to ensure that the components are properly aligned.

1. Lubricate new O-rings, pressure seals, and back-up seals with a thin coat of petroleum jelly, and lubricate all internal pump parts freely with clean hydraulic fluid.
2. Install new shaft seal in the front plate. Note the orientation of seal lips during installation (Figure 139).

   Note: The seal should be pressed into place until it reaches the bottom of the bore.
3. Install the retaining ring into the groove of the front plate.
4. Install the lubricated O-rings into the body.
5. Install the lubricated pressure seals into the machined grooves of the bearing blocks and carefully place the back-up seals into the grooves.
6. Lubricate the gear faces and bearing surfaces of the drive gear, idler gear, and bearing blocks with clean hydraulic fluid.
7. Use the identification marks that you made during disassembly and carefully assemble the bearing blocks and gears.
8. Position the pump body on its side.
9. Use the identification marks that you made during disassembly and carefully slide the bearing block and gear assembly into the body cavity.

Assembling the Gear Pump (continued)

10. Remove excess lubrication from the mating surfaces of the body, back plate, and front plate. Ensure that these surfaces are clean and dry.
11. Install the 2 dowel pins into the body.

IMPORTANT

Do not dislodge the O-rings, pressure seals, or back-up seals during final assembly.

---

12. Using the marker lines for proper location, gently slide the back plate onto the assembly, and engage the dowel pins with firm hand pressure.
13. Place a thin sleeve or tape on the pump shaft splines to prevent seal damage.
14. Position the pump with back plate downwards.
15. Use the marker lines for proper location and carefully slide the front plate onto the assembly.

    Note: Do not damage the seal during the front plate installation.
16. Remove the sleeve or tape from the shaft splines.
17. Install the 4 socket-head screws (item 9 in Figure 137) with the 4 lock washers and tighten them by hand.

IMPORTANT

Clamping the pump body in a vise could damage the pump. When you clamp the pump in a vise, clamp the mounting flange only.

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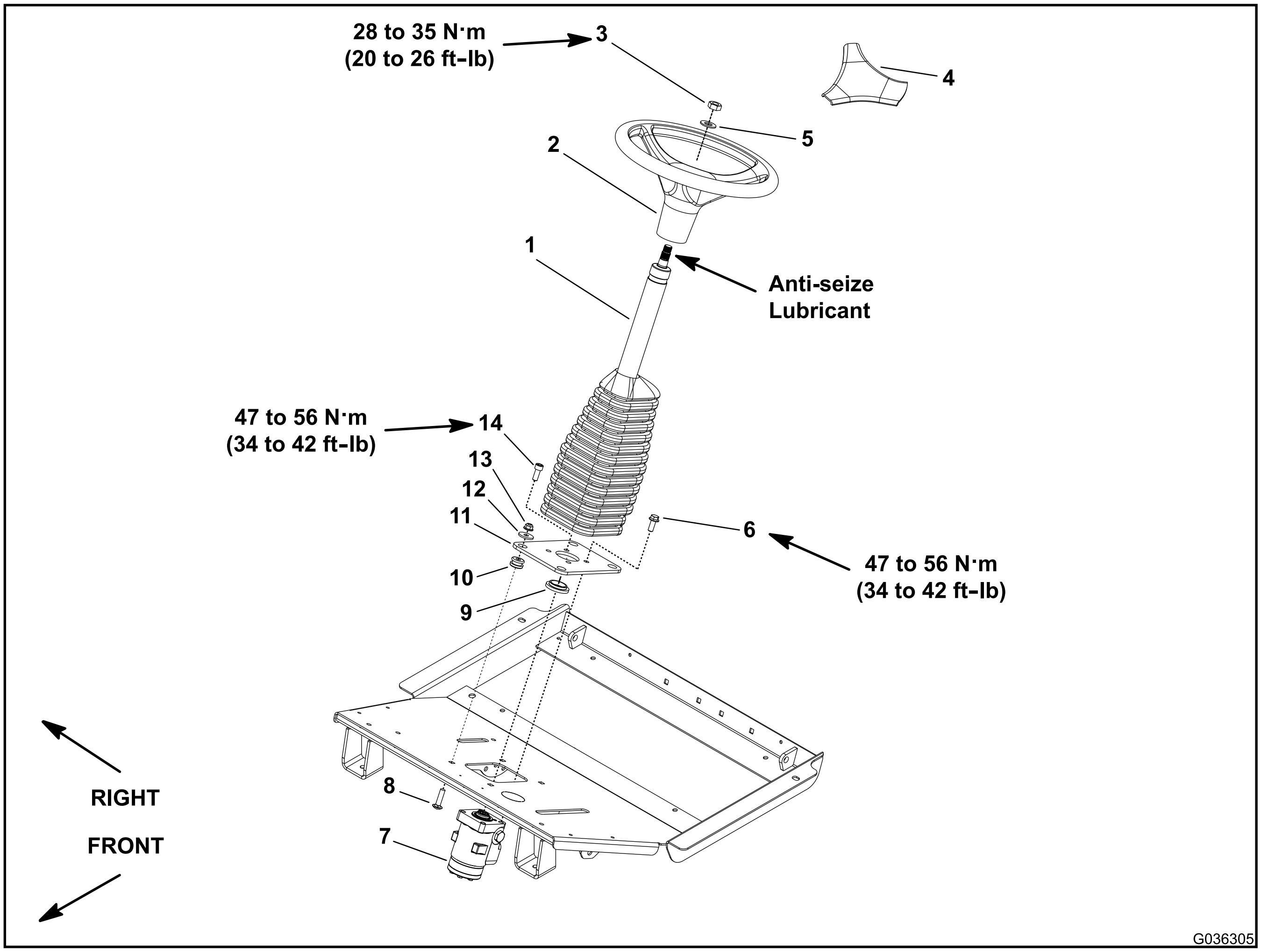
18. Clamp the mounting flange of the pump in a vise with the shaft end down.
19. Alternately torque the 4 socket-head screws to **25 N·m (220 in-lb)**.
20. If the implement relief valve was removed from the back plate, install the relief valve to the back plate; torque the relief valve to **25 N·m (220 in-lb)**.
21. Put a small amount of hydraulic fluid in the inlet port of the pump and rotate the input shaft for 1 revolution. Place the coupler on the input shaft, use pliers on the coupler and rotate the pump shaft. If the input shaft binds, disassemble the pump and repeat the assembly process.
22. Remove the pump from the vise.

Steering Control Valve



g036305

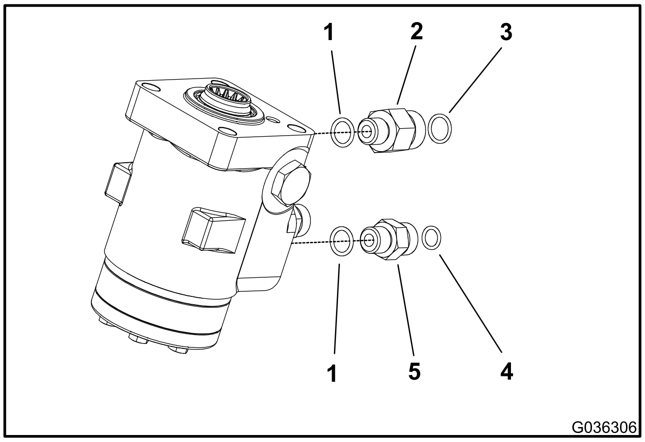
Figure 141

1. Steering column assembly
2. Steering wheel
3. Locknut
4. Steering wheel cover
5. Flat washer
6. Flange-head screw (3 each)
7. Steering control valve
8. Carriage screw (4 each)
9. Alignment bushing
10. Mount (4 each)
11. Steering plate
12. Washer (4 each)
13. Flange nut (4 each)
14. Socket-head screw

Removing the Steering Control Valve

CAUTION

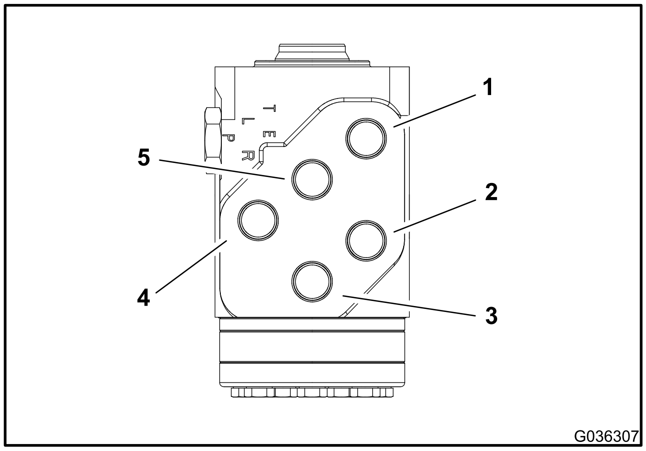
Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to Releasing Pressure from the Hydraulic System (page 4–5).



g036306

Figure 142

1. O-ring	4. O-ring
2. Straight fitting	5. Straight hydraulic fitting (4 each)
3. O-ring	



g036307

Figure 143

1. Out port (T)	4. In port (P)
2. Load sensing port (E)	5. Left turn port (L)
3. Right turn port (R)	

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 4–68).
3. For assembly purposes, label all the hydraulic lines and fittings at the steering control valve. Note the port designations on the steering control valve (Figure 143).

Removing the Steering Control Valve (continued)

4. Clean the hydraulic connections before loosening the hydraulic lines.
5. Disconnect the hydraulic lines from the steering control valve. Allow the lines to drain into a suitable container.
6. Install clean caps or plugs on the hydraulic lines and fittings to prevent system contamination.
7. Support the steering column to prevent it from falling.
8. Loosen and remove the 4 carriage screws (item 8 in Figure 141) and 4 flange nuts that secure the steering column assembly to the machine.
9. Locate and retrieve the 4 washers (item 12 in Figure 141) and 4 mounts.
10. While carefully guiding the steering control valve from the hole in the platform, lift the steering column assembly (with the steering control valve attached) and remove the entire assembly from the machine.
11. Put the steering column assembly on a bench. Slide the rubber bellows up from the bottom of the steering column.
12. Loosen and remove the 3 flange-head screws and 1 socket-head screw (item 14 in Figure 141) that secure the steering column to the steering control valve. Note the location of the socket-head screw for assembly purposes.
13. Remove the steering control valve (item 7 in Figure 141), alignment bushing, and steering plate from the steering column.
14. If necessary, remove the hydraulic fittings from the steering control valve (Figure 142).
15. Remove and discard the O-rings from the fittings.

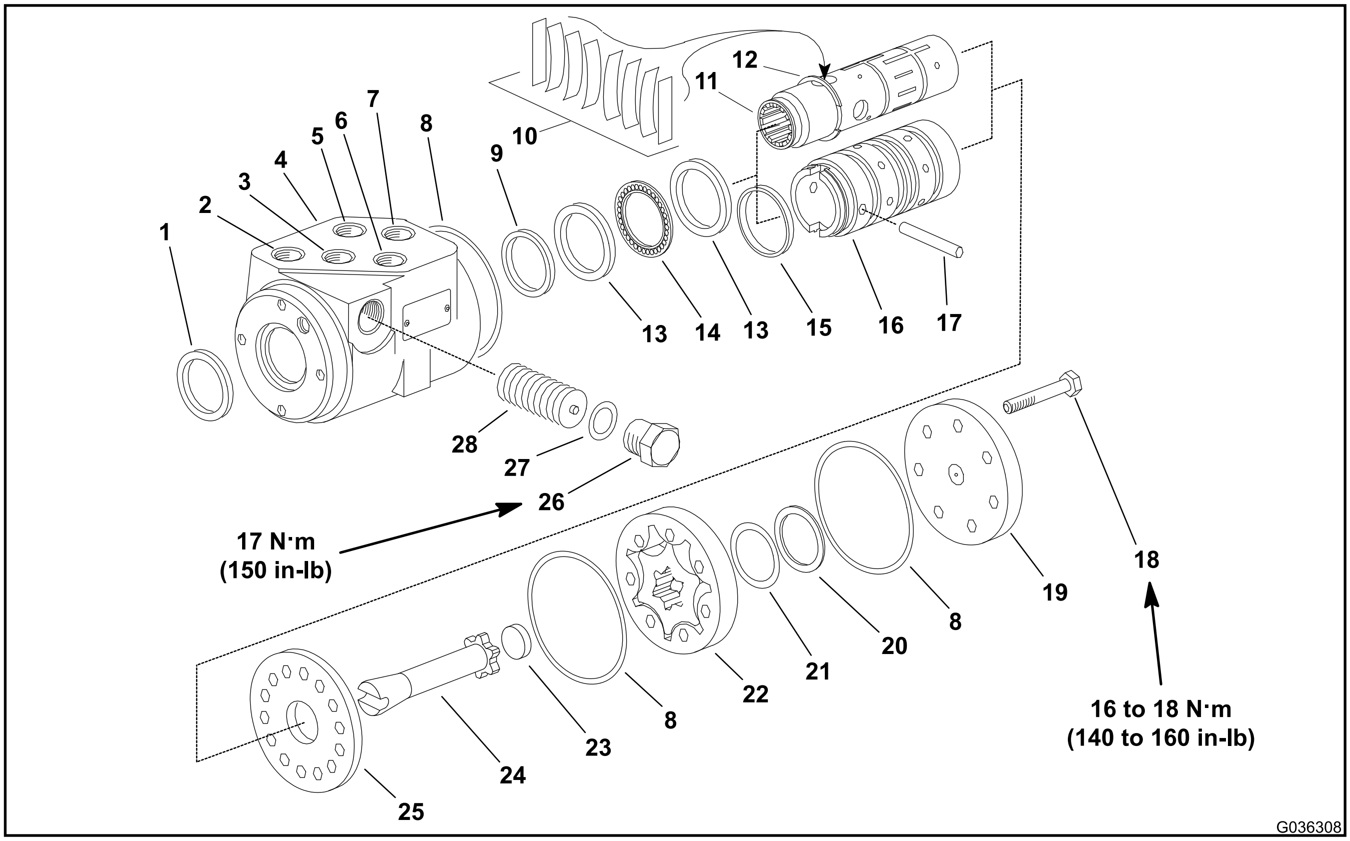
Installing the Steering Control Valve

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 into the control valve; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fitting into the Component Port) (page 4–9).
2. Apply anti-seize lubricant to the splines of the steering control valve input shaft.
3. Position the alignment bushing (item 9 in Figure 141) and steering plate to the steering control valve and then slide the steering control valve input shaft onto the steering column shaft. Position the control valve with the ports toward tilt lever on the steering column.

   Note: Ensure that the alignment bushing is positioned on the steering control valve and into the steering plate bore.

4. Secure the steering column in place with the 3 flange-head screws and 1 socket-head screw (item 14 in Figure 141). Tighten the screws by hand in a crossing pattern and then torque the screws to **47 to 56 N·m (34 to 42 ft-lb)** in a crossing pattern.
5. Carefully position the steering column assembly to the machine.
6. Install the mounts (item 10 in Figure 141) between the frame and steering plate at 4 mounting holes. Secure the steering column assembly to the machine with the 4 carriage screws (item 8), washers (item 12), and flange nuts (item 13).
7. Remove the caps and plugs that were installed to the hydraulic lines and fittings during the removal process.
8. 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 all the connections; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–8).
9. Slide the rubber bellows to the bottom of the steering column.
10. Check the hydraulic-fluid level in the hydraulic reservoir and add correct quantity of fluid if necessary; refer to the *Operator’s Manual*.

Servicing the Steering Control Valve



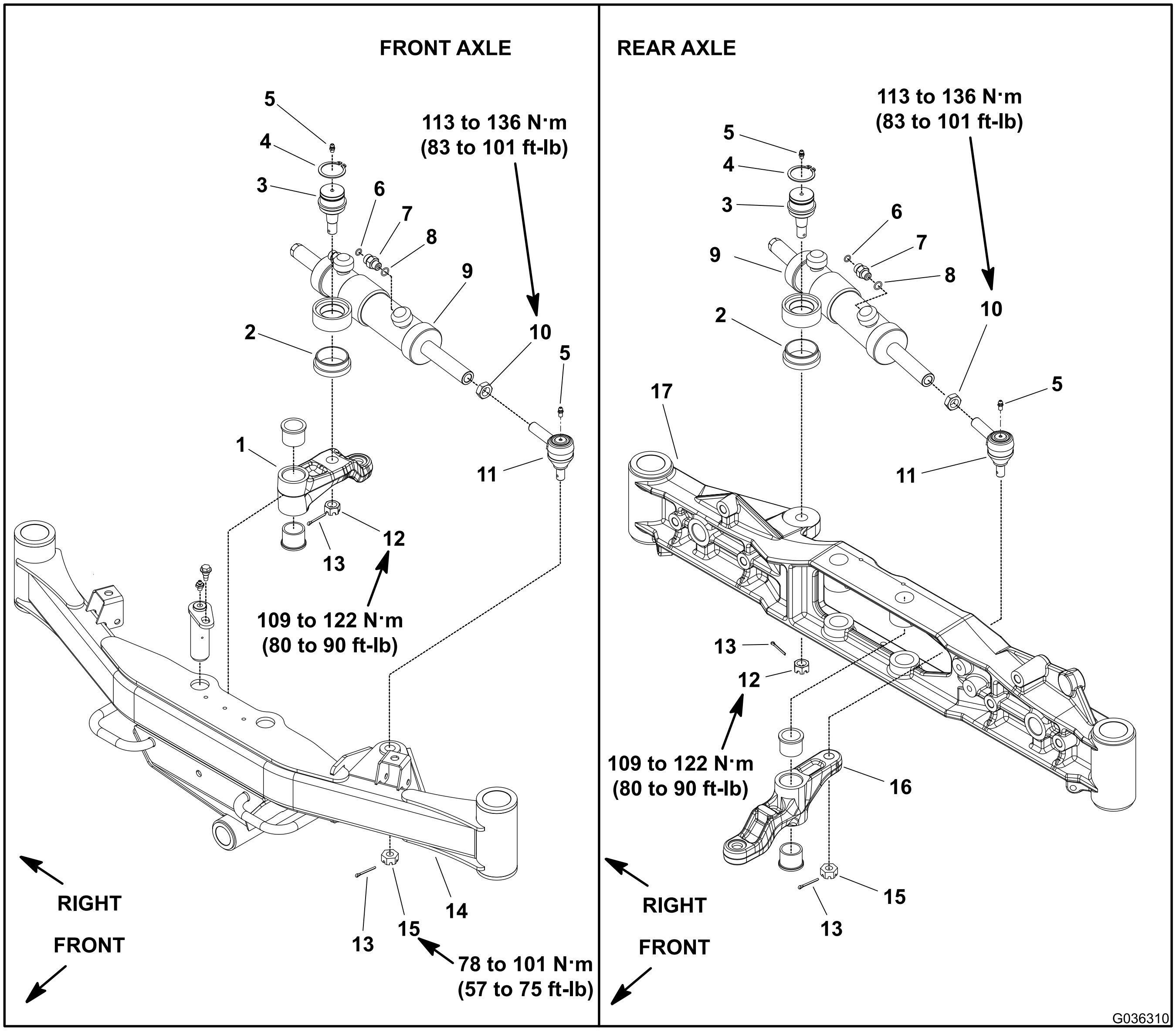
g036308

Figure 144

1. Dust seal
2. T port (return to tank)
3. L port
4. Steering valve housing
5. E port (flow beyond)
6. P port (from pump)
7. R port
8. O-ring
9. Quad seal
10. Centering springs/spacers
11. Spool
12. Spring retaining ring
13. Bearing race
14. Thrust bearing
15. Ring
16. Sleeve
17. Pin
18. Bolt (7 each)
19. End cap
20. Seal ring
21. O-ring
22. Geroter
23. Spacer
24. Geroter drive
25. Wear plate
26. Plug
27. O-ring
28. Relief valve

Note: For the steering control valve repair procedures; refer to the Eaton Parts and Repair Information: 5 Series Steering Control Units.

Steering Cylinder

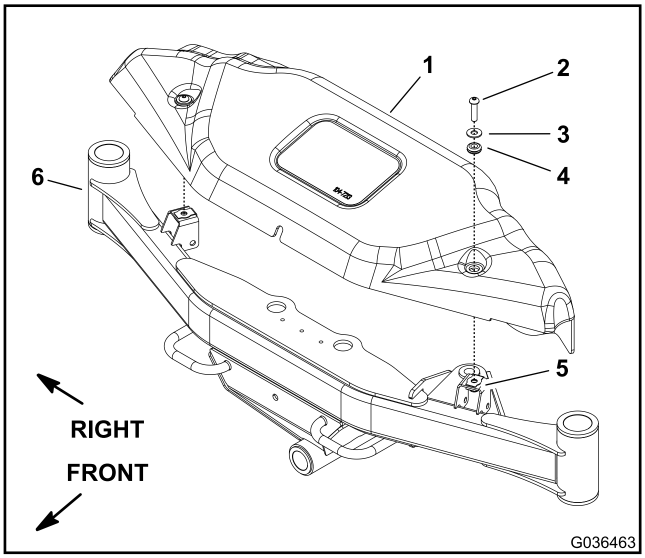


g036310

Figure 145

1.	Right front arm assembly	7.	Straight hydraulic fitting (2 each)	13.	Cotter pin (4 each)
2.	Steering cylinder spacer (2 each)	8.	O-ring (2 each)	14.	Front axle assembly
3.	Ball joint (2 each)	9.	Steering cylinder (2 each)	15.	Slotted hex nut (2 each)
4.	External retaining ring (2 each)	10.	Jam nut (2 each)	16.	Left rear arm assembly
5.	Grease fitting (4 each)	11.	Rod end (2 each)	17.	Rear axle assembly
6.	O-ring (2 each)	12.	Slotted hex nut (2 each)		

Removing the Steering Cylinder



g036463

Figure 146

1. Front cover	4. Grommet (2 each)
2. Screw (2 each)	5. Tinnerman nut (2 each)
3. Flat washer (2 each)	6. Front 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. If the front steering cylinder is to be removed from the machine, remove the front cover from the front axle to get access to the front steering cylinder (Figure 146).
3. If the rear steering cylinder is to be removed from the machine, raise the operator seat and lower the power center assembly behind the operator seat to get clearance for cylinder removal. If the machine is equipped with operator cab, the power center assembly has to be removed; refer to Removing the Power Center Assembly (page 6–58).
4. Read the General Precautions for Removing and Installing the Hydraulic System Components (page 4–68).

⚠ 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 4–5).

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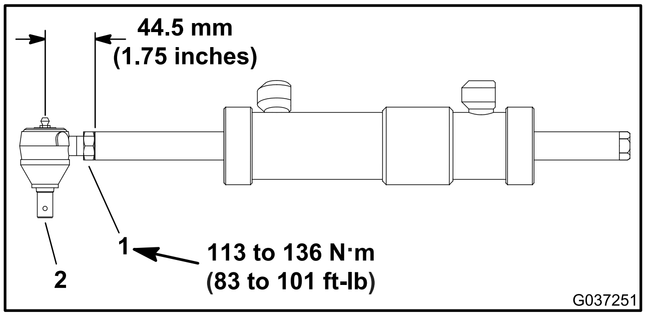
5. For assembly purposes, label all the hydraulic hoses and tubes that are connected to the fittings on the steering cylinder.
6. Clean the hydraulic hose ends before you disconnect the hoses from the steering cylinder.
7. Disconnect the hydraulic hoses from the steering cylinder that is being removed.
8. Install caps or plugs on the disconnected hoses and fittings to prevent contamination.

Removing the Steering Cylinder (continued)

9. Remove the cotter pins (item 13 in Figure 145) and slotted hex nuts that secure the steering cylinder to the axle.
10. Separate the steering cylinder ball joint (item 3 in Figure 145) and rod end from the axle assembly. Remove the steering cylinder from the machine.
11. If the ball joint is to be removed from the cylinder, note the direction that ball joint is installed in the cylinder. Remove the retaining ring and then use a press to remove the ball joint from the steering cylinder barrel.
12. If necessary, remove the rod end (item 11 in Figure 145) from the steering cylinder shaft.
13. If necessary, remove the hydraulic fittings from the steering cylinder and discard the O-rings.

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 (SAE Straight Thread O-Ring Fitting into the Component Port) (page 4–9).
2. If removed, press the ball joint (item 3 in Figure 145) into the barrel and secure the ball joint with the retaining ring.



g037251

Figure 147

1. Jam nut
2. Rod end

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3. If the rod end (item 11 in Figure 145) was removed from the steering cylinder shaft, thread the rod end into the shaft so that the distance from end of the shaft to center of the grease fitting in the rod end is 44.5 mm (1.750 inches) (Figure 147). Torque the jam nut to **113 to 136 N·m (83 to 101 ft-lb)**.

   Note: Ensure that the distance from the end of the shaft to the center of the grease fitting does not change during the jam nut tightening.
4. Clean the tapers on the ball joint, rod end, and axle assembly.
5. Position the steering cylinder to the machine.
6. Secure the steering cylinder to the machine with the slotted hex nuts (items 12 and 15 in Figure 145).

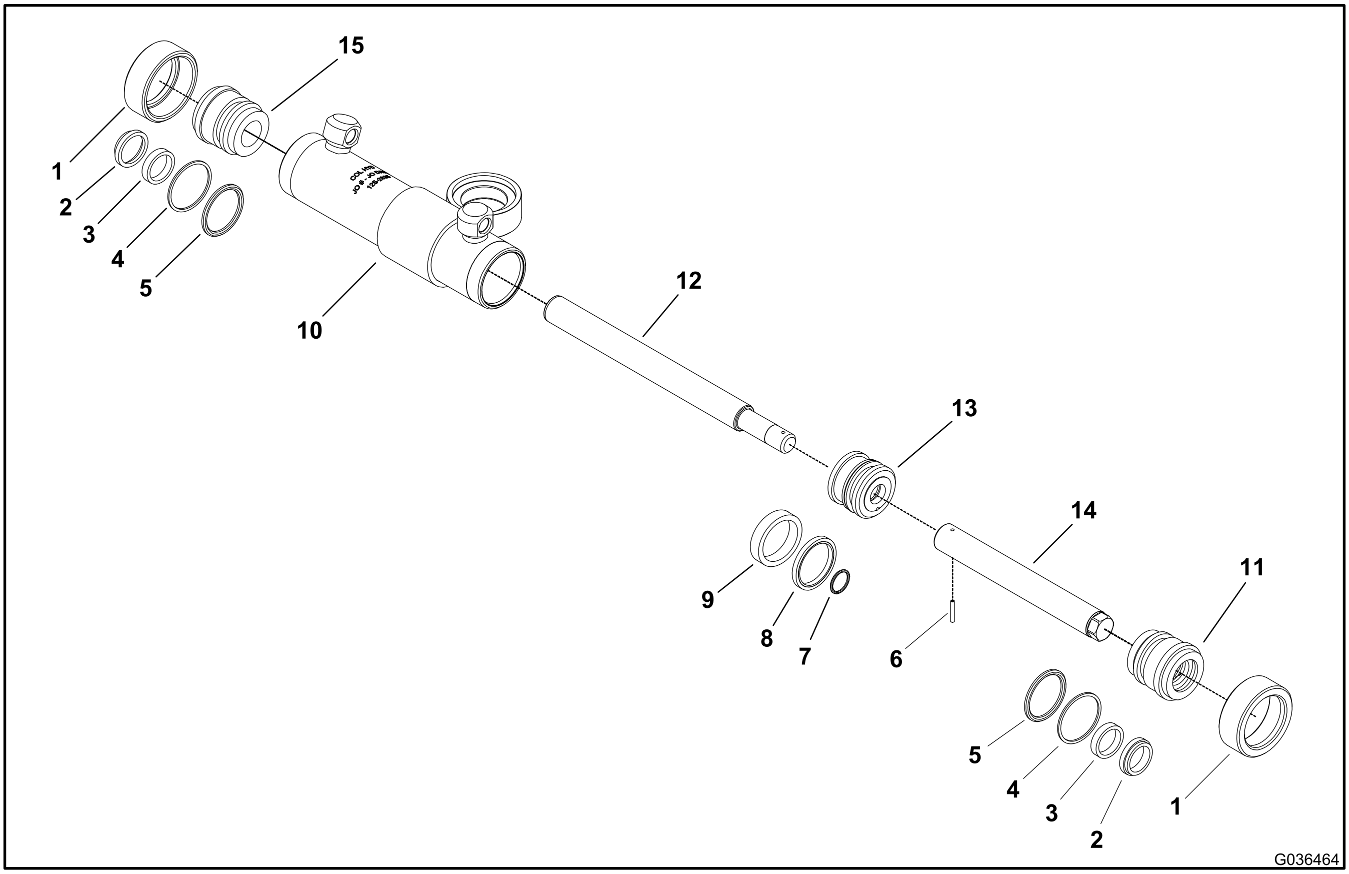
   A. On both the front and rear axle steering cylinders, torque the rod end slotted hex nut (item 15 in Figure 145) to **78 to 101 N·m (57 to 75 ft-lb)**. If necessary, continue to tighten hex nut to allow cotter pin installation.

   B. On both the front and rear axle steering cylinders, torque the barrel end slotted hex nut (item 12 in Figure 145) to **109 to 122 N·m (80 to 90 ft-lb)**. If necessary, continue to tighten the hex nut to allow cotter pin installation.

   C. Insert the cotter pins to secure the hex nuts.

7. Remove the caps and plugs from the hydraulic hoses and fittings.
8. Lubricate and install new O-rings on the steering cylinder fittings. Correctly connect the hydraulic hoses to the steering cylinder; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–8).
9. Check the hydraulic-fluid level in the hydraulic reservoir and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
10. Lubricate the steering cylinder ball joint grease fittings.
11. Check that the steering cylinder does not contact the axle or frame as cylinder moves from fully retracted to fully extended. Also, check that the distance between the drag links and steering stops are equal on both sides of the machine. If necessary, adjust the location of the rod end on the cylinder shaft.
12. If removed, secure the front cover to the front axle (Figure 146).
13. If removed, secure the power center assembly to the machine; refer to Installing the Power Center Assembly (page 6–58), or if the power center assembly is just lowered, raise it to its original position. Lower the operator seat.

Servicing the Steering Cylinder



g036464

Figure 148

1. External collar (2 each)
2. Dust seal (2 each)
3. Head seal (2 each)
4. Back-up ring (2 each)
5. O-ring (2 each)
6. Roll pin
7. O-ring
8. Piston seal
9. Wear ring
10. Barrel assembly
11. Rear head
12. Front rod
13. Piston assembly
14. Rear rod
15. Front head

Note: The front and rear steering cylinders used on the Groundsmaster 360 are the same and use the same service procedures.

Note: The following procedures assume the rod end and ball joint have been removed from the steering cylinder; refer to Removing the Steering Cylinder (page 4–150).

Disassembling the Steering Cylinder

1. Slowly pump the cylinder rod to remove the hydraulic fluid from the steering cylinder into a drain pan. Plug both the ports and clean the outer surface of the cylinder.

IMPORTANT

When you clamp the steering cylinder in a vise, clamp the barrel clevis only to prevent damage. Do not close the vise on the barrel or rod.

Disassembling the Steering Cylinder (continued)

2. Mount the steering cylinder securely in a vise by clamping on the barrel clevis. Use a vise equipped with soft jaws.
3. Use a spanner wrench to loosen and remove the external collars from both ends of the barrel.
4. Use a twisting and pulling motion to carefully extract the rear head from the barrel and rear rod.
5. Hold the end of the front rod and use a twisting and pulling motion to carefully extract the front rod, front head, piston, and rear rod assembly from the barrel.
6. Remove the cylinder barrel from the vise.

IMPORTANT

When removing the roll pin from the front and rear rods, ensure that the rod surfaces are not damaged.

7. Remove and discard the roll pin (item 6 in Figure 148) that secures the front rod to the rear rod. Then, remove the rear rod, piston assembly, and front head from the front rod.
8. Remove and discard the seals, O-rings, and wear ring from the piston and heads.

Inspecting the Steering Cylinder

⚠ CAUTION ⚠

Use eye protection such as goggles when using compressed air.

1. Wash all the cylinder components in clean solvent and dry them with compressed air.
2. Inspect the internal surface of the barrel for deep scratches, out-of-roundness, and bending.
3. Inspect the head, rods, and piston for excessive pitting, scoring, and wear.
4. Check the re-phasing valve in the piston that exists to allow synchronization of the front and rear steering cylinders. The poppet valves should not be stuck in piston. If the valves are stuck or damaged, replace the steering cylinder because the piston is not available separately.
5. Replace the steering cylinder if the internal components are worn or damaged.

Assembling the Steering Cylinder

1. Use a new seal kit and replace all the seals, O-rings, and wear ring to the piston and heads. Apply clean hydraulic fluid to all the seal kit components before you install them.

   Note: Do not damage the head seals during installation.

2. Install the front head (item 15 in Figure 148) with new seals onto the front rod (item 12).

IMPORTANT

Ensure that you do not damage O-ring (item 7 in Figure 148) as piston is installed over the roll pin hole in the front rod.

3. Install the piston (item 13 in Figure 148) with new seal, O-ring, and wear ring onto the front rod.

IMPORTANT

When installing the roll pin into the front and rear rods, ensure that the rod surfaces are not damaged.

4. Slide the rear rod onto the front rod and align the roll pin holes in the rods. Install roll pin (item 6 in Figure 148) to secure the rods.

IMPORTANT

When clamping the cylinder's barrel in a vise; clamp on the clevis only to prevent damage. Do not close the vise on the barrel or rods.

5. Mount the steering cylinder barrel in a vise equipped with soft jaws by clamping on the barrel clevis.

   Note: Do not damage the seals during installation.

6. Coat all the internal cylinder components with clean hydraulic fluid. Slide the rod assembly into the barrel.

   Note: Do not damage the head seals during installation.

7. Insert the rear head with new seals into the barrel.
8. Secure the front and rear heads in the barrel with external collars, tighten the collars with a spanner wrench.

Steering Selector Manifold Assembly

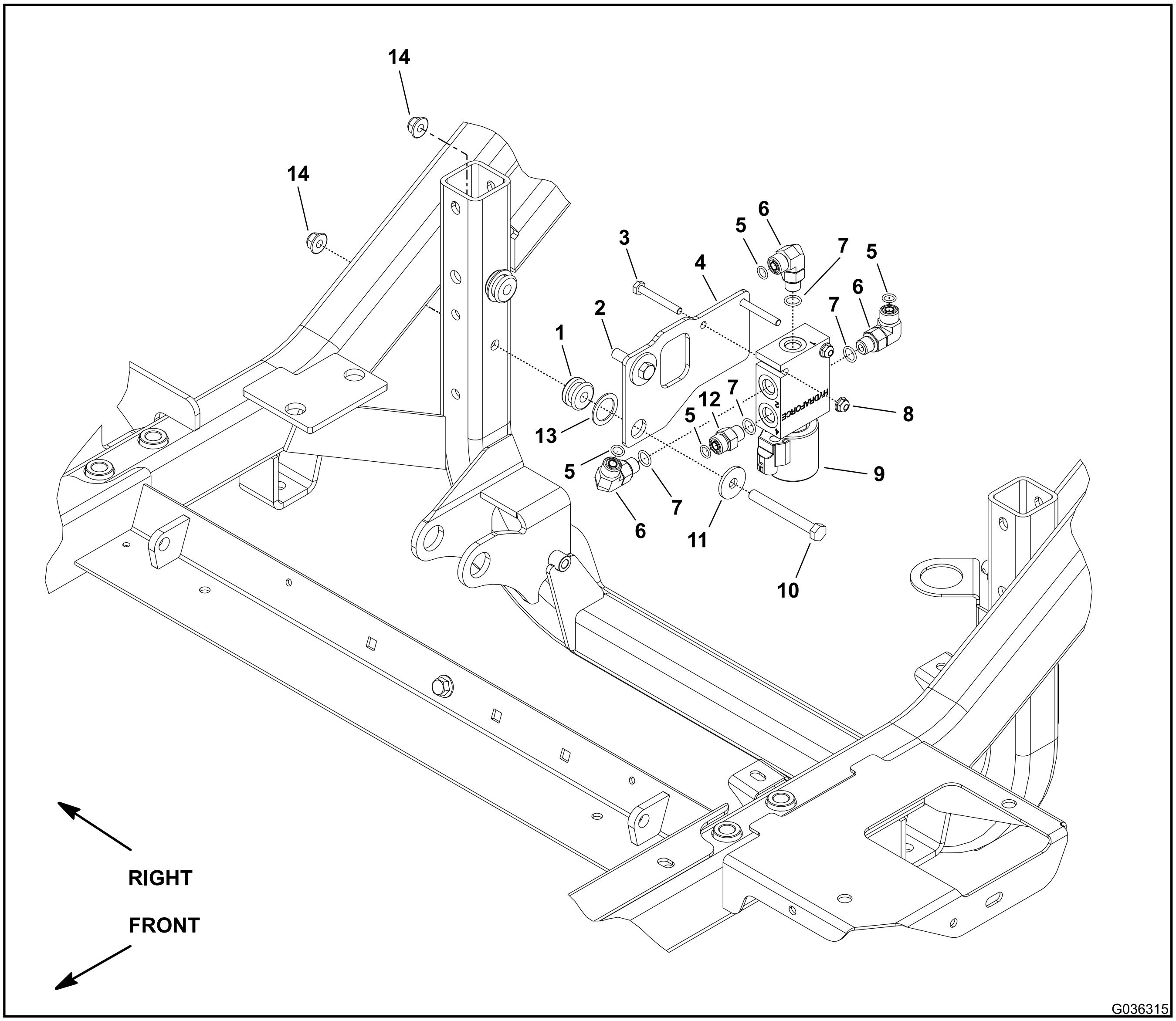


Figure 149

1.	Mount (2 each)	6.	90° hydraulic fitting (3 each)	11.	Washer (2 each)
2.	Screw	7.	O-ring (4 each)	12.	Straight hydraulic fitting
3.	Screw (2 each)	8.	Flange nut (2 each)	13.	Washer (2 each)
4.	Manifold mount plate	9.	Steering selector manifold	14.	Flange nut (2 each)
5.	O-ring (4 each)	10.	Screw		

The steering selector manifold assembly used on the Groundsmaster 360 machines with 4-wheel drive prevents steering of the rear wheels when the operator presses the steering selector switch to the 2 wheel steering position (the switch light is illuminated).

Removing the Steering Selector Manifold 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.

⚠ 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 4–5).

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2. Read the General Precautions for Removing and Installing the Hydraulic System Components (page 4–68).
3. Raise and support the operator seat. Locate the steering selector manifold assembly.
4. Clean the hydraulic hose ends before you disconnect the hoses from the steering selector manifold assembly.
5. For assembly purposes, label all the hydraulic hoses and tubes that are connected to the fittings on the steering selector manifold.
6. Disconnect the hydraulic hoses from the steering selector manifold assembly.
7. Install clean caps or plugs on the disconnected hoses and fittings to prevent contamination.
8. Disconnect the wire harness connector from the solenoid coil on the steering selector manifold assembly.
9. Support the steering selector manifold assembly to prevent it from falling.
10. Remove the 2 screws (item 3 in Figure 149) and 2 flange nuts that secure the steering selector manifold assembly to the mount plate. Remove the steering selector manifold assembly from the machine.
11. If the hydraulic fittings are to be removed from the steering selector manifold assembly, mark the fitting orientation for assembly purposes. Remove the fittings from the steering selector manifold assembly as necessary and discard the O-rings from the fittings.

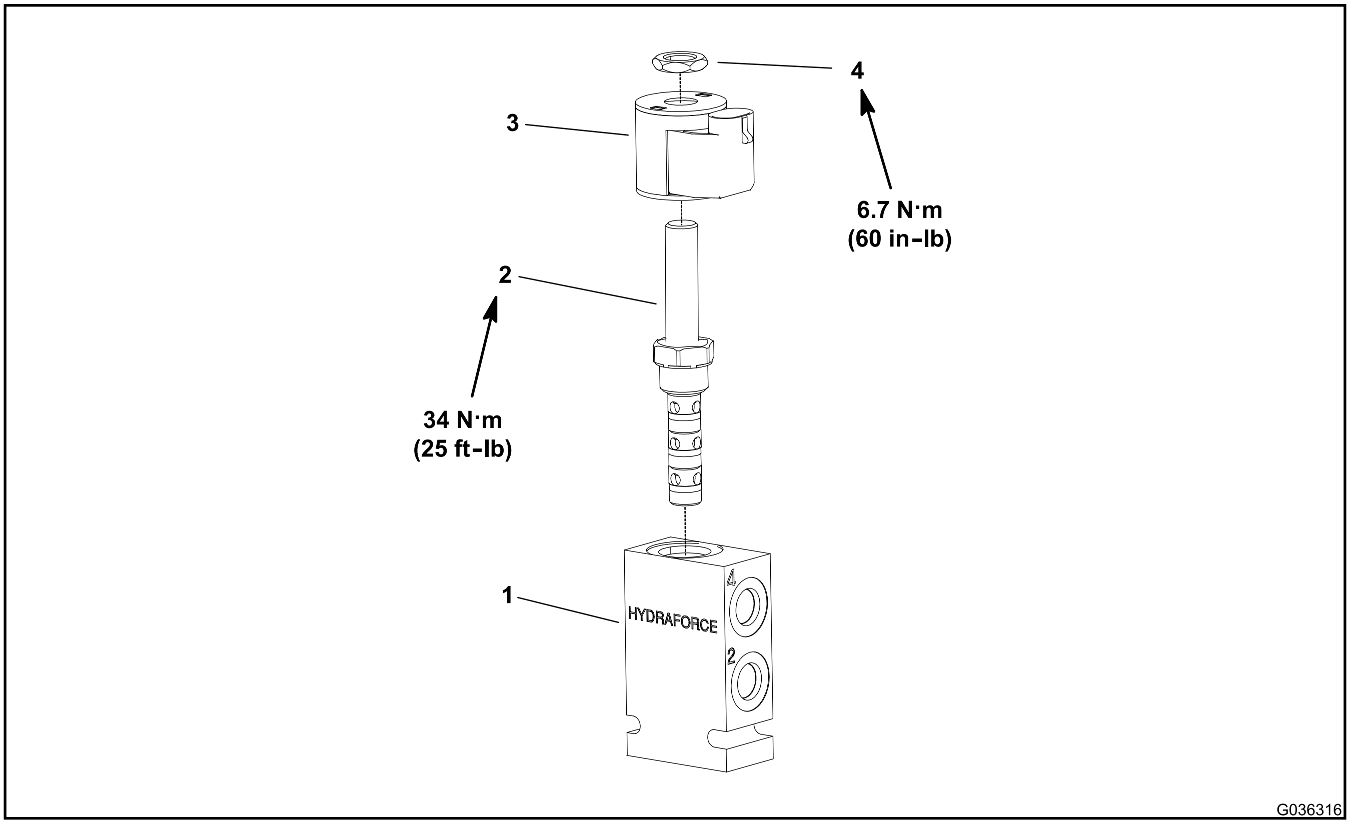
Installing the Steering Selector Manifold Assembly

1. If the hydraulic fittings were removed from the steering selector manifold assembly, lubricate new O-rings with clean hydraulic fluid, position O-rings to the fittings, and install the fittings into the manifold ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fitting into the Component Port) (page 4–9).
2. Position the steering selector manifold assembly to the machine.
3. Secure the steering selector manifold assembly to the machine with 2 screws (item 3 in Figure 149) and 2 flange nuts.
4. Remove the caps and plugs from the hydraulic hoses and fittings.
5. Lubricate and install new O-rings on the steering selector manifold assembly fittings. Using the labels that you attached during manifold removal, correctly connect the hydraulic hoses to the steering selector manifold assembly; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–8).
6. Connect the wire harness connector to the solenoid coil on the steering selector manifold assembly.

Installing the Steering Selector Manifold Assembly (continued)

7. Check the hydraulic-fluid level in the hydraulic reservoir and add correct quantity of fluid if necessary; refer to the *Operator’s Manual*.
8. Lower and secure the operator seat.

Servicing the Steering Selector Manifold Assembly



g036316

Figure 150

1. Manifold block	3. Solenoid coil
2. Solenoid valve	4. Nut

Note: The ports on the steering selector manifold assembly are marked for easy identification of the components. Refer to the Hydraulic Schematic in Appendix A (page A–1)—Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each manifold port.

Servicing the Steering Selector Manifold Assembly Cartridge Valve

WARNING

Before opening the hydraulic system, operate all the hydraulic controls to release all the pressure in the system and avoid injury from pressurized hydraulic fluid; refer to Releasing Pressure from the Hydraulic System (page 4–5).

For the cartridge valve service procedures, refer to Servicing the Cartridge Valves in a Control Manifold (page 4–134) . Refer to Figure 150 for steering selector manifold assembly cartridge valve and solenoid nut installation torque.

Deck Lift Manifold Assembly

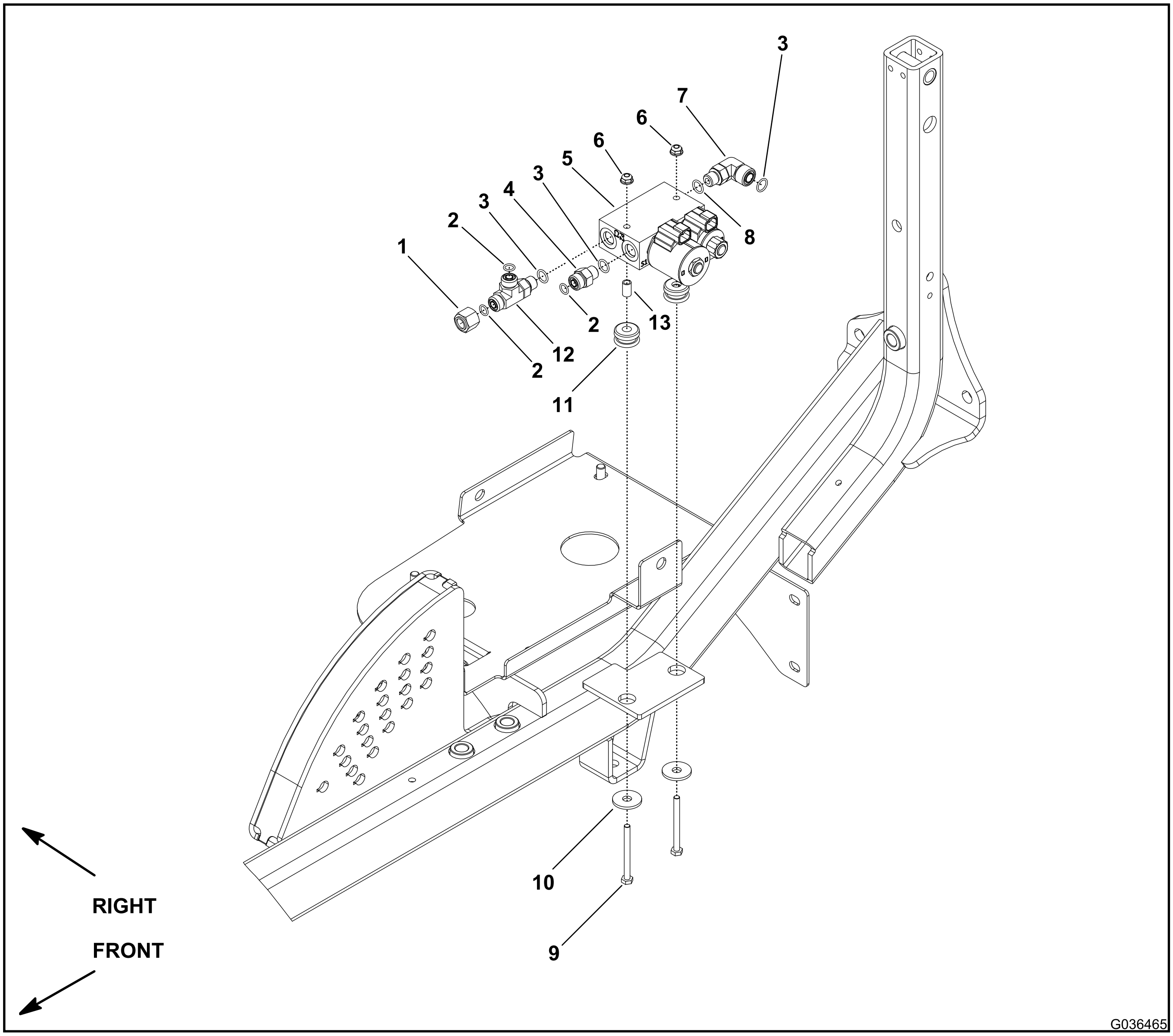


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Figure 151

1. Cap
2. O-ring (3 each)
3. O-ring (3 each)
4. Straight hydraulic fitting
5. Deck lift manifold assembly
6. Flange nut (2 each)
7. 90° hydraulic fitting
8. O-ring
9. Screw (2 each)
10. Washer (2 each)
11. Mount (2 each)
12. Tee fitting
13. Tubular spacer (2 each)

Removing the Deck Lift Manifold 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 4–5).

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. Raise and support the operator seat to get access to the deck lift manifold assembly.

⚠ WARNING ⚠

Ensure that the cutting deck is fully lowered and supported before loosening the hydraulic lines, cartridge valves, or plugs from the deck lift manifold assembly.

If the deck is raised as the deck lift manifold components are loosened, the deck may drop unexpectedly.

3. Ensure that the cutting deck is supported by the HOC pin and not by the lift cylinder so that the deck will remain in position during the deck lift manifold removal. If necessary, support the deck with solid blocks to prevent it from moving.
4. Clean the hydraulic hose and tube ends and fittings on the deck lift manifold assembly to prevent hydraulic system contamination.
5. For assembly purposes, label all the hydraulic and electrical connections.
6. Disconnect the hydraulic lines connected to the hydraulic fittings on the deck lift manifold. Allow the lines to drain into a suitable container.
7. Install clean caps or plugs on the disconnected lines and fittings to prevent contamination.
8. Disconnect the wire harness connectors from the solenoid coils on the deck lift manifold.
9. Support the deck lift manifold to prevent it from falling.
10. Remove the 2 screws (item 9 in Figure 151), 2 washers, and 2 flange nuts that secure the deck lift manifold to the bracket, and remove the deck lift manifold from the machine.
11. If the hydraulic fittings are to be removed from the deck lift manifold, mark the fitting orientation for assembly purposes. Remove the fittings from the deck lift manifold as necessary and discard the O-rings from the fittings.

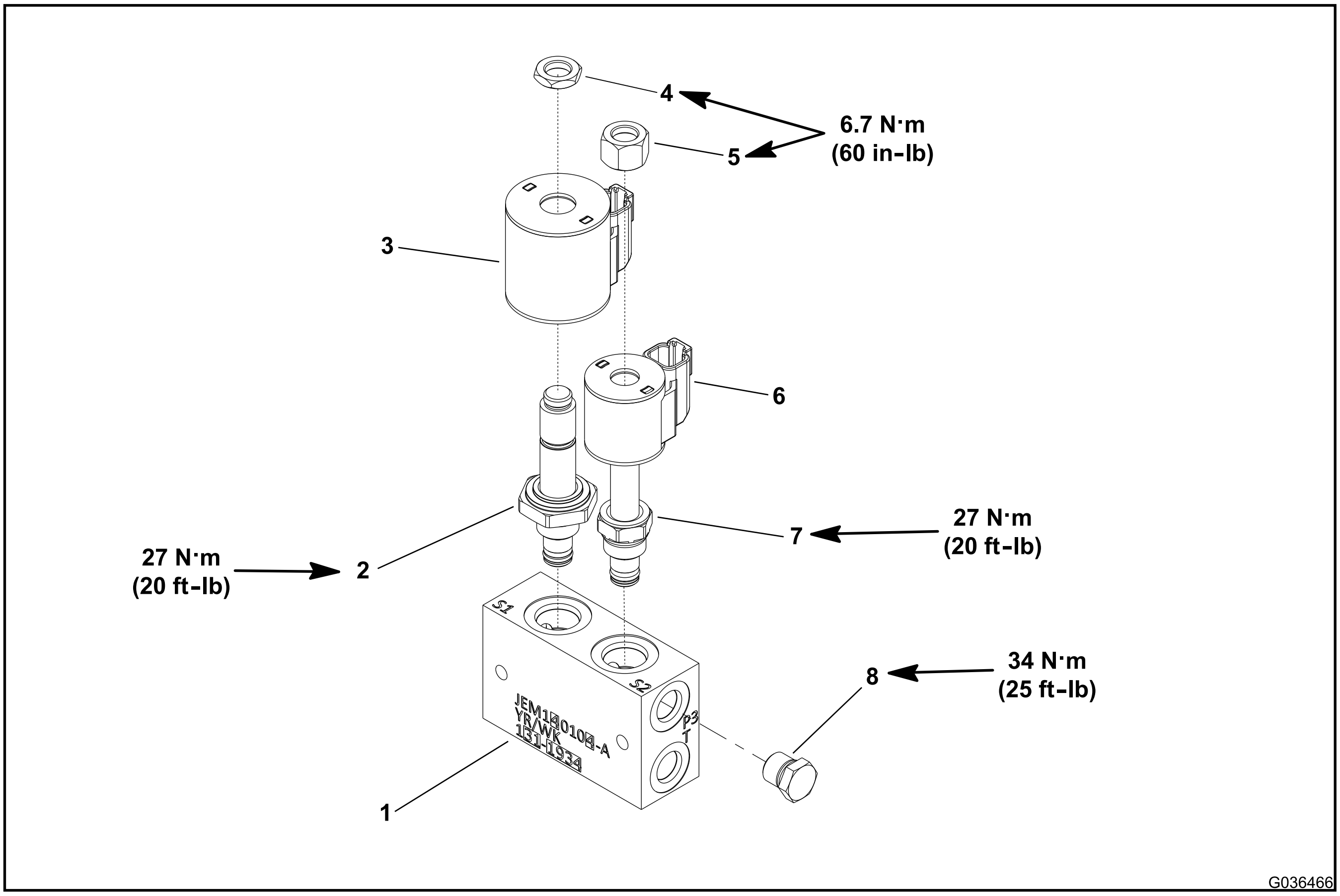
Installing the Deck Lift Manifold Assembly

1. If the hydraulic fittings were removed from the deck lift manifold, lubricate new O-rings with clean hydraulic fluid, position the O-rings to the fittings, and install the fittings into the manifold ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fitting into the Component Port) (page 4–9).
2. Position the deck lift manifold to the machine and secure the deck lift manifold with the 2 screws (item 9 in Figure 151), 2 washers, and 2 flange nuts.

Installing the Deck Lift Manifold Assembly (continued)

3. Remove the caps and plugs from the hydraulic lines and fittings.
4. Lubricate and install new O-rings on the hydraulic fittings. Use the labels that you attached during removal, correctly connect the hydraulic lines to the fittings; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–8).
5. Connect the wire harness connectors to the solenoid coils on the deck lift manifold.
6. Check the hydraulic-fluid level in the hydraulic reservoir and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
7. Lower and secure the operator seat.

Servicing the Deck Lift Manifold Assembly



g036466

Figure 152

1. Manifold block
2. Solenoid valve
3. Solenoid coil
4. Nut
5. Nut
6. Solenoid coil
7. Solenoid valve
8. Zero-leak plug

Note: The ports on the deck lift manifold are marked for easy identification of the components. Refer to the Hydraulic Schematic in Appendix A (page A–1)—Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each manifold port.

Servicing the Deck Lift Manifold Assembly

⚠ WARNING ⚠

Before opening the hydraulic system, operate all the hydraulic controls to release all the pressure in the system and avoid injury from pressurized hydraulic fluid; refer to Releasing Pressure from the Hydraulic System (page 4–5).

⚠ WARNING ⚠

If the deck lift manifold is attached to the machine, ensure that the cutting deck is fully lowered and supported before loosening the hydraulic lines, cartridge valves, or plugs from the deck lift manifold assembly.

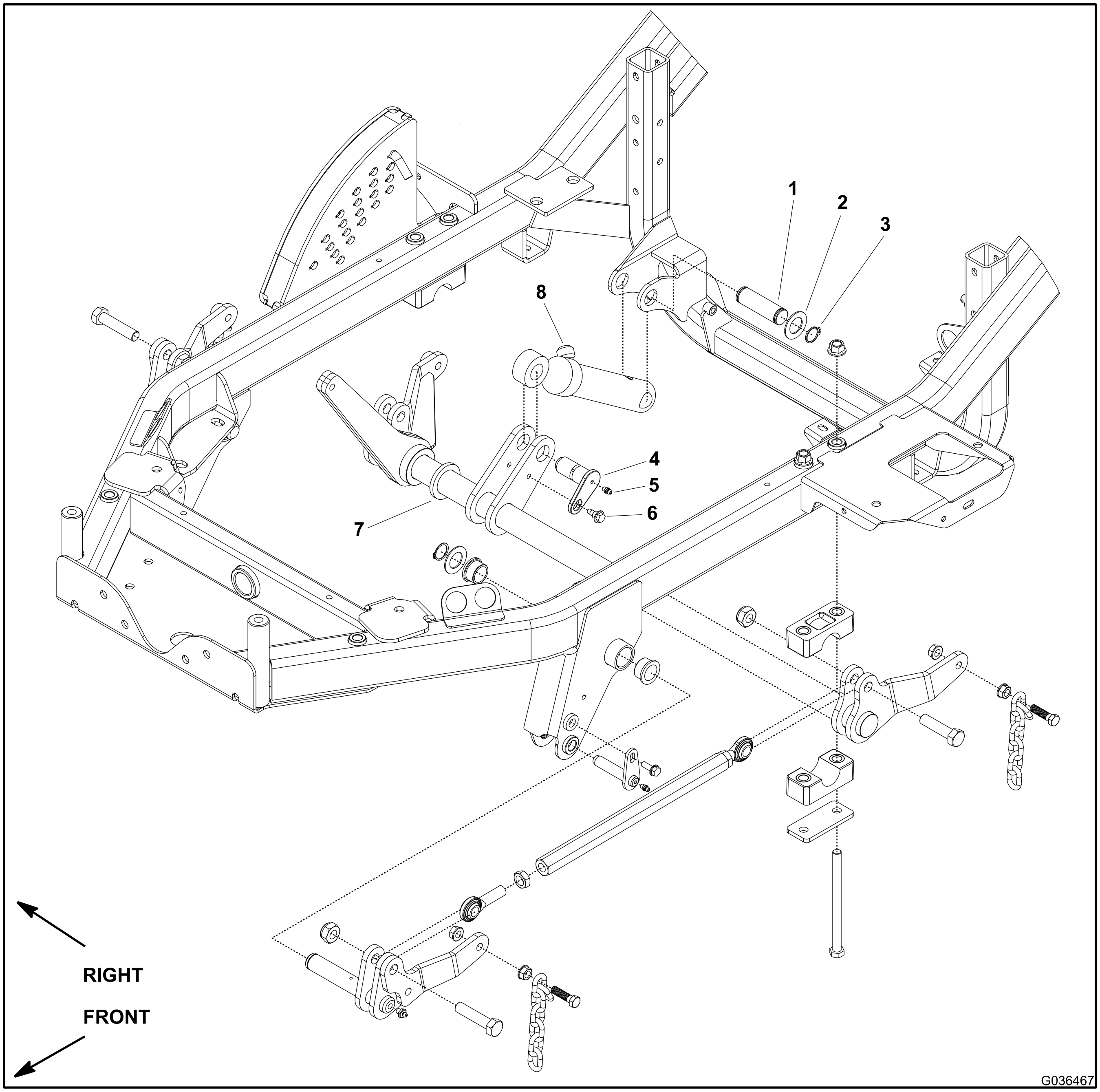
If the deck is raised as the deck lift manifold components are loosened, the deck may drop unexpectedly.

IMPORTANT

The 2 solenoid valves in the deck lift manifold are different. Label the valves before removal so that the valves can be correctly installed into the manifold.

For the cartridge valve service procedures, refer to Servicing the Cartridge Valves in a Control Manifold (page 4–134). Refer to Figure 152 for deck lift manifold assembly cartridge valve, solenoid nut, and plug installation torque.

Lift Cylinder



g036467

Figure 153

1. Cylinder shaft	4. Pivot pin	7. Lift shaft assembly
2. Washer (2 each)	5. Grease fitting	8. Lift cylinder
3. Retaining ring (2 each)	6. Shoulder bolt	

Removing 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 4–5).

---

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.

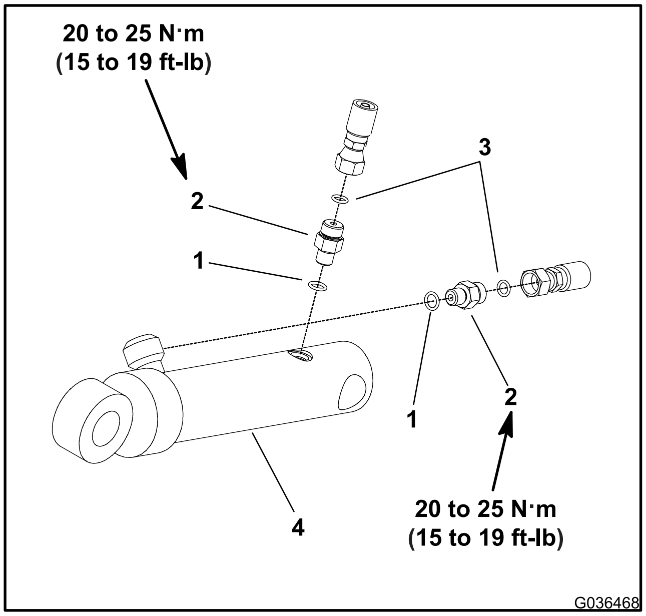
⚠ WARNING ⚠

Ensure that the cutting deck is fully lowered and supported before loosening the hydraulic lines from the lift cylinder.

If the deck is not supported as the hydraulic lines are loosened, the deck may drop unexpectedly.

---

2. Ensure that the cutting deck is supported by the HOC pin and not by the lift cylinder so that the deck will remain in position during the lift cylinder removal. If necessary, support the deck with solid blocks to prevent it from moving.



g036468

Figure 154

1. O-ring	3. O-ring
2. Straight hydraulic fitting (2 each)	4. Lift cylinder

---

3. Clean the hydraulic hose ends and fittings on the lift cylinder to prevent contaminants from entering into the hydraulic system.
4. For assembly purposes, label the hydraulic hoses and tubes that are connected to the fittings on the lift cylinder.
5. Disconnect the hydraulic hoses that are connected to the hydraulic fittings on the lift cylinder.

Removing the Lift Cylinder (continued)

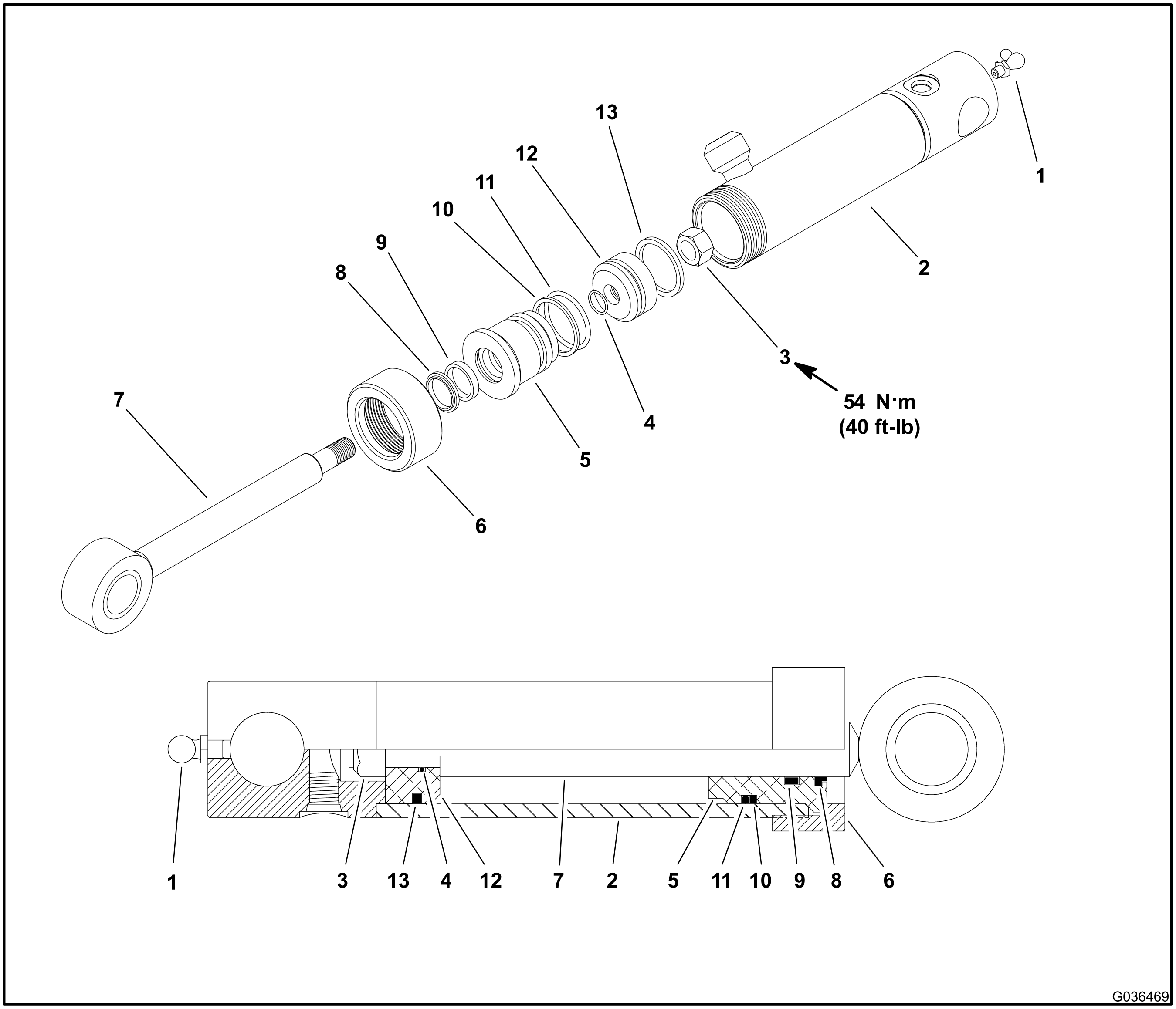
6. Install clean caps or plugs in the hose openings to prevent system contamination.
7. Remove the retaining ring (item 3 in Figure 153) and washer from one end of the cylinder shaft that secures the lift cylinder head to the machine frame.
8. Pull the shaft from the lift cylinder and frame. Locate and retrieve the second washer. Do not remove second retaining ring from the shaft.
9. Remove the shoulder bolt (item 6 in Figure 153) and pivot pin that secure the lift cylinder rod end to the lift shaft assembly.
10. Remove the lift cylinder from the machine.
11. If necessary, remove the hydraulic fittings from the lift cylinder (Figure 154).
12. Remove and discard the O-rings from the fittings.

Installing the Lift Cylinder

1. If the hydraulic fittings were removed from the lift cylinder, lubricate and install new O-rings to the fittings. Install the fittings into the lift cylinder ports and torque the fittings to **20 to 25 N·m (15 to 19 ft-lb)**.
2. Position the lift cylinder to the machine.

   Note: The cylinder head should be attached to the machine frame.
3. Secure the cylinder rod end to the lift shaft assembly with the pivot pin (item 4 in Figure 153) and shoulder bolt.
4. Align the lift cylinder to the frame mounting holes. Slide the cylinder shaft (item 1 in Figure 153) (with a washer and retaining ring installed on the one end) through the lift cylinder and frame. Install the second washer on the shaft and secure the shaft with the second retaining ring.
5. Remove the caps or plugs that were installed to the hydraulic hoses during the removal process.
6. Use the labels that you attached during the lift cylinder removal to correctly connect the hydraulic hoses to the lift cylinder fittings; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–8).
7. Lubricate the grease fittings on the lift cylinder and pivot pin.
8. Ensure that the hydraulic tank is full. Add correct quantity of fluid if necessary; refer to the *Operator's Manual*.

Servicing the Lift Cylinder



g036469

Figure 155

1.	Grease fitting	6.	Collar	11.	O-ring
2.	Cylinder head	7.	Shaft	12.	Piston
3.	Locknut	8.	Dust seal	13.	Piston seal
4.	O-ring	9.	Rod seal		
5.	Head	10.	Back-up ring		

Disassembling the Lift Cylinder

1. Slowly pump the cylinder shaft to remove the hydraulic fluid from the lift cylinder into a drain pan. Plug both the ports and clean the outer surface of the cylinder.

IMPORTANT

When you clamp the hydraulic cylinder in a vise, clamp the clevis only to prevent damage.

2. Mount the lift cylinder in a vise. Use a vise equipped with soft jaws.
3. Carefully remove the collar with a pipe wrench.
4. Remove the plugs from the ports. Carefully twist and pull the shaft and remove the shaft with head and piston.

IMPORTANT

Clamping the vise jaws against the shaft surface could damage the shaft. When securing the shaft in a vise, clamp the shaft clevis only.

5. Mount the shaft in a vise by clamping on the clevis of the shaft. Remove the locknut and piston from the shaft. Slide the head off the shaft.
6. Remove the piston seal and O-ring from the piston, and remove the O-ring, back-up ring, rod seal, and dust seal from the head.

Assembling the Lift Cylinder

1. Ensure that all the parts are clean before assembly.
2. Put a coating of clean hydraulic fluid on new O-rings, piston seal, rod seal, back-up ring, and dust seal, and do the following steps:
   A. Install the piston seal and O-ring to the piston.
   B. Install the rod seal, back-up ring, O-ring, and dust seal to the head.

IMPORTANT

Clamping the vise jaws against the shaft surface could damage the shaft. When securing the shaft in a vise, clamp the shaft clevis only.

3. Mount the shaft in a vise by clamping on the clevis of the shaft, and do the following steps:
   A. Put a coating of clean hydraulic fluid on the shaft.
   B. Ensure that the collar is positioned on the shaft.
   C. Slide the head onto the shaft.

      Note: Ensure that you do not damage the seals.

   D. Install the piston onto the shaft and secure the piston with the locknut. Torque the locknut to **54 N·m (40 ft-lb)**.
   E. Remove the shaft from the vise.

IMPORTANT

When you clamp the cylinder head of the cylinder in a vise, clamp the clevis end of the cylinder head only to prevent damage.

4. Mount the cylinder head in a vise. Use a vise equipped with soft jaws.
5. Put a light coating of clean hydraulic fluid on all internal parts. Carefully slide the piston, shaft, and head assembly into the cylinder head.

   Note: Do not damage the seals during assembly.
6. Use a pipe wrench to install the collar onto the cylinder head.

Quick Attach System (QAS) Control Manifolds (Optional Kit)

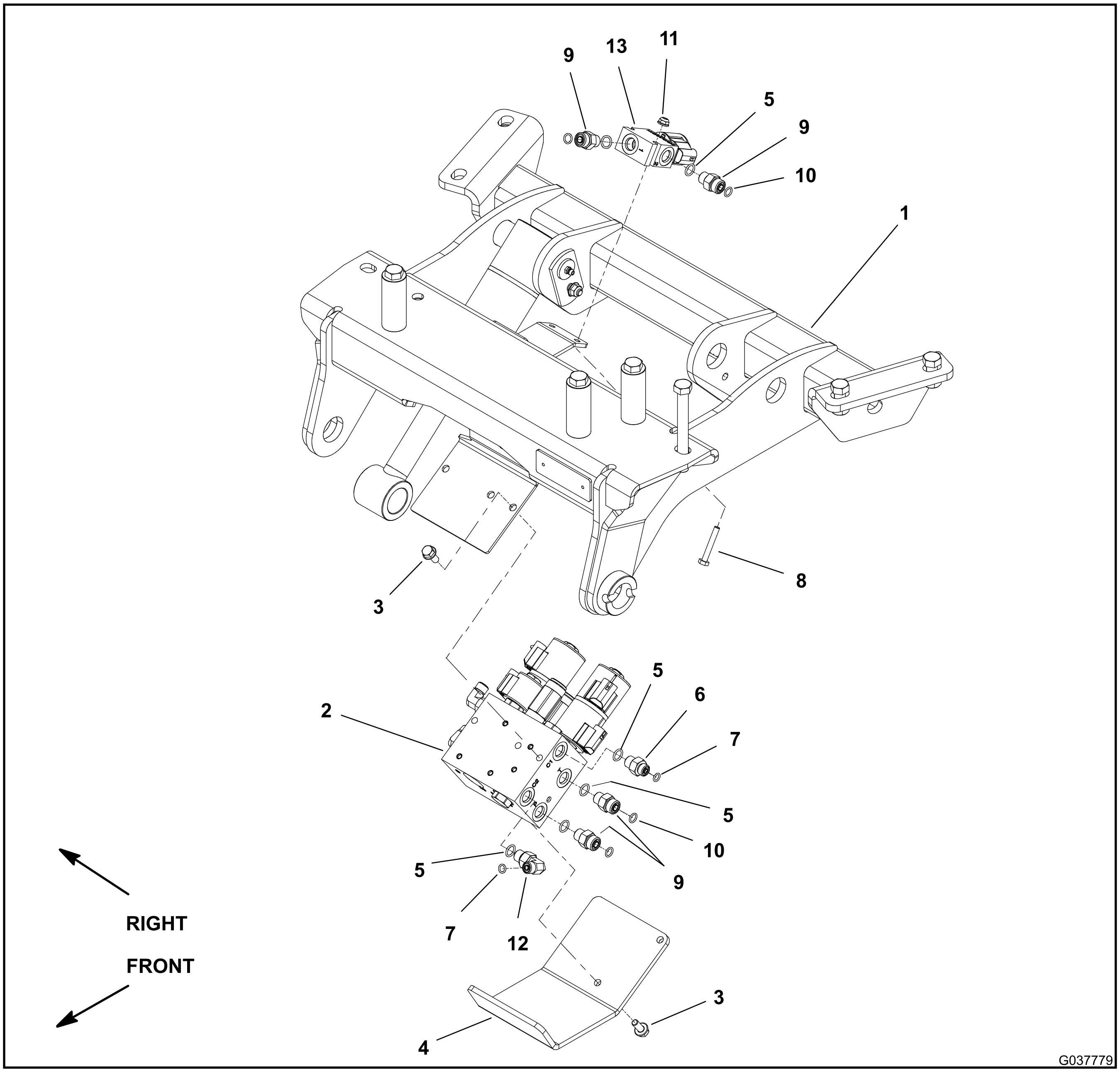


Figure 156

1.	QAS frame assembly	6.	Straight fitting	11.	Flange nut (2 each)
2.	Angle control manifold	7.	O-ring	12.	90° hydraulic fitting
3.	Flange-head screw (5 each)	8.	Bolt (2 each)	13.	Poppet valve control manifold
4.	Guard plate	9.	Straight hydraulic fitting		
5.	O-ring	10.	O-ring		

Removing the Manifold

1. Remove the attachment from the QAS frame.
2. Park the machine on a level surface and ensure that the QAS frame is fully lowered. Shut off the engine, set the parking brake, and remove the key from the key switch.

⚠ WARNING ⚠

Ensure that the QAS frame is fully lowered and supported before loosening the hydraulic lines from the QAS hydraulic manifold.

If the frame is not supported as the hydraulic lines are loosened, the QAS frame may drop unexpectedly.

3. Ensure that the QAS frame is not supported by the QAS lift cylinders so that the frame will remain in position during control manifold service. If necessary, support the QAS frame with solid blocks to prevent it from moving.

⚠ 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 4–5).

4. Read the General Precautions for Removing and Installing the Hydraulic System Components (page 4–68).

   Note: The QAS frame assembly can be removed from the machine to get easier access to the QAS control manifolds. Reverse the QAS installation procedure to remove the QAS frame assembly from the machine; refer to QAS Installation Instructions.
5. Locate the QAS control manifold that you need to service.
6. Clean the hydraulic hose and tube ends before disconnecting the hydraulic lines from the control manifold.
7. For assembly purposes, label all of the hydraulic and electrical connections.
8. Disconnect the hydraulic lines from the control manifold.
9. Install clean caps or plugs on the disconnected hydraulic lines and fittings to prevent contamination.
10. Disconnect the wire harness connector(s) from the solenoid coil(s) on the manifold.
11. Support the manifold to prevent it from falling.
12. Remove the fasteners that secure the manifold to the QAS frame (Figure 156), and remove the manifold from the machine.
13. If the hydraulic fittings are to be removed from the control manifold, mark the fitting orientation for assembly purposes. Remove the fittings from manifold and discard the O-rings from the fittings.

Installing the Manifold

1. If the hydraulic fittings were removed from the control manifold, lubricate the new O-rings with clean hydraulic fluid, position the O-rings to the fittings, and install the fittings into the manifold ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fitting into the Component Port) (page 4–9).
2. Position the control manifold to the machine and secure the control manifold to the QAS frame with the removed fasteners.

Installing the Manifold (continued)

3. Remove the caps and plugs from the hydraulic lines and fittings.
4. Lubricate and install new O-rings on the control manifold fittings.
5. Use the labels that you attached during the manifold removal to correctly connect the hydraulic hoses and tubes to the control manifold; refer to Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting) (page 4–8).
6. Connect the wire harness connector(s) to the solenoid coil(s) on the manifold.
7. Check the hydraulic-fluid level in the hydraulic reservoir and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.

Servicing the Quick Attach System (QAS) Control Manifolds (Optional Kit)

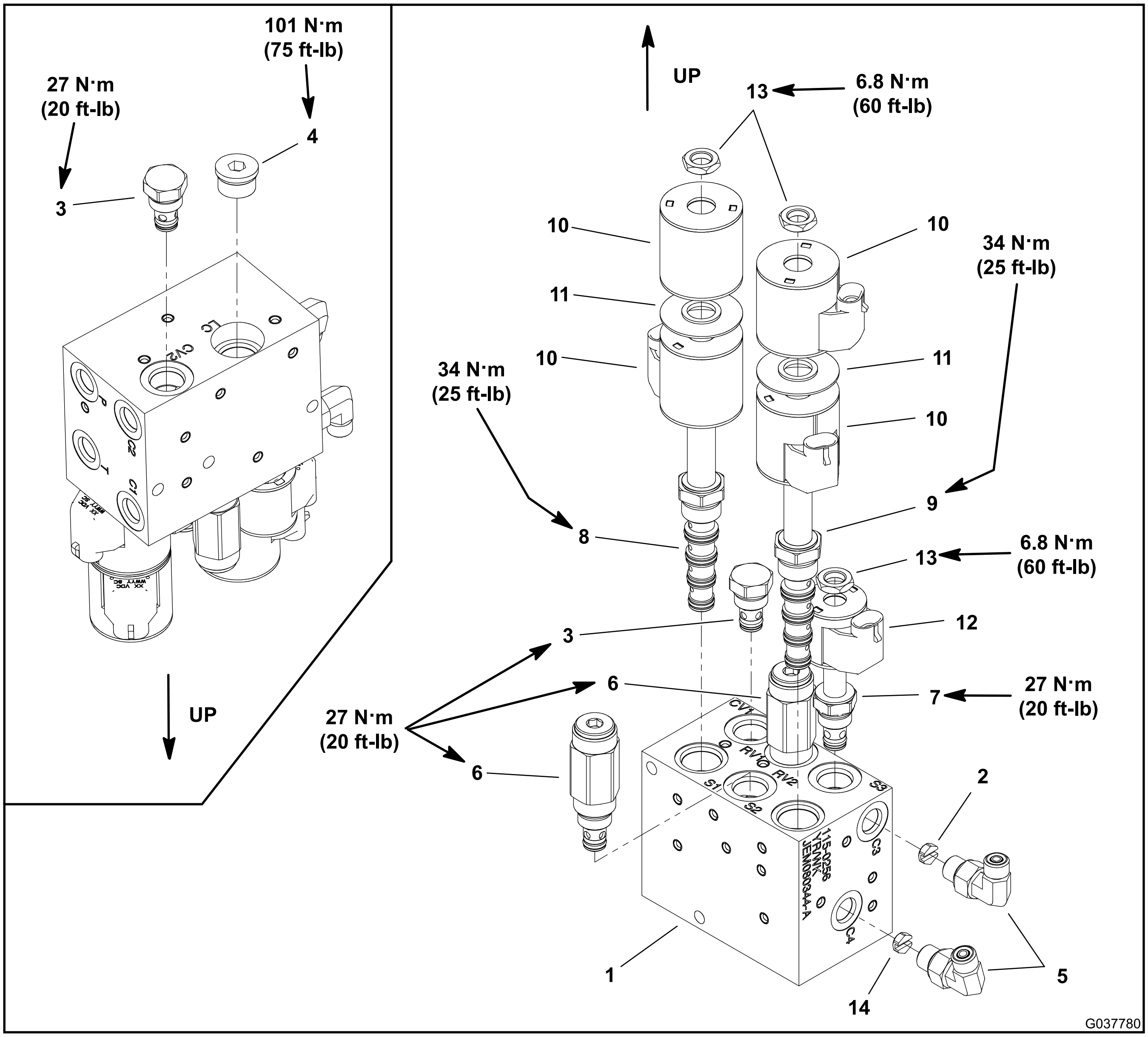


Figure 157

1. QAS angle control manifold
2. Orifice (0.080) (port C3)
3. Check valve (ports CV1 and CV2)
4. Plug
5. 90° hydraulic fitting (2 used)
6. Relief valve (ports RV1 and RV2)
7. Solenoid valve (port S3)
8. Solenoid valve (port S1)
9. Solenoid valve (port S2)
10. Solenoid coil
11. Coil spacer
12. Solenoid coil
13. Nut
14. Orifice (0.046) (port C4)

Note: The ports on the QAS control and poppet valve manifolds are marked for easy identification of the components. Refer to the Hydraulic Schematic in Appendix A (page A–1)—Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each of the manifold ports.

Servicing the QAS Control Manifold Cartridge Valve

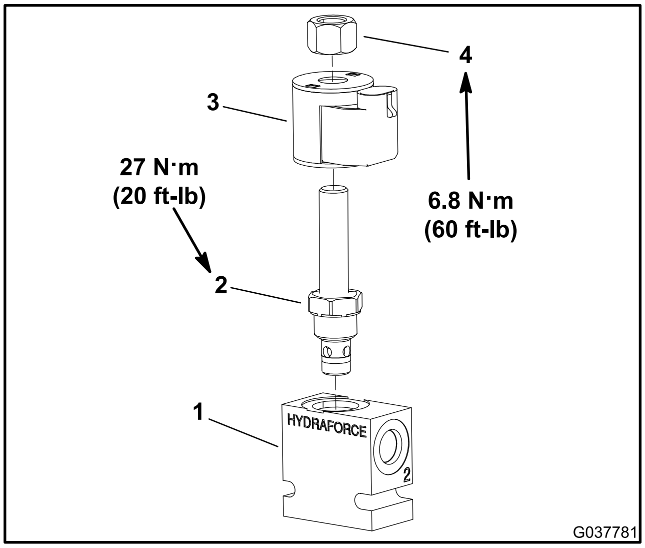
⚠ WARNING ⚠

If the control manifold is attached to the machine, ensure that the attachment and QAS frame are fully lowered and supported before loosening the hydraulic lines, cartridge valves, or plugs from the control manifold.

If the attachment and frame are not supported as the manifold components are loosened, the attachment and QAS frame may drop unexpectedly.

⚠ 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 4–5)

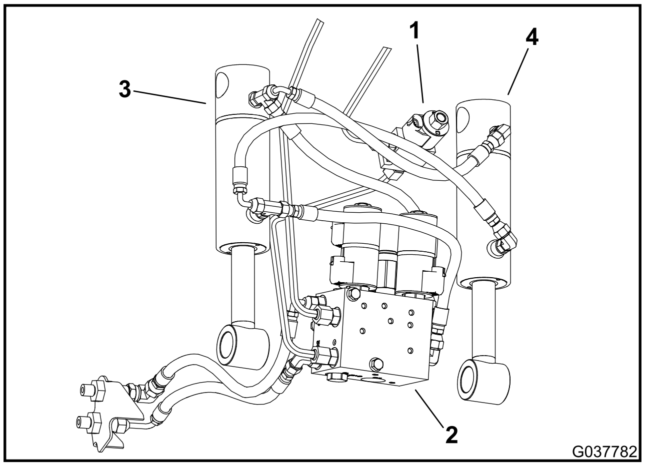


g037781

Figure 158

1. Poppet valve manifold
2. Solenoid valve
3. Solenoid coil
4. Nut

Servicing the QAS Control Manifold Cartridge Valve (continued)



g037782

Figure 159

1. Poppet valve manifold	3. Left QAS lift cylinder
2. Angle manifold	4. Right QAS lift cylinder

IMPORTANT

The solenoid cartridge valves in the QAS angle control manifold (Figure 157) are different. Label the valves before removal so that the valves can be correctly installed into the manifold.

IMPORTANT

An orifice is placed in the C3 and C4 ports of the QAS angle control manifold (Figure 157). If an orifice is removed from this manifold, ensure to label its position for assembly purposes. When installing the orifice in the manifold port, ensure that the orifice is flat in the base of the manifold port. Letting the orifice stay cocked in the cavity can damage the manifold.

For the cartridge valve service procedures; refer to Servicing the Cartridge Valves in a Control Manifold (page 4–134). Refer to Figure 157 for the QAS angle control manifold cartridge valve, check valve solenoid nut and plug installation torque. Refer to Figure 158 for the QAS poppet valve control manifold cartridge valve and solenoid coil nut installation torque.

Oil Cooler

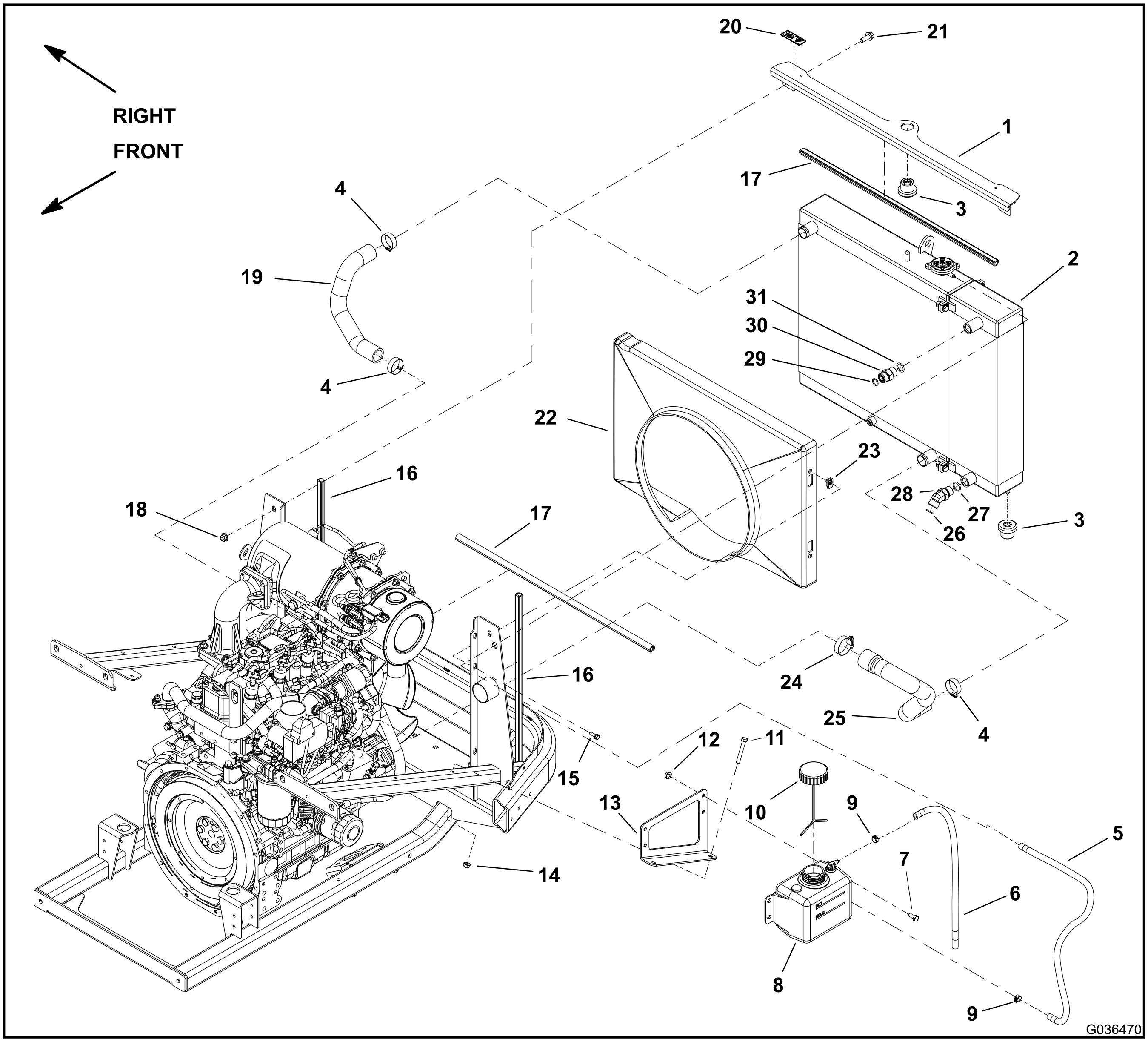


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Figure 160

1. Radiator support
2. Radiator and oil cooler assembly
3. Isolator mount (3 each)
4. Hose clamp (3 each)
5. Coolant hose
6. Coolant hose
7. Screw (4 each)
8. Coolant reservoir assembly
9. Hose clamp (2 each)
10. Reservoir cap
11. Screw (2 each)
12. Flange nut (4 each)
13. Overflow bracket
14. Flange nut (2 each)
15. Washer-head screw (4 each)
16. Bulb seal (2 each)
17. Bulb seal (2 each)
18. Flange nut (2 each)
19. Upper radiator hose
20. Fan warning decal
21. Flange-head screw (2 each)
22. Fan shroud
23. Clip (4 each)
24. Clamp
25. Lower radiator hose
26. O-ring
27. O-ring
28. 45° hydraulic fitting
29. O-ring
30. Straight hydraulic fitting
31. O-ring

Removing the Oil Cooler

The radiator and oil cooler must be removed from the machine as an assembly; refer to Removing the Radiator (page 3–13).

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.

⚠ CAUTION ⚠

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

2. Use compressed air in the opposite direction of the fluid flow and dry the interiors of the oil cooler.
3. Install 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.
4. Inspect the bulb seals on the radiator and oil cooler assembly and replace the bulb seals if damaged or hardened.

Installing the Oil Cooler

The radiator and oil cooler must be installed into the machine as an assembly; refer to Installing the Radiator (page 3–15).

Chapter 5

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 Diagrams

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

Toro Electronic Controller (TEC)

The Groundsmaster 360 machines use a Toro Electronic Controller (TEC) to manage the machine electrical functions. The controller uses microprocessor controlled that senses the condition of various switches (inputs) and directs electrical power to control the appropriate machine functions (outputs) based on the inputs. The status of inputs to the controller as well as outputs from the controller can be monitored with the InfoCenter display.

The TEC is attached to the machine under the power center cover behind the operator seat.

Note: Optional kits for the Groundsmaster 360 are available that may require the use of an additional TEC. Even though the additional controller appears identical to the standard controller, they are different in terms of the connectors and internal hardware. The 2 controllers cannot be interchanged.

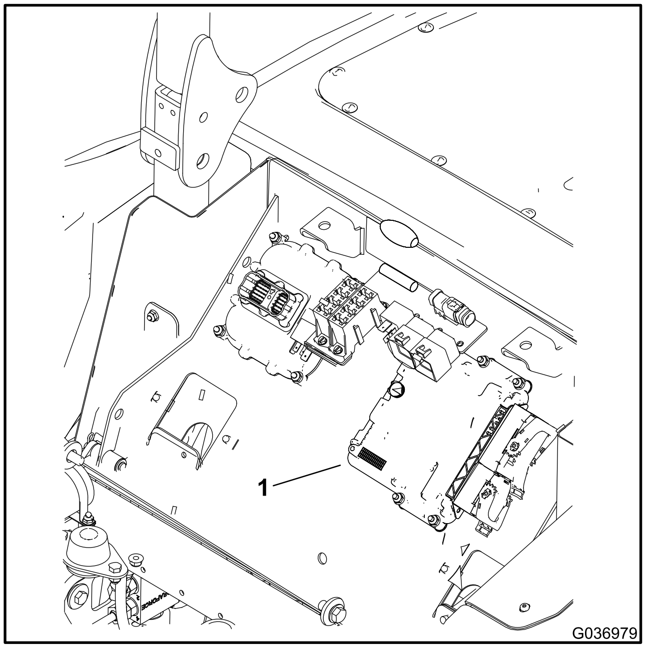
IMPORTANT

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

- Disconnect the battery cables from the battery.
- Disconnect the wire harness connectors from the Toro Electronic Controller.
- Disconnect the wire harness connectors from the engine ECU.
- Disconnect the terminal connector from the alternator.

If the wire harness connector is removed from the TEC controller for any reason, tighten the harness connector screw from **2.8 to 3.2 N·m (25 to 28 in-lb)**.

Yanmar Engine Electronic Control Unit (ECU)



g036979

Figure 161

1. Engine Electronic Control Unit (ECU)

The Groundsmaster 360 machines use an electronic control unit (ECU) for engine management and to communicate with the TEC and InfoCenter display on the machine. If you must disconnect the engine ECU for any reason, ensure that the key switch is in the OFF position with the key removed for a minimum of 30 seconds before disconnecting the engine ECU.

Yanmar Engine Electrical Components

When servicing or troubleshooting the engine electrical components use the Yanmar Engine Service Manual and Troubleshooting Manual. Contact your Toro distributor for additional engine troubleshooting assistance.

CAN-bus Communications

The TEC, Yanmar engine ECU, and InfoCenter display used on the Groundsmaster 360 machines communicate with each other on a CAN-bus system. This system allows the traction unit to fully integrate all the different electrical components of the machine and bring them together as one. The CAN-bus system reduces the number of electrical components and connections that are used on the machine and allows the number of wires in the wire harness to be significantly reduced. The integration of the electrical functions also allows the InfoCenter display to assist with the electrical system diagnostics.

The CAN identifies the controller area network that is used on the machine. The 2 specially designed, twisted cables form the bus. These wires provide the data pathways between the TEC, Yanmar engine ECU, and InfoCenter display used on the machine. The engineering term for these cables are the CAN High and CAN Low. At the ends of the twisted pair of bus cables are the 120-ohm terminator resistors.

The CAN-bus link controls each of the components that requires only 4 wires to operate and communicate to the system: CAN High, CAN Low, B+ (power), and ground.

CAN-bus Communications (continued)

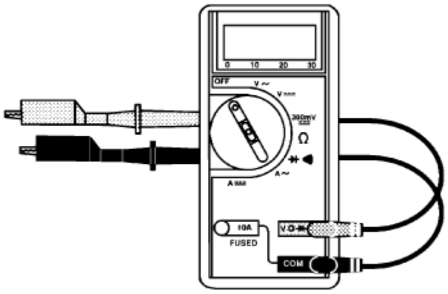
IMPORTANT

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

Special Tools

You can order these special tools from your Authorized Toro Distributor. Some tools are also available from a local supplier.

Multimeter



g033636

Figure 162

The meter can test the electrical components and circuits for current, resistance, or voltage. You can get the digital multimeter locally.

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.

Terminal Protector

g033638

Figure 163

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

g033640

Figure 164

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

Dielectric Gel

g033639

Figure 165

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 connectors as the gel can unseat the connector seals during assembly.

InfoCenter Display

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

The power for the InfoCenter is available when the main power relay is energized (key switch in the RUN or START position). A CAN-bus system involving the machine TEC, Yanmar engine ECU, and InfoCenter display provides necessary machine communication for the InfoCenter operation.

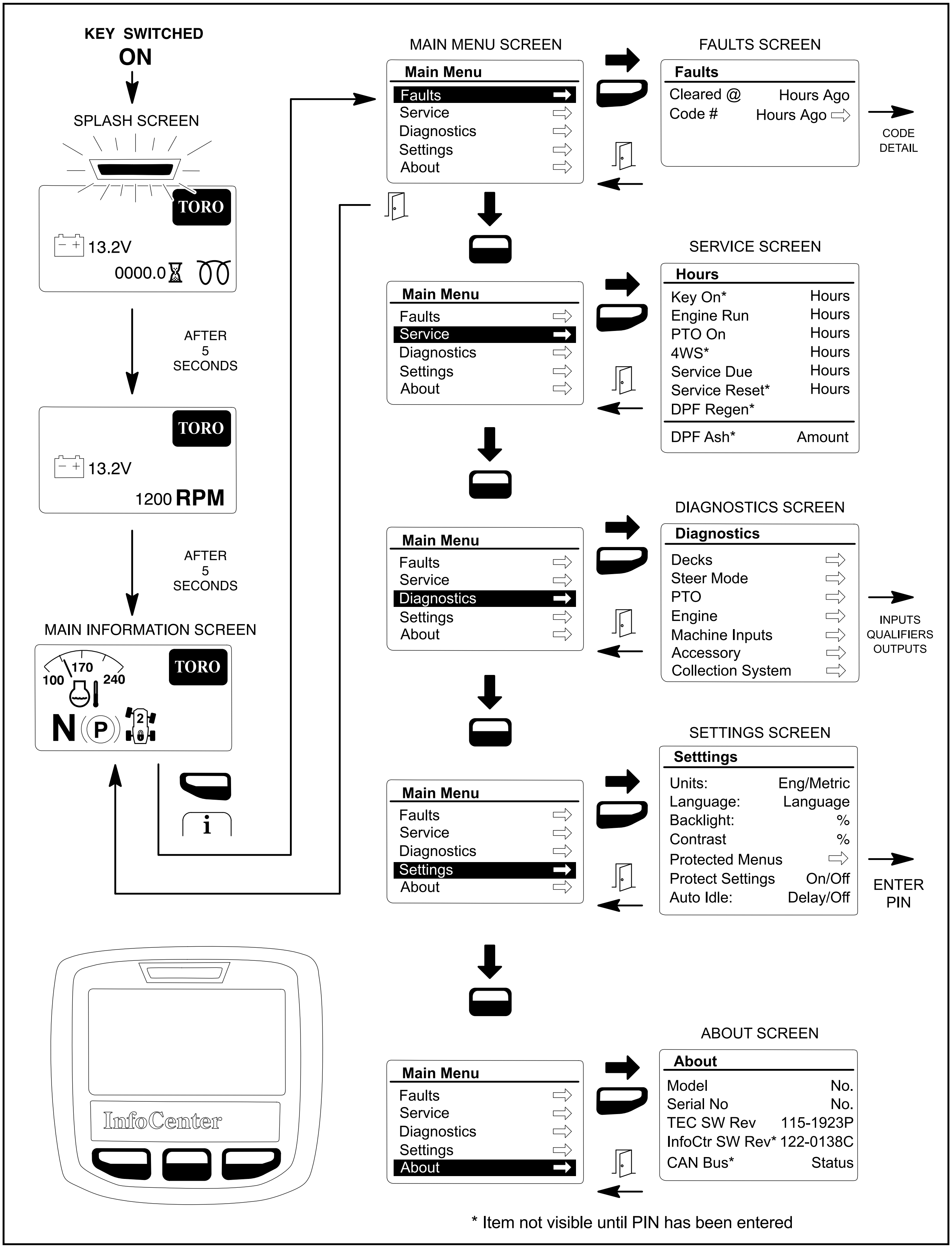


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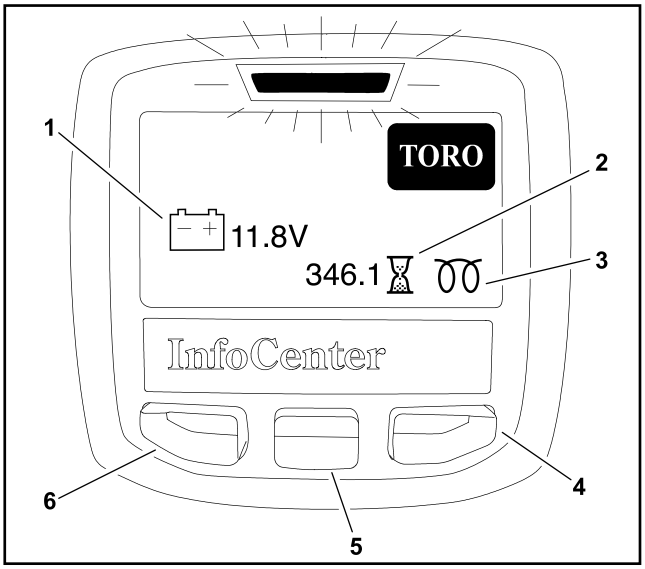
Figure 166

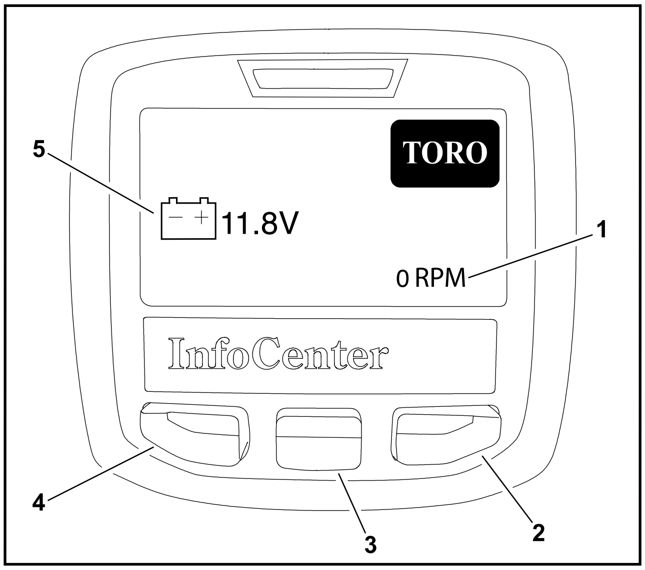
Splash Screen



g187155

Figure 167

1. Battery voltage	4. Left/right button
2. Hour meter	5. Down button
3. Glow plug indicator	6. Menu/back button



g187146

Figure 168

1. Engine RPM	4. Menu/back button
2. Left/right button	5. Battery voltage
3. Down button	

When the key switch is initially turned to the RUN or START position, the fault indicator illuminates for a few seconds to verify indicator operation and the InfoCenter splash screen appears (Figure 167 and Figure 168). The splash screen provides the following information to the operator:

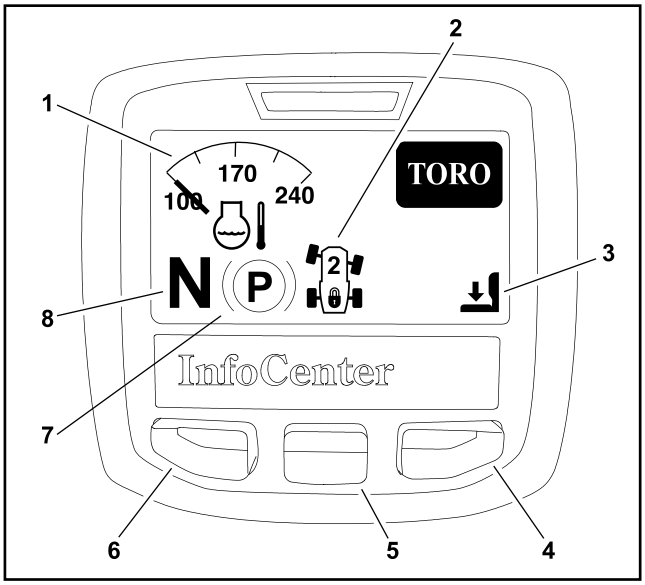
- Battery voltage
- Hour meter (displayed for first 5 seconds)

Splash Screen (continued)

- Glow plug indicator (displayed only while glow plugs are energized)
- Engine RPM (displayed after 5 seconds)

After the splash screen has been displayed for 10 seconds, the main information screen will appear on the InfoCenter.

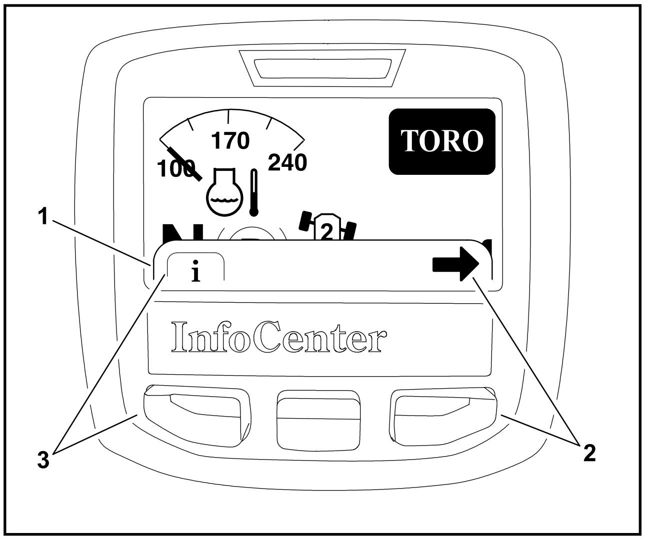
Main Information Screen



g187147

Figure 169

1. Engine coolant temperature	5. Down button
2. 2-wheel steer	6. Menu/back button
3. Operator seat (unoccupied)	7. Parking brake (engaged)
4. Left/right button	8. Traction system (neutral)



g187145

Figure 170

1. Navigation pane	3. Menu/back button
2. Left/right button	

The InfoCenter main information screen (Figure 169) is displayed after the initial splash screen has been displayed for 10 seconds. The main information screen is the default screen as it will be displayed during normal machine operation. The main information screen provides the following information to the operator:

- Engine coolant temperature
- Traction system

  Either the neutral, high (transport) speed range, or low (mow) speed range icon will appear at all times.

Main Information Screen (continued)

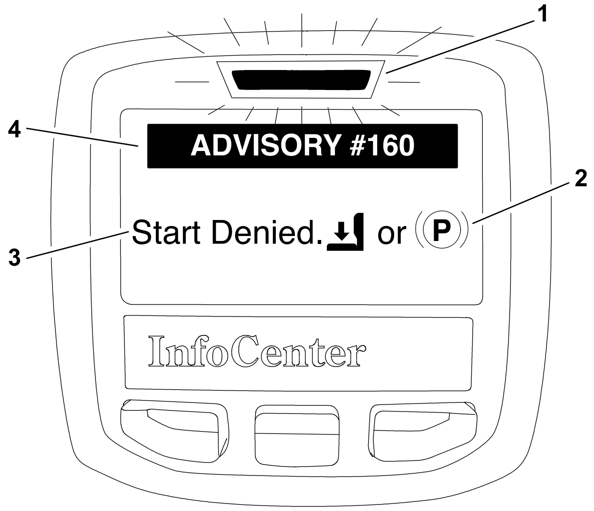
- Parking brake

  The icon appears when the parking brake is engaged.
- 2-wheel steer or 4-wheel steer
- Operator seat

  The icon appears when the operator is out of the seat and the seat must be occupied before machine operation can continue.

Press the menu/back button once to expose the navigation pane, then press the left/right button (as indicated by the ➡ in the navigation pane) to toggle between the main information screen and the splash screen (Figure 170). The navigation pane will close automatically if another button is not pressed within 6 seconds.

Operator Advisory Screen



g187150

Figure 171

1. Fault indicator	3. Advisory description
2. Advisory qualifier	4. Advisory number/code

If the Toro Electronic Controller (TEC) inputs are not in the correct position to allow certain machine operations, or are malfunctioning, the fault indicator will illuminate and an advisory screen will appear on the InfoCenter Display (Figure 171). Each advisory screen has 3 elements: the advisory number/code, advisory description, and advisory qualifier.

An advisory qualifier denotes the condition(s) that triggered the advisory and provides instruction on eliminating the advisory. An operator advisory may involve one or more advisory qualifier. Typically, an advisory can be eliminated by changing the position of the operator control(s) referenced by the advisory qualifier. Once the first qualifier displayed is satisfied, any additional qualifiers that remain to be satisfied will appear in the operator advisory screen individually.

Note: If a machine fault occurs during machine operation, the InfoCenter fault indicator will blink to notify the operator. Accessing the fault log is described in Faults Screen (page 5–17).

Main Menu Screen

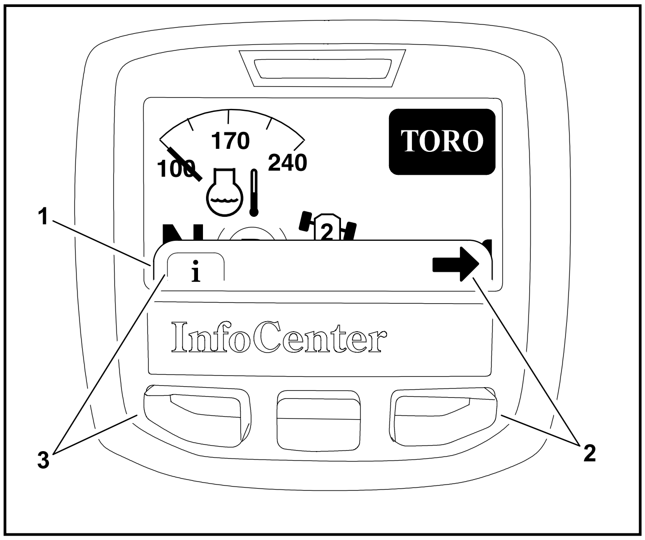


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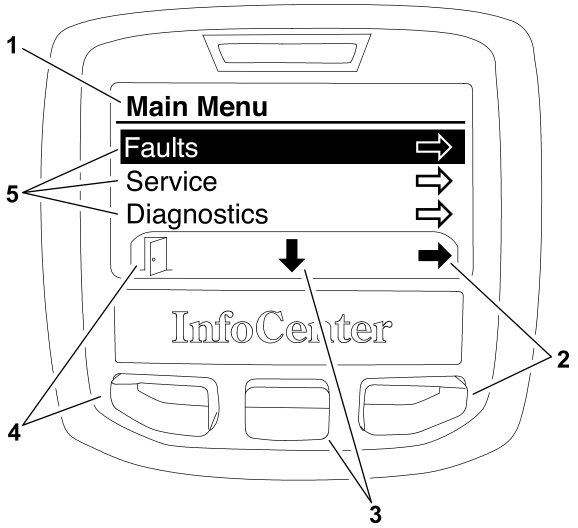
Figure 172

1. Navigation pane
2. Left/right button
3. Menu/back button



g187148

Figure 173

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

The main menu screen (Figure 173) is accessed from the InfoCenter main information screen. Press the menu/back button once to expose the navigation pane (Figure 172), then press the menu/back button again (as indicated by the i in the navigation pane). The main menu screen provides access to the following menu screens:

- Faults
- Service
- Diagnostics
- Settings
- About

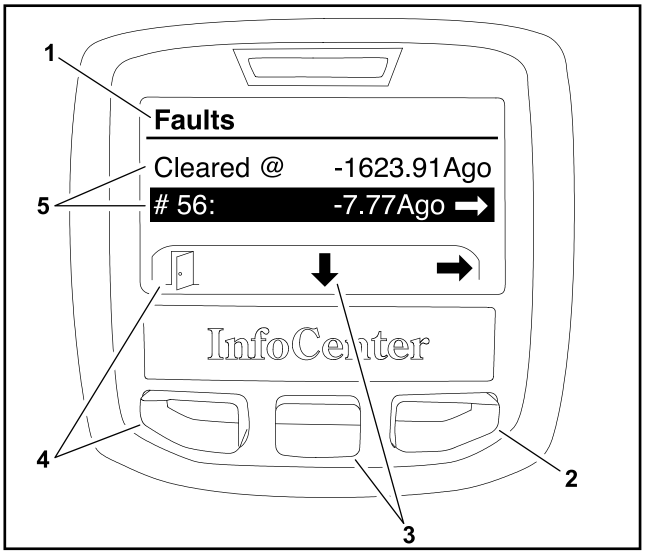
Main Menu Screen (continued)

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

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

Faults Screen

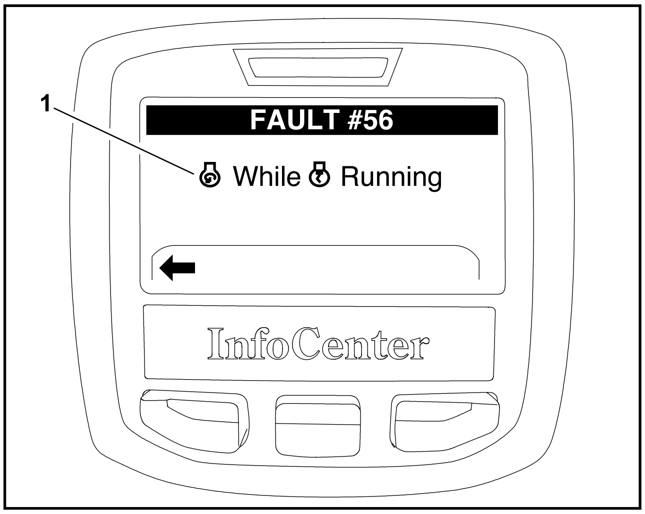
Machine Faults



g187140

Figure 174

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



g187360

Figure 175

1. Fault description

The faults screen (Figure 174 and Figure 175) will list all machine electrical faults that have occurred since the faults were last cleared from the InfoCenter. The faults will be identified by a number code and when the fault occurred. The faults that might occur on the machine are listed in the Fault Codes (page 5–34).

If a machine fault occurs during operation, the InfoCenter fault indicator will blink to notify the operator, and machine functionality may be affected due to the fault. To regain full machine functionality:

1. Disengage the cutting deck, release the traction pedal.
2. Turn the key switch OFF and allow all machine functions to stop.

Machine Faults (continued)

3. Allow the machine to remain OFF for at least 1 minute.
4. Restart the engine and check the machine operation.
5. If a fault continues to occur, further system evaluation and possible component repair or replacement will be necessary

To view a description of a fault that has occurred since the faults were last cleared from the InfoCenter, press the down button (as indicated by the ⬇ at the bottom of the screen) to highlight the desired fault, then press the left/right button (as indicated by the ➡).

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

Clear System Faults (PIN required) If the correct passcode (PIN) has been entered (refer to the Protected Menus in the Settings Screen (page 5–24)) the InfoCenter fault log can be cleared by selecting Clear System Faults. The cleared faults will be removed from the InfoCenter list but will be retained in the TEC memory. Contact your Toro Distributor to view faults stored in the TEC memory.

Engine Faults

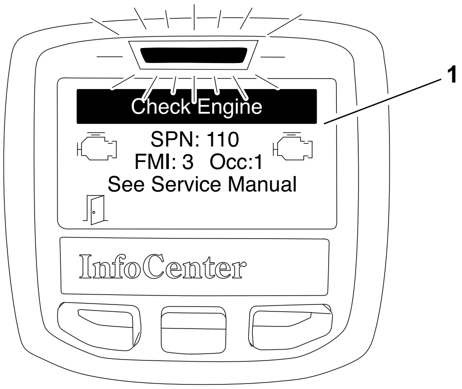
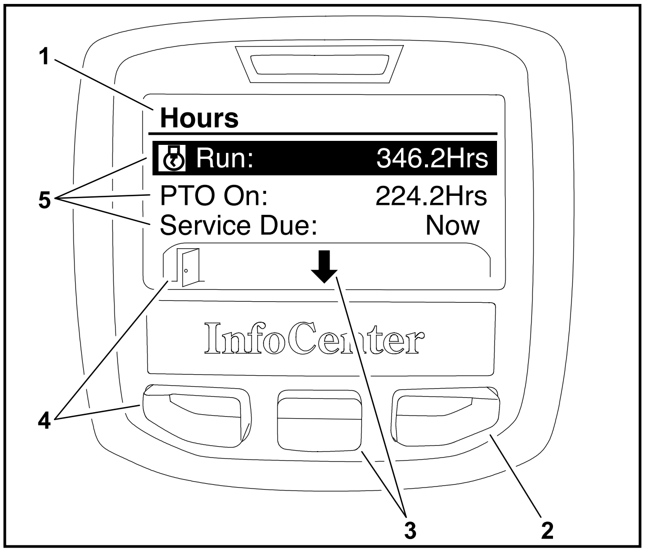


Figure 176

Yanmar Diesel Engines – If an engine fault occurs during machine operation, the fault indicator will illuminate and the fault will be displayed on the InfoCenter to notify the operator (Figure 176). The engine fault will continue to appear until the offending condition is corrected. Once the offending condition has been corrected, the engine fault will be retained in the engine electronic control unit (ECU) and can only be viewed using the engine diagnostic tool. Engine faults are not stored in the Toro Electronic Controller (TEC) so that the engine fault history cannot be viewed using the InfoCenter faults screen.

Note: Refer to the Yanmar Engine Service Manual and Troubleshooting Manual for additional information.

Service Screen



g187153

Figure 177

1. Service screen (hours)
2. Left/right button
3. Down button
4. Menu\back button
5. Service items

The service screen (Figure 177) contains operational information of the machine including hours and counts. If the correct passcode (PIN) has been entered (refer to the Protected Menus in the Settings Screen (page 5–24)) the service screen allows access to initiate a manual DPF regeneration, provides information on DPF ash accumulation, and allows resetting the Service Due timer. To scroll through the list of service records and view the current values, press the down button (as indicated by the ⬇ at the bottom of the screen).

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

Hours provides access to the following information:

- **Key On** (PIN required) identifies the number of hours that the key switch has been in the ON position.
- **Engine Run** identifies the number of hours that the engine has been running.
- **PTO On** identifies the number of hours that the machine has been operated with the cutting deck engaged.
- **4-Wheel Steer** (PIN required) identifies the number of hours that the machine has been in the 4-wheel steer mode.
- **Service Due** identifies the number of hours before the next scheduled maintenance is due. This is a count down timer and the numbers of hours displayed will decrease as the machine is used.
- **Service Reset** (PIN required) identifies the total number of hours between scheduled maintenance intervals. Reset the Service Due timer to the service interval (250 hours) by pressing the left/light button (as indicated by the ➡ at the bottom of the screen) and then pressing the down button (as indicated by the Yes or ➡ at the bottom of the screen).

DPF Regeneration (PIN required) allows an operator or technician to initiate a stationary regeneration for the exhaust system DPF (diesel-particulate filter) on the machines with Yanmar diesel engines. If the engine ECU identifies

Service Screen (continued)

that a stationary DPF regeneration is necessary, an advisory will occur on the InfoCenter Display.

Move the machine to a well ventilated area and initiate a stationary DPF regeneration by pressing the left/right button (as indicated by the ➡ at the bottom of the screen) and then pressing the down button (as indicated by the Yes or ➡ at the bottom of the screen). Additional information can be found in the Yanmar Engine Service Manual.

DPF Ash (PIN required) DPF ash is the level of ash accumulated in the DPF (diesel-particulate filter) on the machines with Yanmar diesel engines. Ash is the byproduct of performing numerous regeneration operations. When there is too much ash build up in the filter, it has to either be serviced or replaced.

Diagnostics Screen

The diagnostics screen (Figure 178) lists a variety of machine operations and the current state of the Toro Electronic Controller (TEC) inputs, qualifiers, and outputs required to allow the operation to proceed. The diagnostics screen should be used to troubleshoot machine operation issues, and check that necessary components and circuit wiring are functioning correctly (refer to Troubleshooting (page 5–28)). To scroll through the list of operations and select (highlight) the operation to be viewed, press the down button (as indicated by the ⬇ at the bottom of the screen).

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

For each of the diagnostics screen items, inputs, qualifiers, and outputs are identified. The diagnostics screen includes the following:

Decks identifies the machine requirements necessary to allow the cutting deck to raise and lower.

Inputs	Qualifiers	Outputs
Lower Input	Seat	Deck Raise (SV1)
Raise Input	Parking brake Off	Deck Float (SV2)

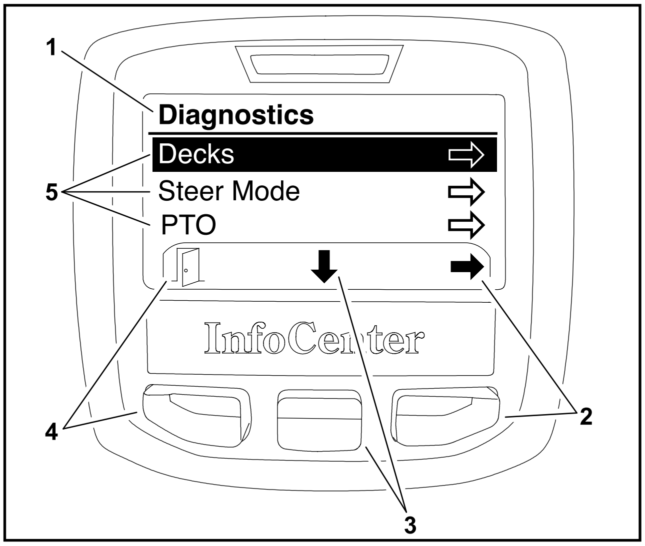
Steer Mode indicates the inputs, qualifiers, and outputs for switching between 2-wheel steer and 4-wheel steer.

Inputs	Qualifiers	Outputs
4 Wheel Steer	Steering on Center	4 WS Enable (SV1)
		Steer Mode Lamp

PTO identifies the requirements necessary to allow the TEC to engage the cutting deck.

Inputs	Qualifiers	Outputs
Input	Seat	Out
	Left Wing Down	
	Right Wing Down	

Diagnostics Screen (continued)



g187135

Figure 178

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

Engine identifies the requirements necessary to allow the TEC to start and run the engine.

Note: The components for engine operation (i.e., glow plugs, starter) are controlled by the Yanmar engine electronic control unit.

Inputs	Qualifiers	Outputs
Key Start	Switch Off	OK Run
Key Run	Neutral	Engine Start
	Seat or Parking Brake	
	No Deck Raise/Lower	

Machine Inputs indicates the state of other machine inputs such as accessories and air conditioning clutch.

Inputs	Qualifiers	Outputs
Accessory	None	None
Increase RPM		
Decrease RPM		
Air Conditioning Clutch		

Diagnostics Screen (continued)

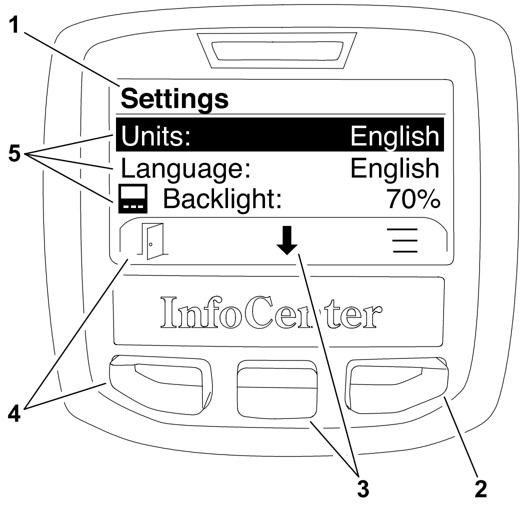
Accessory

Inputs	Qualifiers	Outputs
Weight Transfer	None	None
Accessory Lift		
Accessory Lower		
Accessory Up		
Accessory Angle Left		
Accessory Angle Right		

Collection System

Inputs	Qualifiers	Outputs
None	None	None

Settings Screen



Settings

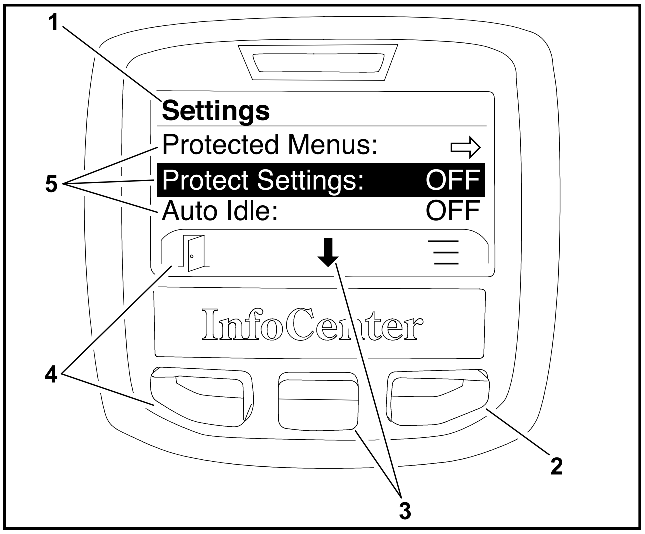
Units: English

Language: English

Backlight: 70%

Figure 179

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



Settings

Protected Menus: ⇨

Protect Settings: OFF

Auto Idle: OFF

Figure 180

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

The settings screen (Figure 179 and Figure 180) allows the operator or technician to customize the InfoCenter display, modify a variety of machine functions, and provides access to unlock various protected menus and settings. To scroll through the list of functions, view its current setting, and select (highlight) the setting to be modified, press the down button (as indicated by the ⬇ at the bottom of the screen).

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

Settings Screen (continued)

Units: Use the left/right button (as indicated by the ☰ at the bottom of the screen) to select between metric or English units of measure. Allow the desired selection to remain in view for 5 seconds. The fault indicator will illuminate and an operator advisory #180 (New Value Saved in Permanent Memory) will appear on the InfoCenter display to confirm that the change has been recorded.

Language: Use the left/right button (as indicated by the ☰ at the bottom of the screen) to select from numerous language options. Allow the desired selection to remain in view for 5 seconds. The fault indicator will illuminate and an operator advisory #180 (New Value Saved in Permanent Memory) will appear on the InfoCenter display to confirm that the change has been recorded.

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

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

Protected menus: Authorized individuals can enter the 4 digit passcode (PIN) to reveal the following service functions (refer to Faults Screen (page 5–17) and Service Screen (page 5–19)):

- Clear System Faults
- Key On
- 4WS (4-Wheel Steer)
- Service Reset
- DPF Regeneration
- DPF Ash

Entering the correct PIN will also reveal and allow adjustment of various machine functions on the settings screen if Protect Settings is set to On (refer to the Protected Menus in the Settings Screen (page 5–24)).

Use the down button and left/right button (as indicated by the ⬇ and the ➡ at the bottom of the screen) to enter the 4 digit passcode (PIN). Once the correct PIN has been entered, press the down button (as indicated by the ✓ at the bottom of the screen). PIN will appear in the upper right hand corner of the InfoCenter display. The protected items will be visible as long as the key switch remains in the Run position.

To edit the passcode (PIN), enter the current PIN as previously described (PIN will appear in the upper right hand corner). Select Protected Menus again and use the down button and left/right button (as indicated by the ⬇ and the ➡ at the bottom of the screen) to enter a new 4 digit PIN. Press the down button to save the change (as indicated by the 💾 at the bottom of the screen).

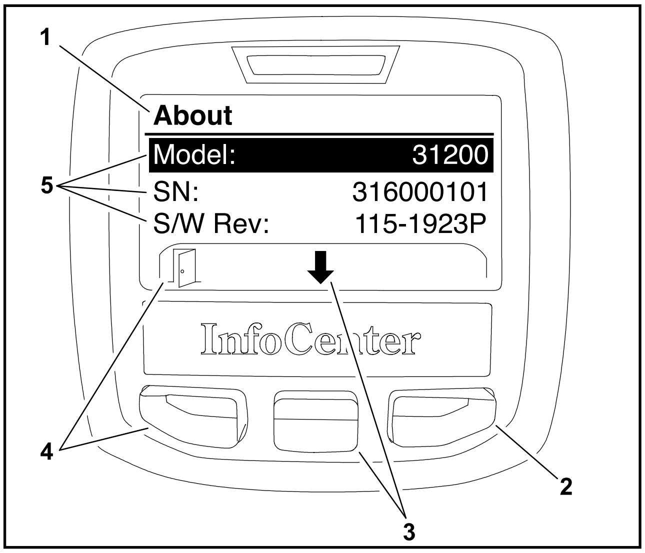
Note: The initial PIN will either be 1234 or 0000. If the PIN has been changed and is forgotten, you can obtain a temporary PIN from your Toro distributor.

The following settings will only be visible if Protect Settings is set to On and the correct passcode (PIN) has been entered, or Protect Settings is set to Off:

Protect settings: Use the left/right button (as indicated by the ☰ at the bottom of the screen) to select Off or On. When the Protect Settings is set to Off, the remaining settings will be visible and adjustable at all times. When the Protect Settings is set to On, the remaining settings will be visible and adjustable only after the correct passcode (PIN) has been entered (refer to the Protected Menus in the Settings Screen (page 5–24)).

Auto Idle: (Yanmar diesel engines only) When the engine is running and the machine is in neutral, the engine will automatically return to the low idle setting after the set time delay. When the engine is running and the machine is not in neutral , the engine will automatically return to the high idle setting after the set time delay. Use the left/right button (as indicated by the ☰ at the bottom of the screen) to select 8, 10, 15, 20, or 30 seconds or the auto idle feature can be set to OFF.

About Screen



About

Model: 31200

SN: 316000101

S/W Rev: 115-1923P

Figure 181

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

The about screen (Figure 181) identifies the machine model number, serial number, and software revision for the machine. If the correct passcode (PIN) has been entered (refer to the Protected Menus in the Settings Screen (page 5–24)), the Toro Electronic Controller (TEC), InfoCenter, and engine ECU software is displayed, and the CAN−bus status will be visible. Press the down button to scroll through the screen items (as indicated by the ⬇ at the bottom of the screen). The information found in the about screen can only be edited by your Toro Distributor.

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

Troubleshooting

CAUTION

Remove all the jewelry, especially rings and watches, before doing any electrical troubleshooting or testing. Disconnect the battery cables unless the test requires battery voltage.

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

If the machine has any interlock switches that are bypassed, connect the switches for the correct troubleshooting and safety.

Note: Use the InfoCenter display when troubleshooting a Groundsmaster 360 electrical problem.

Operator Advisories

The list below identifies the operator advisories that are generated by the TEC. An advisory will be displayed on the InfoCenter display. Typically, an advisory can be eliminated with a change in the machine controls by the operator.

Advisory	Advisory Description
160	Inhibit start
169	Safety shutdown
161	Inhibit PTO
172	4WS/2WS transition
183	Regen complete
184	Regen failed
185	Regen inhibited
186	Regen set full throttle
188	Parked regen required
189	Parked regen required with no PTO
190	Recovery regen required with no PTO
193	Slope not calibrated
194	Slope calibrating
195	Slope calibrated
196	Slope warning
197	Slope alarm

Advisory Qualifiers	Advisory Qualifiers Description
162	Version check restriction
163	Sit down or set parking brake
164	Machine not in neutral
165	Front lift switch closed
166	Front lower switch closed

Operator Advisories (continued)

Advisory Qualifiers	Advisory Qualifiers Description
167	Front left angle switch closed
168	Front right angle switch closed
169	Lift switch on joystick closed
170	Lower switch on joystick closed
171	Deck raise switch closed
172	Deck lower switch closed
173	Not in seat
174	Blower switch closed
175	Decks not floating
176	Engine is overheating
178	Requalify PTO
179	PTO switch is ON
180	Collection door lift switch closed
181	Collection door lower switch closed
182	Collection lift switch closed
183	Collection lower switch closed
184	Parking brake is set
185	Left switch on joystick closed
186	Right switch on joystick closed
187	Front attach up sense active
188	Loss of CAN
191	4WS to 2WS transition
192	2WS to 4WS transition
193	Transition complete 2WS
194	Transition complete 4WS
197	Recycle key switch

Using the InfoCenter Display for Troubleshooting

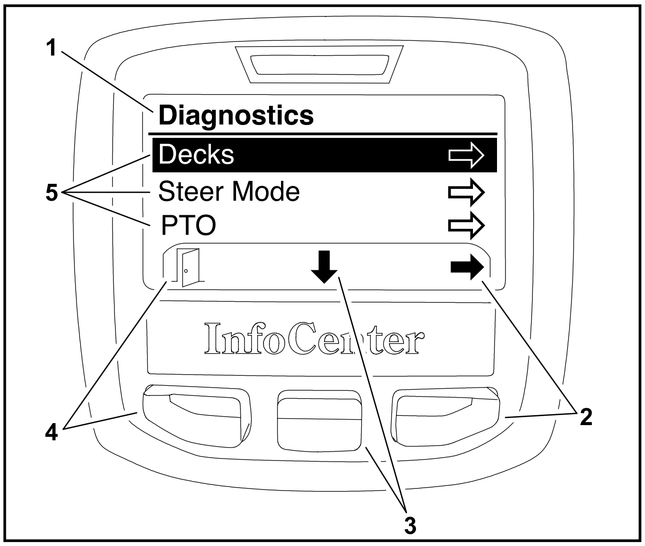


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Figure 182

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

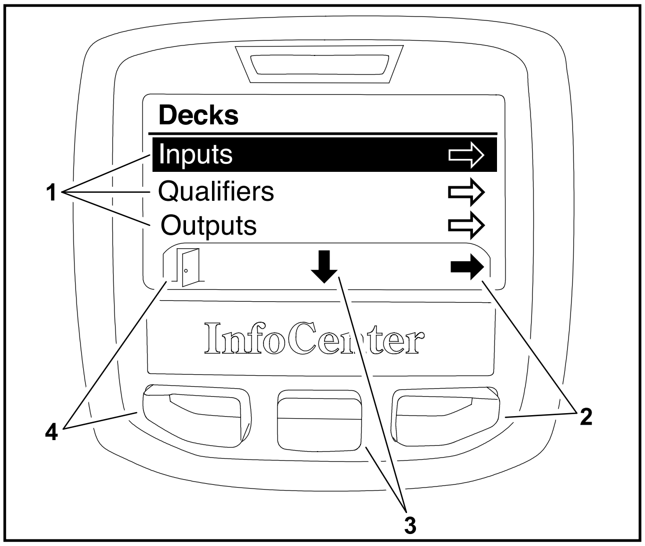

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Figure 183

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

The diagnostics screen of the InfoCenter display can be very helpful when troubleshooting machine operation issues (refer to Diagnostics Screen (page 5–21)). The diagnostics screen (Figure 182) lists a variety of machine operations and the current state of the inputs, qualifiers, and outputs required to allow the operation to proceed. The electrical components involved in the following machine operations can be evaluated using the diagnostics screen prior to testing each component individually:

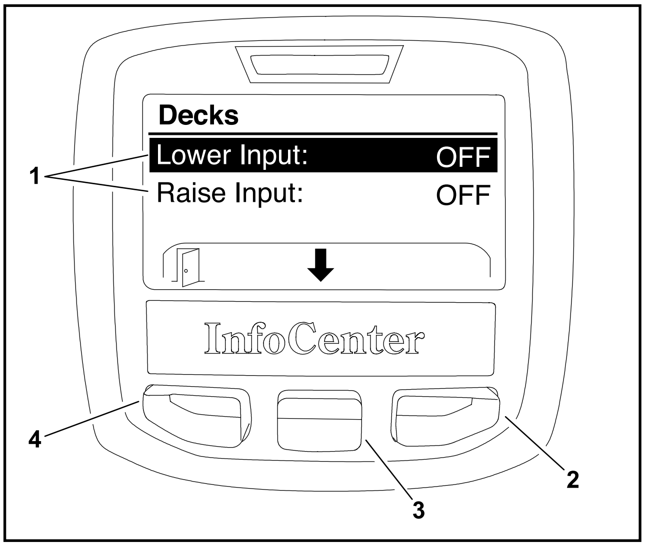
- **Decks** The components necessary to lower or raise the cutting deck.
- **Steer Mode** The components necessary to switch between 2–wheel steer and 4–wheel steer.

Using the InfoCenter Display for Troubleshooting (continued)

- **PTO** The components necessary to engage the cutting deck.
- **Engine** The components necessary to start and run the engine.
- **Machine Inputs** The components necessary to indicate the state of other machine inputs such as accessories and air conditioning clutch.

If a machine operation is malfunctioning, the following procedure can help identify the cause of the component or circuit wiring causing the malfunction.

1. Park the machine on a level surface, set the parking brake, and shut off the engine.
2. Set the key switch to the On position and navigate to the InfoCenter Diagnostic Screen.
3. Select (highlight) the malfunctioning machine operation and press the left/right button (as indicated by the ➡ at the bottom of the screen). For this example, the Decks operation has been selected (Figure 183).
4. Select (highlight) the Inputs and press the left/right button (as indicated by the ➡ at the bottom of the screen).



Decks

Lower Input: OFF

Raise Input: OFF

Figure 184

1. Input items
2. Left/right button
3. Down button
4. Menu/back button

Using the InfoCenter Display for Troubleshooting (continued)

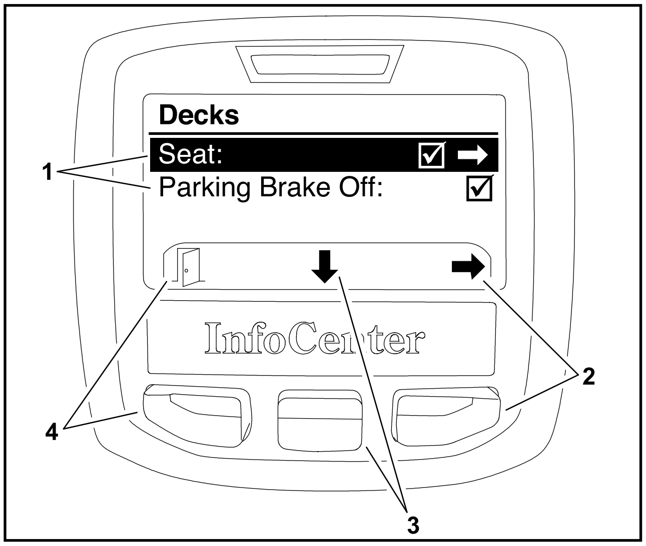


Figure 185

1.	Qualifier items	3.	Down button
2.	Left/right button	4.	Menu/back button

5. Manually operate each input item listed (Figure 184). The input condition on the InfoCenter display should alternate ON and OFF as the input is switched open and closed. If ON and OFF do not alternate during input operation, the input component or its circuit wiring is damaged and should be tested; refer to Testing the Electrical Components (page 5–50).

   In the Decks operation example, the inputs are lower and raise positions of the deck lift switch. If ON and OFF do not alternate when the switch is moved back and forth from ENABLE to DISABLE, the switch or the circuit wiring for the switch is damaged and should be tested as described.

6. Press the menu/back button (as indicated by the 🚪 at the bottom of the screen). Select (highlight) the Qualifiers and press the left/right button (as indicated by the ➡ at the bottom of the screen).

   Note: All of the qualifiers for the machine operation must be in the desired condition (☑) before the operation Outputs can be energized.

7. Manually operate each qualifier listed (Figure 185). The qualifier condition on the InfoCenter display should alternate ☑ and ☐ as the qualifiers condition is changed. If ☑ and ☐ do not alternate during qualifier operation, the qualifier component or its circuit wiring is damaged and should be tested; refer to Testing the Electrical Components (page 5–50).

⚠ CAUTION ⚠

It may be necessary to start and run the engine, raise and lower the cutting deck, or otherwise operate the machine during the troubleshooting process.

Ensure that the machine is in a well ventilated area and keep your hands and feet away from the cutting deck and moving parts while troubleshooting to prevent personal injury.

Using the InfoCenter Display for Troubleshooting (continued)

In the Decks operation example, the following qualifiers must be in the desired condition (☑) before any operation Outputs can be energized:

- Operator must be in seat (seat switch)
- Parking brake Off

If ☑ and ☐ do not alternate when the qualifier condition is changed, the qualifier or the circuit wiring for the qualifier is damaged and should be tested as described.

8. Press the menu/back button (as indicated by the 🚪 at the bottom of the screen). Select (highlight) the Outputs and press the left/right button (as indicated by the ➡ at the bottom of the screen).

9. If all the Inputs are On and all the Qualifiers are in their desired condition (☑), the Outputs for the machine operation should be On. If the outputs remain Off, the Toro Electronic Controller (TEC) or TEC software may be damaged and require reloading or replacement. Contact your Toro Distributor for assistance.

10. If the outputs listed on the InfoCenter Display are On, and the operation is still malfunctioning:

    - Test the specific output and output wiring; refer to Testing the Electrical Components (page 5–50).
    - Test the hydraulic components related to the operation; refer to Chapter 4: Hydraulic System (page 4–1).

    In the Decks operation example, the outputs are the solenoid valve SV1 for cutting deck raise and solenoid valve SV2 for cutting deck float. If On appears next to these outputs on the InfoCenter Display:

    - Test the hydraulic solenoid valve coils; refer to Hydraulic Solenoid Valve Coils (page 5–92).
    - Perform cutting deck hydraulic circuit tests; refer to Chapter 4: Hydraulic System (page 4–1).

Fault Codes

The list below identifies the fault codes that are generated by the TEC to identify an electrical system malfunction (fault) that occurred during machine operation. Use the InfoCenter display for fault retrieval.

Note: The following list of fault codes identifies electrical problems that typically will prevent normal machine operation. The InfoCenter display will identify existing faults if they should occur.

Fault Code	Fault Description
11	Engine coolant temperature is high, PTO is disabled (above 105°C)
12	Engine coolant temperature is high, engine has to be shutdown (above 115°C)
13	Engine oil pressure is too low and engine has to be shutdown
14	Alternator has a fault
15	FET leak occurs when an output circuit is shut off and an abnormal amount of current flow is detected. This is likely due to a bad FET. Qualifier indicates which FET on board. Does not apply to PWM output.
16	TEC Inputs are bad. Input Enable Pullup (IPE) check on board has failed. The input pullups are not being properly powered on the board, therefore the micro controller can not trust the state of the inputs.
21	Check 7.5 A fuse protecting outputs 1 - 4. From VBATT2
22	Check 7.5 A fuse protecting outputs 5 - 8. From VBATT3
23	Check 7.5 A fuse protecting outputs 9 - 12. From VBATT4
24	Main power Relay fault
31	Starter circuit current (from TEC to start relay) is too high. From current sense on start output.
32	Current in fuel pump circuit is too high.
33	Current in the pump clutch circuit is too high.
34	Current in pump lamp circuit is too high
35	Current in throttle lock circuit is too high
41	Current in throttle lamp circuit is too high
42	Current in solenoid that enables the Front PTO is too high
43	Current in solenoid that enable the Rear PTO is too high
44	Current in solenoid that enables the lift/lower capabilities is too high
54	CAN msgs from slave have not been received within specified time limit
55	Assembly or InfoCenter software is incompatible with the master
56	Attempt to start while engine is running
57	Starter has been engaged for more than 30 seconds
61	Hydraulic temperature is too high, PTO shutoff to decks or blower
62	Communication failure between slope sensor and master TEC
63	Slope sensor configuration fault

Fault Codes (continued)

Fault Code	Fault Description
64	Slope sensor is reporting internal fault to TEC
131	Default error code when low/high current cannot be associated with any channel

TEC Logic Chart

Each line of the following chart identifies the necessary component position (INPUTS) in order for the TEC to energize the appropriate OUTPUTS for machine operation.

Example: To start the engine with no operator in the seat, when the key switch is in the START position, the traction pedal is in the NEUTRAL, and the parking brake is set, the glow plugs and other necessary engine starting components will be energized.

X	Component (input) Position
	Not Relevent for Function
P	Component (output) Engergized

MACHINE FUNCTION	INPUTS	Ignition Key in RUN	Ignition Key in START	Traction Pedal in NEUTRAL	Seat Occupied	Parking Brake Applied	Normal Coolant Temperature	Lift Switch Pressed for Lower	Lift Switch Pressed for Raise	PTO Switch in ON	Steering Selector Switch	OUTPUTS	Engine Glow Plugs Energized	Fuel Pump	Lift Manifold SV1 Energized (deck lift)	Lift Manifold SV2 Energized (deck float)	PTO Solenoid Energized	4WS Solenoid	Signal to Engine ECU
Preheat		X											P						
Start (no operator in seat)			X	X		X							P	P					P
Start (operator in seat)			X	X	X								P	P					P
Run (no operator in seat)		X		X		X	X							P					P
Run (operator in seat)		X			X		X							P					P
2WS to 4WS		X			X						X							P	
4WS to 2WS		X			X						X							P	
Lower Cutting Deck		X						X						P	P				
Cutting Deck in Float		X												P	P				
Mow (cutting deck/lowered)		X			X		X			X				P	P		P		
Raise Cutting Deck		X			X				X	X				P	P	P			

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Figure 186

Note: For the Start machine function, the PTO switch must be OFF and the deck lift must be in the OFF position.

Note: The glow plugs are energized for approximately 6 seconds when the key switch is turned from OFF to RUN. The glow plugs are also energized when the key switch is in the START position.

Starting Problems

Problem	Possible Causes
All the electrical power is dead, including the InfoCenter display.	• The battery is discharged or damaged. • The battery cables are loose or corroded. • The left fuse 4 (10 A) to the key switch is damaged. • The ground connection is loose or corroded. • The key switch or circuit wiring is damaged. • The fusible link at the engine starter motor is damaged.
The starter solenoid clicks, but the starter does not crank. **Note:** If the starter solenoid clicks, the problem is not in the interlock circuit.	• The battery charge is low. • The battery is discharged or damaged. • The battery cables are loose or corroded. • The ground connection is loose or corroded. • The wiring at the starter motor is damaged. • The starter solenoid or starter motor is damaged.

Starting Problems (continued)

Problem	Possible Causes
Nothing happens when you attempt to start the engine. The InfoCenter display operates with the key switch in the RUN position. **Note:** Use the InfoCenter display to assist with identifying problem.	• The traction pedal is not in the NEUTRAL position. • The operator seat is unoccupied or the parking brake is not applied. • The traction neutral sensor is damaged or out of adjustment. • The PTO switch is in the ON (up) position or it is damaged. • The engine coolant temperature is excessive or the engine high temperature switch is damaged. • The battery is discharged or damaged. • The battery cables are loose or corroded. • The ground connection is loose or corroded. • The fuse(s) is (are) damaged. • The in-line fuses near the battery are damaged. • The fusible link harness at the engine starter motor is damaged. • The wiring in the engine crank circuit is loose, corroded, or damaged; refer to the Electrical Schematics in Appendix A (page A–1)—Foldout Drawings. • The key switch is damaged. • The starter solenoid wiring is loose, corroded, or damaged. • The starter solenoid is damaged. • The main power relay or circuit wiring is damaged. • The TEC is damaged. • The start relay or circuit wiring is damaged. • The starter motor is damaged. • The engine ECU or circuit wiring is damaged.
The engine cranks, but does not start.	• The fuel tank is empty. • The fuel filter is plugged. • The engine and/or fuel can be too cold. • The engine fuel pump or circuit wiring is damaged. • The engine glow plug circuit does not operate properly. • The engine or fuel system is malfunctioning; refer to Chapter 3: Diesel Engine (page 3–1).

Starting Problems (continued)

Problem	Possible Causes
The glow plug circuit does not operate properly.	• The wiring in the engine glow circuit is loose, corroded, or damaged; refer to the Electrical Schematics in Appendix A (page A–1)—Foldout Drawings. • The engine glow plug(s) is(are) damaged. • The glow relay is damaged. • The fusible link harness at the engine starter motor is damaged. • The fuse(s) is (are) damaged. • The engine ECU or circuit wiring is damaged.
The engine cranks, but should not, when the PTO switch is in the ON (up) position.	• The PTO switch or circuit wiring is damaged. • The TEC is damaged.
The engine starts, but stops when the key switch is released from the START position.	• The fuse(s) is (are) damaged (other electrical components most likely affected as well). • The circuit wiring is damaged. • The key switch is damaged.

General Run and Transport Problems

Problem	Possible Causes
The engine shuts off during the operation (the operator sitting on the seat).	• The operator is not in the center of the seat (the seat switch is not pressed). • The fuel tank is empty. • The machine is operated on a slope with a low fuel level. • The parking brake is engaged or the parking brake sensor is damaged. • The fuse(s) is (are) damaged (other electrical components most likely affected as well). • The engine temperature is excessive (above 115°C/240°F). • The seat switch is damaged. • The engine high temperature shutdown switch is damaged. • The fuel pump is damaged.
The battery does not charge.	• A loose, corroded, or broken wire(s) exist in the charging circuit; refer to the Electrical Schematics in Appendix A (page A–1)—Foldout Drawings. • The engine alternator belt is loose or damaged. • The fusible link connecting the engine starter motor to the alternator is damaged. • The battery is damaged. • The alternator is damaged.

Cutting Deck Operating Problems

Problem	Possible Causes
With a running engine, the cutting deck does not operate with the PTO switch in the On (up) position.	• The operator seat is unoccupied. • The hydraulic-fluid level in the hydraulic tank is low. • The seat switch or circuit wiring is damaged. • The wiring to the transmission PTO solenoid valve coil is loose, corroded, or damaged; refer to the Electrical Schematics in Appendix A (page A–1)—Foldout Drawings. • The transmission PTO solenoid valve coil is damaged. • The PTO switch is damaged. • The right fuse 3 for TEC outputs (7.5 A) is damaged. • The engine temperature is excessive (above 115°C/240°F). • The high temperature warning switch or circuit wiring is damaged. • The transmission hydraulic solenoid valve is damaged; refer to Chapter 4: Hydraulic System (page 4–1). • The PTO clutch in the transmission is worn or damaged; refer to Chapter 4: Hydraulic System (page 4–1). • The transmission pressure valve or charge pump is damaged; refer to Chapter 4: Hydraulic System (page 4–1). • The TEC is damaged.
The cutting deck does not raise or lower.	• The right fuse 3 for TEC outputs (7.5 A) is damaged. • The deck lift switch or circuit wiring damaged. • The deck lift manifold solenoid valve coil(s) or circuit wiring is damaged. • A hydraulic problem in the deck lift circuit exists; refer to Chapter 4: Hydraulic System (page 4–1). • The TEC is damaged.

4-Wheel Steer Operating Problems

Problem	Possible Causes
Cannot change between 2 and 4 wheel steer.	• The wheels are not directed straight ahead when steering selector switch is pressed (the switch light should be flashing). • The right fuse 4 for TEC outputs (7.5 A) is damaged. • The steering home sensor is out of adjustment. • The steering home sensor bracket is loose or damaged. • The steering selector switch or circuit wiring is damaged. • The steering manifold solenoid valve coil is damaged. • The steering home sensor or circuit wiring is damaged. • A hydraulic problem exists; refer to Chapter 4: Hydraulic System (page 4–1). • The TEC is damaged.

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 5–42).

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 switch 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 5–42) 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 5–111).

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 set to 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 **(3,000 rpm)**. 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 5–43) for an example of a charging system that is functioning.

Testing the Charging System (continued)

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 Groundsmaster 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 by turning the key switch to the RUN position and record the multimeter results.

The glow plug system of the Groundsmaster 360 machines should have a reading of approximately 21 A. If low current reading is observed, 1 (or more) of the glow plugs is damaged.

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.

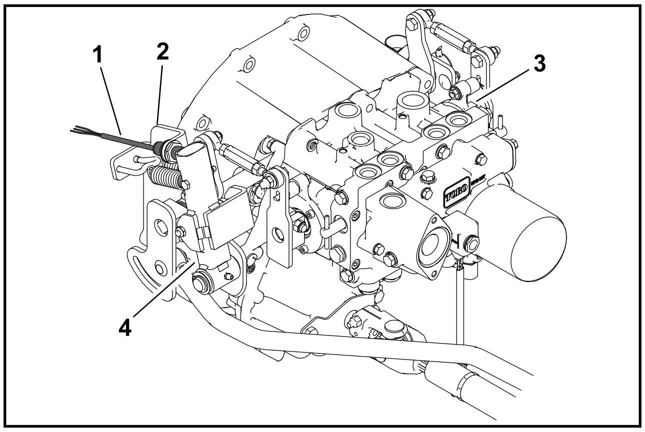
Replace any malfunctioning switches before operating the machine.

Interlock switch operation is described in the *Traction Unit Operator's Manual*. The Groundsmaster 360 machines are equipped with a Toro Electronic Controller (TEC) which monitors interlock switch operation. Testing of individual interlock switches is included in the Testing the Electrical Components (page 5–50).

Note: Use the InfoCenter display to test the Toro Electronic Controller inputs and outputs before further troubleshooting of an electrical problem on your Groundsmaster.

Adjustments

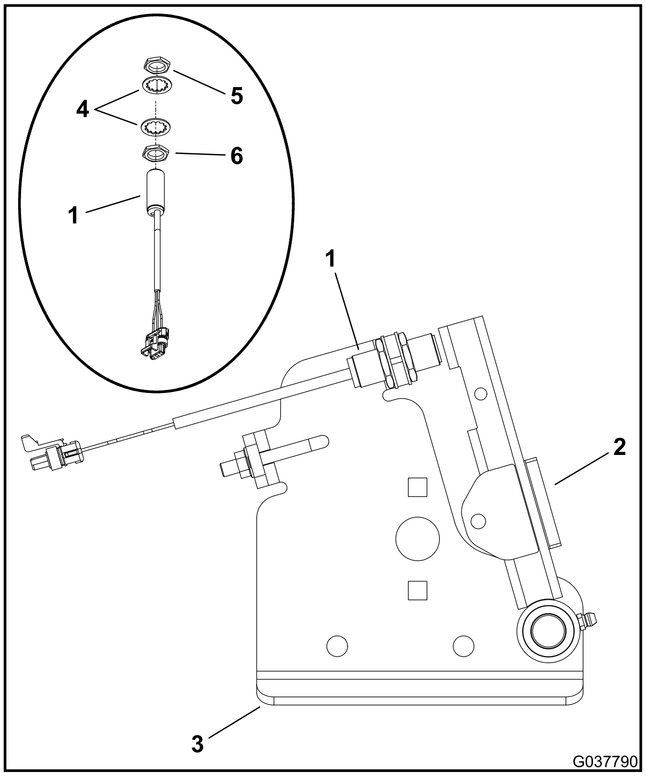
Traction Neutral Sensor



g186522

Figure 187

1. Traction neutral sensor	3. Transmission
2. Neutral end plate	4. Neutral arm assembly



g037790

Figure 188

1. Traction neutral sensor	4. Lock washer (2 each)
2. Neutral arm assembly	5. Front jam nut
3. Neutral end plate	6. Rear jam nut

The traction neutral sensor is a normally open proximity sensor that closes when the traction pedal is in the NEUTRAL position. The sensor mounts to a neutral end plate (Figure 187). The sensing plate for the traction neutral sensor is the neutral arm.

Adjusting the Traction Neutral Sensor

1. Before adjusting the traction neutral sensor, check and adjust the traction system neutral position; refer to the *Operator's Manual*.
2. Park the machine on a level surface, lower the cutting deck, and shut off the engine.
3. Loosen both the jam nuts that secure the neutral sensor to the neutral end plate.
4. Adjust the location of the neutral sensor as follows:
   A. Turn the key switch to the RUN position.

   B. Manually move the sensor towards the neutral arm and adjust the rear jam nut until the LED on the cable end of the traction neutral sensor is not illuminated.

   C. Rotate the rear jam nut in the opposite direction until the LED illuminates. Continue to rotate the rear jam nut 1 full turn.

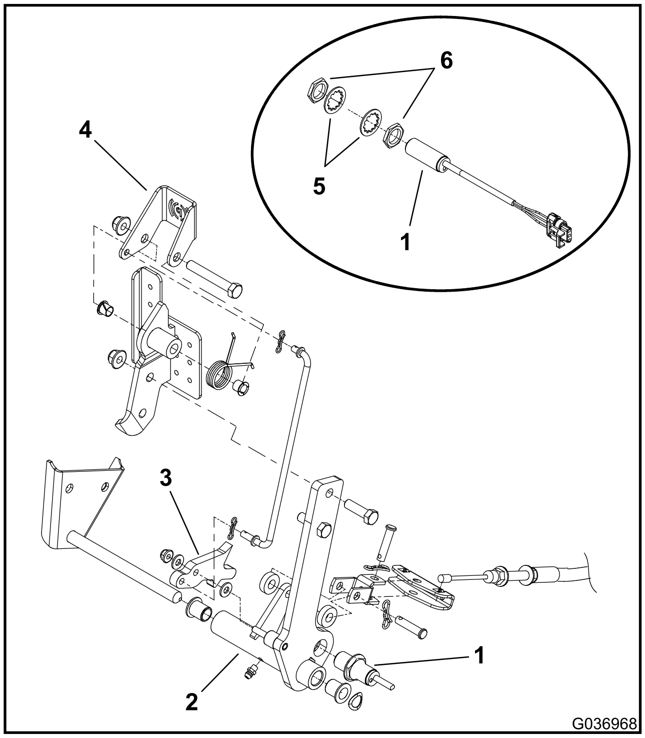
   D. Tighten the front jam nut to secure the sensor. Ensure that the sensor position does not change. Torque the jam nut to **18.4 to 22.4 N·m (162 to 198 in-lb)**.

IMPORTANT

To prevent the traction neutral sensor damage, ensure that the sensor does not contact any machine components during the traction pedal movement.

5. After adjustment to the traction neutral sensor, use the InfoCenter display to verify that the traction neutral sensor and circuit wiring are functioning correctly; refer to Using the InfoCenter Display for Troubleshooting (page 5–30).

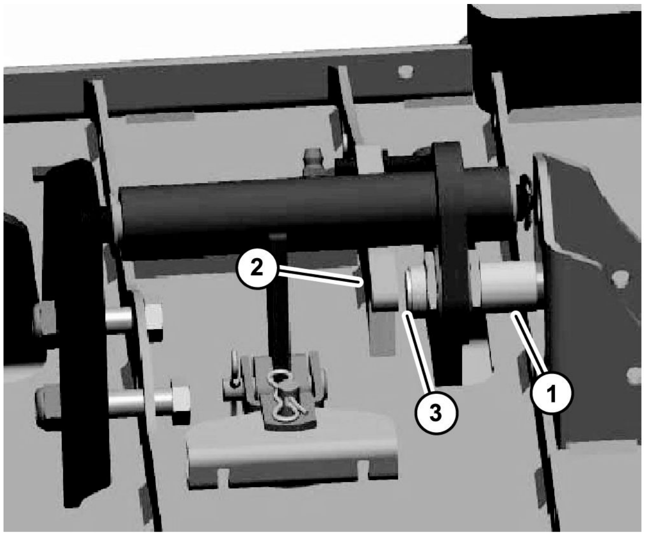
Parking Brake Sensor



g036968

Figure 189

1.	Parking brake sensor	4.	Parking brake latch
2.	Brake lever	5.	Lock washer (2 each)
3.	Parking brake detent	6.	Jam nut (2 each)



g188848

Figure 190

1.	Parking brake sensor	3.	Gap
2.	Parking brake detent		

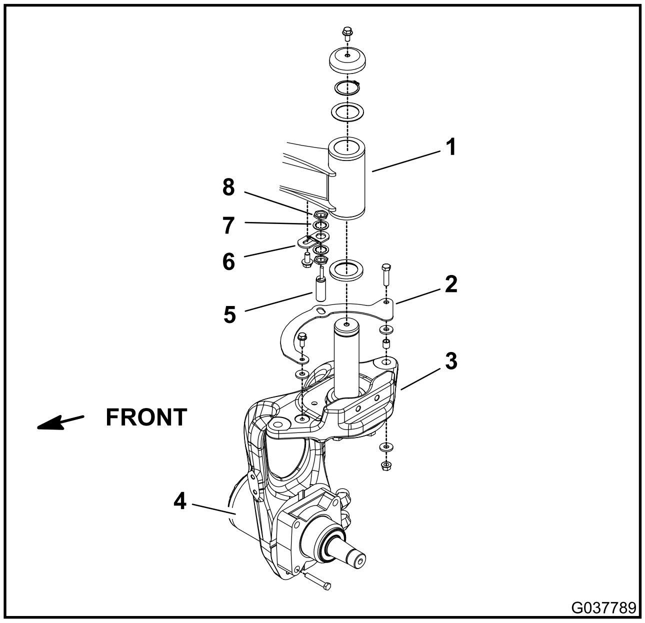
The parking brake sensor acts as an input for the TEC to determine when the parking brake is set (brake latch engaged). The brake sensor is a normally open proximity sensor that mounts to the brake lever assembly (Figure 189).

When the parking brake is not set (brake latch not engaged), the parking brake detent is positioned near the target end of the parking brake sensor so that the sensor is closed. The parking brake detent is moved away from the sensor when the parking brake is set (brake latch engaged) causing the sensor to open.

Adjusting the Parking Brake Sensor

1. When the parking brake is not applied (brake latch not engaged), the gap between the parking brake sensor and the tab on the parking brake detent should be 3.8 to 4.7 mm (0.148 to 0.188 inch).
2. If the gap is incorrect, loosen the jam nuts that secure the sensor to the brake lever. Position the sensor with jam nuts to allow correct gap between the sensor and the brake detent tab. Tighten the jam nuts to secure the adjustment. Torque the jam nuts to **18.4 to 22.4 N·m (162 to 198 in-lb)**. After the jam nuts are tightened, ensure that clearance between the head of the parking brake sensor and the tab on the parking brake detent has not changed.
3. Check that the LED on the cable end of the parking brake sensor is illuminated when the parking brake is not applied (brake latch not engaged). The LED should not be illuminated when the parking brake is set (brake latch is engaged).
4. After adjustment to the parking brake sensor, use the InfoCenter display to verify that the parking brake sensor and circuit wiring are functioning correctly; refer to Using the InfoCenter Display for Troubleshooting (page 5–30).

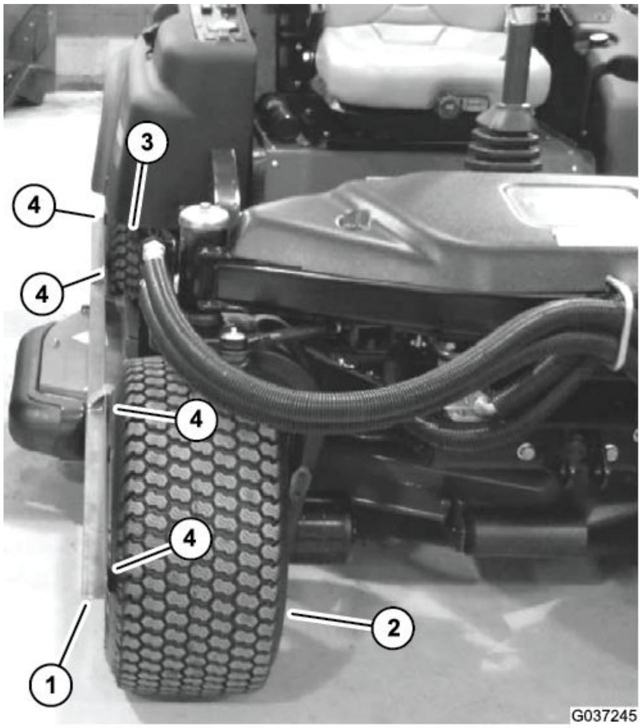
Steering Home Sensor



g037789

Figure 191

1. Front axle
2. Target bracket
3. Left front steering fork
4. Wheel motor
5. Steering home sensor
6. Sensor bracket
7. Lock washer (2 each)
8. Jam nut (2 each)



g037245

Figure 192

1.	Straight edge	3.	Rear wheel
2.	Front wheel	4.	Tire contact point

The steering home sensor is used to determine when the wheels are directed straight ahead. The sensor acts as an input for the TEC to determine when steering can be changed from 4-wheel steering to 2-wheel steering.

The steering home sensor is a normally open proximity sensor. The sensor mounts to a bracket that is secured to the bottom of the front axle near the left side front steering fork (Figure 191). The sensing plate for the sensor is a target bracket attached to the left side front fork.

When the left side front steering fork is in the straight ahead position, an oval hole in the target bracket is positioned directly below the steering home sensor allowing the sensor to be in its normally open state. The sensor closes when the left side front steering fork is not in the straight ahead position.

Before performing an adjustment to the steering home sensor, ensure that the front and rear wheels are aligned in a straight ahead position. A rigid straight edge (e.g., angle iron or metal pipe) at least 2 m (80 inches) long can be used to confirm the wheel alignment. Place the straight edge across the sides of both front and rear tires to confirm the wheel alignment. The straight edge should contact both front and rear tires at 2 points when the wheels are aligned (Figure 192). If necessary, turn the steering wheel until the front and rear tires are aligned with the straight edge. Once the front and rear wheels are aligned, proceed with the steering home sensor adjustment.

Note: If the wheel alignment cannot be achieved by turning the steering wheel, additional adjustment may be required. Refer to Aligning the Wheels (page 6–8).

Adjusting the Steering Home Sensor

1. When the wheels are in the straight ahead position, ensure that the steering home sensor is directly over the oval opening in the target bracket attached to the left side front steering fork. If necessary, loosen and change the

Adjusting the Steering Home Sensor (continued)

position of the sensor bracket so that the sensor is directly over the target bracket opening.

2. The gap between the steering home sensor and the target bracket should be 3.8 to 4.3 mm (0.150 to 0.170 inch). If necessary, loosen the jam nuts that secure the sensor to the sensor bracket. Position the sensor with jam nuts to allow correct gap between the sensor and the target bracket. Tighten the jam nuts to secure the sensor adjustment. Torque the jam nuts to **18.4 to 22.4 N·m (162 to 198 in-lb)**. After the jam nuts are tightened, ensure that clearance between the head of the steering home sensor and the target bracket has not changed.

3. After adjustment to the steering home sensor, use the InfoCenter display to verify that the steering home sensor and circuit wiring are functioning correctly; refer to Using the InfoCenter Display for Troubleshooting (page 5–30).

Testing the Electrical Components

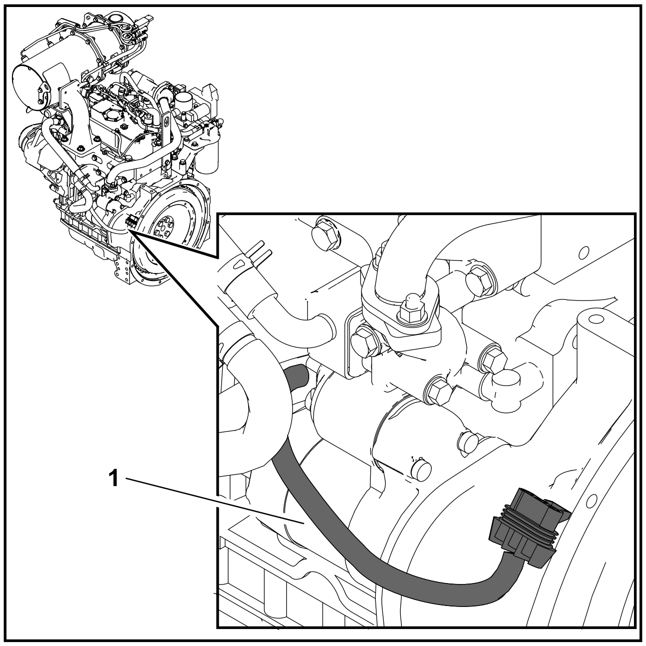
For accurate resistance and/or continuity checks, electrically disconnect the component being tested from the circuit (e.g., unplug the key switch connector before doing a continuity check of the switch).

Note: For engine component testing information; refer to the Yanmar Engine Service Manual or Troubleshooting Manual.

IMPORTANT

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

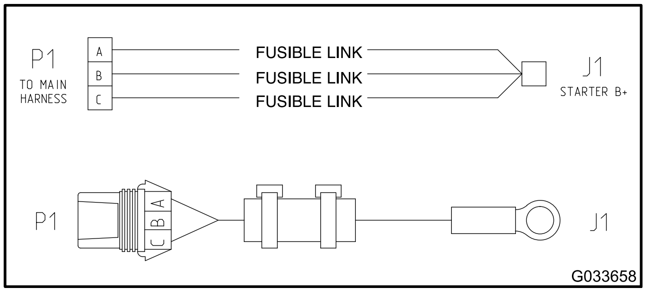
Fusible Link Harness



g186536

Figure 193

1. Fusible link harness



g033658

Figure 194

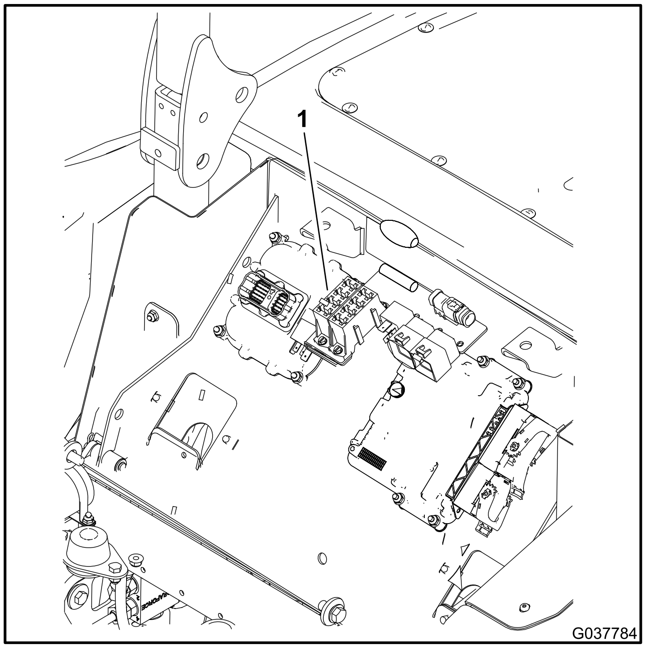
The Groundsmaster 360 machine uses 3 fusible links for the circuit protection. These fusible links are located in a harness that connects the starter B+ terminal to the main wire harness. If any of these links fail, current to the protected circuit stops; refer to the Electrical Schematics in Appendix A (page A–1)—Foldout Drawings for additional circuit information.

Testing the Fusible Link Harness

1. Ensure that the key switch is in the OFF position, disconnect the negative battery cable from the battery terminal, and then disconnect the positive cable from the battery; refer to Servicing the Battery (page 5–111).
2. Locate and unplug the fusible link connector P1 from the machine wire harness.
3. Use a multimeter to ensure that the continuity exists between each terminal pin in the connector P1 and connector J1 at the starter (Figure 194).
4. If any of the fusible links are open, replace the fusible link harness.

   Note: Before installing a new fusible link harness, ensure any conditions that may have damaged the fusible links have been identified and repaired.
5. After you complete the testing, ensure that the fusible link harness connectors are correctly attached to the starter and machine wire harness. Connect the positive battery cable to the battery terminal and then connect the negative cable to the battery.

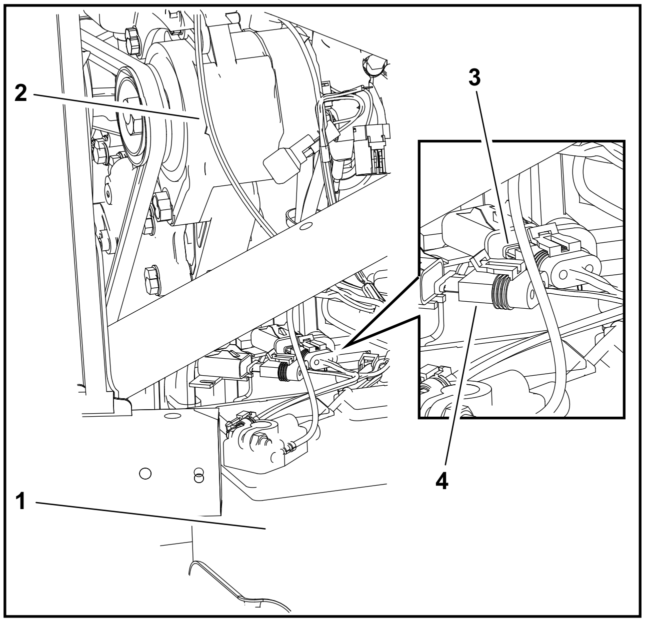
Fuses



g037784

Figure 195

1. Fuse block



g186521

Figure 196

1. Battery	3. 25 A fuse
2. Alternator	4. 2 A fuse

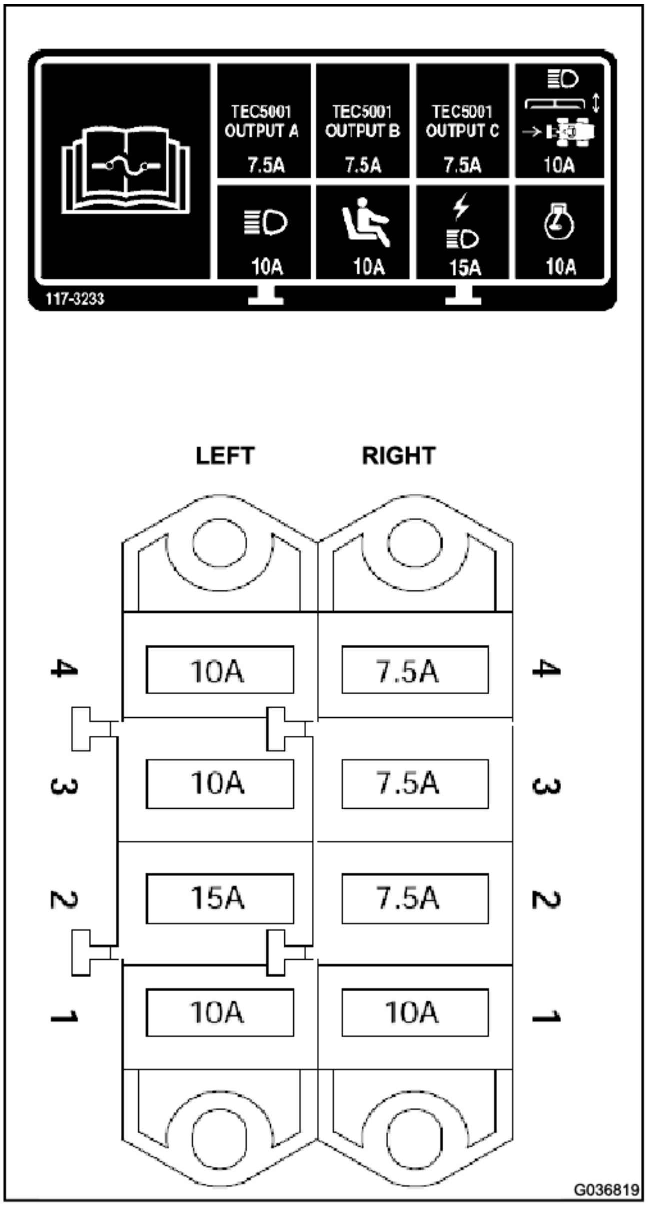
The fuse blocks are located inside the power center assembly that is behind the operator seat (Figure 195).

In addition to the fuses in the fuse blocks, there are 2 additional fuses included in the engine wire harness. These fuses plug into the in-line fuse holders near the battery (Figure 196). The fuses have the following functions:

2 A fuse: Protects the TEC logic power circuit.

25 A fuse: Protects the engine ECU and EGR relay power circuit.

Identification and Function



g036819

Figure 197

Refer to Figure 197 to identify each individual fuse and its correct amperage. The fuses have the following functions.

Left fuse 1 (10 A): Protects power supply for the steering, neutral, parking brake sensors, and InfoCenter Display.

Left fuse 2 (15 A): Protects power supply for the power point and optional light kit hazard lights.

Left fuse 3 (10 A): Protects power supply for the optional air ride seat.

Left fuse 4 (10 A): Protects power supply for the key switch and optional light kit.

Right fuse 1 (10 A): Protects power supply for the operator cab power relay circuit if equipped.

Identification and Function (continued)

Right fuse 2 (7.5 A): Protects power supply for TEC outputs 1 through 4 (fuel pump and engine ECU). The TEC outputs 3 and 4 are not used on the machine.

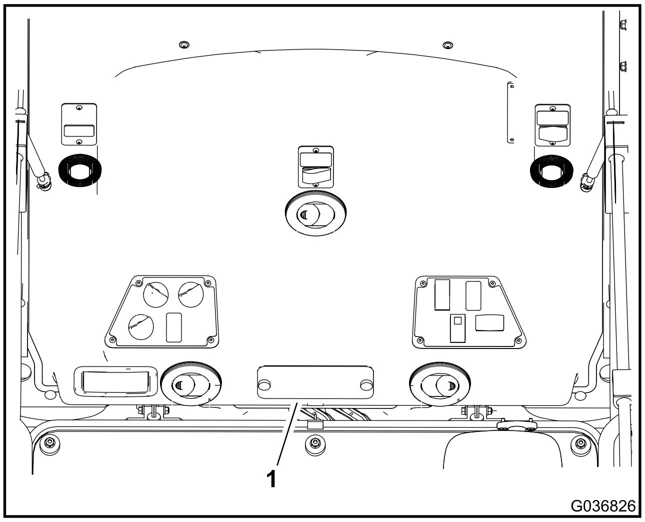
Right fuse 3 (7.5 A): Protects power supply for TEC outputs 5 through 8 (PTO solenoid coil, steering selector switch, indicator light, deck lift manifold S1 and S2 coils).

Right fuse 4 (7.5 A): Protects power supply for TEC outputs 9 through 12 (steer mode selector valve coil). The TEC outputs 10, 11, and 12 are not used on the machine.

Testing the Fuses

Ensure that the key switch is in the OFF position and the key is removed from the switch. Remove the fuses from the fuse block for testing. The fuse should have continuity between the fuse terminals.

Operator Cab Fuses (Machines with Operator Cab)



g036826

Figure 198

1. Fuse blocks location

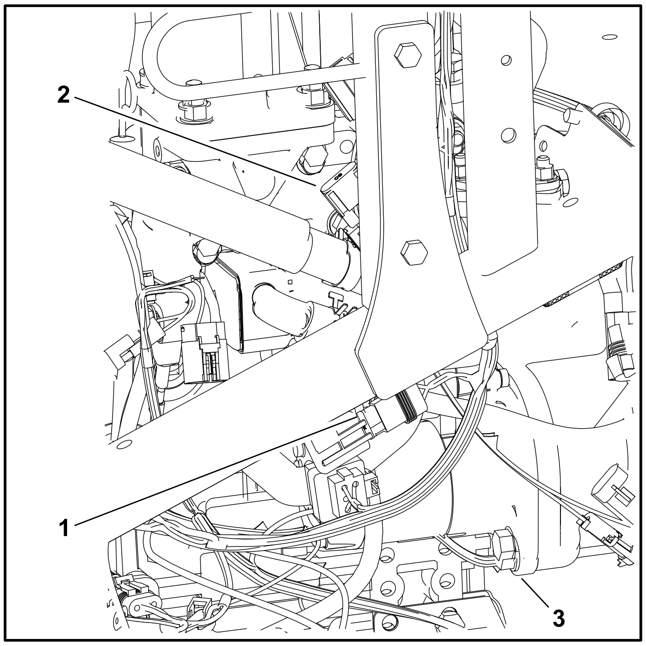


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Figure 199

1. 10 A fuse	3. Engine starter motor
2. 60 A maxi-fuse	

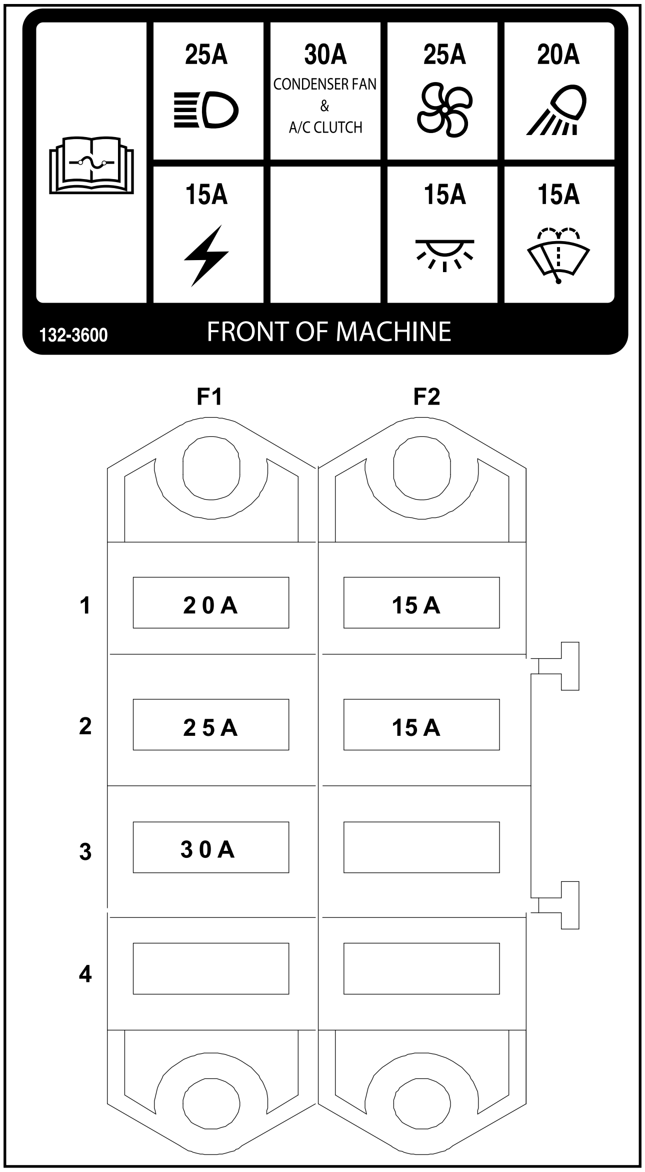
The operator cab fuse blocks are located in the cab headliner (Figure 198).

In addition to the cab fuses in the fuse blocks, there are 2 additional fuses included in the cab wire harness. These fuses plug into the fuse holders near the engine starter motor (Figure 199). The fuses have the following functions:

60 A maxi-fuse: Protects the unswitched cab power circuit.

10 A fuse: Protects the unswitched cab radio power.

Identification and Function



g187999

Figure 200

Refer to Figure 200 to identify each individual fuse and its correct amperage. The fuses have the following functions.

Fuse F1-1 (20 A): Protects the cab work light circuit.

Fuse F1-2 (25 A): Protects the blower fan circuit.

Fuse F1-3 (30 A): Protects the air conditioner compressor clutch circuit.

Fuse F2-1 (15 A): Protects the windshield wiper/washer circuit.

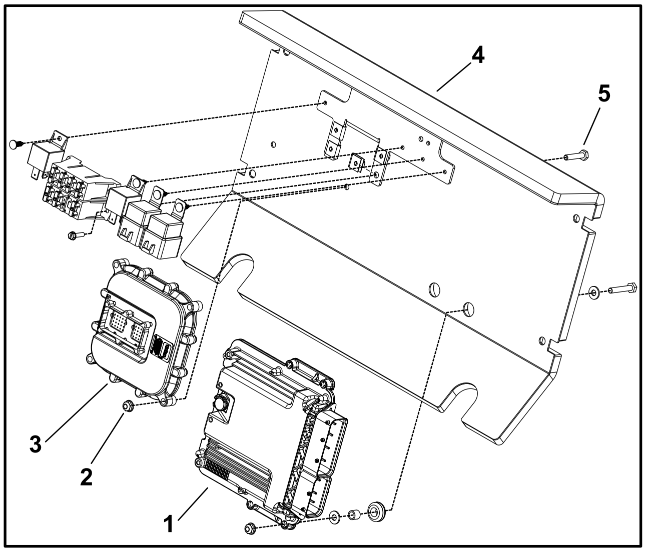
Fuse F2-2 (15 A): Protects the cab dome light circuit.

Fuses F1-4, F2-3, and F2-4 are available for optional equipment.

Testing the Fuses

Ensure that the key switch is in the OFF position and the key is removed from the switch. Remove the fuses from the fuse block for testing. The fuse should have continuity between the fuse terminals.

Toro Electronic Controller (TEC)



g186519

Figure 201

1. Engine ECU
2. Flange nut (4 each)
3. TEC
4. Power center tray assembly
5. Screw (4 each)

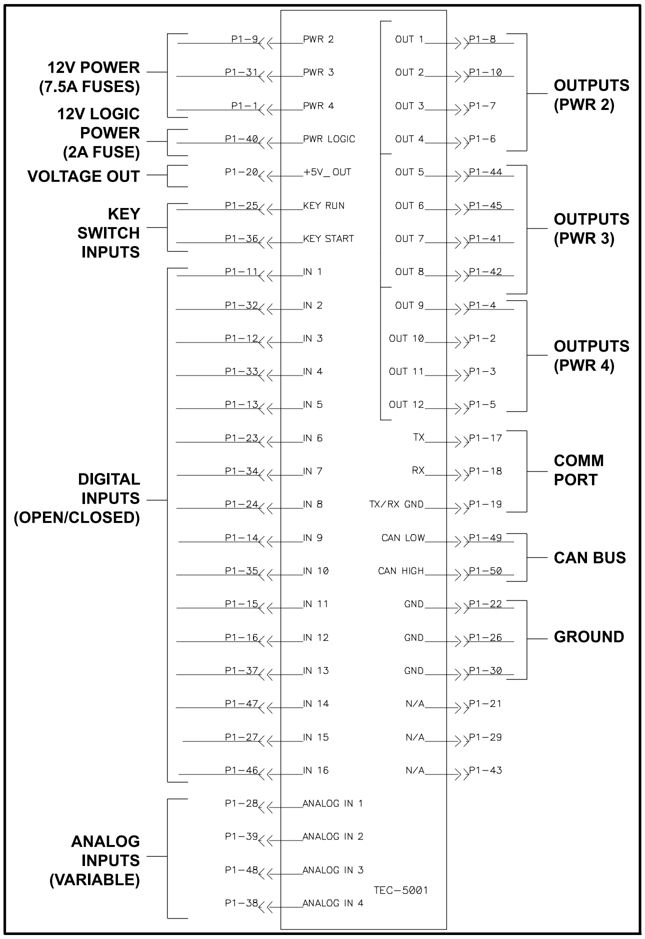


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Figure 202

Toro Electronic Controller (TEC) (continued)

The Groundsmaster 360 machines use a Toro Electronic Controller (TEC) to monitor the condition of various switches (inputs) and then direct electrical power output to allow certain machine functions. The controller is attached inside the power center assembly behind the operator seat (Figure 201). Use the InfoCenter display when checking the inputs and outputs of the TEC used on your machine.

The logic power is provided to the controller as long as the battery cables are connected to the battery. Circuit protection for this logic power to the controller is provided by 2 A fuse.

The inputs from the key, neutral, parking brake, PTO, seat, deck lift, steering selector, engine speed, steering home switches, and engine temperature sender are all monitored by the controller.

The current output to the following components are controlled based on the inputs received by the controller.

- PTO circuit hydraulic valve solenoid coil
- Lift circuit hydraulic valve solenoid coils
- Steering selector switch light
- 4-wheel steering hydraulic valve solenoid coil
- Fuel pump and engine ECU

The InfoCenter displays a machine fault code and description when an issue is detected.

The connection terminal functions for the TEC are shown in Figure 202. Note that electrical power for the controller outputs is provided through 3 connectors (PWR 2, PWR 3, and PWR 4) each protected with a 7.5 A fuse. A 50 pin wire harness connector attaches to the controller. The connector pins are identified in Figure 202.

IMPORTANT

When testing for wire harness continuity at the connector for the TEC, ensure that you do not damage the connector pins with the multimeter test leads. If the connector pins are enlarged or damaged during testing, connector repair will be necessary for proper machine operation.

Toro Electronic Controller (TEC) (continued)

The machine Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1)—Foldout Drawings can be used to identify possible circuit problems between the controller and the input/output devices (e.g., switches and solenoid coils).

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

IMPORTANT

Before performing any welding on the machine, disconnect both negative and positive battery cables from the battery, disconnect the wire harness connector from the TEC and engine ECU, and disconnect the terminal connector from the alternator. This will prevent damage to the electrical system of your Groundsmaster.

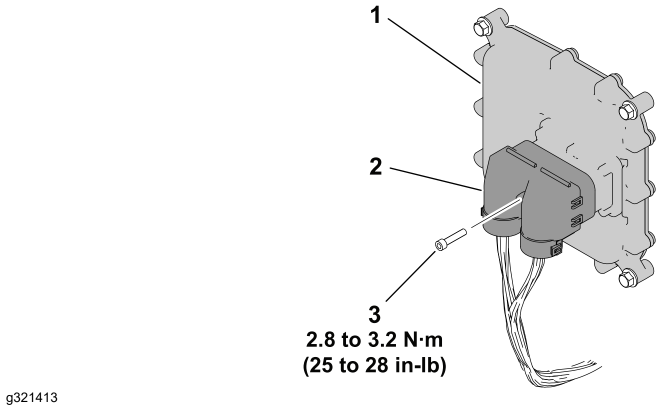
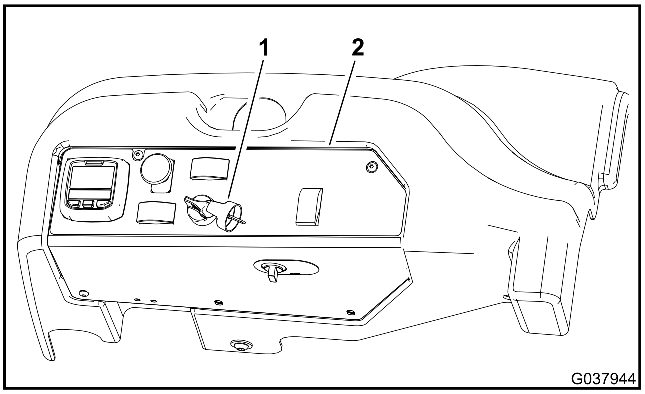


Figure 203

1. TEC controller
2. Machine harness connector
3. Socket head screw

If the wire harness connector is removed from the TEC controller for any reason, tighten the harness connector screw from **2.8 to 3.2 N·m (25 to 28 in-lb)**.

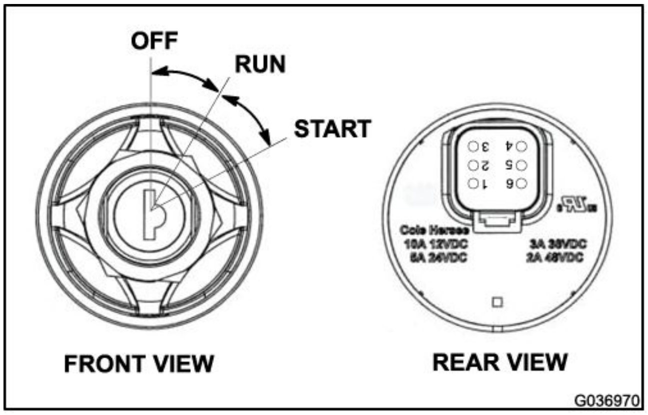
Key Switch



g037944

Figure 204

1. Key switch	2. Control panel



g036970

Figure 205

The key switch is located on the control panel and has three positions: Off, Run, and Start (Figure 205).

The Toro Electronic Controller (TEC) monitors the operation of the key switch.

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. Remove the key from the key switch.
2. Before you disconnect the key switch for testing, ensure that you test the switch and its circuit wiring as a TEC electrical input with the InfoCenter display; refer to Using the InfoCenter Display for Troubleshooting (page 5–30).
3. If the input testing verifies that the key switch and circuit wiring are functioning correctly, no further key switch testing is necessary.
4. If the input testing determines that the key switch and circuit wiring are not functioning correctly, proceed with the following key switch testing procedure.
5. Remove the control panel to get access to the key switch; refer to Disassembling the Control Console (page 6–54).
6. Ensure that the key switch is in the Off position. Disconnect the wire harness connector from the key switch.
7. The key switch terminals are identified in Figure 205 and the circuitry of the switch is shown in the Circuit Logic Table (page 5–61). 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. Check the continuity between the switch terminals.

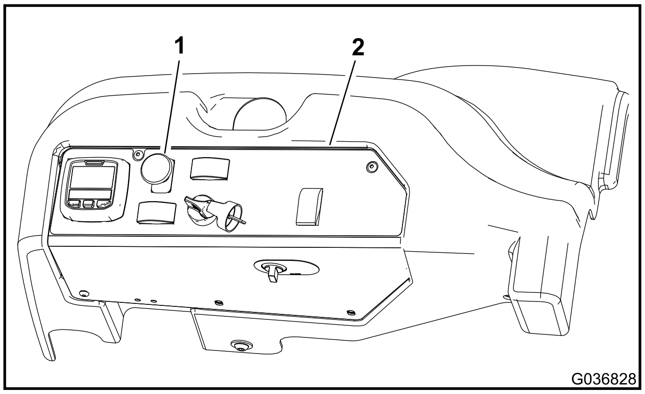
8. Replace the key switch if testing determines that it is damaged.
9. If the key switch testing is correct and a circuit problem still exists, check the wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1)—Foldout Drawings.
10. After you complete the testing, connect the machine wire harness connector to the key switch.
11. Secure the control panel to the machine with the removed fasteners; refer to Assembling the Control Console (page 6–54).

Circuit Logic Table

Switch Position	Circuits
OFF	1+6
RUN	1+3+4+5+6
START	1+2+4+5+6

Note: The key switch terminals 1 and 6 are connected internally. The terminals 4 and 5 are also connected internally. These terminals should have continuity regardless of the switch position.

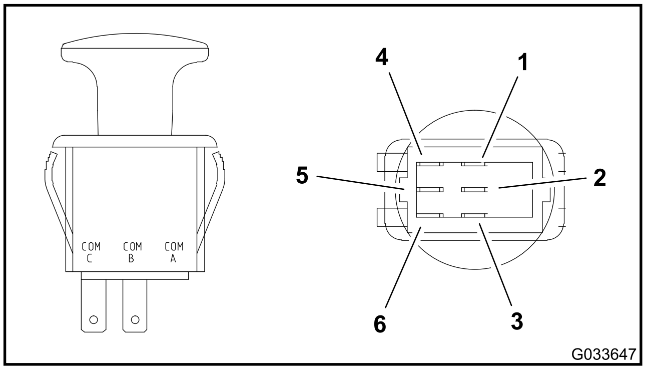
PTO Switch



g036828

Figure 206

1. PTO switch
2. Control panel



g033647

Figure 207

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

The PTO switch is located on the control panel (Figure 206). The PTO switch is pulled up to engage the PTO and pushed in to disengage the PTO.

The TEC 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 TEC controls the energizing of the hydraulic solenoid valve used to drive the cutting deck motor.

Note: To engage the PTO, the seat has to be occupied, traction pedal should be in the NEUTRAL position, and the cutting deck has to be fully lowered.

Testing the PTO Switch

1. Park the machine on a level surface, lower the cutting deck, set the parking brake, and shut off the engine.
2. Before you disconnect the PTO switch for testing, ensure that you test the switch and its circuit wiring as a TEC electrical input with the InfoCenter display; refer to Using the InfoCenter Display for Troubleshooting (page 5–30).
3. If the InfoCenter verifies that the PTO switch and circuit wiring are functioning correctly, no further switch testing is necessary.
4. If the InfoCenter determines that the PTO switch and circuit wiring are not functioning correctly, proceed with the test.

Testing the PTO Switch (continued)

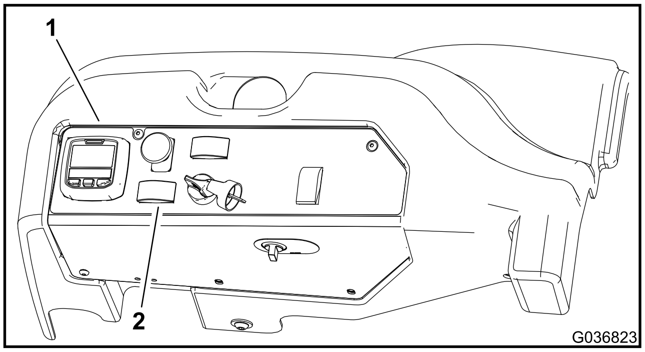
5. Ensure that the key switch is in the OFF position.
6. Remove the control panel to get access to the PTO switch; refer to Disassembling the Control Console (page 6–54).
7. Disconnect the wire harness electrical connector from the PTO switch.
8. The PTO switch terminals are identified in Figure 207 and the circuitry of the switch is shown in the Circuit Logic Table (page 5–63). 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. Check the continuity between the switch terminals.

Circuit Logic Table

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

9. Replace the PTO switch if testing determines that the switch is damaged.
10. 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)–Foldout Drawings.
11. After you complete the testing, connect the wire harness connector to the PTO switch.
12. Secure the control panel to the machine with the removed fasteners; refer to Assembling the Control Console (page 6–54).

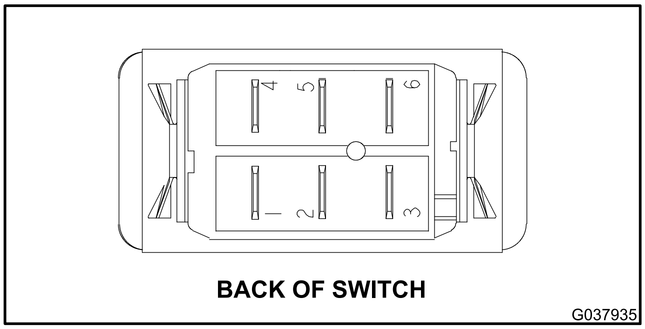
Deck Lift Switch



g036823

Figure 208

1. Control panel
2. Deck lift switch



g037935

Figure 209

The deck lift switch is used to raise or lower the cutting deck. The deck lift switch is located on the control panel (Figure 208).

The engine must be running to allow the cutting deck to be raised or lowered. When the front of the lift switch is pressed, the deck will lower fully. When the rear of the lift switch is pressed and held, the deck will raise. When raising the deck, the deck will remain in position if the switch is released.

Note: To raise or lower the deck, the seat has to be occupied. Also, to lower the cutting deck, the engine must be in running condition.

The Toro Electronic Controller (TEC) monitors the operation of the deck lift switch.

Testing the Deck Lift Switch

1. Park the machine on a level surface, lower the cutting deck, set the parking brake, and shut off the engine.
2. Before you disconnect the deck lift switch for testing, ensure that you test the switch and its circuit wiring as a TEC electrical input with the InfoCenter display; refer to Using the InfoCenter Display for Troubleshooting (page 5–30).
3. If the InfoCenter verifies that the deck lift switch and circuit wiring are functioning correctly, no further switch testing is necessary.
4. If the InfoCenter determines that the deck lift switch and circuit wiring are not functioning correctly, proceed with the test.
5. Remove the control panel to get access to the deck lift switch; refer to Disassembling the Control Console (page 6–54).

Testing the Deck Lift Switch (continued)

6. Ensure that the key switch is in the OFF position. Disconnect the wire harness electrical connector from the deck lift switch.
7. The deck lift switch terminals are identified in Figure 209 and the circuitry of the switch is shown in the Circuit Logic Table (page 5–65). 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. Check the continuity between the switch terminals.

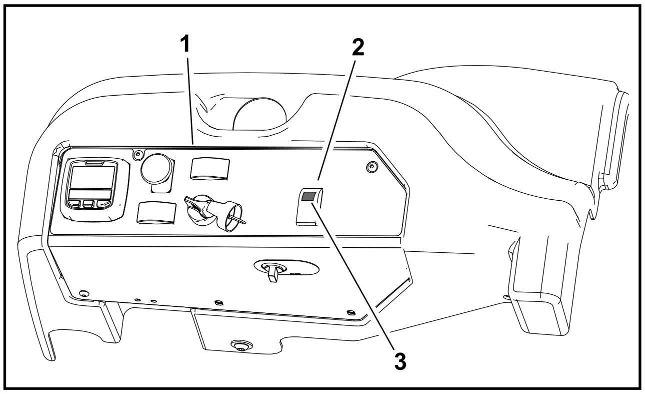
Circuit Logic Table

Switch Position	Normal Circuits	Other Circuits
RAISE	2+1	5+4
OFF	None	None
LOWER	2+3	5+6

Note: The lift switch terminals 4, 5, and 6 are not used on the Groundsmaster 360 machines.

8. Replace the deck lift switch if testing determines that the switch is damaged.
9. If the deck lift 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)—Foldout Drawings.
10. After you complete the testing, connect the wire harness connector to the deck lift switch.
11. Secure the control panel to the machine with the removed fasteners; refer to Assembling the Control Console (page 6–54).

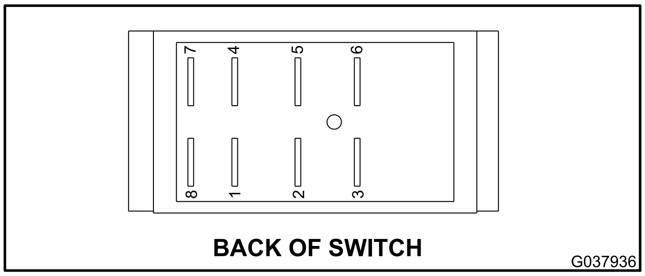
Steering Selector Switch



g187655

Figure 210

1. Control panel
2. Steering selector switch
3. Green light



g037936

Figure 211

The steering selector switch is used to control 4-wheel steer operation. The steering selector switch is located on the control panel (Figure 210).

When the steering selector switch is pressed to the forward position with the wheels not aligned in the forward position, the green light flashes and the machine remains in the 4-wheel steering mode until the 4 tires point straight ahead. Turn the steering wheel slowly to straighten out the wheels until the green light stops flashing and remains on. When the switch light is solid green, the machine is in the 2-wheel steering. This position is recommended for transporting the machine.

When the steering selector switch is pressed to the rearward position, with the front wheels not aligned in the forward position, the green light flashes and the machine remains in the 2-wheel steering mode until the 4 tires point straight ahead. Turn the steering wheel slowly to straighten out the wheels until the green light stops flashing and remains off. When the switch light is continuously off, the machine is in the 4-wheel steering mode.

The Toro Electronic Controller (TEC) monitors the operation of the steering selector switch.

Testing the Steering Selector Switch

1. Park the machine on a level surface, lower the cutting deck, set the parking brake, and shut off the engine.
2. Before you disconnect the steering selector switch for testing, ensure that you test the switch and its circuit wiring as a TEC electrical input with the InfoCenter display; refer to Using the InfoCenter Display for Troubleshooting (page 5–30).

3. If the InfoCenter verifies that the steering selector switch and circuit wiring are functioning correctly, no further switch testing is necessary.
4. If the InfoCenter determines that the steering selector switch and circuit wiring are not functioning correctly, proceed with the test.
5. Remove the control panel to get access to the steering selector switch; refer to Disassembling the Control Console (page 6–54).
6. Ensure that the key switch is in the OFF position. Disconnect the wire harness electrical connector from the steering selector switch.
7. The steering selector switch terminals are identified in Figure 211 and the circuitry of the switch is shown in the Circuit Logic Table (page 5–67). 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. Check the continuity between the switch terminals.

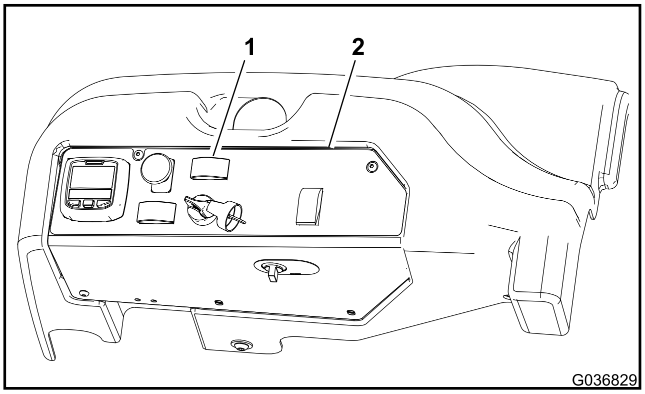
Circuit Logic Table

Switch Position	Normal Circuits	Other Circuits
4-WHEEL STEER	2+1	5+4
2-WHEEL STEER	2+3	5+6

Note: The steering selector switch terminals 3, 4, 5, and 6 are not used on the Groundsmaster 360 machines.

8. Terminals 7 (-) and 8 (+) are used for the indicator light in the switch. The light should be illuminated when the machine is in 4-wheel steer mode. To test the switch light, apply 12 VDC to terminal 8 (+) and ground terminal 7 (-). The light should illuminate.
9. Replace the steering selector switch if testing determines that the switch is damaged.
10. If the steering selector 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)—Foldout Drawings.
11. After you complete the testing, connect the wire harness connector to the steering selector switch.
12. Secure the control panel to the machine with the removed fasteners; refer to Assembling the Control Console (page 6–54).

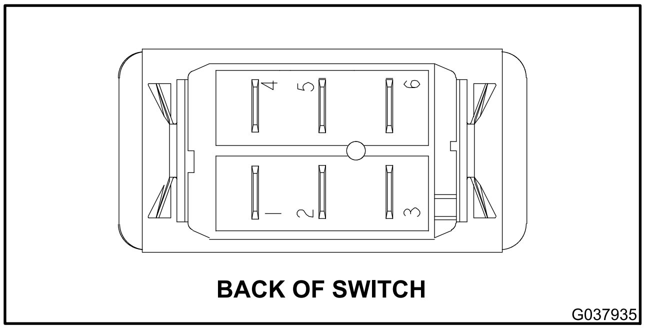
Engine Speed Switch



g036829

Figure 212

1. Engine speed switch	2. Control panel



g037935

Figure 213

The engine speed switch is used as an input for the TEC to signal the engine ECU via the CAN-bus to increase or decrease the engine speed. When the switch is pressed and held in the forward position, the engine speed will increase. Conversely, when the rear of the switch is pressed, the engine speed will decrease.

Testing the Engine Speed Switch

1. Park the machine on a level surface, lower the cutting deck, set the parking brake, and shut off the engine.
2. Before you disconnect the engine speed switch for testing, ensure that you test the switch and its circuit wiring as TEC input with the InfoCenter display; refer to Using the InfoCenter Display for Troubleshooting (page 5–30).
3. If the InfoCenter verifies that the engine speed switch and circuit wiring are functioning correctly, no further switch testing is necessary.
4. If the InfoCenter determines that the engine speed switch and circuit wiring are not functioning correctly, proceed with the test.
5. Remove the control panel to get access to the engine speed switch; refer to Disassembling the Control Console (page 6–54).
6. Ensure that the key switch is in the OFF position. Disconnect the wire harness electrical connector from the engine speed switch.
7. The engine speed switch terminals are identified in Figure 213 and the circuitry of the switch is shown in the Circuit Logic Table (page 5–69). 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. Check the continuity between the switch terminals.

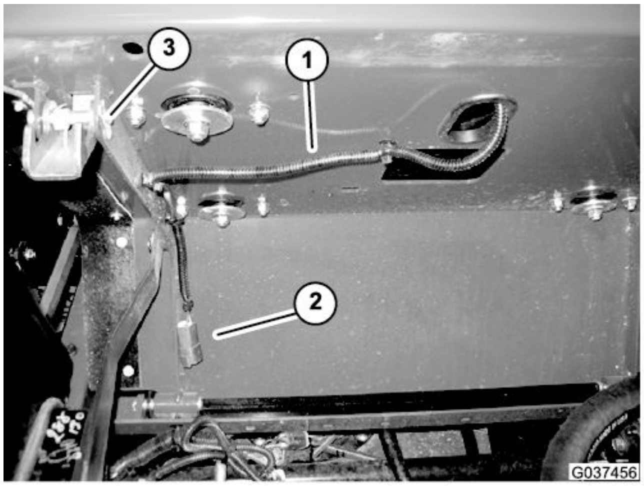
Circuit Logic Table

Switch Position	Normal Circuits	Other Circuits
DECREASE	2+1	5+4
OFF	None	None
INCREASE	2+3	5+6

Note: The engine speed switch terminals 4,5, and 6 are not used on the Groundsmaster 360 machines.

8. Replace the engine speed switch if testing determines that the switch is damaged.
9. If the engine speed 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)—Foldout Drawings.
10. After you complete the testing, connect the wire harness connector to the engine speed switch.
11. Secure the control panel to the machine with the removed fasteners; refer to Assembling the Control Console (page 6–54).

Seat Switch



g037456

Figure 214

1. Seat wire harness
2. Seat harness connector
3. Seat latch

The seat switch is 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, an operator advisory will be displayed on the InfoCenter. 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 switch wire from the machine wire harness (Figure 214).

The Toro Electronic Controller (TEC) 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. Before you disconnect the seat switch for testing, ensure that you test the switch and its circuit wiring as a TEC electrical input with the InfoCenter display; refer to Using the InfoCenter Display for Troubleshooting (page 5–30).
3. If the InfoCenter verifies that the seat switch and circuit wiring are functioning correctly, no further switch testing is necessary.
4. If the InfoCenter determines that the seat switch and circuit wiring are not functioning correctly, proceed with the test.
5. Ensure that the key switch is in the OFF position. Tilt the seat assembly up to get access to the seat switch electrical connections.

   Note: There is a short wire harness that is used to connect the seat switch to the main wire harness of the machine. This seat switch harness is between the seat and the seat plate.
6. Disconnect the machine wire harness electrical connector from the seat switch harness electrical lead under the operator seat (Figure 214).
7. 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.

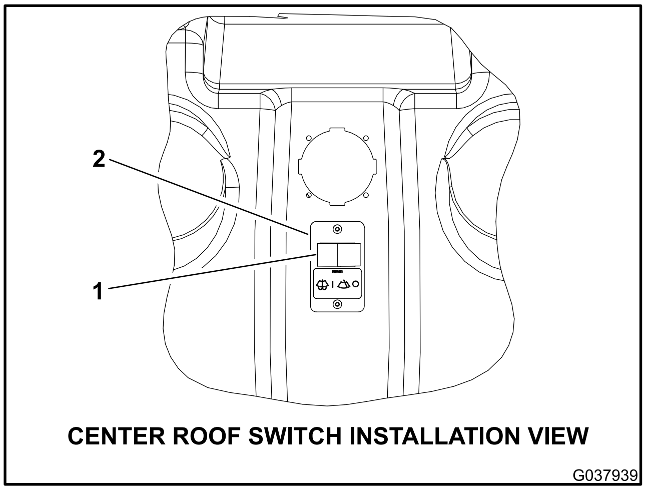
⚠ WARNING ⚠

To prevent injury, do not attempt to reach the switch through openings in the seat plate.

If seat switch service is necessary, remove the seat from the seat plate to access the switch.

8. Replace the seat switch if testing determines that the switch is damaged; refer to Servicing the Operator Seat (Machines without Operator Cab) (page 6–62) and Servicing the Operator Seat (Machines with Operator Cab) (page 6–65).
9. If the seat switch testing is correct and a 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)—Foldout Drawings.
10. After you complete the seat switch testing, connect the machine wire harness connector to the seat switch electrical lead. Lower the seat assembly. Check the operation of the seat switch.

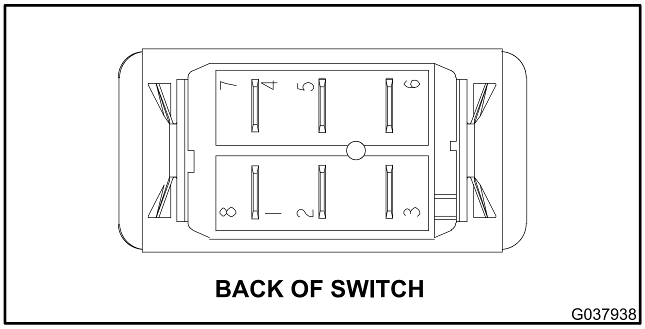
Windshield Washer/Wiper Switch (Machines with Operator Cab)



g037939

Figure 215

1. Washer/wiper switch
2. Switch panel



g037938

Figure 216

The windshield washer/wiper switch controls the operation of the windshield wiper and washer pump. The switch is located in the cab headliner (Figure 215).

Testing the Windshield Washer/Wiper Switch

1. Park the machine on a level surface, lower the cutting deck, set the parking brake, and shut off the engine.
2. To access the switch, remove the roof panel from the top of the cab; refer to Roof Assembly (page 8–10).
3. Remove the left or right defrost vent hose from the heat and air conditioning mixing box to access the flange nuts securing the switch panel and remove the switch panel from the cab headliner.
4. Disconnect the wire harness electrical connector from the windshield wiper/washer switch.
5. The windshield wiper/washer switch terminals are identified in Figure 216 and the circuitry of the switch is shown in the Circuit Logic Table (page 5–73). 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. Check the continuity between the switch terminals.

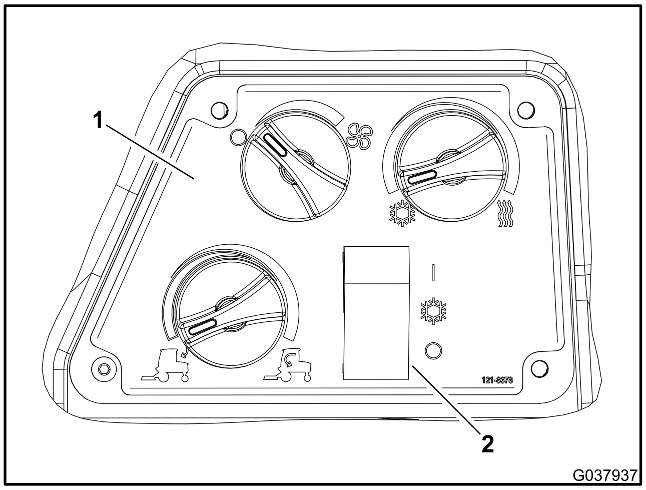
Testing the Windshield Washer/Wiper Switch (continued)

Circuit Logic Table

Switch Position	Normal Circuits	Other Circuits
OFF	2+1	None
WIPER ON	2+3	None
WASHER ON	2+3	5+6

6. Replace the windshield wiper/washer switch if testing determines that the switch is damaged.
7. If the windshield wiper/washer 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)—Foldout Drawings.
8. After you complete the testing, connect the wire harness connector to the windshield wiper/washer switch.
9. Secure the switch panel to the cab headliner with the removed fasteners.
10. Install the cab roof; refer to Roof Assembly (page 8–10)

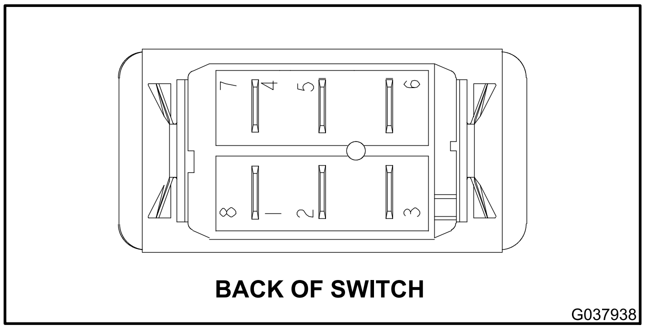
Air Conditioning Switch (Machines with Operator Cab)



g037937

Figure 217

1. Cab headliner (air/heat panel)
2. Air conditioning switch



g037938

Figure 218

The air conditioning switch controls the operation of the air conditioning system. The switch is located in the cab headliner (Figure 217).

Testing the Air Conditioning Switch

1. Park the machine on a level surface, lower the cutting deck, set the parking brake, and shut off the engine.
2. To access the switch, remove the roof panel from the top of the cab; refer to Roof Assembly (page 8–10).
3. Remove the air/heat panel from the cab headliner.
4. Disconnect the wire harness electrical connector from the air conditioning switch.
5. The air conditioning switch terminals are identified in Figure 218 and the circuitry of the switch is shown in the Circuit Logic Table (page 5–75). 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. Check the continuity between the switch terminals.

Testing the Air Conditioning Switch (continued)

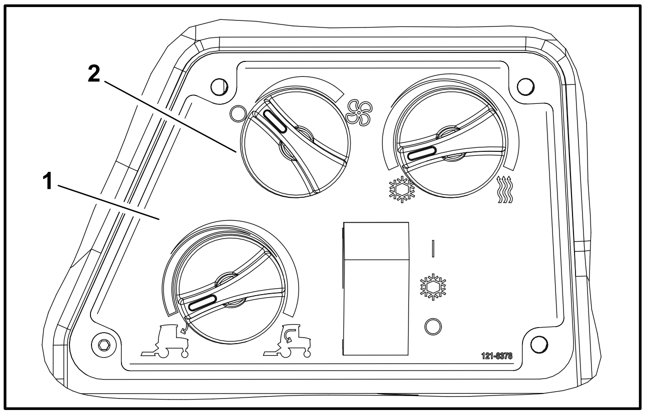
Circuit Logic Table

Switch Position	Normal Circuits	Other Circuits
OFF	2+1	5+4
ON	2+3	5+6

Note: The air conditioning switch terminals 1, 4, 5, and 6 are not used on the Groundsmaster 360 machines.

6. Replace the air conditioning switch if testing determines that the switch is damaged.
7. If the air conditioning 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)—Foldout Drawings.
8. After you complete the testing, connect the wire harness connector to the air conditioning switch.
9. Secure the air/heat panel to the cab headliner with the removed fasteners.
10. Install the cab roof; refer to Roof Assembly (page 8–10).

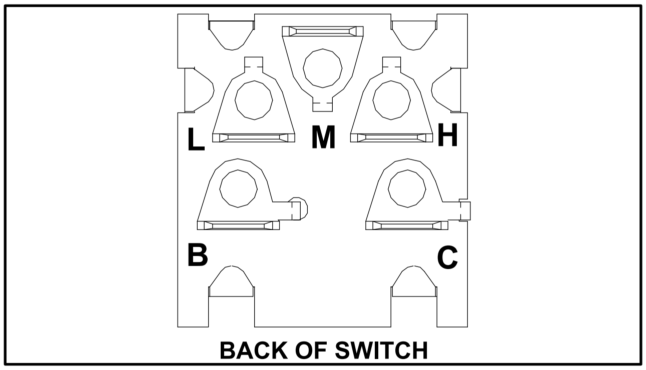
Fan Speed Switch (Machines with Operator Cab)



g186593

Figure 219

1. Cab headliner (air/heat panel)
2. Fan speed switch



g186592

Figure 220

The fan speed switch is located in the cab headliner (Figure 219). The switch is used to select the air conditioning/heater fan speed (off, low, medium, or high).

Testing the Fan Speed Switch

1. Park the machine on a level surface, lower the cutting deck, and shut off the engine. Remove the key from the key switch.
2. To access the switch, remove the roof panel from the top of the cab; refer to Roof Assembly (page 8–10).
3. Remove the air/heat panel from the cab headliner.
4. Disconnect the machine wire harness connector from the fan speed switch.
5. The switch terminals are identified in Figure 220 and the circuitry of the switch is shown in the Circuit Logic Table (page 5–77). With the use of a multimeter (ohms setting), test the switch functions to determine if continuity exists between only the terminals listed for each switch position. Check the continuity between the switch terminals.

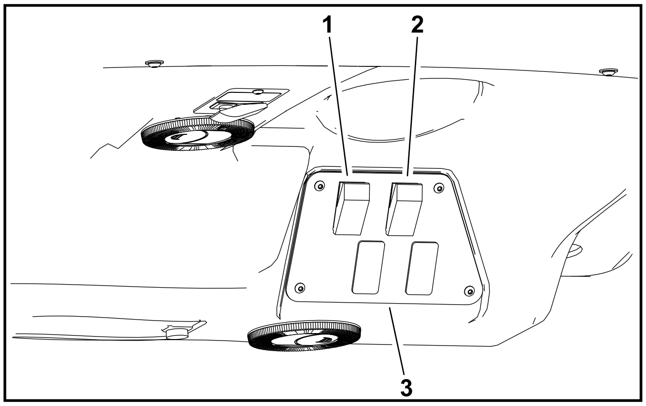
Testing the Fan Speed Switch (continued)

Circuit Logic Table

Switch Position	Closed Circuits
OFF	L+H
LOW	B+C+L
MEDIUM	B+C+M
HIGH	B+C+H

6. Replace the fan speed switch if testing determines that the switch is damaged.
7. If the fan speed switch testing is correct and a circuit problem still exists, check the wire harnesses; refer to Electrical Schematics and Wire Harness Drawings and Diagrams in Appendix A (page A–1)-Foldout Drawings.
8. After you complete the testing, connect the machine wire harness connector to the switch and install the air/heat panel.
9. Install the cab roof; refer to Roof Assembly (page 8–10).

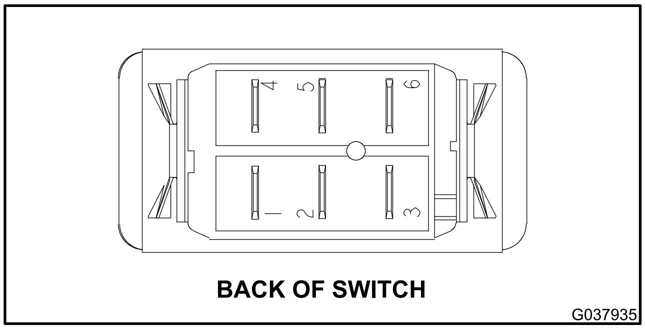
Work Light Switch (Machines with Operator Cab–Optional)



g186594

Figure 221

1. Work light switch (optional)
2. Beacon switch (optional)
3. Cab headliner (lights switch panel)



g037935

Figure 222

The switches are located in the cab headliner (Figure 221). The switches are used to turn the optional light kits on and off.

Testing the Work Light Switch

1. Park the machine on a level surface, lower the cutting deck, and shut off the engine. Remove the key from the key switch.
2. To access the switch, remove the roof panel from the top of the cab; refer to Roof Assembly (page 8–10).
3. Remove the lights switch panel from the cab headliner.
4. Disconnect the machine wire harness connector from the switch that you are testing.
5. The switch terminals are identified in Figure 222 and the circuitry of the switch is shown in the Circuit Logic Table (page 5–78). 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. Check the continuity between the switch terminals.

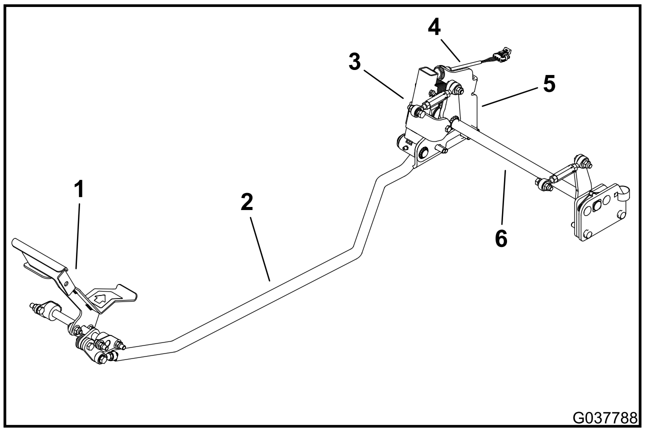
Circuit Logic Table

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

Testing the Work Light Switch (continued)

6. Replace the 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 harnesses; refer to Electrical Schematics and Wire Harness Drawings and Diagrams in Appendix A (page A–1)—Foldout Drawings.
8. After you complete the testing, connect the machine wire harness connector to the switch and install the lights switch panel.
9. Install the cab roof; refer to Roof Assembly (page 8–10).

Traction Neutral Sensor



g037788

Figure 223

1. Traction pedal
2. Traction rod assembly
3. Neutral arm assembly
4. Traction neutral sensor
5. Neutral end plate
6. Neutral shaft assembly

The traction neutral sensor is a normally open proximity sensor that closes when the traction pedal is in the NEUTRAL position. The sensor mounts to a neutral end plate (Figure 223). The sensing plate for the traction neutral sensor is the neutral arm.

The Toro Electronic Controller (TEC) monitors the operation of the neutral sensor.

Testing the Traction Neutral Sensor

1. Park the machine on a level surface, lower the cutting deck, set the parking brake, and shut off the engine.
2. Before you disconnect the neutral sensor for testing, ensure that you test the sensor and its circuit wiring as a TEC electrical input with the InfoCenter display; refer to Using the InfoCenter Display for Troubleshooting (page 5–30).
3. If the input testing verifies that the neutral sensor and circuit wiring are functioning correctly, no further neutral sensor testing is necessary.
4. If the input testing determines that the neutral sensor and circuit wiring are not functioning correctly, proceed with the test.
5. Raise and support the operator seat. Locate the neutral sensor (Figure 223).
6. Turn the key switch to the RUN position (do not start the engine) and check the LED on the cable end of the neutral sensor. The LED should be illuminated when the traction pedal is in the NEUTRAL position.
7. With the key switch still in the RUN position (do not start the engine), press the traction pedal out of the NEUTRAL position and check the LED on the cable end of the neutral sensor. The LED should not be illuminated when the traction pedal is not in the NEUTRAL position.
8. If the neutral sensor LED did not function correctly, do the following:
    A. Ensure that the neutral sensor is properly adjusted; refer to Adjusting the Traction Neutral Sensor (page 5–45). If necessary, adjust the sensor and return to step 6.

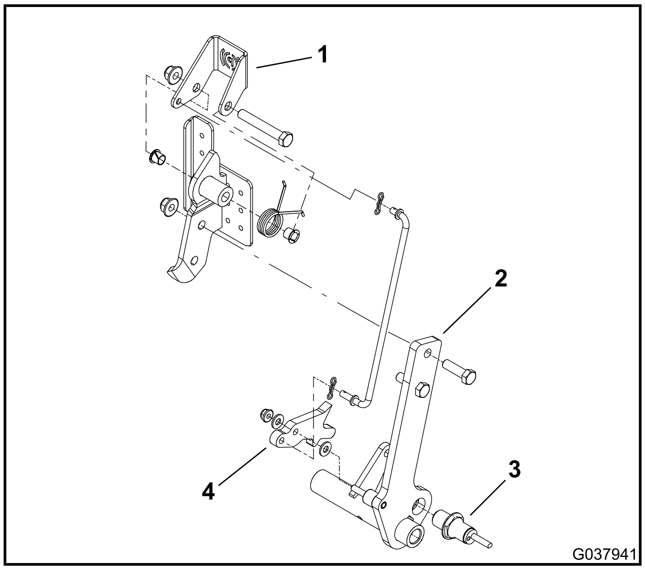
    B. Ensure that the key switch is in the OFF position and disconnect the traction neutral sensor connector from the machine wire harness.

Testing the Traction Neutral Sensor (continued)

   C. Use a multimeter, check that the machine wire harness connector terminal for black wire is closed (continuity) to the ground.
   D. Turn key switch to the RUN position (do not start the engine) and check with a multimeter that the machine wire harness connector terminal for pink wire has system voltage (12 VDC) present.
   E. If the black wire is closed to the ground, the pink wire has system voltage present, and the sensor LED did not function, replace the traction neutral sensor. Adjust the sensor after installation; refer to Adjusting the Traction Neutral Sensor (page 5–45).

9. After you complete the neutral sensor testing, ensure that the sensor connector is plugged into machine wire harness.
10. Lower and secure the operator seat.

Parking Brake Sensor



g037941

Figure 224

1. Parking brake latch
2. Brake lever
3. Parking brake sensor
4. Parking brake detent

The parking brake sensor is a normally open proximity sensor that mounts to the brake lever assembly (Figure 224). The sensing plate for the brake sensor is the parking brake detent.

The machine is equipped with an interlock switch on the parking brake. The engine shuts off if the traction control pedal is moved from the NEUTRAL position with the parking brake engaged. Refer to the Safety Interlock System in the *Traction Unit Operator's Manual*.

When the parking brake is not set (the brake latch is not engaged), the parking brake detent is positioned near the target end of the parking brake sensor so that the sensor is closed. The parking brake detent is moved away from the sensor when the parking brake is set (the brake latch is engaged) causing the sensor to open.

The Toro Electronic Controller (TEC) monitors the operation of the parking brake sensor.

Testing the Parking Brake Sensor

1. Park the machine on a level surface, lower the cutting deck, and shut off the engine.
2. Before you disconnect the parking brake sensor for testing, ensure that you test the sensor and its circuit wiring as a TEC electrical input with the InfoCenter display; refer to Using the InfoCenter Display for Troubleshooting (page 5–30).
3. If the InfoCenter verifies that the brake sensor and circuit wiring are functioning correctly, then no more brake sensor testing is necessary.
4. If the InfoCenter determines that the brake sensor and circuit wiring are not functioning correctly, proceed with the test.
5. Locate the parking brake sensor (Figure 224).

   Note: Ensure that the parking brake is not set.

Testing the Parking Brake Sensor (continued)

6. Turn the key switch to the RUN position (do not start the engine) and check the LED on the cable end of the parking brake sensor. The LED should be illuminated when the parking brake is not set (the brake latch is not engaged).
7. With the key switch still in the RUN position (do not start the engine), set the parking brake (the brake latch engaged) and check the LED on the cable end of the parking brake sensor. The LED should not be illuminated when the parking brake is set (the brake latch engaged).
8. If the brake sensor LED did not function correctly, do the following:
    A. Ensure that the parking brake sensor is properly adjusted; refer to Adjusting the Parking Brake Sensor (page 5–47). If necessary, adjust the sensor and return to step 6.

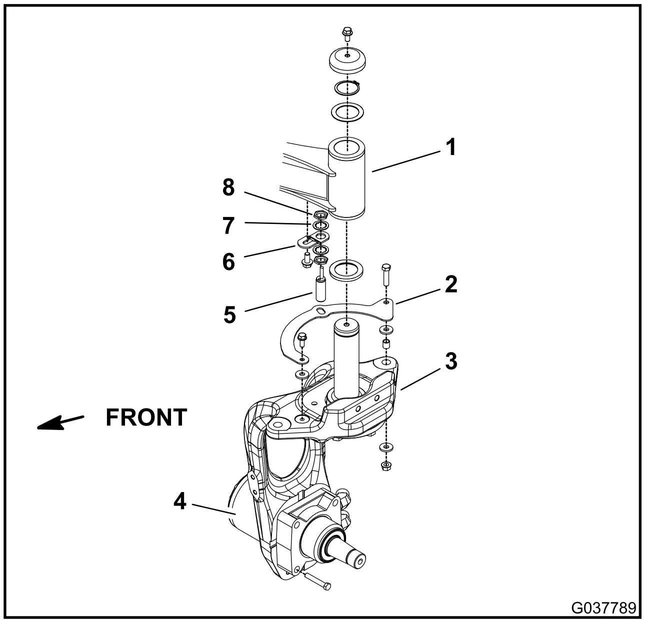
    B. Ensure that the key switch is in the OFF position and disconnect the parking brake sensor connector from the machine wire harness.

    C. Use a multimeter, check that the machine wire harness connector terminal for the black wire is closed (continuity) to the ground.

    D. Turn the key switch to the RUN position (do not start the engine) and check with a multimeter that the machine wire harness connector terminal for pink wire has system voltage (12 VDC) present.

    E. If the black wire is closed to the ground, the pink wire has system voltage present, and the sensor LED did not function, replace the parking brake sensor. Adjust the sensor after installation; refer to Adjusting the Parking Brake Sensor (page 5–47).
9. After you complete the brake sensor testing, ensure that the sensor connector is plugged into the machine wire harness.

Steering Home Sensor



g037789

Figure 225

1.	Front axle	5.	Steering home sensor
2.	Target bracket	6.	Sensor bracket
3.	Left front steering fork	7.	Lock washer (2 each)
4.	Wheel motor	8.	Jam nut (2 each)

The steering home sensor is used to determine when the wheels are directed straight ahead. The sensor acts as an input for the Toro Electronic Controller (TEC) to determine when steering can be changed from 4-wheel steering to 2-wheel steering. This interlock system is described in the Steering Selector Switch (page 5–66).

The steering home sensor is a normally open proximity sensor. The sensor mounts to a bracket that is secured to the bottom of the front axle near the left side front steering fork (Figure 225). The sensing plate for the steering home sensor is a target bracket attached to the left side front steering fork.

When the left side front steering fork is in the straight ahead position, a hole in the target bracket is positioned directly below the steering home sensor allowing the sensor to be in its normally open state. The sensor closes when the left side front steering fork is not in the straight ahead position.

Testing the Steering Home Sensor

1. Park the machine on a level surface, lower the cutting deck, and shut off the engine.
2. Before you disconnect the steering home sensor for testing, ensure that you test the sensor and its circuit wiring as a TEC electrical input with the InfoCenter display; refer to Using the InfoCenter Display for Troubleshooting (page 5–30).
3. If the InfoCenter verifies that the steering home sensor and circuit wiring are functioning correctly, then no more steering home sensor testing is necessary.
4. If the InfoCenter determines that the steering home sensor and circuit wiring are not functioning correctly, proceed with the test.
5. Locate the steering home sensor and target bracket on the left side front steering fork (Figure 225).

Testing the Steering Home Sensor (continued)

6. Turn the steering wheel so that the front wheels are turned and check that the hole in the target bracket on the left side steering fork is not directly below the steering home sensor. Turn the key switch to the RUN position (do not start the engine) and check the LED on the cable end of the steering home sensor. The LED should be illuminated when the front wheel is turned (is not aimed straight ahead).

7. Turn the steering wheel so that the front wheels are straight ahead and check that the hole in target bracket on the left side steering fork is directly below the steering home sensor. With the key switch still in the RUN position (do not start the engine), check the LED on the cable end of the steering home sensor. The LED should not be illuminated when the front wheel is not turned (is aimed straight ahead).

8. If the steering home sensor LED did not function correctly, do the following:

    A. Ensure that the steering home sensor is properly adjusted; refer to Adjusting the Steering Home Sensor (page 5–48). If necessary, adjust the sensor and return to step 6.

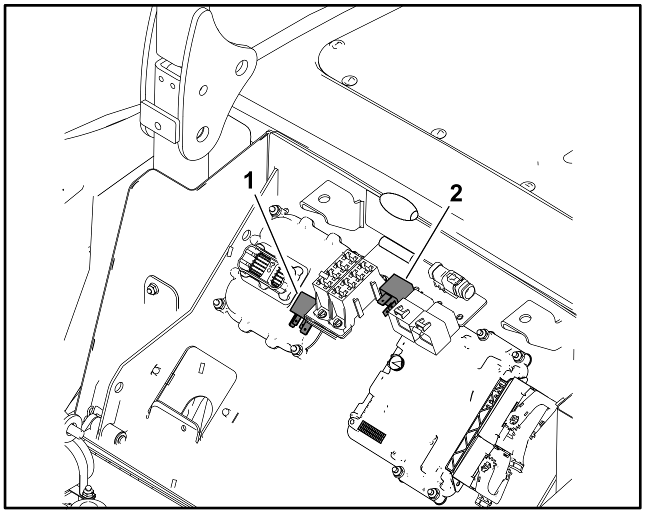
    B. Ensure that the key switch is in the OFF position and disconnect the steering home sensor connector from the machine wire harness.

    C. Use a multimeter, check that the machine wire harness connector terminal for the black wire is closed (continuity) to the ground.

    D. Turn the key switch to the RUN position (do not start the engine) and check with a multimeter that the machine wire harness connector terminal for pink wire has system voltage (12 VDC) present.

    E. If the black wire is closed to the ground, the pink wire has system voltage present, and the sensor LED did not function, replace the steering home sensor. Adjust the sensor after installation; refer to Adjusting the Steering Home Sensor (page 5–48).

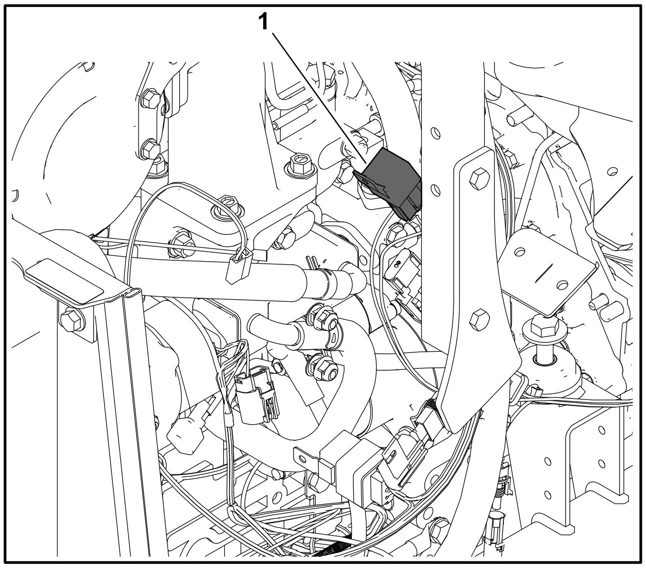
9. After you complete the steering home sensor testing, ensure that the sensor connector is plugged into the machine wire harness.



g188103

Figure 226

1. Main power relay
2. Glow relay



g188101

Figure 227

1. Cab power relay

The Groundsmaster 360 machine uses 3 electrical relays that have 4 terminals. A tag near the wire harness relay connector can be used to identify each relay.

The main power relay is used to provide current to the fuse blocks. When the key switch is in the RUN or START position, the main power relay is energized.

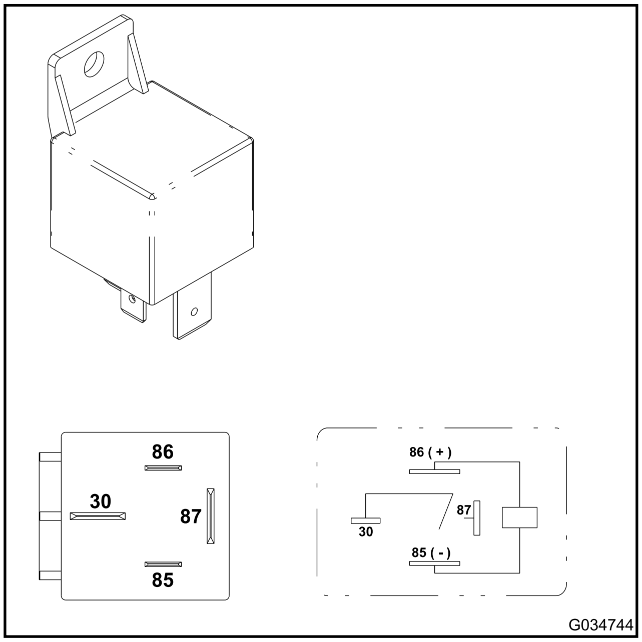
The glow relay is used to provide current to the engine glow plugs when the relay is energized. The engine ECU provides current to energize the glow relay.

The cab power relay (on the machines with operator cab) is used to provide current to the operator cab electrical circuits. The cab power relay is energized when the main power relay is energized.

The main power and glow relay are located inside the power center assembly behind the operator seat (Figure 226).

The cab power relay is located near the washer fluid tank (Figure 227).

Testing the Relays with 4 Terminals



g034744

Figure 228

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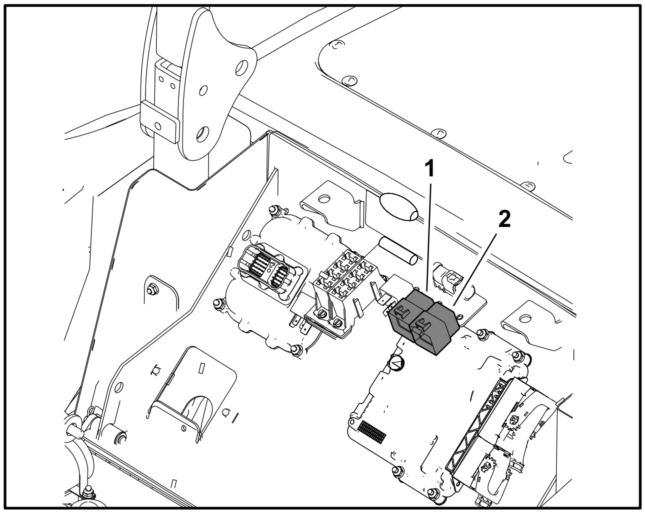
1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. To ensure that the machine operation does not occur unexpectedly, disconnect the negative (-) cable from the battery and then disconnect the positive (+) cable from the battery; refer to Servicing the Battery (page 5–111).
3. Locate the relay that is to be tested.
4. Disconnect the wire harness electrical connector from the relay.

   Note: Before taking the small resistance readings with a digital multimeter, short the multimeter test leads together. The meter displays a small resistance value (usually 0.5 ohms or less). This resistance is because of the internal resistance of the multimeter and test leads. Subtract this value from the measured value of the component that you are testing.
5. Check the coil resistance between the terminals 85 and 86 with a multimeter (ohms setting). The resistance must be approximately 72 ohms.
6. Connect the multimeter (ohms setting) leads to the relay terminals 30 and 87. Then ground terminal 85 and apply +12 VDC to terminal 86. The relay must break the continuity between the terminals 30 and 87 as +12 VDC is set and removed from terminal 86.
7. Disconnect the voltage and leads from the relay terminals.
8. Replace the relay if testing determines that it is damaged.
9. Connect the wire harness electrical connector to the relay after you complete the testing.
10. Connect the positive (+) cable to the battery and then connect the negative (-) cable to the battery; refer to Servicing the Battery (page 5–111).

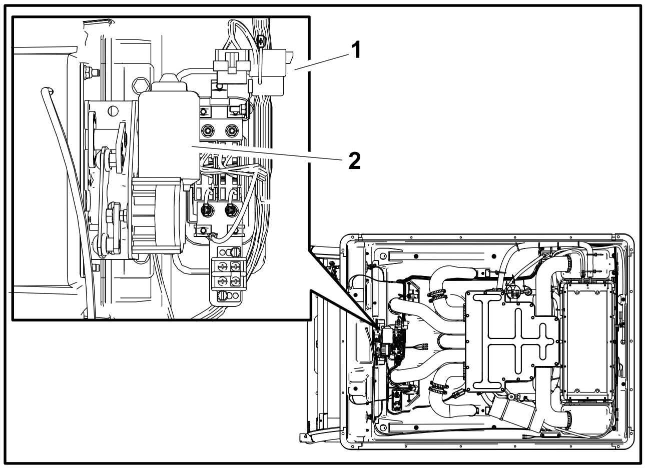
Relays with 5 Terminals



g188104

Figure 229

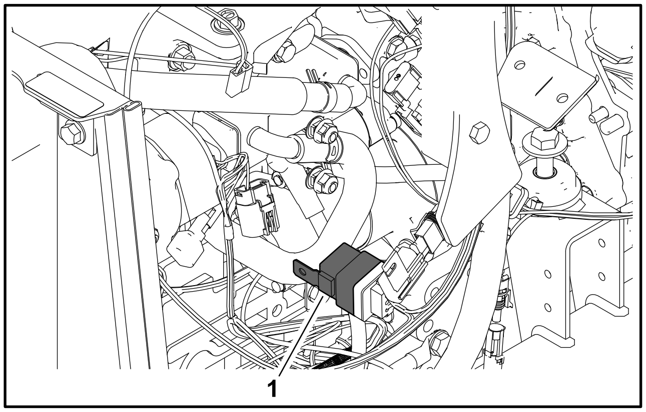
1. Start relay
2. EGR relay



g188105

Figure 230

1. Air conditioning relay
2. Wiper motor assembly



g188102

Figure 231

1. Air conditioning clutch relay

The Groundsmaster 360 machine uses 4 electrical relays that have 5 terminals. A tag near the wire harness relay connector can be used to identify each relay.

The start relay is used in the engine starting circuit. When energized by the engine ECU, the start relay provides a current path to energize the engine starter solenoid.

The EGR relay is used to provide current to the engine EGR valve when energized by the engine ECU.

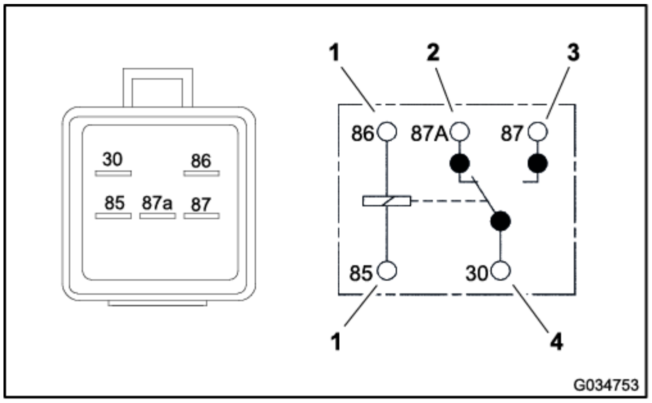
The air conditioning relay (on the machines with operator cab) is used to control the air conditioning electrical power circuit on the machine. When energized by the air conditioning switch, the relay provides current for the air conditioning components.

The air conditioning clutch relay (on the machines with operator cab) is used to monitor the air conditioning clutch.

The start and EGR relays are located inside the power center assembly behind the operator seat (Figure 229).

The air conditioning relay is located in the cab headliner (Figure 230). The air conditioning clutch relay is attached near the washer fluid tank (Figure 231).

Testing the Relays with 5 Terminals



g034753

Figure 232

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

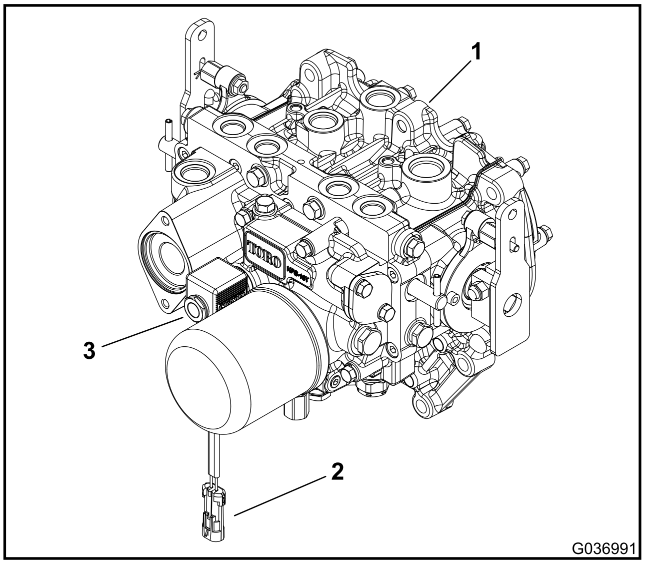
---

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. 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 5–111).
3. Locate the relay that is to be tested.
4. Disconnect the wire harness electrical connector from the relay.

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

5. Check the coil resistance between the terminals 85 and 86 with a multimeter (ohms setting). The resistance must be approximately 71 to 88 ohms.
6. Connect the multimeter (ohms setting) leads to the relay terminals 30 and 87. Then ground terminal 85 and apply +12 VDC to terminal 86. The relay must break the continuity between the terminals 30 and 87 as +12 VDC is set and removed from terminal 86.
7. Disconnect the voltage from terminal 85 and multimeter lead from terminal 87.
8. Connect the multimeter (ohms setting) leads to the relay terminals 30 and 87A and apply +12 VDC to the terminal 85. The relay should make and break continuity between the terminals 30 and 87A as +12 VDC is set and removed from the terminal 85.
9. After testing, disconnect the voltage and multimeter test leads from the relay terminals.
10. Replace the relay if testing determines that it is damaged.
11. Connect the wire harness electrical connector 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 5–111).

PTO Solenoid Valve Coil



g036991

Figure 233

1. Transmission
2. Coil connector
3. Solenoid valve and coil

The hydraulic system of the Groundsmaster 360 machine includes a solenoid valve coil that is used to engage the PTO drive (Figure 233).When the solenoid valve coil is energized, hydraulic flow is directed to operate the PTO system.

The Toro Electronic Controller (TEC) provides current to the PTO solenoid valve coil based on the position of several input switches.

Testing the PTO Solenoid Valve Coil

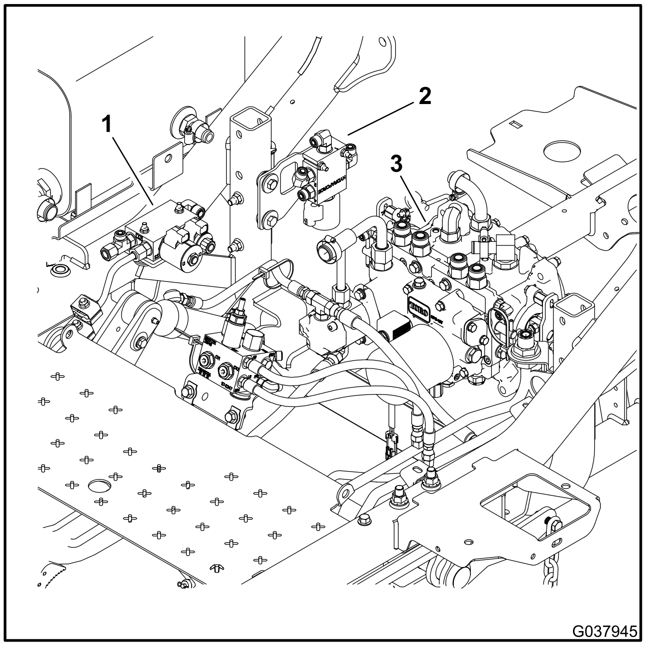
Note: Do not remove the solenoid from the cartridge valve for testing.

1. Before you disconnect the PTO solenoid valve coil, test the solenoid and its circuit wiring as TEC outputs with the InfoCenter display; refer to Using the InfoCenter Display for Troubleshooting (page 5–30).
2. Raise the operator seat to get access to the PTO solenoid valve coil.
3. Ensure that the key switch is in the OFF position. Unplug the wire harness electrical connector from the solenoid valve coil.

   Note: Before taking the small resistance readings with a digital multimeter, short the multimeter test leads together. The multimeter 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 solenoid coil that you are testing.
4. Measure the resistance between the 2 solenoid coil connector terminals of the solenoid coil.

   Note: The resistance of the solenoid coil must be approximately 7.5 ohms.
5. If the solenoid coil requires replacement; refer to PTO Solenoid Valve Coil (page 5–105).
6. After you complete the testing, connect the wire harness connector to the solenoid coil.
7. Lower and secure the operator seat.

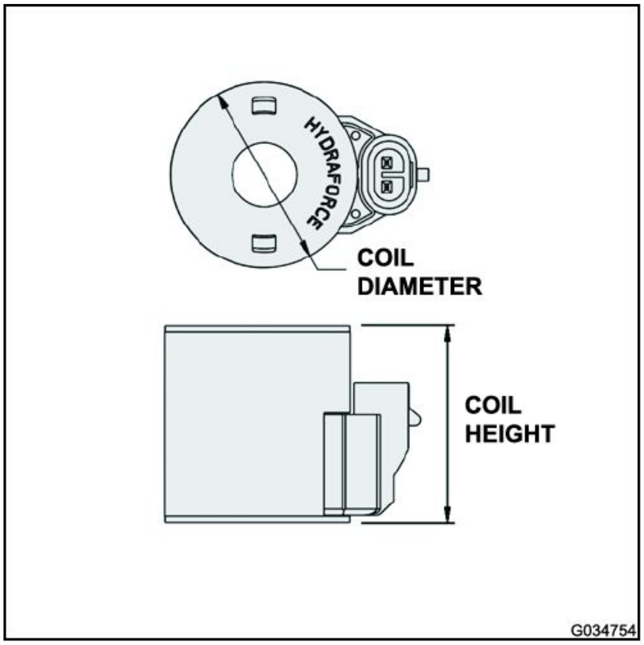
Hydraulic Solenoid Valve Coils



g037945

Figure 234

1. Deck lift manifold assembly
2. Steering selector manifold assembly
3. Transmission



g034754

Figure 235

The Groundsmaster 360 hydraulic control manifolds use several hydraulic solenoid valve coils for system control (Figure 234). The deck lift manifold assembly includes 2 solenoid valves and the steering selector manifold assembly includes a single solenoid valve. When the solenoid coils are energized, the hydraulic valve shift occurs to control the hydraulic fluid flow. The correct resistance of a coil can be identified by measuring the height and diameter of the coil (Figure 235). Refer to Solenoid Valve Coil Specifications Table (page 5–93). Testing of the coils can be done with the coil installed on the hydraulic valve.

Testing the Hydraulic Solenoid Valve Coils

Note: Before you disconnect the solenoid valve coils, test the solenoids and their circuit wiring as TEC outputs with the InfoCenter display; refer to Using the InfoCenter Display for Troubleshooting (page 5–30). If the InfoCenter verifies that the solenoid coils and circuit wiring are functioning correctly, then no more testing is necessary.

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 support the operator seat to get access to the control manifolds and solenoid coils.
3. Locate the hydraulic solenoid valve coil that is to be tested (Figure 234). Disconnect the wire harness connector from the coil.
4. Identify the height and diameter of the coil that you are testing.

   Note: Before taking the small resistance readings with a digital multimeter, short the multimeter test leads together. The multimeter 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.

   Note: The solenoid coil resistance should be measured with solenoid at approximately 20°C (68°F). Resistance may be slightly different than listed at different temperatures. Typically, a damaged solenoid coil will either be shorted (very low or no resistance) or open (infinite resistance).

5. Use a multimeter (ohms setting), measure the resistance between the 2 connector terminals on the solenoid coil. The resistance for the solenoid coils is identified in the Solenoid Valve Coil Specifications Table (page 5–93).

Solenoid Valve Coil Specifications Table

Solenoid Valve Coil	Diameter	Height	Resistance
Deck lift manifold S2	35.8 mm (1.41 inches)	36.3 mm (1.43 inches)	8.8 ohms
Deck lift manifold S1	46.7 mm (1.84 inches)	49.9 mm (1.96 inches)	7.1 ohms
Steering selector manifold	46.7 mm (1.84 inches)	49.9 mm (1.96 inches)	7.1 ohms

6. If the solenoid coil resistance is incorrect, replace the solenoid coil; refer to Hydraulic Solenoid Valve Coils (page 5–107).
7. After testing the coils, connect the wire harness electrical connector to the solenoid valve coil.
8. Lower and secure the operator seat.

Fuel Pump

The fuel pump is attached to the frame near the fuel/water separator (Figure 236). Electrical current is available for the fuel pump when the key switch is in either the RUN or START position.

The Toro Electronic Controller (TEC) energizes the fuel pump.

IMPORTANT

When testing the fuel pump, ensure that the pump is not operated without fuel.

⚠ DANGER ⚠

Diesel fuel is highly flammable.

- **Use caution whenever you handle diesel fuel.**
- **Do not smoke while testing the fuel pump.**
- **Do not test the fuel pump while the engine is hot.**
- **Ensure that there is adequate ventilation when testing.**
- **Always wipe up any spilled diesel fuel before starting the engine.**

Testing the Fuel Pump Capacity

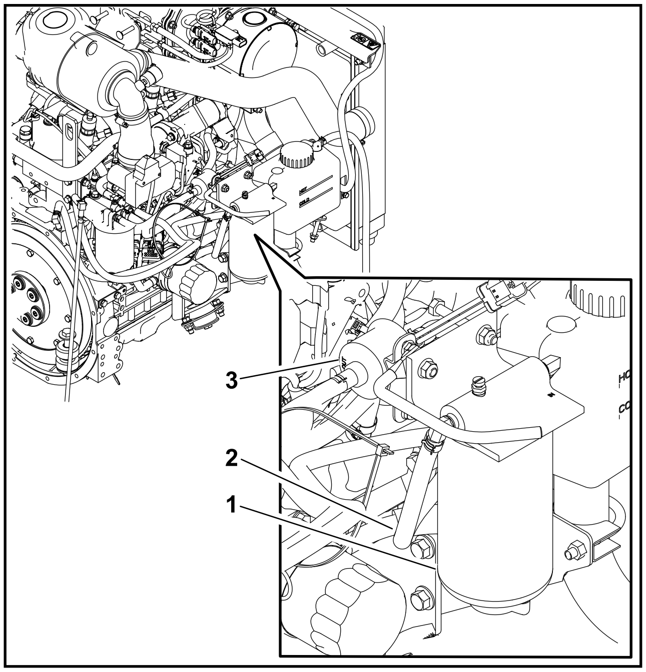


Figure 236

1. Fuel/water separator
2. Pump discharge hose
3. Fuel pump

---

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

Testing the Fuel Pump Capacity (continued)

3. Disconnect the fuel hose (pump discharge) from the inlet fitting of the fuel/water separator.
4. Place the disconnected fuel hose into a large, graduated cylinder sufficient enough to collect 0.9 L (32 fl oz).

IMPORTANT

When testing the fuel pump, do not turn the key switch to the START position.

---

5. Turn the key switch to the ON position and collect the fuel in the graduated cylinder. Allow the pump to run for 30 seconds and then turn the switch to the OFF position.

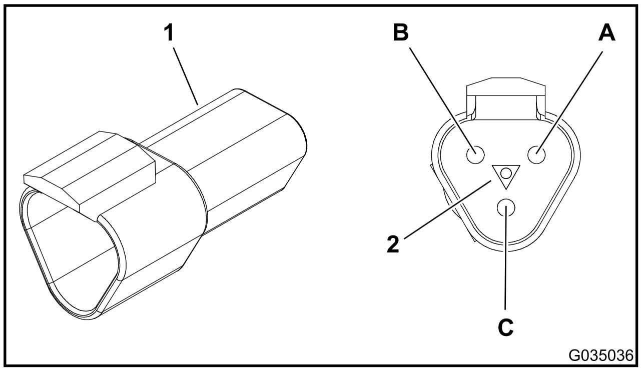
   Note: The amount of fuel pumped in 30 seconds must be approximately 350 ml (11.8 fl oz).
6. Ensure that the fuel hoses attached to the fuel pump, fuel/water separator, and fuel tank suction tube screen are free of obstructions.
7. Replace the fuel pump if necessary.
8. Connect the fuel hose to the fuel/water separator. Ensure to secure the fuel hose with the hose clamp.
9. Prime the fuel system; refer to Priming the Fuel System (page 3–17).

Fuel Pump Specifications

Pump Capacity	700 ml/minute (23.5 fl oz/minute)
Pressure	22.8 kPa (3.3 psi)
Maximum Current Draw	0.9 A

10. Lower the hood and secure it with the latches.

CAN-bus Terminator Resistor



g035036

Figure 237

1. CAN-bus terminator resistor
2. Keyway

The system communication between the electrical components on the Groundsmaster 360 machine is accomplished on a CAN-bus communication system. The 2 specially designed, twisted cables form the bus for the network are used on the machine. These wires provide the data pathways between the machine components.

The two 120 ohm CAN-bus terminator resistors plug into the platform wire harness in the power center assembly behind the operator seat. The resistor can be accessed by removing the power center cover.

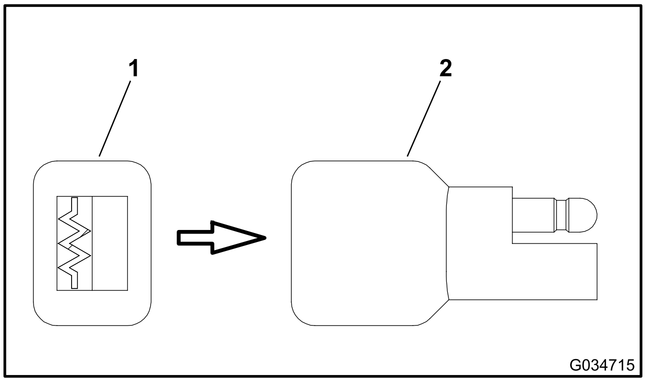
Note: The insulator wedge in the terminator resistor is blue for identification purposes. There is also a center keyway to prevent the terminator resistor from plugging into the wrong wire harness connector.

Note: Refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1)—Foldout Drawings for additional information on the location of the terminator resistor and wire connections.

Testing the CAN-bus Terminator Resistor

1. The CAN-bus terminator resistor (Figure 237) can be tested using a digital multimeter (ohms setting). Locate the CAN-bus terminator resistor and remove the cable tie that secures the resistor to the wire harness. Unplug the resistor from the wire harness for testing.
2. Use a digital multimeter (ohms setting) to measure the resistance value for the CAN-bus terminator resistor. There should be **120 ohms** resistance between the terminals A and B. The terminal C is not used.
3. If the testing determines that the CAN-bus terminator resistor is damaged, replace the CAN-bus terminator resistor.
4. After you complete the testing, ensure that the CAN-bus terminator resistor is fully installed into the wire harness connector and secured to the wire harness with cable tie.

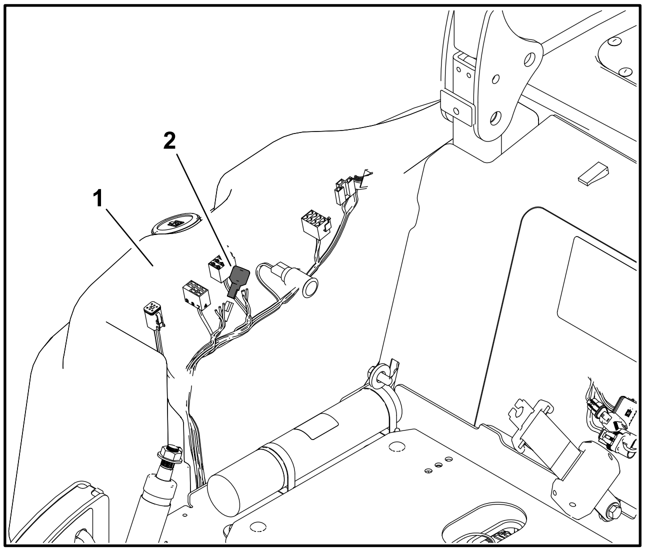
Resistor Assemblies



g034715

Figure 238

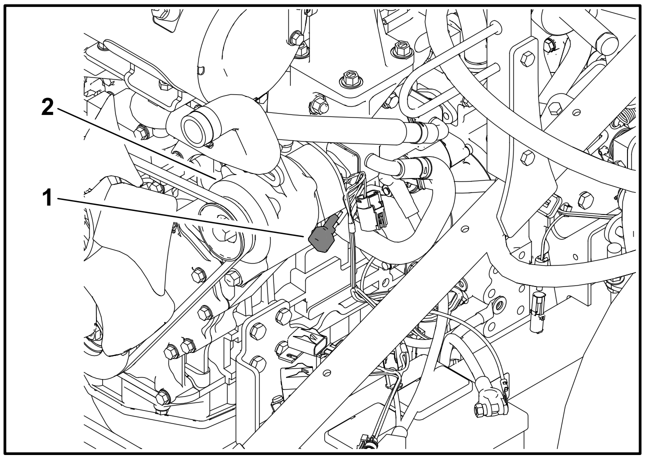
1. End of the resistor body	2. Resistor assembly



g187151

Figure 239

1. Hydraulic tank cover	2. 75 ohm resistor



g187152

Figure 240

1. 1600 ohm resistor	2. Alternator

A 75 ohm resistor (Figure 239) plugs into the console wire harness near the key switch connector; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in Appendix A (page A–1)—Foldout Drawings. This resistor is necessary for proper key switch operation.

The engine wire harness also contains a 1600 ohm resistor (Figure 240). This resistor is used in all the engine wire harnesses for Groundsmaster 360 machines that is necessary for operating the key switch. The resistor plugs into the wiring harness near the alternator; refer to the Engine Wire Harness Drawing in Appendix A (page A–1)—Foldout Drawings.

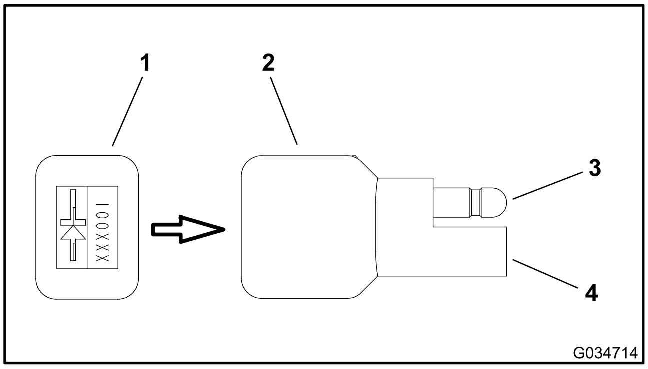
The resistor assembly can be identified by its gray color and resistor symbol on the end of the resistor assembly body.

Testing the Resistor Assembly

The resistor can be tested using a digital multimeter (ohms setting).

Note: The resistance across the resistor terminals should be 75 ohms or 1600 ohms depending on which resistor is tested.

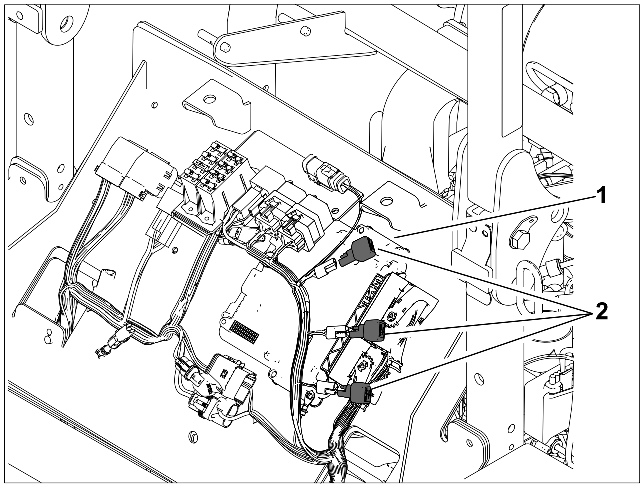
Diode Assemblies



g034714

Figure 241

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



g186681

Figure 242

1.	Engine ECU	2.	Diode (3 each)

The electrical system of the Groundsmaster 360 machine includes 3 diodes. The maximum current allowed through any of the diodes is 6 A. The diode assemblies can be identified by a black color, diode symbol, and Toro Part Number on the end of the diode assembly body (Figure 241). All the 3 diodes plug into the engine wire harness near the Yanmar engine ECU (Figure 242); refer to the Engine Wire Harness Drawing in Appendix A (page A–1)—Foldout Drawings.

A diode assembly is used for circuit protection from the voltage spikes that occur when the engine starter solenoid is de-energized.

A diode assembly is used to protect the engine ECU from reverse polarity in the EGR relay circuit.

A diode assembly is used to protect the engine ECU from reverse polarity in the alternator circuit.

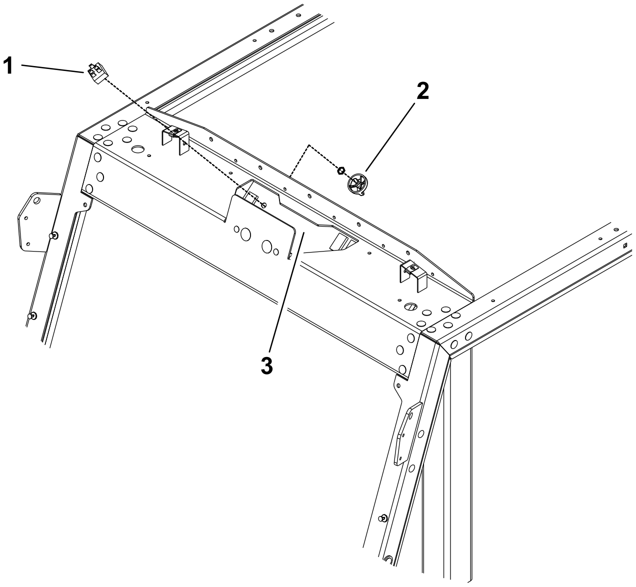
Testing the Diode Assembly

The diode shown in Figure 241 can be tested by using a digital multimeter (diode test or ohms setting); refer to Diode Test Table (page 5–100).

Diode Test Table

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

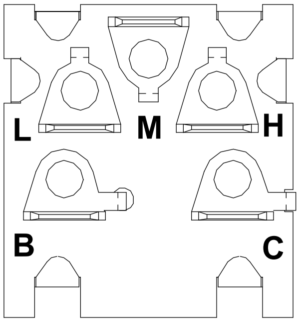
Fan Speed Switch (Machines with Two−Post ROPS Extension Operator Fan Kit)



g242793

Figure 243

1. Fan speed switch	3. Control panel
2. Control knob	



g242792

Figure 244
Back of Switch

The fan speed switch is attached to the overhead control panel (Figure 243). The switch is used to select the fan speed (OFF, LOW, MEDIUMOR HIGH).

Testing

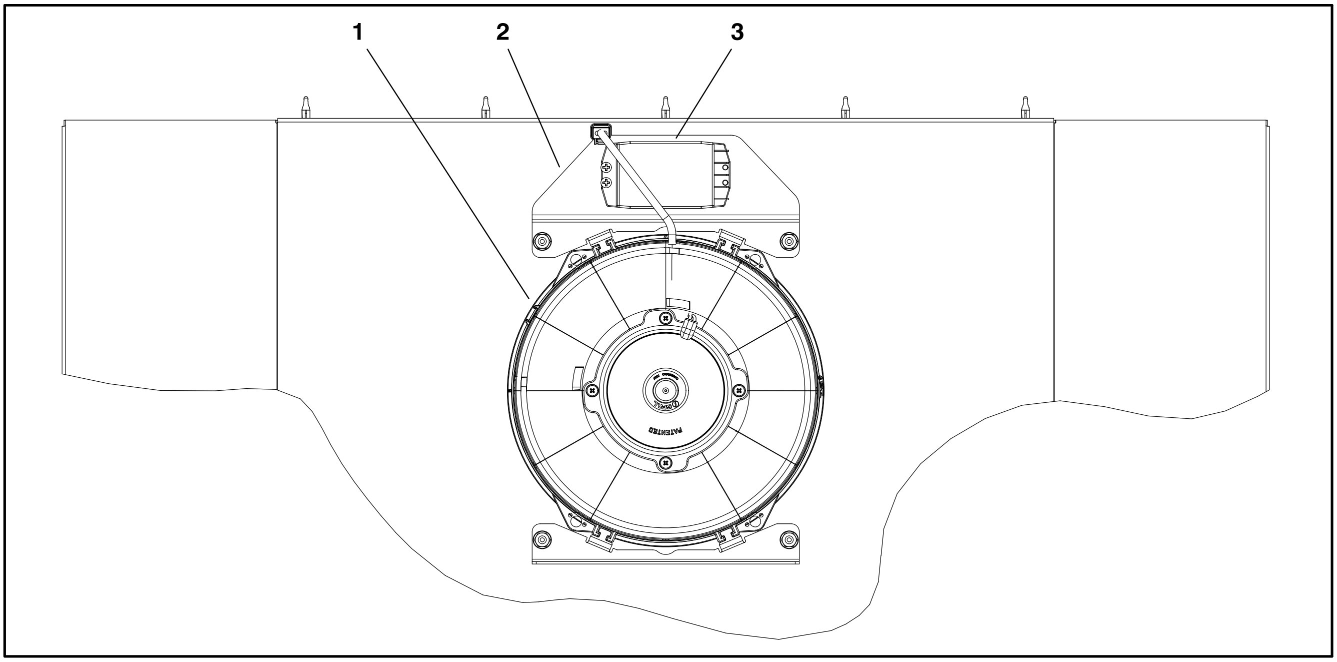
1. Park the machine on a level surface, lower the cutting decks, and shut off the engine. Remove the key from the key switch.
2. To access the switch, remove the sunshade from the top of the ROPS extension.
3. Disconnect the machine wire harness from the fan speed switch.
4. The switch terminals are identified in (Figure 244). With the use of a multimeter (ohms setting), test the switch functions to determine if continuity exists between only the terminals listed for each switch position. Check the continuity between the switch terminals.

Testing (continued)

Switch Position	Closed Circuits
OFF	L+H
LOW	B+C+L
MEDIUM	B+C+M
HIGH	B+C+H

5. Replace the fan speed switch if testing determines that the switch is damaged.
6. If the fan speed switch testing is correct and a circuit problem still exists, check the wire harness; refer to Appendix A (page A–1) - Foldout Drawings.
7. After you complete the testing, connect the machine wire harness to the switch and install the sunshade.

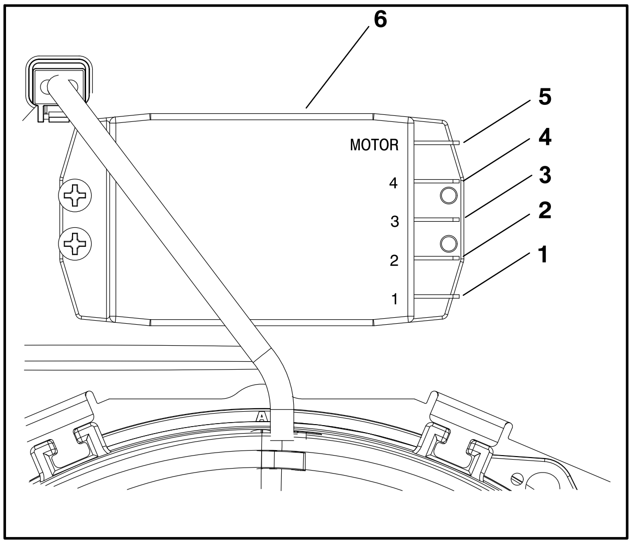
Resistor Module (Machines with Two-Post ROPS Extension Operator Fan Kit)



g242796

Figure 245

1. Operator’s fan	3. Resistor module
2. Fan mount bracket	



g250221

Figure 246

1. Pin 1 (Violet wire)	4. Pin 4 (Not used)
2. Pin 2 (Brown wire)	5. Motor pin
3. Pin 3 (Orange wire)	6. Resistor module

The resistor module is attached to the rear of the fan mounting bracket (Figure 245). The resistor module is used for operation of the operator’s fan.

Testing

1. Park the machine on a level surface, lower the cutting decks, and shut off the engine. Remove the key from the key switch.
2. To access the resistor, remove the sunshade from the top of the ROPS extension.
3. Disconnect the wire harness connectors from the resistor module terminals.
4. Use a multimeter to check that the resistance values of the resistor module as below:

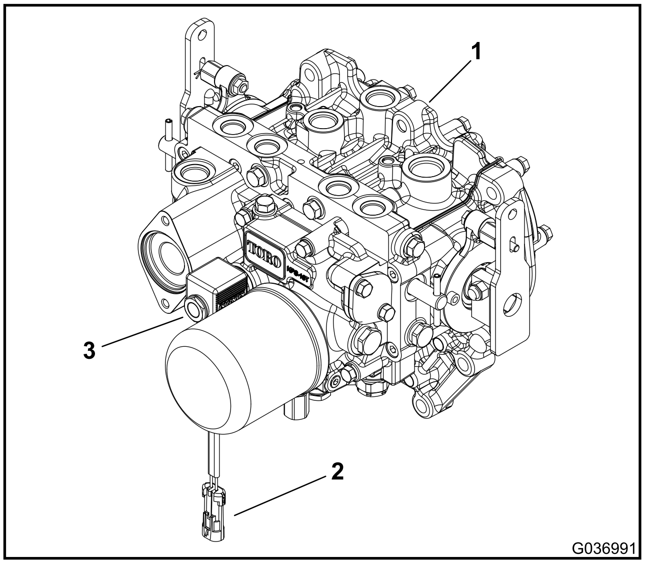
Test Point 1	Test Point 2	Expected Reading
Motor Pin	Pin 1	Less than 9 ohms
Motor Pin	Pin 2	Less than 6 ohms
Motor Pin	Pin 3	Less than 3 ohms

5. Replace the resistor module if it fails the test.
6. If the resistor module testing is correct and a circuit problem still exists, check the wire harness; refer to Appendix A (page A–1) - Foldout Drawings.
7. After you complete the testing, connect the wire harness connectors to the resistor module terminals (Figure 246) and install the sunshade.

Service and Repairs

Note: For engine component testing information, refer to the Yanmar Engine Service Manual or Troubleshooting Manual.

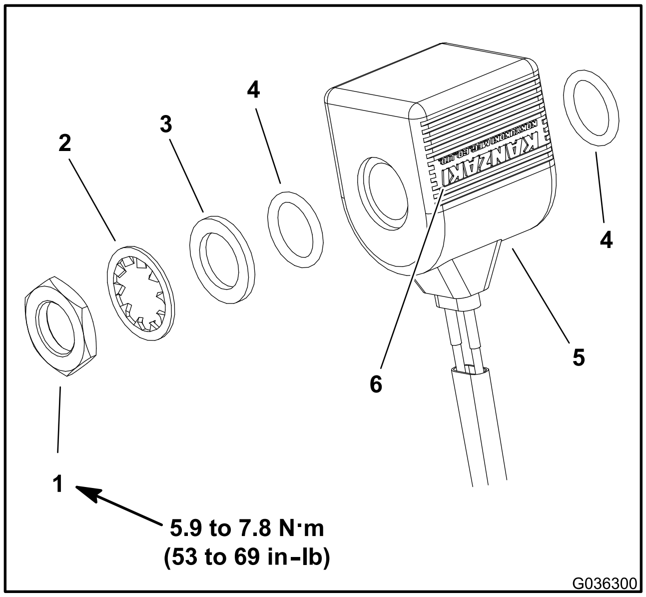
PTO Solenoid Valve Coil



g036991

Figure 247

1. Transmission	3. Solenoid valve and coil
2. Coil connector	



g036300

Figure 248

1. Hex nut	4. Seal
2. Lock washer	5. Solenoid valve coil
3. Washer	6. Letter I

You can replace the PTO solenoid valve coil on the transmission without opening the hydraulic system (Figure 247).

Removing the PTO Solenoid Valve Coil

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. Raise the operator seat to get access to the PTO solenoid valve coil.
3. Disconnect the wire harness electrical connector from the PTO solenoid valve coil connector.
4. Remove the nut from the spool assembly.
5. Slide the coil assembly from the solenoid valve stem (Figure 248).
6. Clean any corrosion or dirt from the valve stem.

Installing the PTO Solenoid Valve Coil

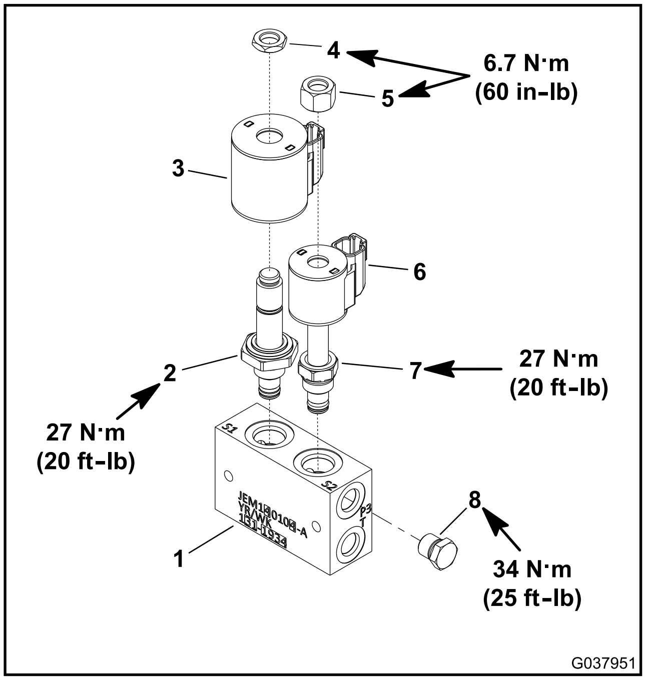
1. Slide the new coil assembly, seals, and washers onto the solenoid valve stem. Ensure that you correctly position the seals and washers (Figure 248). Coil should be installed so the “KANZAKI” molded into the coil has the “I” nearest the nut location as coil direction is important for proper solenoid operation.

IMPORTANT

When securing the solenoid valve coil to the solenoid, do not overtighten the hex nut.

2. Install the hex nut onto the spool assembly and torque the nut to **5.9 to 7.8 N·m (53 to 69 in-lb)**.
3. Connect the wire harness electrical connector to the solenoid valve coil connector.
4. Lower and secure the operator seat.

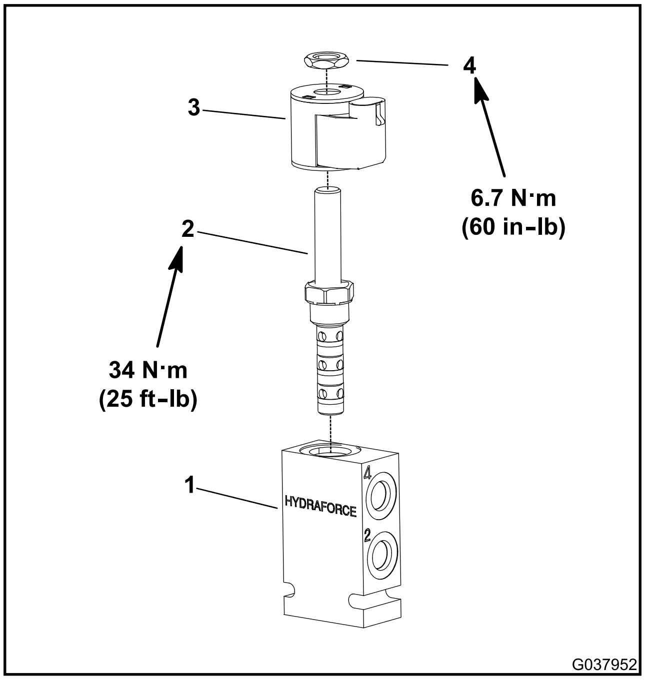
Hydraulic Solenoid Valve Coils



g037951

Figure 249

1. Deck lift manifold	5. Solenoid nut
2. Solenoid valve	6. E-coil
3. Coil	7. Solenoid valve
4. Coil nut	8. Zero-leak plug



g037952

Figure 250

1. Steering selector manifold	3. Solenoid coil
2. Solenoid valve	4. Nut

You can replace a hydraulic solenoid valve coil on the deck lift manifold (Figure 249) or steering selector manifold (Figure 250) without opening the hydraulic system.

Removing the Hydraulic Solenoid Valve Coils

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 solenoid valve coil that you replace.
   A. Raise the operator seat to get access to the deck lift manifold (Figure 249) for the location of solenoid coils on the deck lift manifold.
   B. Raise the operator seat to get access to the steering selector manifold (Figure 250) for the location of solenoid coils on the steering selector manifold.
3. Disconnect the wire harness electrical connector from the solenoid valve coil that you replace.
4. Remove the nut from the hydraulic valve.
5. Slide the solenoid coil from the valve.
6. Clean any corrosion or dirt from the valve.

Installing the Lift Control Manifold Solenoid Valve Coils

1. Slide the coil assembly onto the hydraulic valve.
2. Install the nut onto the valve and torque the nut to **6.8 N·m (60 in-lb)**.

   Note: Do not overtighten the nut.
3. Connect the machine wire harness connector to the solenoid coil.
4. Lower and secure the seat.

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 5–111).
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 5–111).

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.**

2. Clean the top of the battery by washing at the intervals with a brush dipped in ammonia or bicarbonate of soda solution. Flush the top surface with water after cleaning.

IMPORTANT

Do not remove fill caps while cleaning.

3. Tighten the battery cables on the battery terminals to provide a good electrical contact.

⚠ 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 grease 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 ⚠

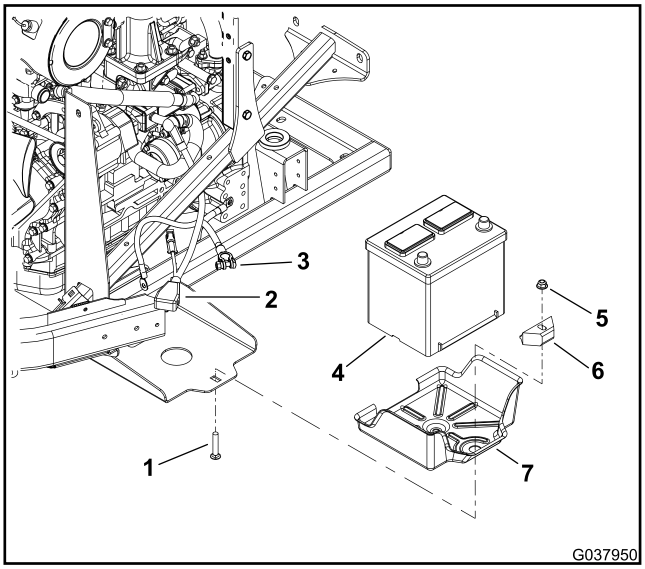
Battery-electrolyte is corrosive and can burn skin and eyes and damage clothing.

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.

Battery Specifications

Battery-electrolyte specific gravity	Fully Charged: 1.250 to 1.280 Discharged: less than 1.240
Battery specifications	BCI Group Size 26: 540 CCA at -18°C (0°F) Reserve Capacity of 80 minutes at 27°C (80°F)
Battery dimensions (including terminal posts and caps)	Length 22.4 cm (8.8 inches) Width 16.7 cm (6.6 inches) Height 20.3 cm (8.0 inches)

Removing and Installing the Battery



g037950

Figure 251

1. Carriage screw
2. Positive cable
3. Negative cable
4. Battery
5. Flange nut
6. Battery retainer
7. Battery tray

IMPORTANT

Be careful when removing the battery cables and ensure that you do not damage the terminal posts or cable connectors.

1. Unlatch, raise the hood and support it.
2. 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.
3. Loosen the flange nut that secures the battery retainer.
4. Carefully remove the battery from the machine.
5. 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.
6. Lower the hood and secure it with the latches.

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.
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 5–113).

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 5–114) 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.

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.

Inspecting, Maintaining, and Testing the Battery (continued)

H. Use the Minimum Voltage Table (page 5–114), 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: Using 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

Charging the Battery (continued)

2. Determine the charging time and rate using the manufacturer's battery charger instructions or the following Battery Charge Level Table (page 5–115).

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

⚠ **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.

Charging the Battery (continued)

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.

Chapter 6

Chassis

Table of Contents

Specifications

Chassis

Item	Description
Rear tire pressure	172 kPa (25 psi)
Front tire pressure (machines without operator cab)	103 kPa (15 psi)
Front tire pressure (machines with operator cab)	172 kPa (25 psi)
Wheel lug nut torque	102 to 115 N·m (75 to 85 ft-lb)
Wheel hub locknut torque	407 to 542 N·m (300 to 400 ft-lb)

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.

Special Tools

You can order these special tools from your Toro Distributor.

Wheel Hub Puller

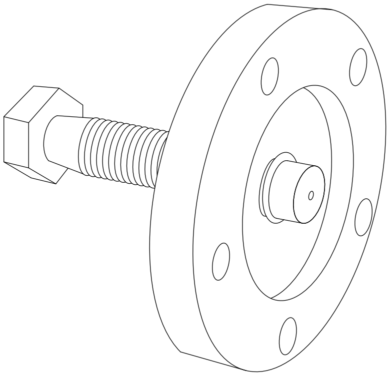


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Figure 252

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

Toro Part No. TOR6004

Steering Alignment Tools

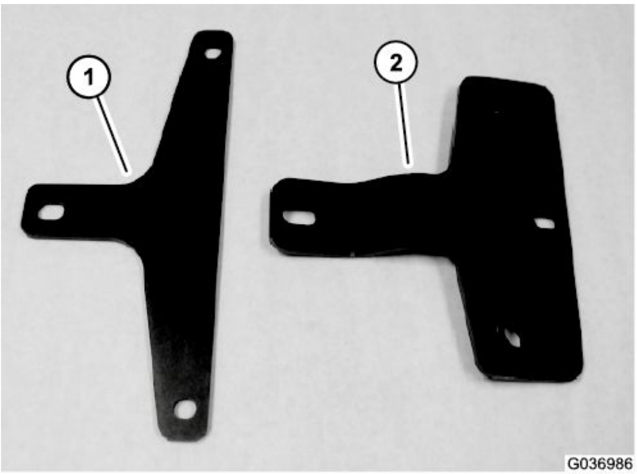

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Figure 253

1. Front alignment tool
2. Rear alignment tool

The steering alignment tools are used to ensure that the front and rear steering assemblies are properly centered for steering assembly service. These tools are required for adjustment of wheel alignment or when replacing the tie rods. The steering alignment tool kit includes the 2 tools necessary for use on your machine. One of the tools centers the front steering assembly and the other centers the rear. The tool kit also includes necessary hardware for attaching the tools to the machine.

Toro Part No. TOR6019

The front alignment tool (TOR6019-1) requires the following hardware for attachment purposes:

Steering Alignment Tools (continued)

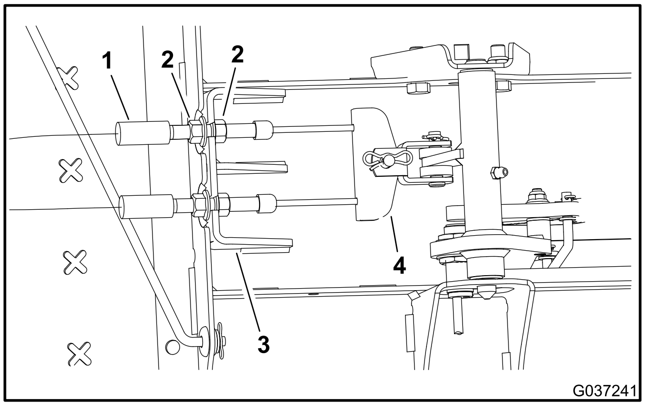
Hardware	Toro Part Number	Quantity
1/2-13×1 inch bolt	325-4	2 each
1/2-13×2 inch bolt	325-8	1 each
1/2 inch nut	3217-9	3 each

The rear alignment tool (TOR6019-2) requires the following hardware for attachment purposes:

Hardware	Toro Part Number	Quantity
3/8-16×1.25 inch bolt	323-7	1 each
3/8 inch nut	3217-7	1 each
1/2-13×2 inch bolt	325-8	1 each
1/2 inch nut	3217-9	1 each

Adjustments

Adjusting the Brake



g037241

Figure 254

1. Brake cable	3. Platform bracket
2. Flange nut/washer	4. Cable yoke

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, and remove the key from the key switch. Raise the rear of the machine so that both wheels are off the ground.
2. Adjust the flange nuts at the rear of each brake cable until a slight drag is felt against the brake drum when the brake pedal is not engaged.
3. Adjust the brake cable at the rear until the rear wheel is locked and a 7.6 mm (0.3 inch) gap exists between the brake pedal and the end of the slot in the floor plate. Tighten the flange nuts against the cable bracket.

   If the brake pedal contacts the floor plate or the brake cable clevis contacts the cable housing before the rear wheel locks:

   A. Loosen the cable at the rear of the machine.

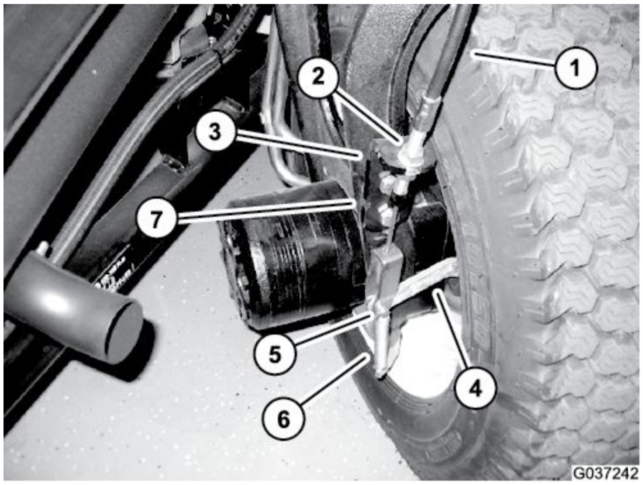
   B. Adjust the cable at the front of the machine so that the cable housing moves closer to the cable yoke.

   C. Repeat the step 3. The cable yoke should be square to both cables after adjustment (Figure 254).

⚠ 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.

Adjusting the Brake (continued)



g037242

Figure 255

1. Brake cable	5. Clevis pin
2. Flange nut/washer	6. Return spring
3. Brake cable bracket	7. Bracket notch
4. Brake actuator lever	

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4. Check the operation of the brake before you return the machine to operation.

Aligning the Wheels

1. Park the machine on a level surface with the wheels directed straight ahead. Lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.

   Note: Machine handling issues may be caused by improper or unbalanced tire pressures. Ensure that all tire pressures (front and rear) are properly adjusted before checking or adjusting the wheel alignment; refer to Specifications (page 6–2).

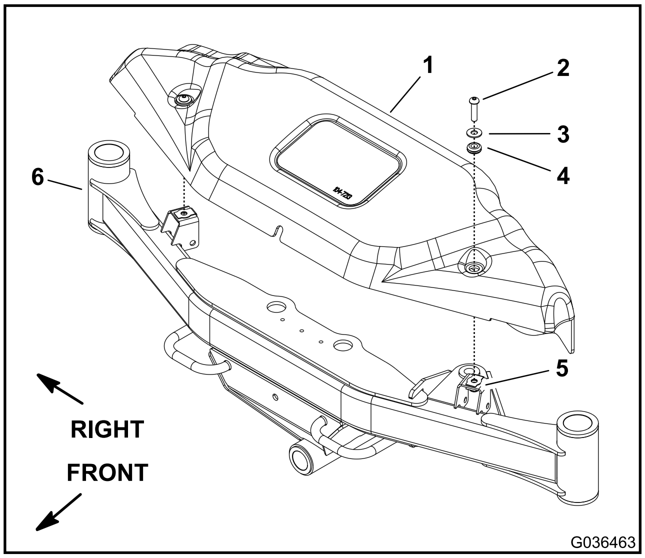

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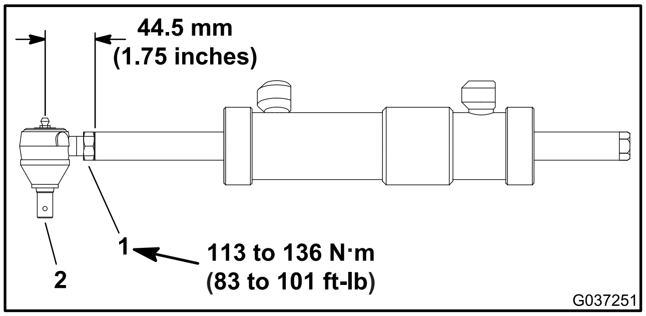
Figure 256

1.	Front cover	4.	Grommet (2 each)
2.	Screw (2 each)	5.	Tinnerman nut (2 each)
3.	Flat washer (2 each)	6.	Front axle



g037251

Figure 257

1.	Jam nut	2.	Rod end

2. Remove the front cover from the front axle to get access to the front steering components (Figure 256).
3. Raise the operator seat and lower the power center assembly to get access to the rear steering components; refer to Power Center Assembly (Machines without Operator Cab) (page 6–55) and Power Center Assembly (Machines with Operator Cab) (page 6–57).

Aligning the Wheels (continued)

IMPORTANT

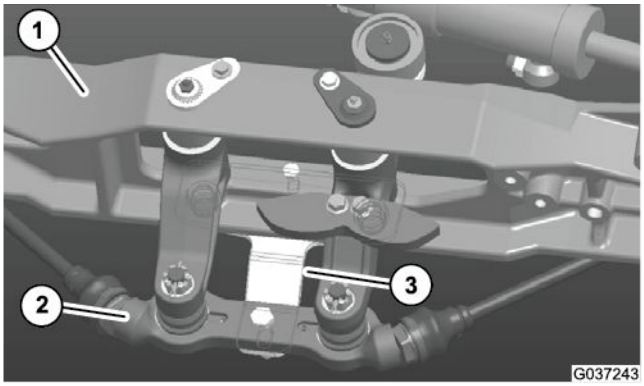
Before lifting the machine with a jack, review and follow Jacking Instructions (page 1–7).

4. Lift the machine with a jack until the 4 wheels are off the ground. Support raised machine with appropriate jack stands.
5. Ensure that the steering cylinder rod ends (both front and rear) are properly installed. The distance from the end of the cylinder shaft to the center of the rod end grease fitting should be 44.5 mm (1.750 inches). If necessary, loosen the rod end jam nut (item 1 in Figure 257) and adjust the location of the rod end. After adjustment, torque the jam nut to **113 to 136 N·m (83 to 101 ft-lb)**.

IMPORTANT

After installation of either of the steering alignment tools, do not rotate the steering wheel. Rotating the steering wheel with either or both of the alignment tools in place will damage the tools.

Note: Installation of steering alignment tools (Special Tools (page 6–4)) to the machine ensures that the steering components are properly centered to the machine so that correct wheel alignment can be achieved.

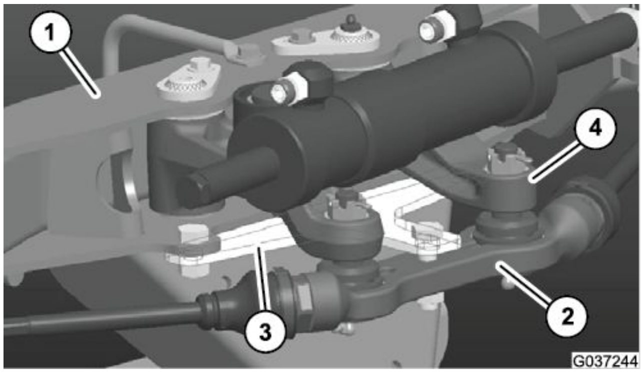


g037243

Figure 258

1. Rear axle
2. Rear center link
3. Rear alignment tool

Aligning the Wheels (continued)



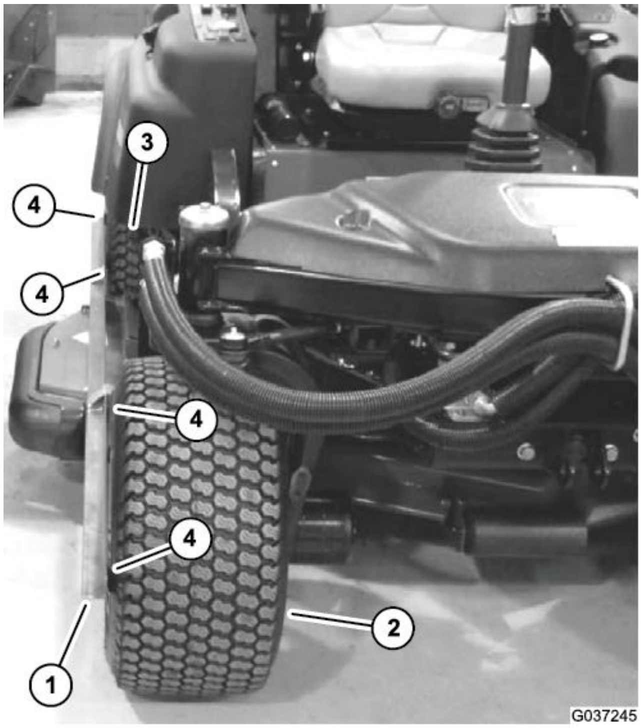
g037244

Figure 259

1. Front axle
2. Front center link
3. Front alignment tool
4. Front steering arm

6. Secure the rear alignment tool (refer to Special Tools (page 6–4)) to the rear axle and center link (Figure 258). If necessary, use the steering wheel to align the rear steering components with the alignment tool before securing the tool to the machine.
7. Secure the front alignment tool (refer to Special Tools (page 6–4)) to the front axle and the center link (Figure 259). If necessary to align the front steering components with the alignment tool, loosen the hydraulic hoses on the front steering cylinder to allow the front cylinder movement independent of the rear steering cylinder. Then, use a large adjustable wrench to rotate the front steering arm so that the front steering components are aligned with the alignment tool.
8. With both alignment tools installed, place a rigid straight edge (e.g., angle iron, metal pipe) that is at least 2 m (80 inches) long against the sides of the front and rear tires on one side of the machine (Figure 260). The straight edge should contact the tires at 4 points if the wheel alignment is correct.

Aligning the Wheels (continued)



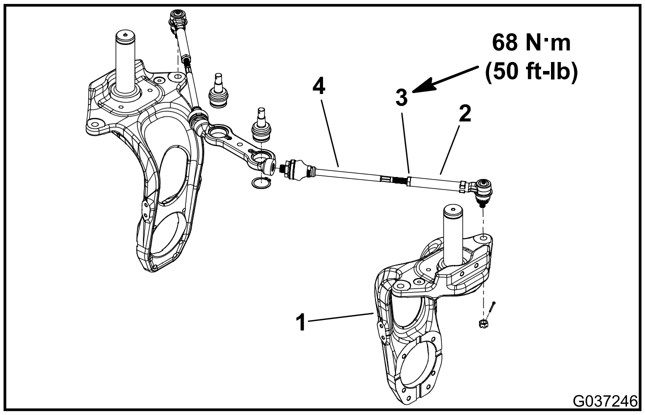
g037245

Figure 260

1. Straight edge
2. Front wheel
3. Rear wheel
4. Tire contact point

---

9. If the straight edge does not contact the tires at 4 points, adjustments to the tie rods are necessary to align the wheels (Figure 261).
   A. Loosen the jam nut on the tie rod and rotate the inner tie rod end to adjust the wheel alignment.
   B. Repeat the tie rod adjustment for the front and rear wheels as necessary.
   C. When the front and rear wheels are aligned, tighten the tie rod jam nuts to **68 N·m (50 ft-lb)**.
10. After the tie rod adjustment has been completed, ensure that the straight edge contacts the front and rear tires at 4 points. Repeat the tie rod adjustment if necessary.
11. Use the rigid straight edge, repeat the steps 8 through 10 for the other side of the machine.



g037246

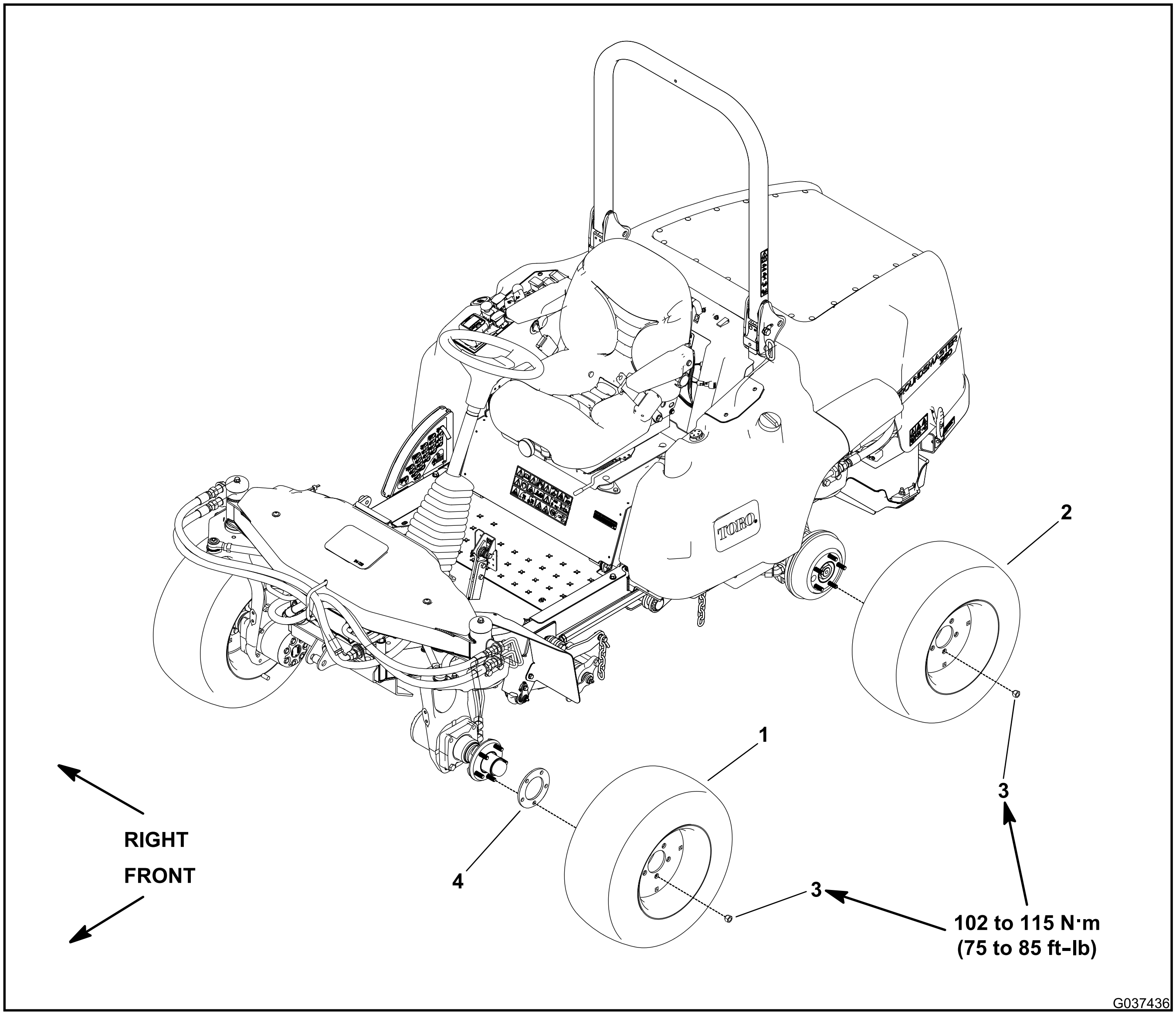
Figure 261

1. Steering fork (rear)	3. Jam nut
2. Outer tie rod end	4. Inner tie rod end

12. Once the wheel alignment adjustment is correct for both sides of the machine:
    - A. Check the steering home sensor alignment and adjust as necessary; refer to Adjusting the Steering Home Sensor (page 5–48).
    - B. Remove the alignment tools from the front and rear steering components.
    - C. Ensure that the hydraulic hoses on the front steering cylinder are properly tightened.
    - D. Install the front cover to the front axle (Figure 256).
    - E. Lower the machine to the ground.

Service and Repairs

Wheels



g037436

Figure 262

1. Front wheel	3. Wheel-lug nut (5 each per wheel)
2. Rear wheel	4. Front wheel spacer

Removing the Wheel

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.
3. Loosen, but do not remove the 5 wheel-lug nuts 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 5 wheel-lug nuts that attach the wheel to the machine, and remove the wheel.
6. If the front wheel was removed, locate and retrieve the front wheel spacer.

Installing the Wheel

1. If the front wheel was removed, position the front wheel spacer to the wheel hub.
2. Install the wheel to the machine with the 5 wheel-lug nuts.
3. Lower the machine to the ground.

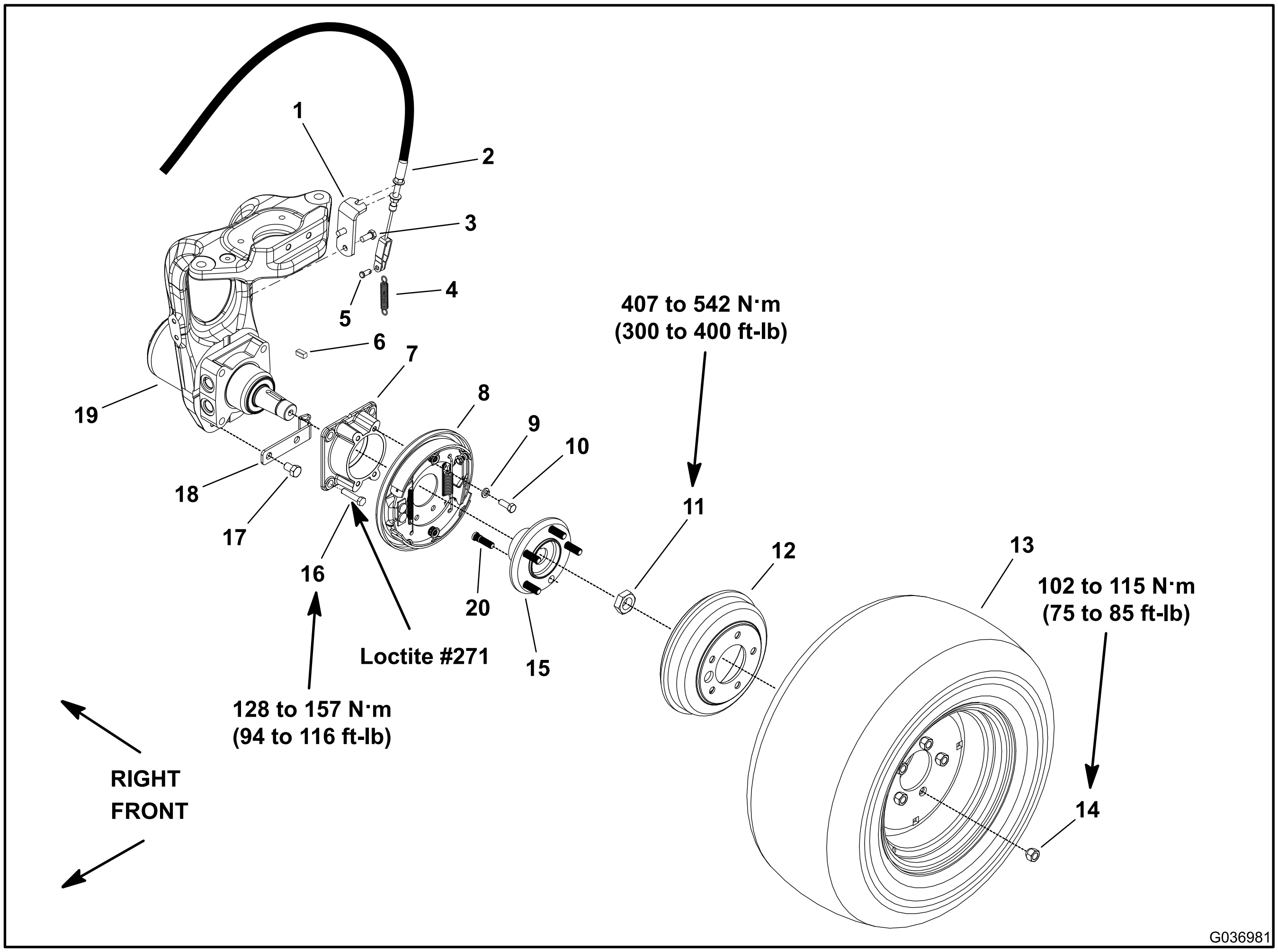
⚠ WARNING ⚠

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.

4. Torque the wheel-lug nuts evenly to **102 to 115 N·m (75 to 85 ft-lb)** in a crossing pattern.
5. Check and adjust the tire pressures; refer to Specifications (page 6–2).

Servicing the Brake

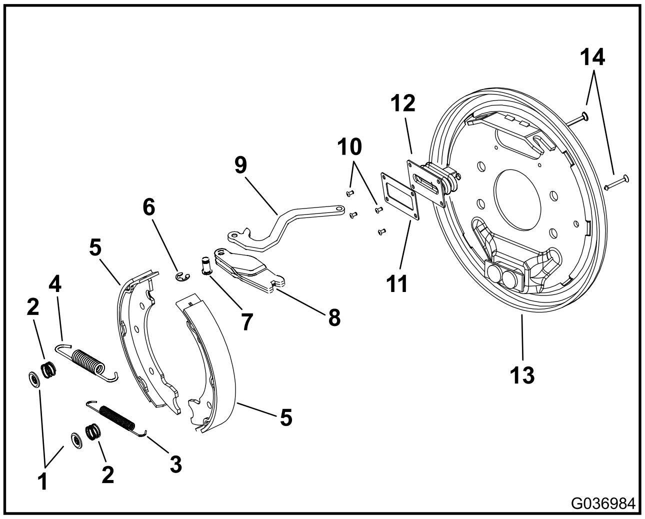


g036981

Figure 263

1.	Brake cable bracket (left)	8.	Brake assembly (left)	15.	Wheel hub
2.	Brake cable (2 each)	9.	Lock washer (4 each per side)	16.	Bolt (4 each per side)
3.	Bolt (2 each per bracket)	10.	Bolt (4 each per side)	17.	Bolt (2 each per bracket)
4.	Brake return spring	11.	Locknut	18.	Return spring bracket
5.	Clevis pin	12.	Brake drum	19.	Wheel motor
6.	Square key	13.	Rear wheel (left)	20.	Drive stud (5 each per hub)
7.	Brake adapter	14.	Wheel-lug nut (5 each per wheel)		

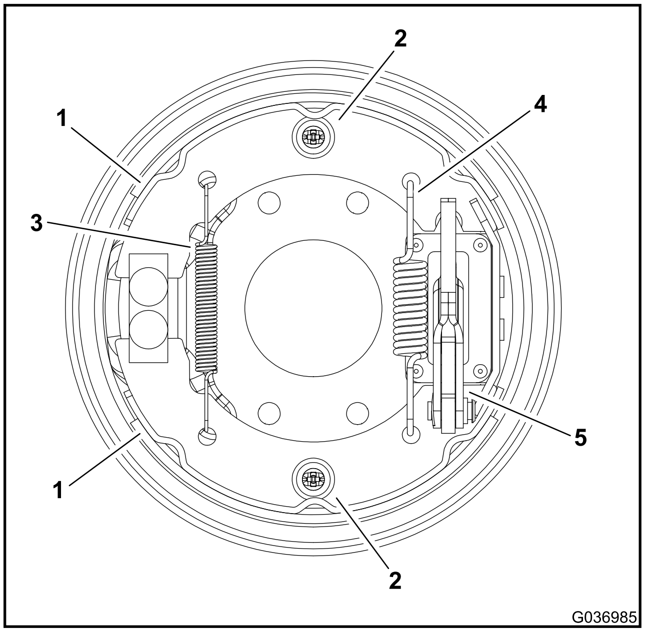
Disassembling the Brake



g036984

Figure 264

1.	Hold down cup (2 each)	8.	Brake actuator
2.	Hold down spring (2 each)	9.	Brake actuator lever
3.	Shoe spring	10.	Rivet (4 each)
4.	Shoe spring (actuator)	11.	Back-up plate
5.	Brake shoe (2 each)	12.	Boot
6.	Retaining ring	13.	Backing plate
7.	Clevis pin	14.	Hold down pin (2 each)



g036985

Figure 265

1.	Brake shoe	4.	Shoe spring (actuator)
2.	Hold down components	5.	Brake actuator
3.	Shoe spring		

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.

Disassembling the Brake (continued)

3. Remove the rear wheel; refer to Removing the Wheel (page 6–14).
4. Loosen, but do not remove the locknut (item 11 in Figure 263) securing the wheel hub to the motor shaft.
5. Ensure that the parking brake is disengaged.
6. Remove the brake return spring (item 4 in Figure 263) and clevis pin that attach the brake cable to the brake actuator lever.
7. Remove the brake drum (item 12 in Figure 263) from the brake assembly.

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.

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8. Ensure that the locknut (item 11 in Figure 263) on the wheel motor shaft is loosened at least to 2 turns. Use a hub puller (refer to Special Tools (page 6–4)) to loosen the wheel hub from the wheel motor.
9. Remove the locknut and wheel hub from the motor shaft. Discard the locknut. Locate and retrieve the square key.

   Note: If necessary, the complete brake assembly can be removed from the machine for disassembly (step 13).
10. Remove the 2 shoe springs (items 3 and 4 in Figure 264) from the brake shoes.
11. Remove the 2 hold down cups (item 1 in Figure 264) and 2 hold down springs.
12. Remove the 2 brake shoes (item 5 in Figure 264) and 2 hold down pins from the backing plate.
13. If necessary, remove the 4 bolts (item 10 in Figure 263), 4 lock washers to remove the brake backing plate from the brake adapter.

Assembling the Brake

1. Use a wire brush to remove rust and unwanted material from all the brake parts before the installation. Clean all the 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 backing plate was removed from the machine, secure the backing plate to the brake adapter with the 4 bolts and 4 lock washers.
4. Lightly lubricate the brake shoe pivot points with high-temperature grease.
5. Position the brake shoe to the backing plate. Install the hold down pin and secure with the hold down spring and hold down cup. Repeat for the second brake shoe.
6. Install the 2 shoe springs (items 3 and 4 in Figure 264) to the brake shoes. The larger spring should be installed at the actuator end of the brake shoes and ensure that the brake shoes are properly positioned to the pivot and actuator points.

Assembling the Brake (continued)

IMPORTANT

Before installing the wheel hub, clean the tapers of the wheel hub (item 15 in Figure 263) and wheel motor shaft. Ensure that the tapers are free of grease, oil, rust, and dirt. Do not use anti-seize lubricant, when you install the wheel hub.

7. Mount the square key in the wheel motor shaft, and then install the wheel hub (item 15 in Figure 263) onto the wheel motor shaft.

IMPORTANT

Do not use the locknut previously removed to attach the wheel hub to the wheel motor.

8. Install new locknut (item 11 in Figure 263) onto the wheel motor shaft to secure the wheel hub to the motor shaft.
9. Install the brake drum (item 12 in Figure 263).
10. Position the end of the brake cable to the brake actuator lever (item 9 in Figure 264). Attach the cable to the brake actuator lever with the clevis pin and brake return spring.
11. Install the rear wheel assembly; refer to Installing the Wheel (page 6–14).
12. Check and adjust the brakes; refer to Adjusting the Brake (page 6–6).
13. Lower the machine to the ground.

⚠ **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.

14. Torque the new wheel hub locknut (item 11 in Figure 263) that secures the wheel hub to **407 to 542 N·m (300 to 400 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.

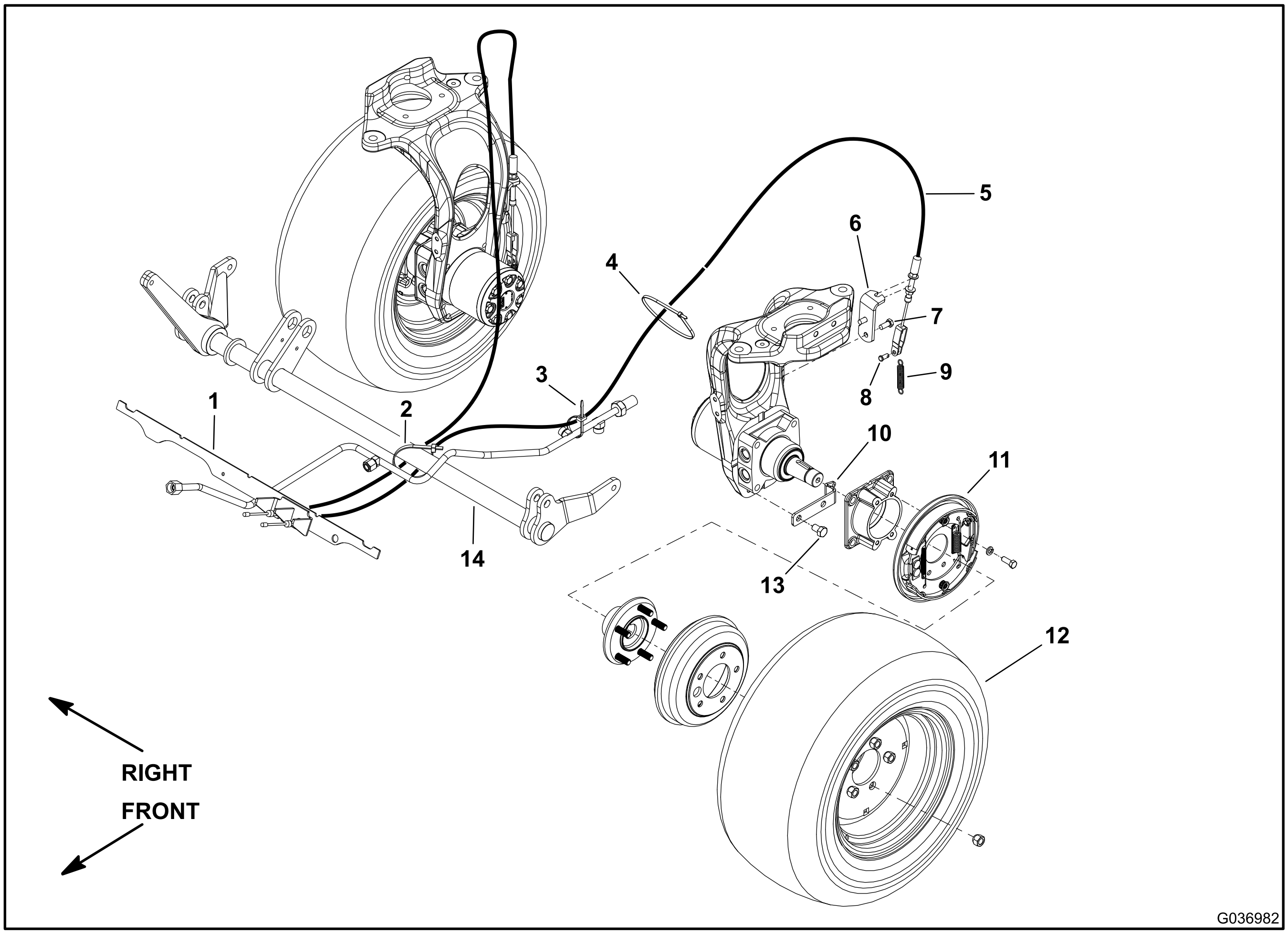
15. Check for the operation of the brake, before you return the machine to operation.

Burnish Brake Pads

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

1. Bring the machine to full speed and apply the brakes to rapidly stop the machine without skidding or locking up the wheels.
2. Repeat this procedure 10 times. To avoid overheating the brakes, wait 1 minute between each stop.

Brake Cables



g036982

Figure 266

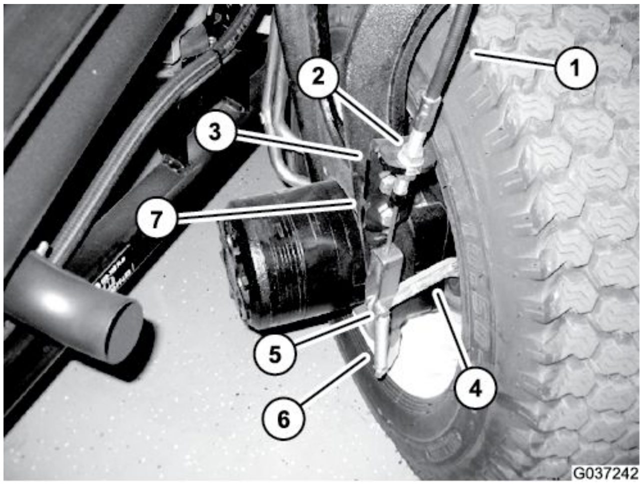
1.	Operator platform bracket	6.	Brake cable bracket (left)	11.	Brake assembly (left)
2.	Cable tie	7.	Bolt (2 each per bracket)	12.	Rear wheel (left)
3.	Cable tie	8.	Clevis pin	13.	Bolt (2 each per bracket)
4.	Cable tie	9.	Brake return spring	14.	Deck lift shaft
5.	Brake cable (2 each)	10.	Return spring bracket		

Removing the Brake Cable

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, and remove the key from the key switch. Ensure that the parking brake is not applied.
2. Block the wheels with chocks to prevent the machine from moving.
3. Disconnect the brake cable (item 1 in Figure 267) from the rear of the machine as follows:
    A. Remove the return spring (item 6 in Figure 267) and clevis pin that secure the brake cable to the brake actuator lever.

    B. Loosen 1 of the flange nuts (item 2 in Figure 267) that secures the brake cable to the brake cable bracket.

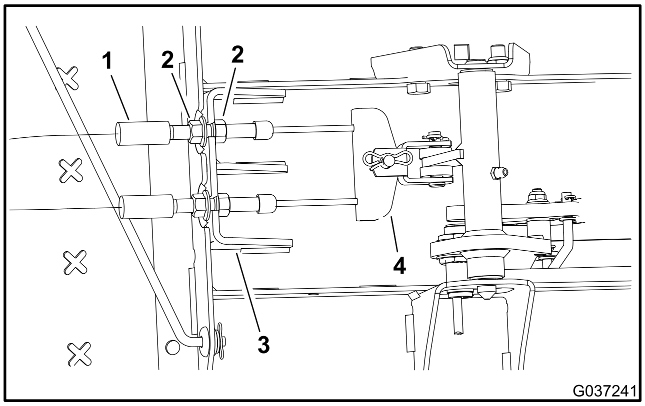
4. Disconnect the brake cable (item 1 in Figure 268) from the front of the machine as follows:



g037242

Figure 267

1.	Brake cable	5.	Clevis pin
2.	Flange nut/washer	6.	Return spring
3.	Brake cable bracket	7.	Bracket notch
4.	Brake actuator lever		



g037241

Figure 268

1.	Brake cable	3.	Platform bracket
2.	Flange nut/washer	4.	Cable yoke

A. Loosen 1 of the flange nuts (item 2 in Figure 268) that secures the brake cable to the operator platform bracket.

B. Separate the cable from the bracket.

C. Remove the cable end from the cable yoke.

5. Record the location of cable ties and routing of the brake cable for assembly purposes. Remove the brake cable from the machine.

6. Disassemble any additional brake linkage components as necessary. Repair or replace the components that are worn or damaged.

Installing the Brake Cable

1. Raise the rear of the machine so that both wheels are off the ground
2. Install the brake linkage components that were previously removed. If the brake cable brackets (item 3 in Figure 267) were removed from the steering fork, install the bracket with notch oriented toward the machine frame.
3. Use the notes that you recorded during the brake cable removal, position the brake cable to the machine.
4. Connect the brake cable (item 1 in Figure 268) to the front of the machine as follows:
   A. Install the end of brake cable to the cable yoke.
   B. Position the brake cable to the operator platform bracket.
   C. Tighten the cable housing flange nuts (item 2 in Figure 268) to secure the brake cable to the operator platform bracket.
5. Connect the brake cable (item 1 in Figure 267) to the rear of the machine as follows:
   A. Secure the brake cable to the brake actuator lever with the clevis pin and the return spring.
   B. Position the brake cable to the brake cable bracket.
   C. Adjust the flange nuts at the rear of each brake cable until a slight drag is felt against the brake drum when the brake pedal is not engaged.
6. Press the brake pedal with a 68 Kg (150 lbs) force and hold it for 5 seconds. Release the brake pedal. Repeat this step 4 more times to pre-stretch the cable.

   If the brake pedal contacts the floor plate or the brake cable clevis contacts the cable housing during the pre-stretching procedure:

   A. Loosen the cable at the rear of the machine.
   B. Adjust the cable at the front of the machine so that the cable housing moves closer to the cable yoke.
   C. Repeat the step 6. The cable yoke should be square to both cables after adjustment (Figure 268).
7. Adjust the brake cable at the rear until the rear wheel is locked and a 7.6 mm (0.3 inch) gap exists between the brake pedal and the end of the slot in the floor plate. Tighten the flange nuts against the cable bracket.
8. Secure the brake cable to the machine with the cable ties in locations that you noted during the cable removal.

⚠ **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.

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9. Check for the operation of the brake, before you return the machine to operation.

Rear Steering Fork

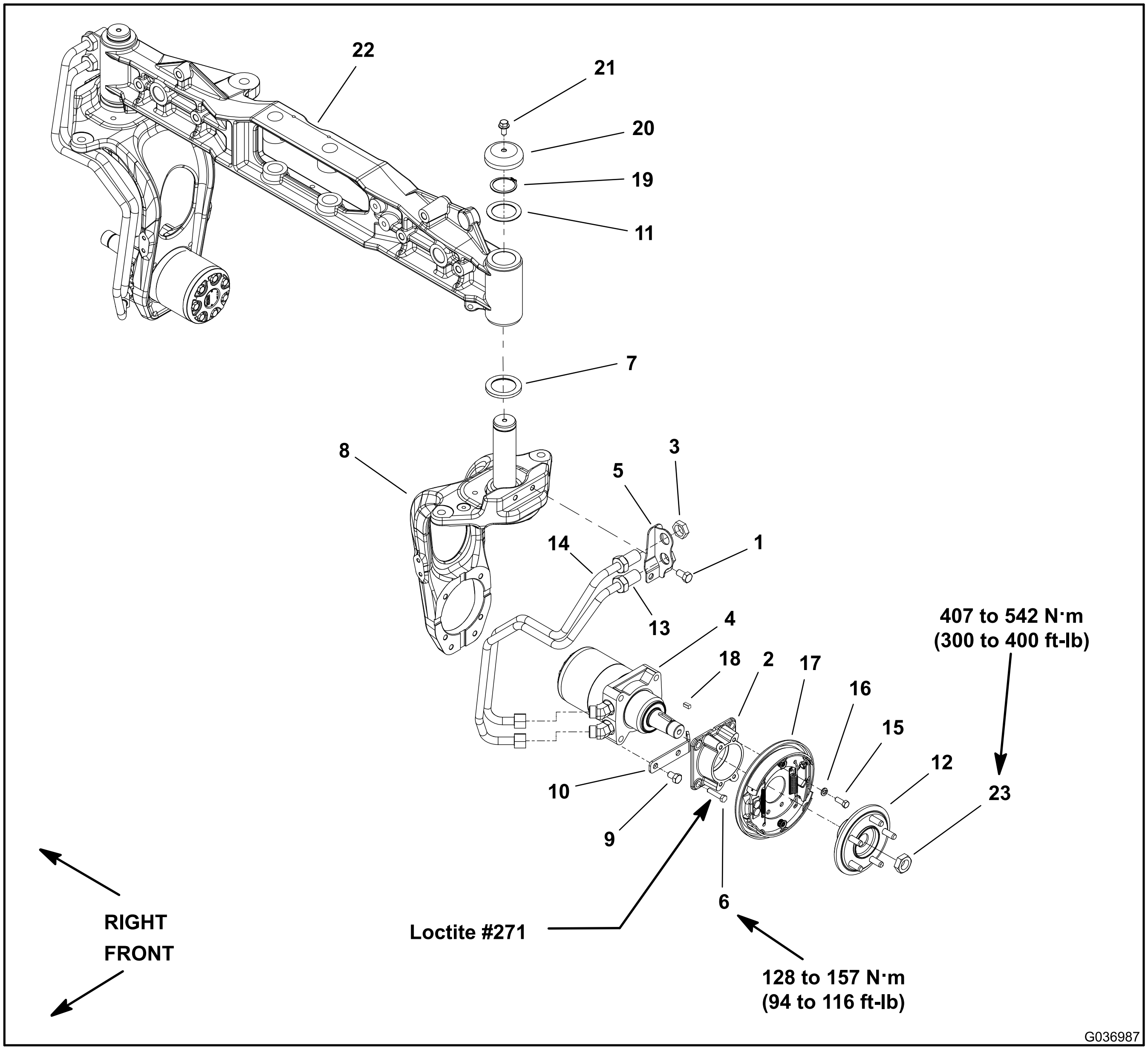


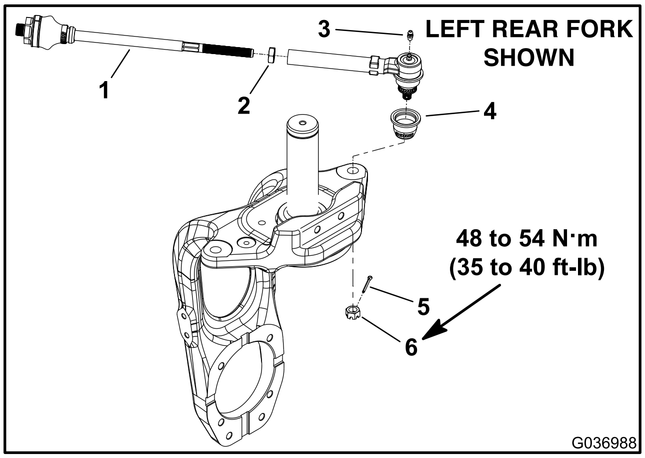
Figure 269

1. Bolt (2 each per bulkhead)
2. Brake adapter
3. Bulkhead nut (1 per hydraulic tube)
4. Wheel motor
5. Bulkhead bracket
6. Bolt (4 each per motor)
7. Lower thrust washer 6.3 mm (0.250 inch thick)
8. Rear steering fork assembly
9. Bolt (2 each per bracket)
10. Spring bracket
11. Upper thrust washer 1.6 mm (0.062 inch thick)
12. Wheel hub
13. Lower hydraulic tube
14. Upper hydraulic tube
15. Bolt (4 each per brake)
16. Lock washer (4 each per brake)
17. Brake assembly
18. Square key
19. Retaining ring
20. Spindle cap
21. Flange-head screw
22. Rear axle
23. Locknut

Note: The rear steering fork assembly includes the brake assembly and wheel motor.

Removing the Rear Steering Fork

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



g036988

Figure 270

1. Tie rod	4. Dust boot
2. Jam nut	5. Cotter pin
3. Grease fitting	6. Slotted hex nut

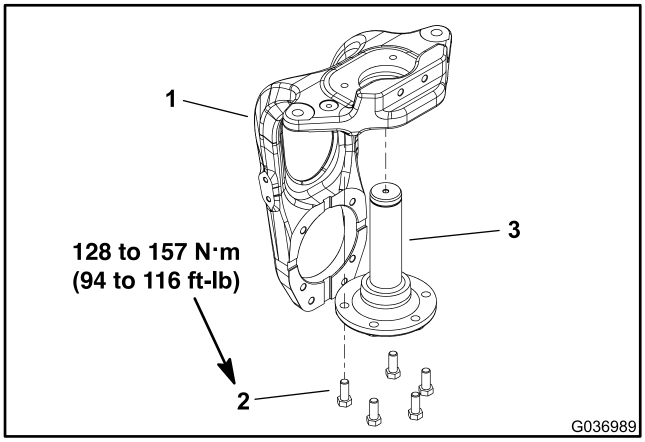


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Figure 271

1. Steering fork	3. Steering fork spindle
2. Bolt (5 each)	

2. Block the wheels with chocks to prevent the machine from moving.
3. Remove the rear wheel; refer to Removing the Wheel (page 6–14).
4. Loosen, but do not remove the locknut (item 23 Figure 269) securing the wheel hub to the motor shaft.
5. Disconnect the brake cable at the rear of the machine; refer to Brake Cables (page 6–20).
6. Remove the brake drum, wheel hub, and brake assembly (item 17 in Figure 269) from the machine; refer to Servicing the Brake (page 6–15).
7. Remove and discard the cotter pin (item 5 in Figure 270) and slotted hex nut that secure the tie rod end to the steering fork.
8. Carefully pry the rod end from the steering fork with a ball joint pickle fork.

Removing the Rear Steering Fork (continued)

9. Remove the 2 bolts (item 1 in Figure 269) that secure the bulkhead bracket to the rear steering fork assembly.
10. Remove the 4 bolts (item 6 in Figure 269) that secure the wheel motor and brake adapter to the steering fork. Remove the brake adapter and slide the wheel motor (with the hydraulic lines attached) from the steering fork. Carefully, position the wheel motor assembly away from the steering fork and support the wheel motor. Do not allow the wheel motor to hang from the hydraulic lines.
11. Support the steering fork to prevent it from falling.

⚠ **CAUTION** ⚠

The weight of the steering fork assembly is approximately 23 kg (50 lb).

Support the steering fork assembly when removing it to prevent it from falling and causing personal injury.

12. Remove the flange-head screw (item 21 in Figure 269), spindle cap, and retaining ring that secure the steering fork spindle into the axle tube. Slide the steering fork spindle out of the axle tube.
13. Locate and retrieve the upper and lower thrust washers from the steering fork spindle.
14. Clean the steering fork spindle. Inspect the shaft for wear and replace the steering fork spindle if the shaft is worn or damaged (Figure 271).
15. Clean and inspect the thrust washers and flange bushings in the axle. Replace the components that are worn or damaged as necessary; refer to Servicing the Steering Assembly Bushings (page 6–38).

Installing the Rear Steering Fork

1. If the spindle was removed, torque the bolts to **128 to 157 N·m (94 to 116 ft-lb)** during assembly.
2. Apply a light coating of grease to the steering fork spindle.
3. Install the lower 6.3 mm (0.25 inch) thrust washer (item 7 in Figure 269) onto the steering fork spindle and slide the steering fork spindle up through the axle tube.
4. Hold the steering fork in a place and install the upper 1.6 mm (0.062 inch) thrust washer and retaining ring onto the end of the steering fork spindle. Ensure that the retaining ring is fully seated in the spindle groove.
5. Place the spindle cap (item 20 in Figure 269) to the top of the steering fork spindle and secure with the flange-head screw.
6. Install the wheel motor assembly and brake adapter as follows:
   A. Position the wheel motor assembly (with the hydraulic hoses attached) and brake adapter to the steering fork.
   B. Apply the Loctite #271 (or equivalent) to the threads of the 4 bolts (item 6 in Figure 269).
   C. Secure the wheel motor and brake adapter to the steering fork with the 4 bolts; tighten the bolts from **128 to 157 N·m (94 to 116 ft-lb)** .

Installing the Rear Steering Fork (continued)

D. Secure the bulkhead bracket (item 5 in Figure 269) to the steering fork with the 2 bolts.

IMPORTANT

Before installing the tie rod end, clean the tapers of the steering fork and tie rod end. Ensure that the tapers are free of grease, oil, rust, and dirt. Do not use anti-seize lubricant, when you install the tie rod end.

Note: If necessary, tighten the slotted hex nut further until the slot in the hex nut aligns with the hole in the tie rod ball joint stud.

7. Connect the tie rod end (item 1 in Figure 270) to the steering fork with the slotted hex nut; tighten the hex nut from **48 to 54 N·m (35 to 40 ft-lb)**. Install a new cotter pin.
8. Install the brake cable to the brake actuator lever and brake cable bracket; refer to Brake Cables (page 6–20).
9. Lubricate the steering fork spindle through the grease fitting on the axle. Grease should purge from the ends of the spindle identifying that the grease cavity is completely filled. Wipe up excess grease.
10. Install the brake assembly, wheel hub, and brake drum to the machine; refer to Servicing the Brake (page 6–15).
11. Install the rear wheel; refer to Installing the Wheel (page 6–14).

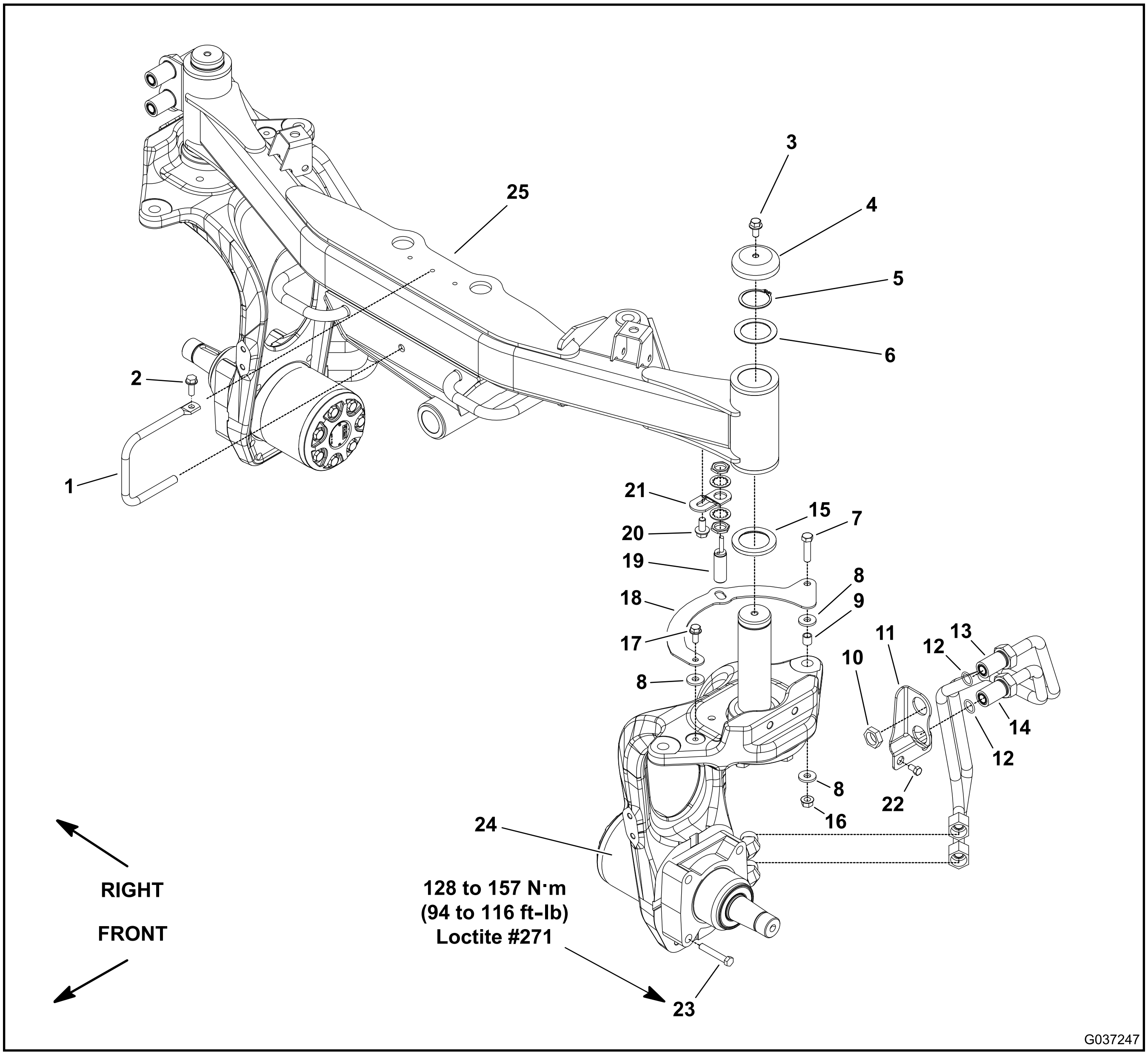
⚠ WARNING ⚠

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.

12. Tighten the locknut that secures the wheel hub to the wheel motor from **407 to 542 N·m (300 to 400 ft-lb)**.
13. Check and adjust the wheel alignment; refer to Aligning the Wheels (page 6–8).
14. Check and adjust the brakes; refer to Adjusting the Brake (page 6–6).
15. Ensure that there is no contact between the machine components while the wheels move from lock to lock. Adjust if necessary.
16. Check the operation of the brake, before you return the machine to operation.

Front Steering Fork



128 to 157 N·m (94 to 116 ft-lb) Loctite #271

g037247

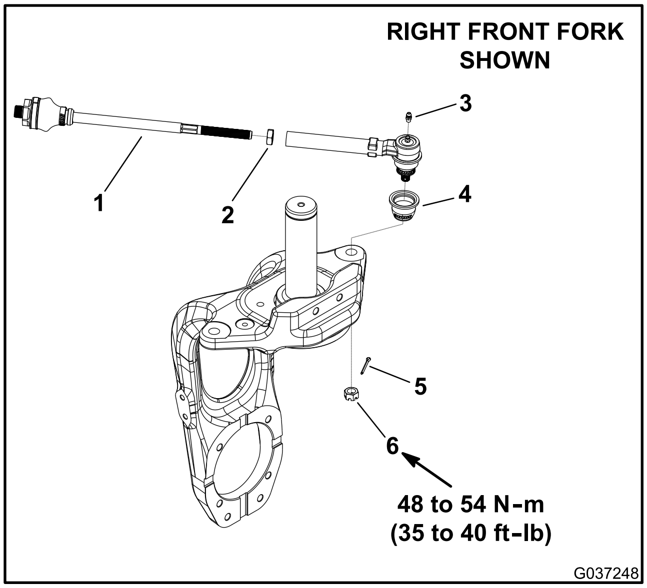
Figure 272

1. Rod guide
2. Taptite screw
3. Flange-head screw
4. Spindle cap
5. Retaining ring
6. Upper thrust washer 1.3 mm (0.062 inch thick)
7. Bolt
8. Washer (3 each)
9. Spacer
10. Bulkhead nut (1 per hydraulic tube)
11. Bulkhead bracket
12. O-ring (2 each)
13. Upper hydraulic tube
14. Lower hydraulic tube
15. Lower thrust washer 6.3 mm (0.250 inch thick)
16. Flange nut
17. Flange-head screw
18. Target bracket
19. Steering home sensor
20. Washer-head screw
21. Sensor bracket
22. Bolt (2 each per bracket)
23. Bolt (4 each per motor)
24. Wheel motor
25. Front axle

Note: The front steering fork assemblies of your Groundsmaster include a wheel motor. The left front fork (Figure 272) also includes a steering home sensor used by the TEC to determine when the front wheel is turned.

Removing the Front Steering Fork

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 Wheel (page 6–14).



g037248

Figure 273

1. Tie rod
2. Jam nut
3. Grease fitting
4. Dust boot
5. Cotter pin
6. Slotted hex nut

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4. Remove the cotter pin (item 5 in Figure 273) and slotted hex nut that secure the tie rod end to the front steering fork.
5. Carefully pry the rod end from the steering fork with a ball joint pickle fork.
6. Remove the wheel motor assembly from the steering fork assembly as follows:
   A. Remove the 2 bolts (item 22 in Figure 272) that secure the bulkhead bracket to the steering fork assembly, and remove the bulkhead bracket.
   B. Remove the 4 bolts (item 23 in Figure 272) that secure the wheel motor to the steering fork. Slide the wheel motor assembly (with the wheel hub and hydraulic lines attached) from the steering fork. Carefully, position the wheel motor away from the steering fork and support the wheel motor. Do not allow the wheel motor to hang from the hydraulic lines.
7. Support the steering fork to prevent it from falling.

⚠ **CAUTION** ⚠

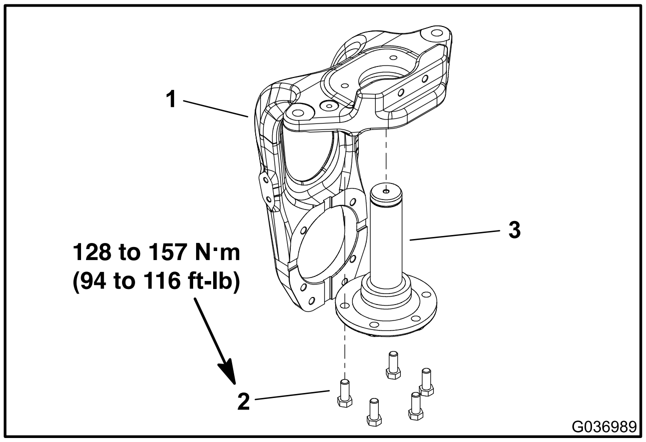
The weight of the steering fork assembly is approximately 23 kg (50 lb).

Support the steering fork assembly when removing it to prevent it from falling and causing personal injury.

Removing the Front Steering Fork (continued)

8. Remove the flange-head screw (item 3 in Figure 272), spindle cap, and retaining ring that secure the steering fork shaft into the axle tube. Slide the steering fork out of the axle tube.
9. Locate and retrieve the upper and lower thrust washers from the steering fork spindle.
10. If necessary, remove the flange nut (item 16 in Figure 272), 3 washers, spacer, bolt, and flange-head screw that secures the target bracket to the steering fork assembly.
11. Clean the steering fork spindle (item 3 in Figure 274). Inspect the shaft for wear and replace the steering fork spindle if the shaft is worn or damaged.
12. Clean and inspect the thrust washers and flange bushings in the axle. Replace the components that are worn or damaged as necessary; refer to Servicing the Steering Assembly Bushings (page 6–38).

Installing the Front Steering Fork



g036989

Figure 274

1. Steering fork
2. Bolt (5 each)
3. Steering fork spindle

---

1. If the spindle was removed from the steering fork, torque the 5 bolts to **128 to 157 N·m (94 to 116 ft-lb)** during assembly.
2. Apply a light coating of grease to the steering fork spindle (item 3 in Figure 274).
3. If removed, secure the target bracket to the steering fork assembly with the flange nut (item 16 in Figure 272), 3 washers, spacer, bolt, and flange-head screw.
4. Install the lower 6.3 mm (0.25 inch) thrust washer (item 15 in Figure 272) onto the steering fork spindle and slide the spindle up through the axle tube.
5. Hold the steering fork in place and install the upper 1.3 mm (0.062 inch) thrust washer and retaining ring onto the end of the spindle. Ensure that the retaining ring is fully seated in the spindle groove.
6. Place the spindle cap (item 4 in Figure 272) to the top of the steering fork spindle and secure the spindle cap with the flange-head screw.
7. Secure the wheel motor assembly as follows:
   A. Slide the wheel motor assembly (with the wheel hub and hydraulic lines attached) into the steering fork.

Installing the Front Steering Fork (continued)

B. Secure the wheel motor to the steering fork with the 4 bolts; tighten the bolts from **128 to 157 N·m (94 to 116 ft-lb).**

C. Secure the bulkhead bracket (item 11 in Figure 272) to the steering fork with the 2 bolts.

IMPORTANT

Before installing the tie rod end, clean the tapers of the steering fork and tie rod end. Ensure that the tapers are free of grease, oil, rust, and dirt. Do not use anti-seize lubricant, when you install the tie rod end.

Note: If necessary, tighten the slotted hex nut further until the slot in hex nut aligns with the hole in the tie rod ball joint stud.

8. Connect the tie rod end (item 1 in Figure 273) to the front steering fork with the slotted hex nut. Tighten the hex nut from **48 to 54 N·m (35 to 40 ft-lb)**. Install a new cotter pin.
9. Lubricate the steering fork spindle through the grease fitting on the axle. Grease should purge from the ends of the spindle identifying that the grease cavity is completely filled. Wipe up excess grease.
10. Install the wheel assembly; refer to Installing the Wheel (page 6–14).

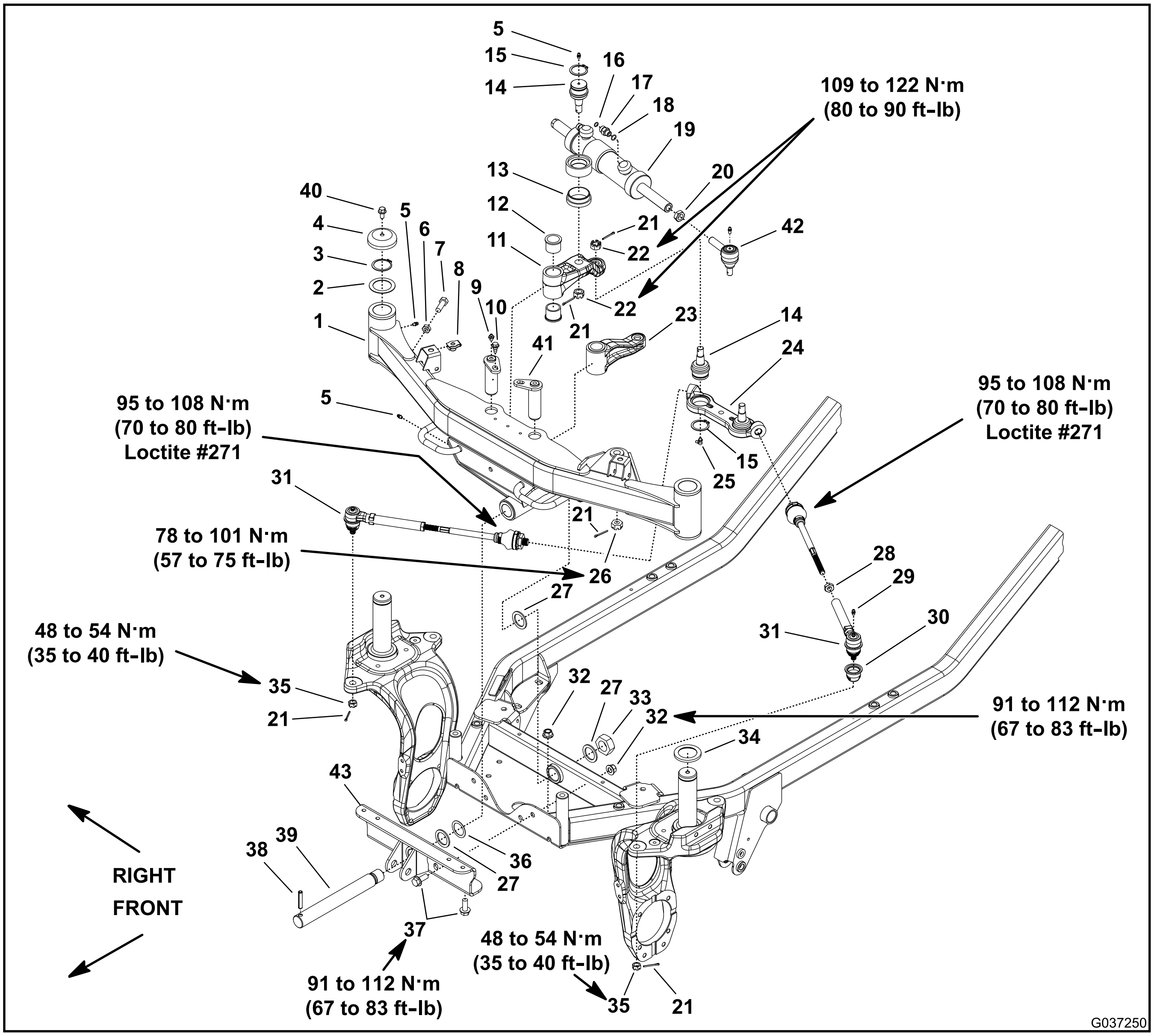
⚠ WARNING ⚠

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.

11. Check and adjust the wheel alignment; refer to Aligning the Wheels (page 6–8).
12. Ensure that there is no contact between the machine components while the wheels move from lock to lock. Adjust if necessary.

Front Steering Assembly

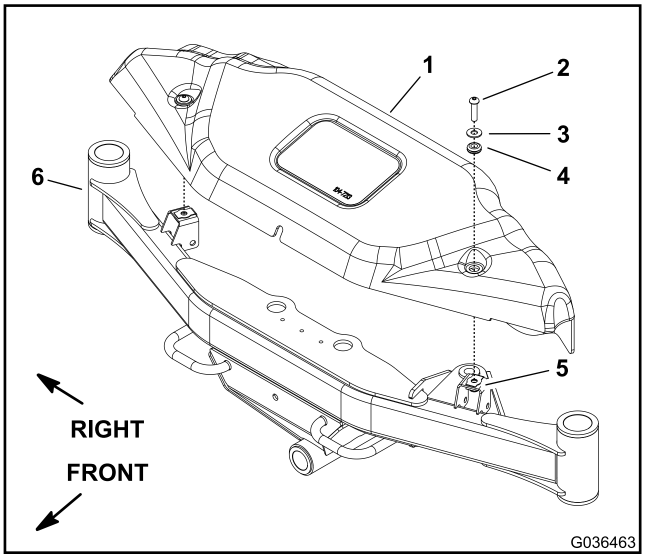


g037250

Figure 275

1. Front axle assembly
2. Thrust washer 1.3 mm (0.062 inch)
3. Retaining ring (2 each)
4. Spindle cap (2 each)
5. Grease fitting (4 each)
6. Jam nut (2 each)
7. Steering stop bolt (2 each)
8. Tinnerman nut (2 each)
9. Grease fitting (2 each)
10. Shoulder bolt (2 each)
11. Right front arm assembly
12. Flange bushing (2 each per arm)
13. Cylinder spacer
14. Ball joint (3 each)
15. Retaining ring (3 each)
16. O-ring
17. Straight hydraulic fitting
18. O-ring
19. Steering cylinder
20. Jam nut
21. Cotter pin (6 each)
22. Slotted hex nut (3 each)
23. Left front arm assembly
24. Center link
25. Grease fitting (2 each)
26. Slotted hex nut
27. Thrust washer (3 each)
28. Jam nut
29. Grease fitting
30. Dust boot
31. Front tie rod (2 each)
32. Locknut (6 each)
33. Locknut
34. Thrust washer 6.3 mm (0.25 inch)
35. Slotted hex nut (2 each)
36. Washer (2 each)
37. Flange-head screw (6 each)
38. Slotted roll pin
39. Pivot shaft
40. Flange-head screw (2 each)
41. Front pin assembly (2 each)
42. Rod end
43. Axle support

Disassembling the Front Steering Assembly



g036463

Figure 276

1.	Front cover	4.	Grommet (2 each)
2.	Screw (2 each)	5.	Tinnerman nut (2 each)
3.	Flat washer (2 each)	6.	Front axle

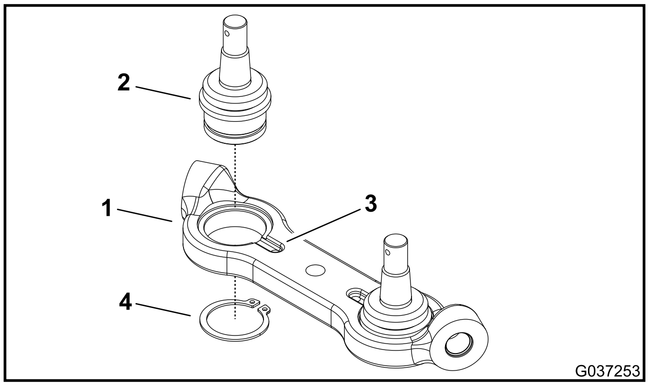
1. Park the machine on a level surface, lower the cutting deck, shut off the engine, and remove the key from the key switch.
2. Remove the front cover from the front axle to get access to the front steering components (Figure 276).
3. If necessary, remove the front wheel; refer to Removing the Wheel (page 6–14).
4. If necessary, remove the steering cylinder; refer to Removing the Steering Cylinder (page 4–150).
5. If necessary, remove the front wheel motor; refer to Removing the Front Wheel Motor (page 4–84).
6. If necessary, remove the front steering fork assembly; refer to Removing the Front Steering Fork (page 6–28).
7. Remove the tie rod (item 31 in Figure 275) from the machine as follows:
   A. Remove the cotter pin (item 21 in Figure 275) and slotted hex nut that secure the outer tie rod ball joint stud to the steering fork.

   B. Carefully pry the ball joint from the steering fork with a ball joint pickle fork.

   C. Loosen the inner tie rod end from the center link and remove the tie rod from the machine.

   Note: The inner and outer tie rod ends are not available separately. If wear or damage occurs to the tie rod components, replace the tie rod assembly.
8. Remove the additional front steering components as necessary (Figure 275). When removing the center link, carefully pry the center link ball joints from the right and left arms with a ball joint pickle fork.
9. If the flange bushings (item 12 in Figure 275) in the front axle, front axle left arm, or front axle right arm are worn or damaged, replace the flange bushings; refer to Servicing the Steering Assembly Bushings (page 6–38).

Assembling the Front Steering Assembly



g037253

Figure 277

1.	Center link	3.	Center link notch
2.	Ball joint	4.	Retaining ring

1. Install all the front steering components that were removed (Figure 275). Note the torque specifications identified in Figure 275 during assembly. If the front axle was removed from the frame, use the washers (item 36 in Figure 275) so that the axle has less than 0.76 mm (0.030 inch) free play between the frame and axle support. If the ball joints were removed from the center link, press new ball joints into the center link from the side of the link that has a notch at the ball joint bore (Figure 277).
2. Install the tie rod (item 31 in Figure 275) to the machine as follows:
   A. If the tie rod assembly is being replaced, adjust the new tie rod assembly to the approximate length of the removed tie rod.

   B. Apply Loctite #271 (or equivalent) to the threads of the inner tie rod end. Thread the tie rod into the center link and torque to **95 to 108 N·m (70 to 80 ft-lb)**.

   C. Clean the tapers of the steering fork and ball joint stud of the outer tie rod end.

   D. Insert the outer tie rod end ball joint stud into the steering fork and secure with the slotted hex nut. Torque the slotted hex nut to **48 to 54 N·m (35 to 40 ft-lb)**. If necessary, tighten the slotted hex nut further until the slot in the nut aligns with the hole in the tie rod ball joint stud. Install the cotter pin.
3. If the steering cylinder was removed, install the steering cylinder; refer to Installing the Steering Cylinder (page 4–151).
4. If the front steering fork assembly was removed, install the steering fork; refer to Installing the Front Steering Fork (page 6–29).
5. If the front wheel motor was removed, install the wheel motor; refer to Installing the Front Wheel Motor (page 4–85).
6. If the front wheel was removed, install the wheel; refer to Installing the Wheel (page 6–14).
7. Install the front cover to the front axle (Figure 276).

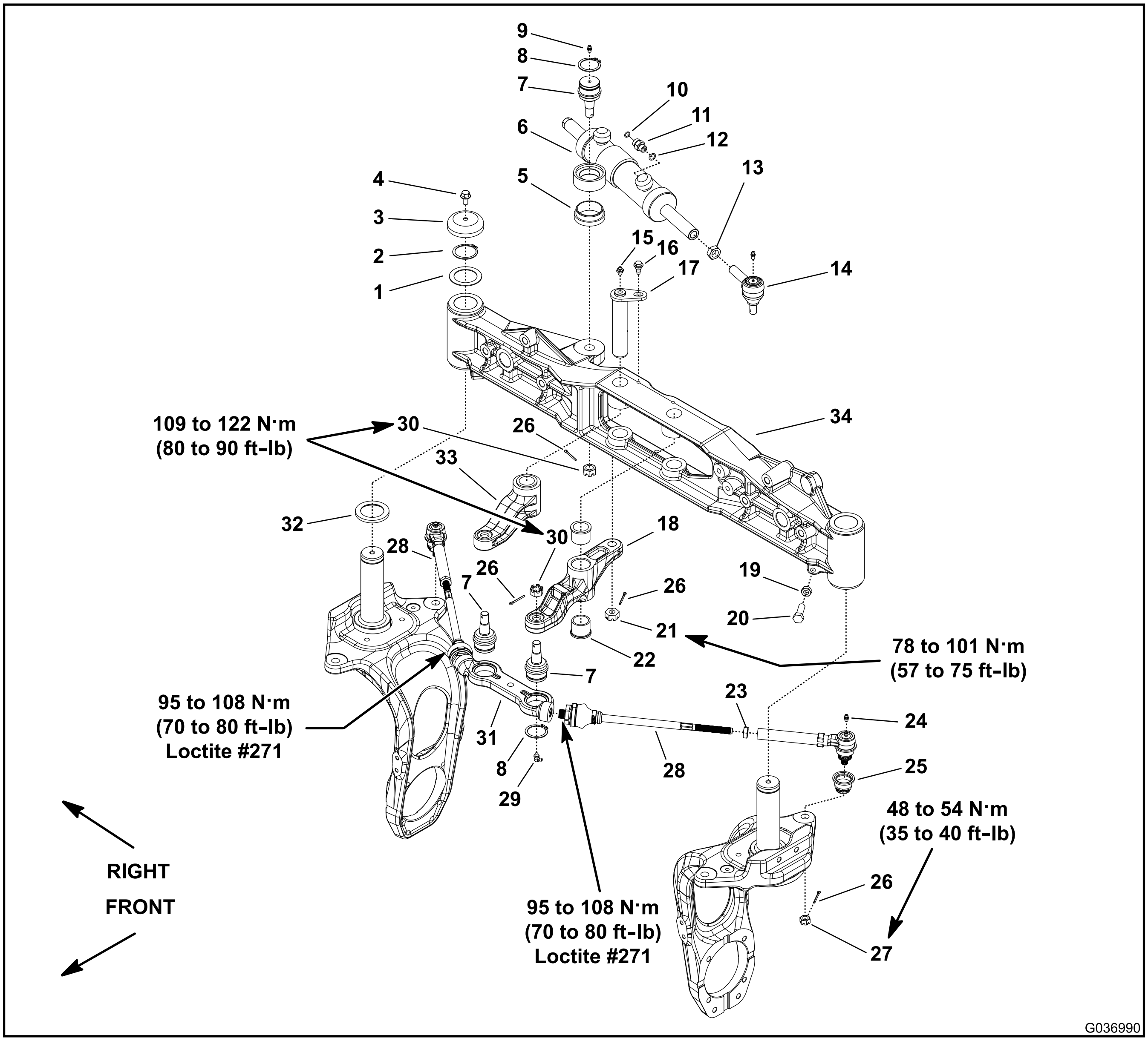
⚠ WARNING ⚠

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.

8. Lubricate all the grease fittings in the front steering assembly.
9. Check and adjust the wheel alignment; refer to Aligning the Wheels (page 6–8).
10. Ensure that there is no contact between the machine components while the wheels move from steering lock to lock. With the steering cylinder fully extended, and when fully retracted, a 1.3 mm (0.05 inch) gap should exist between the steering stop bolt head and the adjacent steering fork. Adjust the steering stop bolt if necessary.

Rear Steering Assembly



g036990

Figure 278

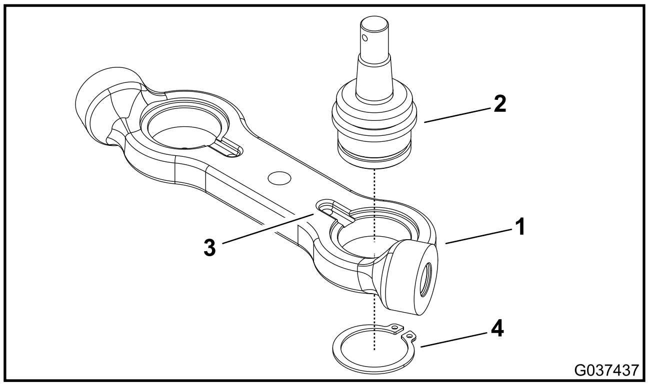
1. Thrust washer 1.3 mm (0.062 inch) (2 each)
2. Retaining ring (2 each)
3. Spindle cap (2 each)
4. Flange-head screw (2 each)
5. Cylinder spacer
6. Steering cylinder
7. Ball joint (3 each)
8. Retaining ring (3 each)
9. Grease fitting
10. O-ring
11. Straight hydraulic fitting
12. O-ring
13. Jam nut
14. Right tie rod end assembly
15. Grease fitting (2 each)
16. Shoulder bolt (2 each)
17. Pin assembly (2 each)
18. Left rear arm assembly
19. Jam nut
20. Steering stop bolt (2 each)
21. Slotted hex nut
22. Flange bushing (2 each per arm)
23. Jam nut
24. Grease fitting
25. Dust boot
26. Cotter pin (6 each)
27. Slotted hex nut (2 each)
28. Rear tie rod (2 each)
29. Grease fitting (2 each)
30. Slotted hex nut (3 each)
31. Center link
32. Thrust washer 6.3 mm (0.25 inch) (2 each)
33. Rear right arm assembly
34. Rear axle assembly

Disassembling the Rear Steering Assembly

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. Unlatch the hood and raise it.
3. Raise the operator seat.
4. Remove the power center assembly behind the operator seat; refer to Removing the Power Center Assembly (page 6–56) or, if the machine is equipped with operator cab; refer to Removing the Power Center Assembly (page 6–58).
5. If necessary, remove the rear wheel; refer to Removing the Wheel (page 6–14).
6. If necessary, remove the steering cylinder; refer to Removing the Steering Cylinder (page 4–150).
7. If necessary, remove the rear wheel motor; refer to Removing the Rear Wheel Motor (page 4–80).
8. If necessary, remove the rear steering fork assembly; refer to Removing the Rear Steering Fork (page 6–24).
9. Remove the tie rod (item 28 in Figure 278) from the machine as follows:
   A. Remove the cotter pin and slotted hex nut that secure the outer tie rod ball joint stud to the steering fork.
   B. Carefully pry the ball joint from the steering fork with a ball joint pickle fork.
   C. Loosen the inner tie rod end from the center link and remove the tie rod from the machine.

   Note: The inner and outer tie rod ends are not available separately. If wear or damage occurs to the tie rod components, replace the tie rod assembly.
10. Remove the additional rear steering components as necessary (Figure 278). When removing the center link, carefully pry the center link ball joints from the right and left arms with a ball joint pickle fork.
11. If the flange bushings (item 22 in Figure 278) in the rear axle, rear axle left arm, or rear axle right arm are worn or damaged, replace the bushings; refer to Servicing the Steering Assembly Bushings (page 6–38).

Assembling the Rear Steering Assembly



g037437

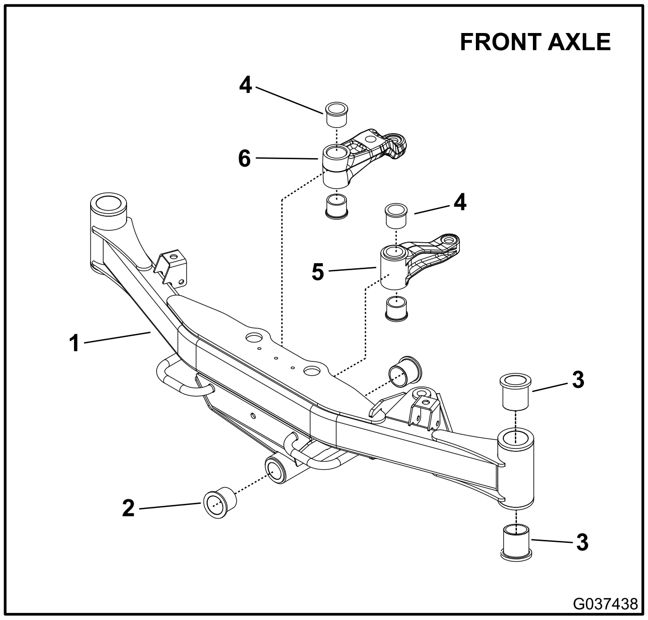
Figure 279

1.	Center link	3.	Center link notch
2.	Ball joint	4.	Retaining ring

Assembling the Rear Steering Assembly (continued)

1. Install all the rear steering components that were removed (Figure 278). Note the torque specifications identified in Figure 278 during assembly. If the ball joints were removed from the center link, press new ball joints into the center link from the side of the link that has a notch at the ball joint bore (Figure 279).
2. Install the tie rod (item 28 in Figure 278) to the machine as follows:
   - A. If the tie rod assembly is being replaced, adjust the new tie rod assembly to the approximate length of the removed tie rod.
   - B. Apply Loctite #271 (or equivalent) to the threads of the inner tie rod end. Thread the tie rod into the center link and torque to **95 to 108 N∙m (70 to 80 ft-lb)**.
   - C. Clean the tapers of the steering fork and outer tie rod end ball joint stud.
   - D. Insert the outer tie rod end ball joint stud into the steering fork and secure with the slotted hex nut. Torque the slotted hex nut to **48 to 54 N∙m (35 to 40 ft-lb)**. If necessary, tighten the slotted hex nut further until the slot in the hex nut aligns with the hole in the tie rod ball joint stud. Install the cotter pin.
3. If the steering cylinder was removed, install the steering cylinder; refer to Installing the Steering Cylinder (page 4–151).
4. If the rear steering fork assembly was removed, install the steering fork assembly; refer to Installing the Rear Steering Fork (page 6–25).
5. If the rear wheel motor was removed, install the rear wheel motor; refer to Installing the Rear Wheel Motor (page 4–81).
6. If the rear wheel was removed, install the wheel; refer to Installing the Wheel (page 6–14).
7. Lubricate all the grease fittings in the rear steering assembly.
8. Check and adjust the wheel alignment; refer to Aligning the Wheels (page 6–8).
9. Check and adjust the brakes; refer to Adjusting the Brake (page 6–6).
10. Ensure that there is no contact between the machine components while the wheels move from steering lock to lock. With the steering cylinder fully extended, and when fully retracted, a 1.3 mm (0.05 inch) gap should exist between the steering stop bolt head and the adjacent steering fork. Adjust the steering stop bolt if necessary.
11. Install the power center assembly to the machine; refer to Installing the Power Center Assembly (page 6–56) or, if the machine is equipped with operator cab; refer to Installing the Power Center Assembly (page 6–58).
12. Lower the operator seat.
13. Lower the hood and secure it with the latches.

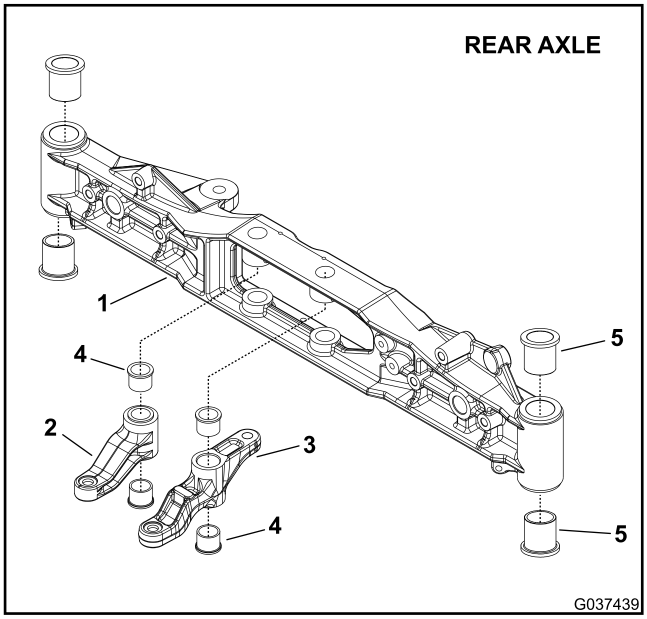
Servicing the Steering Assembly Bushings



g037438

Figure 280

1. Front axle
2. Flange bushing
3. Flange bushing
4. Flange bushing
5. Left front arm
6. Right front arm



g037439

Figure 281

1. Rear axle
2. Right rear arm
3. Left rear arm
4. Flange bushing
5. Flange bushing

Use the following procedure to replace the bushings in the front axle and front arm (Figure 280) or the rear axle and rear arm (Figure 281) assemblies:

Servicing the Steering Assembly Bushings (continued)

Note: Ream the bushings (item 4 in Figure 280 and item 4 in Figure 281) in the steering arms after installation. If the tools for ream are not available, replace the arm assembly which has bushings installed and properly sized.

IMPORTANT

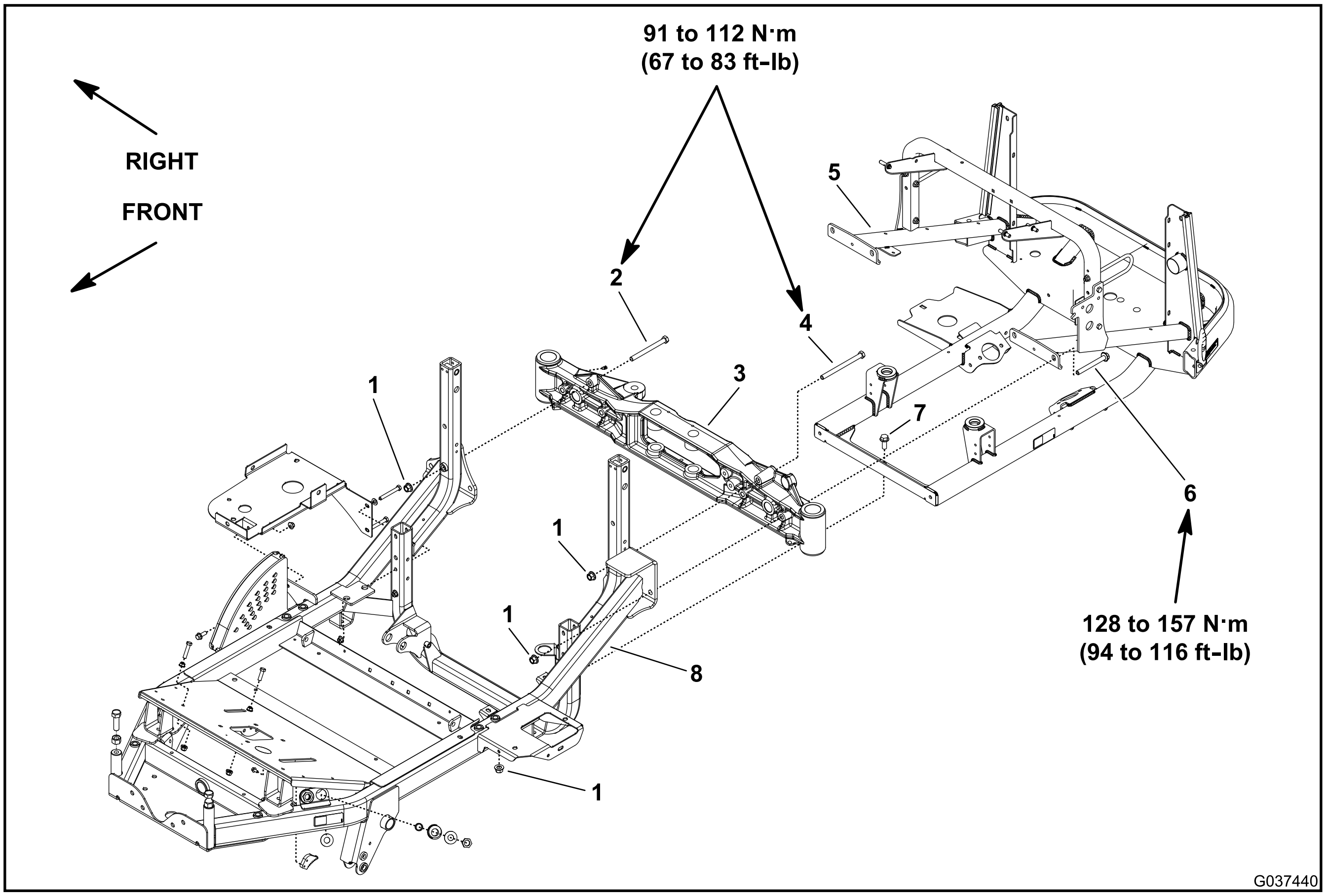
Do not damage the axle or arm bore during bushing removal.

---

1. Use a bushing removal tool to extract both the flange bushings from the component.
2. Clean the inside of the component bore to remove any dirt or unwanted material.
3. Apply grease to the inner and outer surfaces of new flange bushings.
4. Press the new flange bushings into the top and bottom of the component until bushing flange bottoms on the component.
5. After bushing installation, ensure that the appropriate shaft, slides easily into the bushings. If there is any binding, locate and correct the source of binding before final assembly.

   The left arm and right arm on both front and rear axles should have 0.03 to 1.03 mm (0.001 inch to 0.005 inch) clearance between the pin and the inner diameter of installed bushing.

Frame Assembly



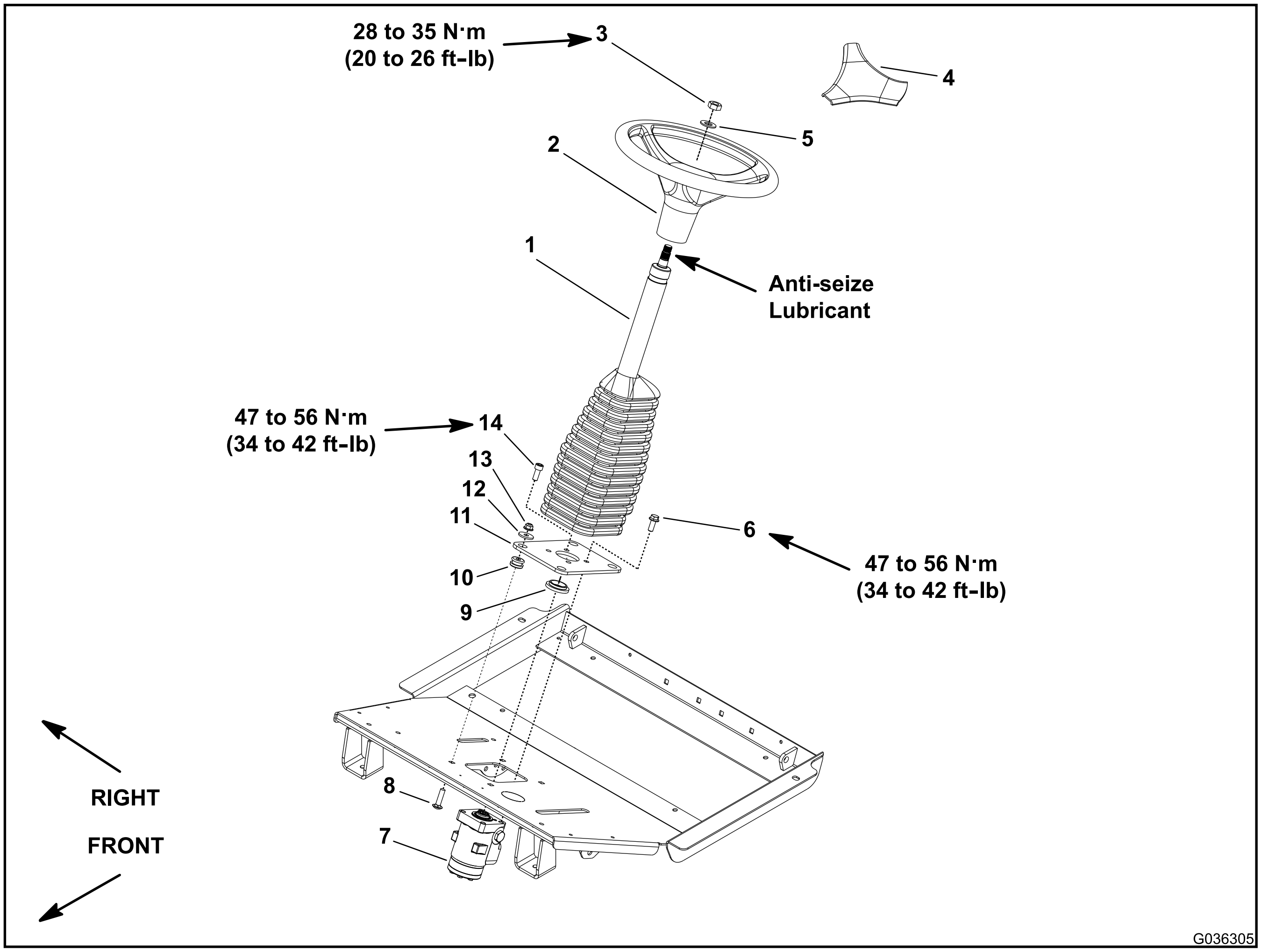
g037440

Figure 282

1.	Flange nut (9 each)	4.	Bolt	7.	Flange-head screw (3 each)
2.	Bolt	5.	Rear frame	8.	Front frame
3.	Rear axle	6.	Flange-head screw (4 each)		

The frame assembly of the Groundsmaster 360 machine is illustrated in Figure 282. If the fasteners used to secure the front frame, rear axle, or rear frame are loosened or removed; refer to Figure 282 for the fastener tightening torque recommendations.

Steering Column



g036305

Figure 283

1.	Steering column assembly	6.	Flange-head screw (3 each)	11.	Steering plate
2.	Steering wheel	7.	Steering control valve	12.	Washer (4 each)
3.	Locknut	8.	Carriage screw (4 each)	13.	Flange nut (4 each)
4.	Steering wheel cover	9.	Alignment bushing	14.	Socket-head screw
5.	Flat washer	10.	Mount (4 each)		

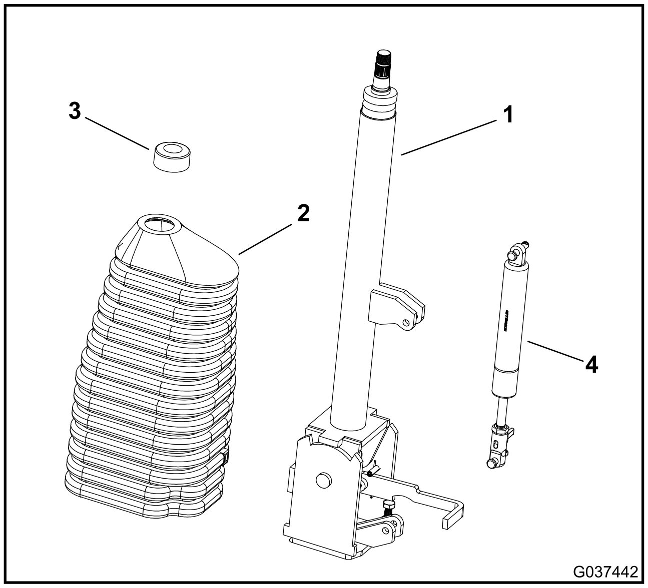
Removing the Steering Column

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. Remove the steering wheel cover (item 4 in Figure 283) from the steering wheel by carefully prying up on one of the cover spokes.
3. Remove the locknut (item 3 in Figure 283) and flat washer that secure the steering wheel to the steering column.
4. Use a suitable puller to remove the steering wheel (item 2 in Figure 283) from the steering column assembly.
5. Slide the rubber bellows up to the steering column to get access to the fasteners that secure the steering column to the machine.
6. Support the steering control valve (item 7 in Figure 283) to prevent it from shifting during the steering column removal.

Removing the Steering Column (continued)

7. Loosen and remove the 3 flange-head screws (item 6 in Figure 283) and socket-head screw that secure the steering column to the steering control valve. Note the location of the socket-head screw for the assembly purposes.
8. Slide the steering column from the steering control valve and the machine.
9. Disassemble the steering column assembly as necessary (Figure 284).

Installing the Steering Column



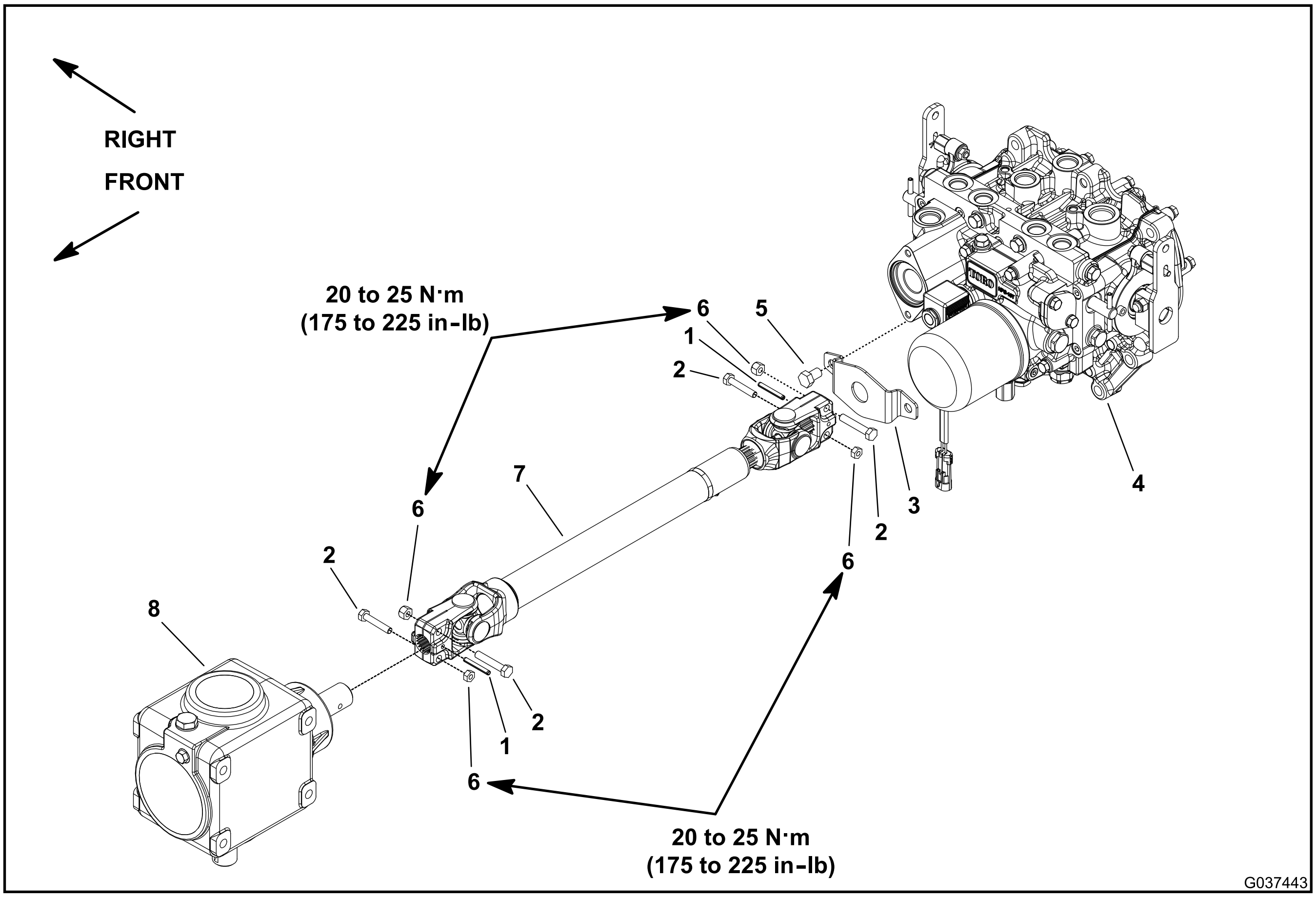
g037442

Figure 284

1.	Steering column	3.	Bearing
2.	Boot	4.	Cylinder

1. Apply anti-seize lubricant to the input shaft of the steering control valve (item 7 in Figure 283).
2. Ensure that the alignment bushing (item 9 in Figure 283) is positioned on the steering control valve and into the bore of the steering plate.
3. Slide the steering column assembly (item 1 in Figure 283) onto the steering control valve. Secure the steering column in place with the 3 flange-head screws and socket-head screw. Tighten the screws by hand and then torque the screws to **47 to 56 N·m (34 to 42 ft-lb)** in a crossing pattern.
4. Slide the rubber bellows to the bottom of the steering column.
5. Clean the tapered surfaces of the steering wheel (item 2 in Figure 283) and steering column.
6. Apply anti-seize lubricant to the splines of steering column and ensure to keep the anti-seize lubricant from the steering column taper. Slide the steering wheel onto the steering column.
7. Secure the steering wheel to the steering column assembly with the flat washer and locknut; torque the locknut to **28 to 35 N·m (20 to 26 ft-lb)**.
8. Install the steering wheel cover (item 4 in Figure 283) onto the steering wheel.

PTO Driveshaft



g037443

Figure 285

1. Roll pin (2 each)	4. Transmission assembly	7. PTO driveshaft
2. Bolt (4 each)	5. Bolt (2 each)	8. Cutting deck gearbox
3. Seal shield	6. Locknut (4 each)	

Removing the PTO Driveshaft

Note: The PTO driveshaft removal is easier if the machine is positioned on a hoist.

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.

⚠ 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.

Before disconnecting the PTO driveshaft from the cutting deck, disconnect the PTO solenoid coil connector from the wire harness to prevent the PTO clutch from engaging unintentionally.

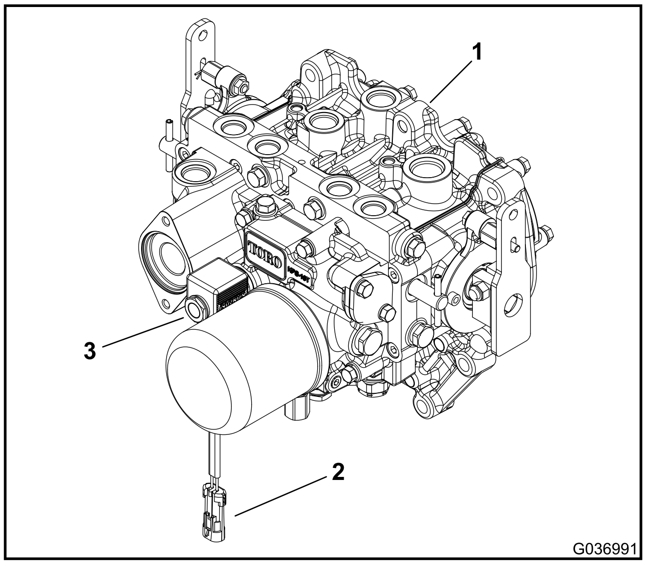


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Figure 286

1. Transmission	3. Solenoid valve and coil
2. Coil connector	

Removing the PTO Driveshaft (continued)

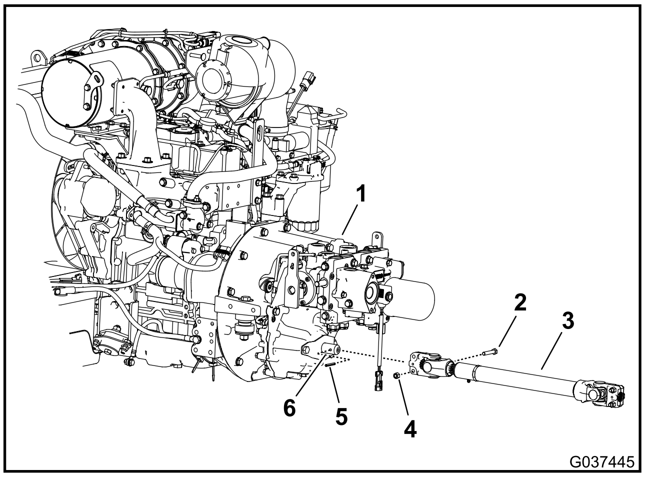

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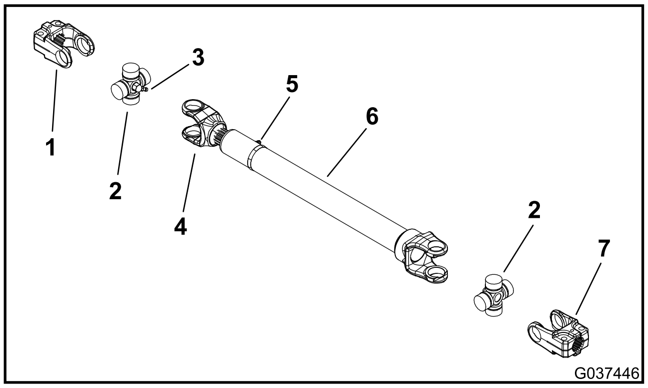
Figure 287

1.	Transmission	4.	Locknut
2.	Bolt	5.	Roll pin
3.	PTO driveshaft	6.	PTO shaft

2. Disconnect the wire harness electrical connector from the PTO solenoid valve coil connector (item 2 in Figure 286) to prevent the PTO clutch from engaging unintentionally.
3. Disconnect the end yoke of the PTO driveshaft (item 3 in Figure 287) from the PTO shaft on transmission as follows:
    - A. Remove the roll pin from the end yoke and PTO shaft.
    - B. Loosen the 2 bolts and the 2 locknuts.
    - C. Slide the driveshaft end yoke from the PTO shaft.
4. Disconnect the end yoke of PTO driveshaft from the cutting deck gearbox shaft as follows:
    - A. Remove the roll pin from the end yoke and gearbox shaft.
    - B. Loosen the 2 bolts and the 2 locknuts.
    - C. Slide the driveshaft end yoke from the gearbox shaft.
5. Remove the PTO driveshaft from the machine.

Installing the PTO Driveshaft



g037446

Figure 288

1. End yoke
2. Cross and bearing set
3. Grease fitting
4. Yoke and shaft
5. Grease fitting
6. Yoke and slip tube
7. End yoke

---

1. Position the PTO driveshaft to the machine.

   Note: Ensure that the driveshaft yoke and slip tube (item 6 in Figure 288) is toward the cutting deck gearbox shaft.

2. Align the splines and roll pin holes of the driveshaft yokes with the transmission and gearbox shafts.
3. Slide the PTO driveshaft end yokes onto the transmission PTO shaft and gearbox shaft.
4. Attach the end yokes of the PTO driveshaft as follows:
   - A. Install the 2 roll pins to the end yokes and shafts.
   - B. Install the 4 bolts in the driveshaft end yokes. Alternate direction that the bolt is installed on each yoke.
   - C. Install and tighten the 4 locknuts that attach the end yokes to the gearbox and PTO shafts; torque the locknuts to **20 to 25 N·m (175 to 225 in-lb)**.
5. Lubricate the PTO driveshaft grease fittings.
6. Connect the wire harness electrical connector to the PTO solenoid valve coil connector (item 2 in Figure 286).

Servicing the PTO Driveshaft Cross and Bearing

1. Remove the PTO driveshaft from the machine; refer to Removing the PTO Driveshaft (page 6–44).

IMPORTANT

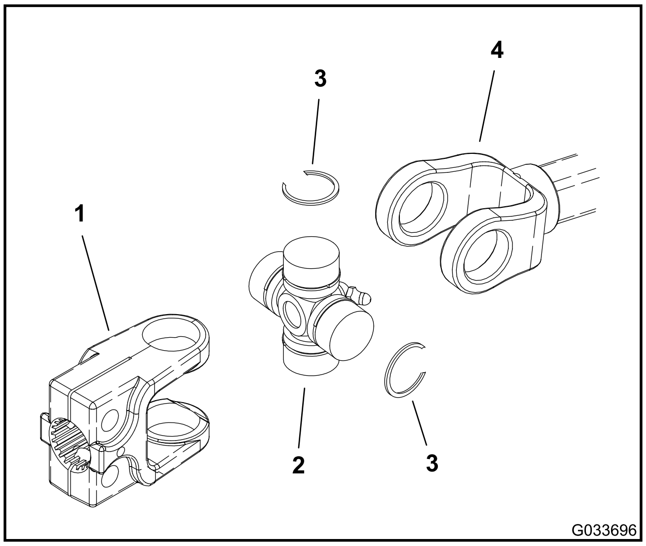
When you place the yoke in a vise, clamp lightly on the solid part of the yoke to prevent damage. Use a vise equipped with soft jaws.

2. Lightly clamp the yoke in a vise. Use 2 screwdrivers to remove the 4 snap rings that attach the bearings at the inside of each yoke. Remove the yoke from the vise.

IMPORTANT

Support the yokes when removing and installing the bearings to prevent damage.

3. Use a press to remove the cross and bearings from the yokes, do the following steps:
   - A. Place a small socket against 1 bearing and a large socket against the yoke on the opposite side.
   - B. While you support the large socket, apply pressure on small socket to partially push the opposite bearing into the large socket.
   - C. Remove the yoke from the press, hold the partially removed bearing and tap on the yoke to completely remove the bearing.
   - D. Repeat the process for the remaining bearings.
   - E. Clean and inspect all the components.



g033696

Figure 289

1. End yoke
2. Cross and bearing kit
3. Snap ring (4 each)
4. Shaft yoke

Servicing the PTO Driveshaft Cross and Bearing (continued)

4. Install new cross and bearings as follows:

   A. Apply a coat of grease to the bearing bores of the end yoke and shaft yoke. Also, apply grease to the bearings and seal of the bearing assembly.

      Note: Ensure that all the bearing rollers are correctly seated in the bearing cage.

   B. Press 1 bearing partially into the yoke.

IMPORTANT

When installing the cross into the bearing, ensure that you do not damage the bearing seal.

   C. Carefully insert the cross into the bearing and yoke.

   D. Hold the cross in alignment and press the bearing in until it hits the yoke.

   E. Carefully position the second bearing into the yoke bore and onto the cross shaft. Press the bearing into the yoke.

   F. Install the 4 snap rings to the bearings to secure the bearings in place.

   G. Repeat the procedure for the other yoke.

   H. Apply grease to the cross until it comes out of all the 4 bearing cups.

   I. Ensure that the assembled joint moves without any binding. Lightly rap the yoke lugs with a soft-faced hammer to remove slight binding. If the binding continues, disassemble the joint to identify the source of binding.

   J. Install the PTO driveshaft to the machine; refer to Installing the PTO Driveshaft (page 6–46).

Cutting Deck Lift Assembly

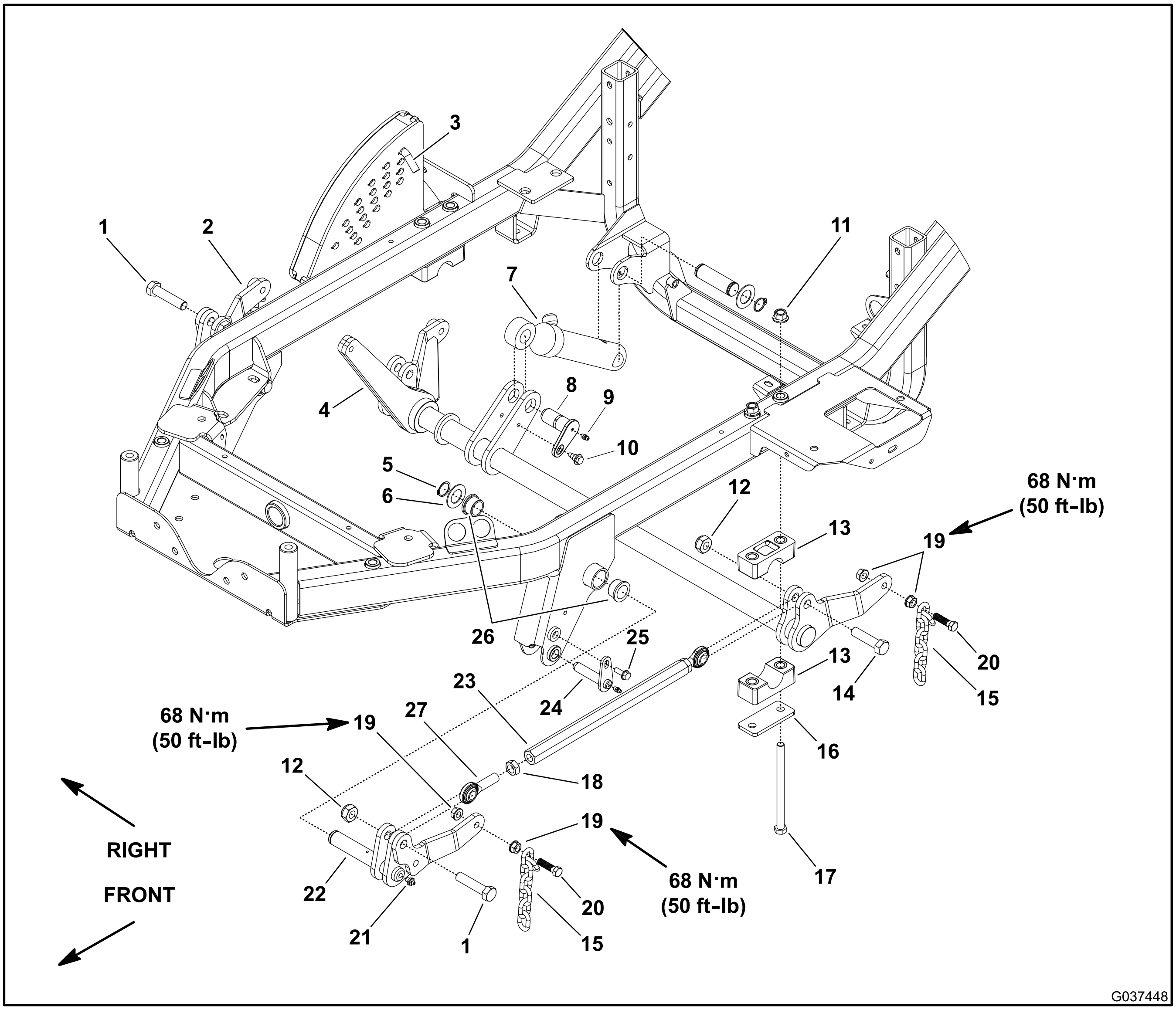
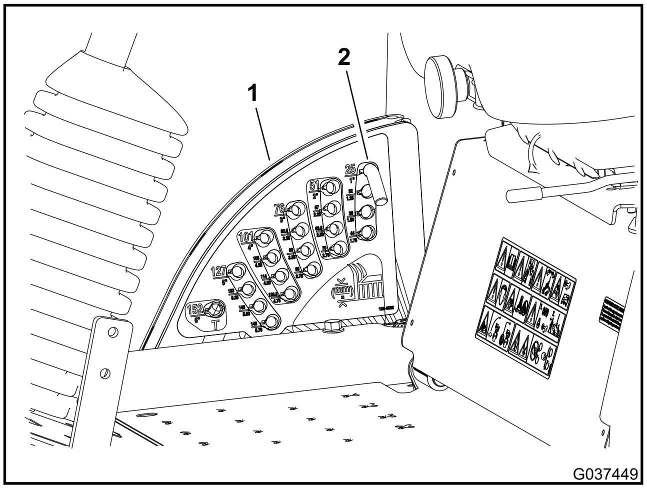


Figure 290

1. Bolt (2 each)
2. Right lift arm
3. HOC pin
4. Lift shaft assembly
5. Retaining ring (1 each per lift arm)
6. Washer (1 each per lift arm)
7. Lift cylinder
8. Pivot pin
9. Grease fitting (3 each)
10. Shoulder bolt
11. Locknut (4 each)
12. Locknut (4 each)
13. Bearing cap (4 each)
14. Bolt (2 each)
15. HOC chain (4 each)
16. Bearing plate (2 each)
17. Bolt (4 each)
18. Jam nut
19. Flange nut (2 each per chain)
20. Bolt (4 each)
21. Grease fitting (2 each)
22. Left lift arm
23. Link assembly (2 each)
24. Retainer pin (2 each)
25. Taptite screw (2 each)
26. Flange bushing (4 each)
27. Ball joint (2 each per link)

Disassembling the Cutting Deck Lift Assembly



g037449

Figure 291

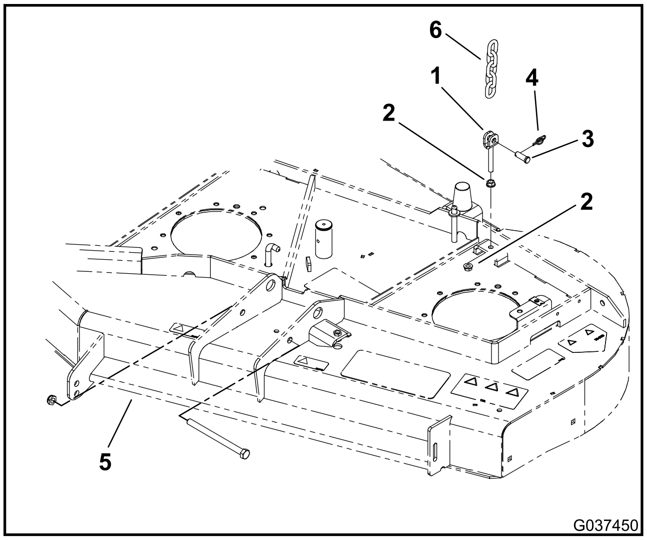
1. HOC bracket
2. HOC pin

1. Park the machine on a level surface with the cutting deck fully raised. Shut off the engine, set the parking brake.
2. Note the location of the HOC pin in the HOC bracket for assembly purposes, and remove the HOC pin from the HOC bracket (Figure 291).
3. Start the engine and fully lower the cutting deck. Shut off the engine and remove the key from the key switch.

   Note: If the cutting deck is to be removed from machine; refer to the *Cutting Deck Operator's Manual*.
4. Remove the lift arm components as shown in Figure 290 and Figure 292.

   Note: If the pull link assembly removal is necessary; refer to Cutting Deck Pull Links (page 7–19).

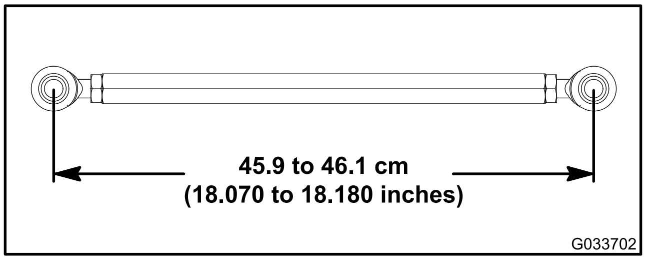
Assembling the Cutting Deck Lift Assembly



g037450

Figure 292

1. Adjustment clevis	4. Cotter pin
2. Flange nut (8 each)	5. Cutting deck
3. Clevis pin	6. HOC chain



g033702

Figure 293

1. Check the bearing caps (item 13 in Figure 290) and flange bushings (item 26 in Figure 290) for wear or damage. Replace the components if necessary.
2. Install the lift arm components as shown in Figure 290 and Figure 292.
   A. If the ball joints were removed from the link assembly (item 23 in Figure 290), install the ball joints equally on both ends of the link. Adjust the center-to-center length of the link assembly (Figure 293) to 45.9 to 46.1 cm (18.070 to 18.180 inches). Tighten the jam nuts to secure the ball joints to the link. Ensure that the ball joints stay in-line when you tighten the jam nuts.

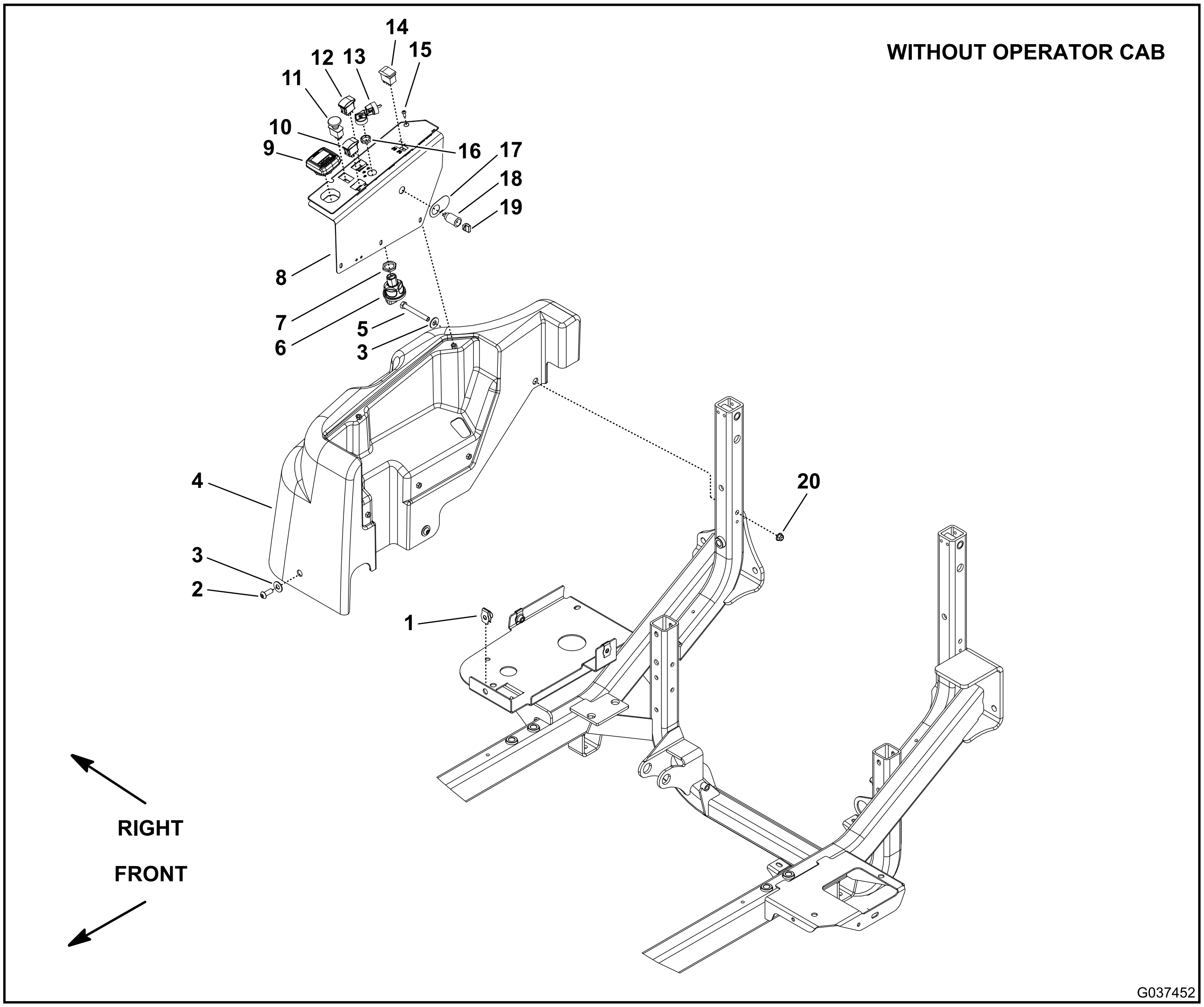
   Note: Do not change the length of the link assembly to adjust the height-of-cut or for any other reason.

   Note: When properly installed, the flange nuts (item 19 in Figure 290) should have the flange surface against the lift arm and not against the chain. Correct assembly will allow chain to free to pivot.

   B. If the bolt (item 20 in Figure 290) was removed from the HOC chain, insert the bolt into the upper link of the chain and thread the flange nut onto the bolt with the flange away from the link; torque the flange nut to **68 N·m (50 ft-lb)**. When you fasten the chain to the front lift arm, torque the second flange nut to **68 N·m (50 ft-lb)**. When you install the chain to the rear lift arm; torque the bolts to **68 N·m (50 ft-lb)**.

3. Lubricate all the lift arm grease fittings after assembly.
4. Start the engine and fully raise the cutting deck. Shut off the engine and remove the key from the key switch.
5. Install the HOC pin into the HOC bracket to allow desired height-of-cut.

Control Console

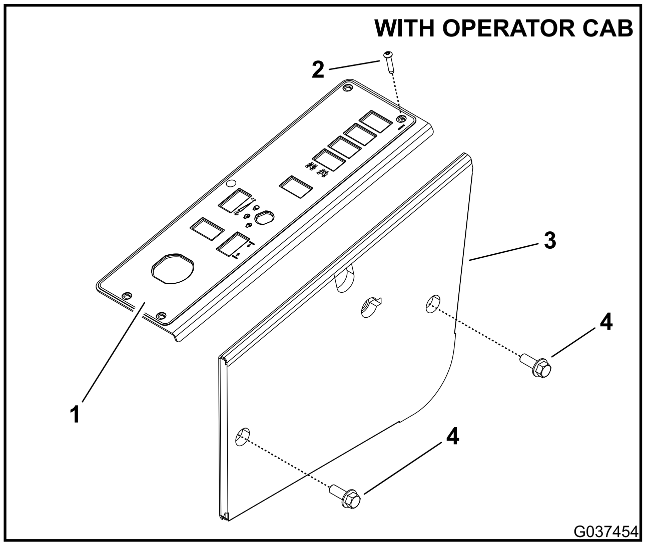


g037452

Figure 294

1. Tinnerman nut (3 each)
2. Button-head screw (3 each)
3. Flat washer (4 each)
4. Hydraulic tank cover
5. Screw
6. Key switch
7. Hex nut
8. Control panel
9. InfoCenter display
10. Deck lift switch
11. PTO switch
12. Engine speed switch
13. Key set
14. 4–wheel steering switch
15. Button-head screw (5 each)
16. Face nut
17. Power point decal
18. Power point
19. Cap
20. Flange nut

Disassembling the Control Console



g037454

Figure 295

1. Control panel	3. Access panel
2. Button-head torx screw (5 each)	4. Screw (2 each)

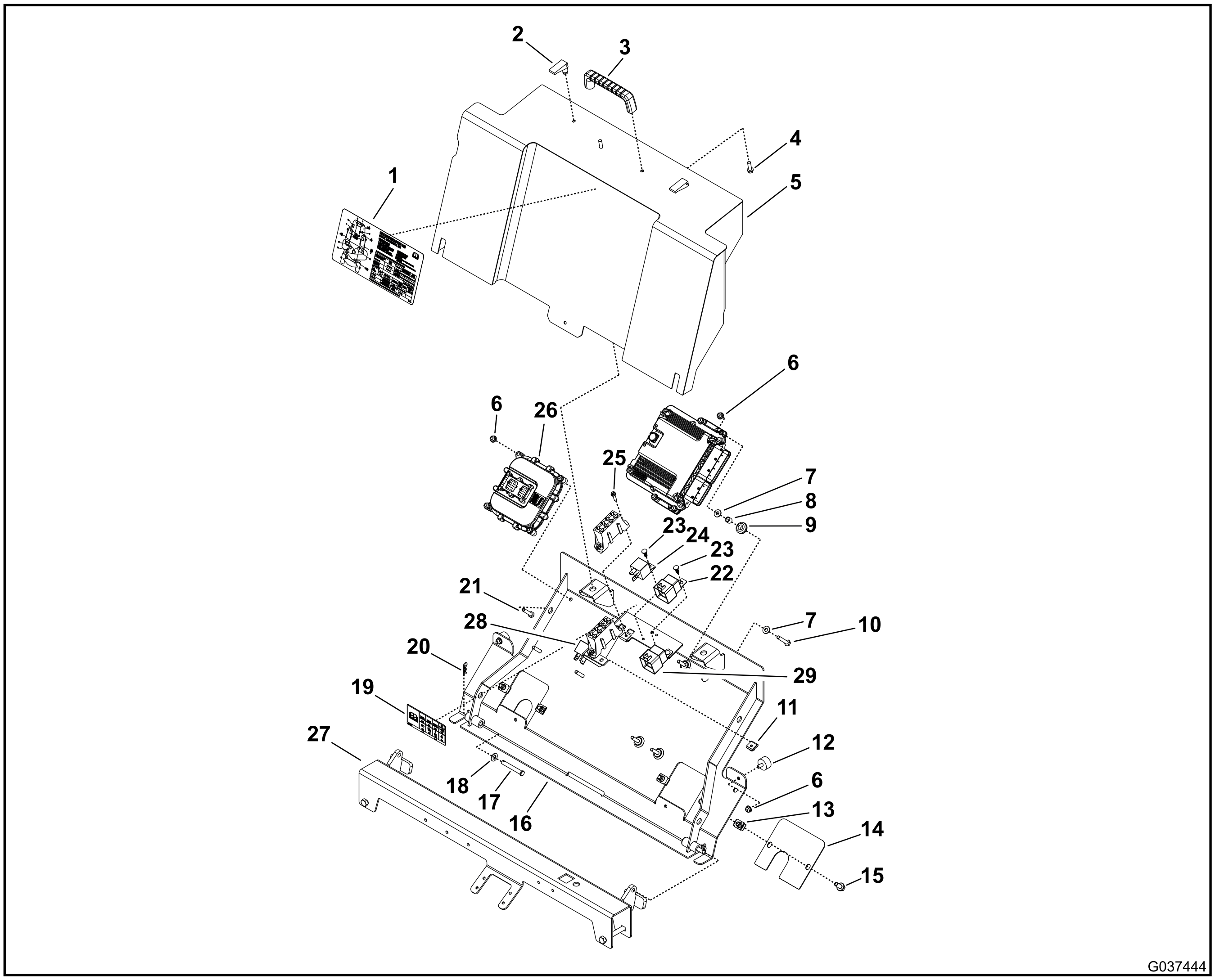
---

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. Disconnect the battery cables from the battery. Remove the negative battery cable and then remove the positive cable; refer to Servicing the Battery (page 5–111).
3. Remove the 5 screws that secure the control panel to the machine.
4. On machines with an operator cab, remove the 2 screws that secure the access panel and then remove the access panel (Figure 295).
5. Carefully lift and support the control panel to get access to the electrical connections.
6. For assembly purposes, label all the wire harness connectors.
7. Disconnect the wire harness connectors from all the electrical components on the control panel.
8. Remove the control panel from the machine.
9. If necessary, remove the hydraulic tank cover as shown in Figure 294.

Assembling the Control Console

1. If the hydraulic tank cover was removed, install the hydraulic tank cover as shown in Figure 294.
2. Use the labels that you attached during disassembly to connect the wire harness connectors to the components on the control panel.
3. On machines with an operator cab, position the access panel in place and secure with the 2 screws (Figure 295).
4. Position the control panel on the hydraulic tank cover and secure the control panel with the 5 screws (Figure 294).
5. Connect the battery cables to the battery. Connect the positive cable and then connect the negative cable; refer to Servicing the Battery (page 5–111).

Power Center Assembly (Machines without Operator Cab)



g037444

Figure 296

1.	Instructions decal	11.	U-type speed nut (4 each)	21.	Screw (4 each)
2.	Swell latch (2 each)	12.	Rubber bumper (2 each)	22.	Start relay
3.	Cover handle	13.	U-nut (4 each)	23.	Plastic plug (4 each)
4.	Washer-head screw (2 each)	14.	Cover plate (2 each)	24.	Glow relay
5.	Power center cover	15.	Flange-head screw (4 each)	25.	Washer-head screw (4 each)
6.	Flange nut (10 each)	16.	Power center assembly	26.	TEC
7.	Flat washer (8 each)	17.	Clevis pin (2 each)	27.	Seat channel
8.	Spacer (4 each)	18.	Flat washer (2 each)	28.	Main power relay
9.	Grommet (4 each)	19.	Fuse block decal	29.	EGR relay
10.	Screw (4 each)	20.	Hairpin cotter (2 each)		

Removing the Power Center Assembly

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. Disconnect the battery cables from the battery. Remove the negative battery cable and then remove the positive cable; refer to Servicing the Battery (page 5–111).
3. Unlatch the operator seat and raise it.
4. Unlatch and remove the power center cover (item 5 in Figure 296).

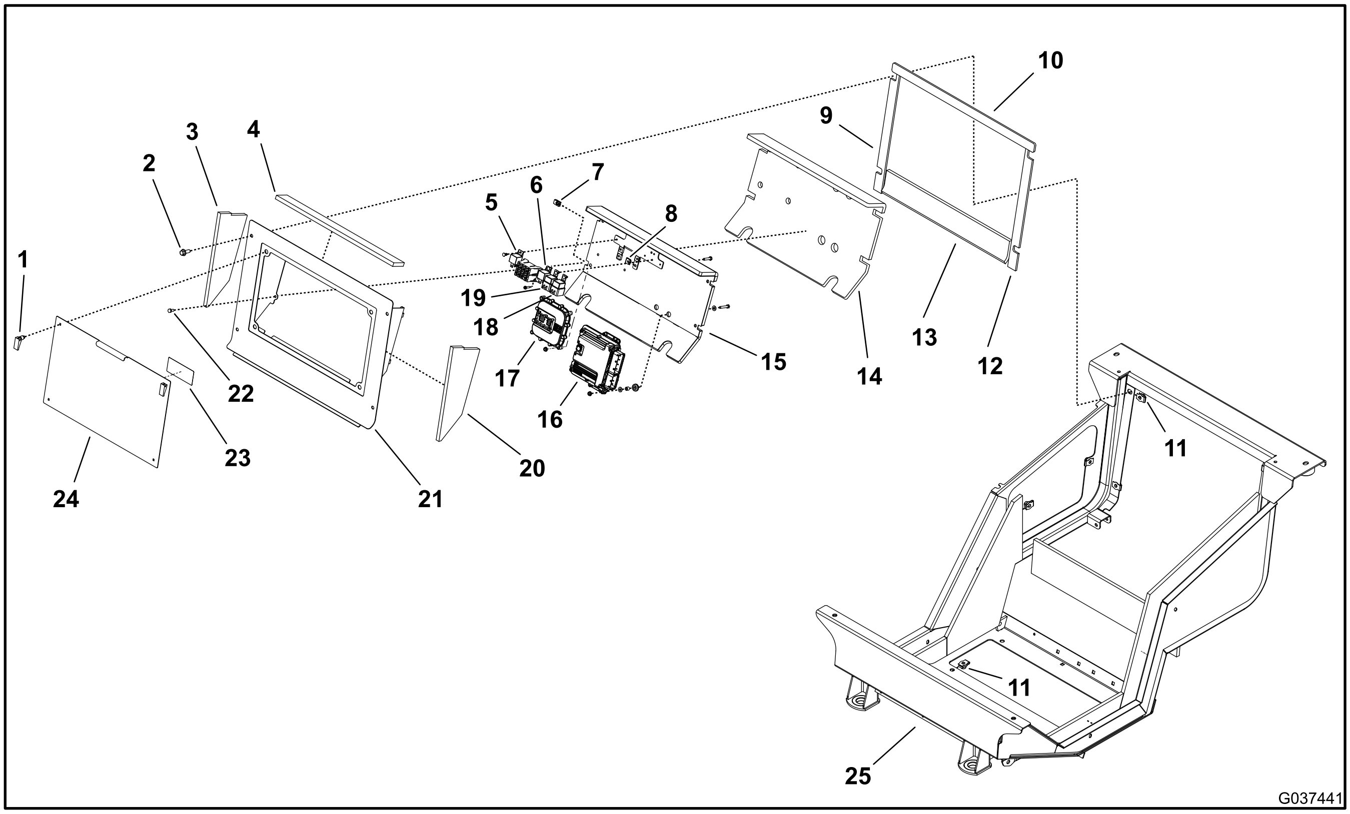
   Note: To access machine components below the power center assembly, it is possible to remove the cotter pins, clevis pins, and washers that secure the power center to the seat channel. Then, the power center with all attached electrical components can carefully be raised and supported to get access below the power center. If complete removal of the power center is necessary, continue with the following steps.

5. For assembly purposes, label all the wire harness connectors.
6. Disconnect all the wire harness connectors from the electrical components attached to the power center assembly (item 16 in Figure 296).
7. Support the power center assembly and remove the 2 hairpin cotters (item 20 in Figure 296) and 2 clevis pins that secure the power center assembly to the seat channel, and remove the power center assembly.

Installing the Power Center Assembly

1. Position the power center assembly onto the seat channel.
2. Secure the power center assembly to the seat channel with the 2 hairpin cotters (item 20 in Figure 296) and 2 clevis pins.
3. Use the labels that you attached during removal to connect all the wire harness connectors to the electrical components attached to the power center assembly.
4. Install and secure the power center cover with the 2 swell latches (item 2 in Figure 296).
5. Lower the operator seat and latch it.
6. Connect the battery cables to the battery. Connect the positive cable and then connect the negative cable; refer to Servicing the Battery (page 5–111).

Power Center Assembly (Machines with Operator Cab)



g037441

Figure 297

1. Swell latch (4 each)
2. Flange-head screw (4 each)
3. Right foam
4. Top foam
5. Main power relay
6. Glow relay
7. Clip (4 each)
8. Speed nut (4 each)
9. Foam
10. Foam
11. Tinnerman nut (4 each)
12. Foam
13. Bottom foam
14. Tray foam
15. Power center tray assembly
16. Engine ECU
17. Toro electronic controller (TEC)
18. EGR relay
19. Start relay
20. Left foam
21. Power center housing
22. Screw (4 each)
23. Fuse block decal
24. Cover panel
25. Cab platform

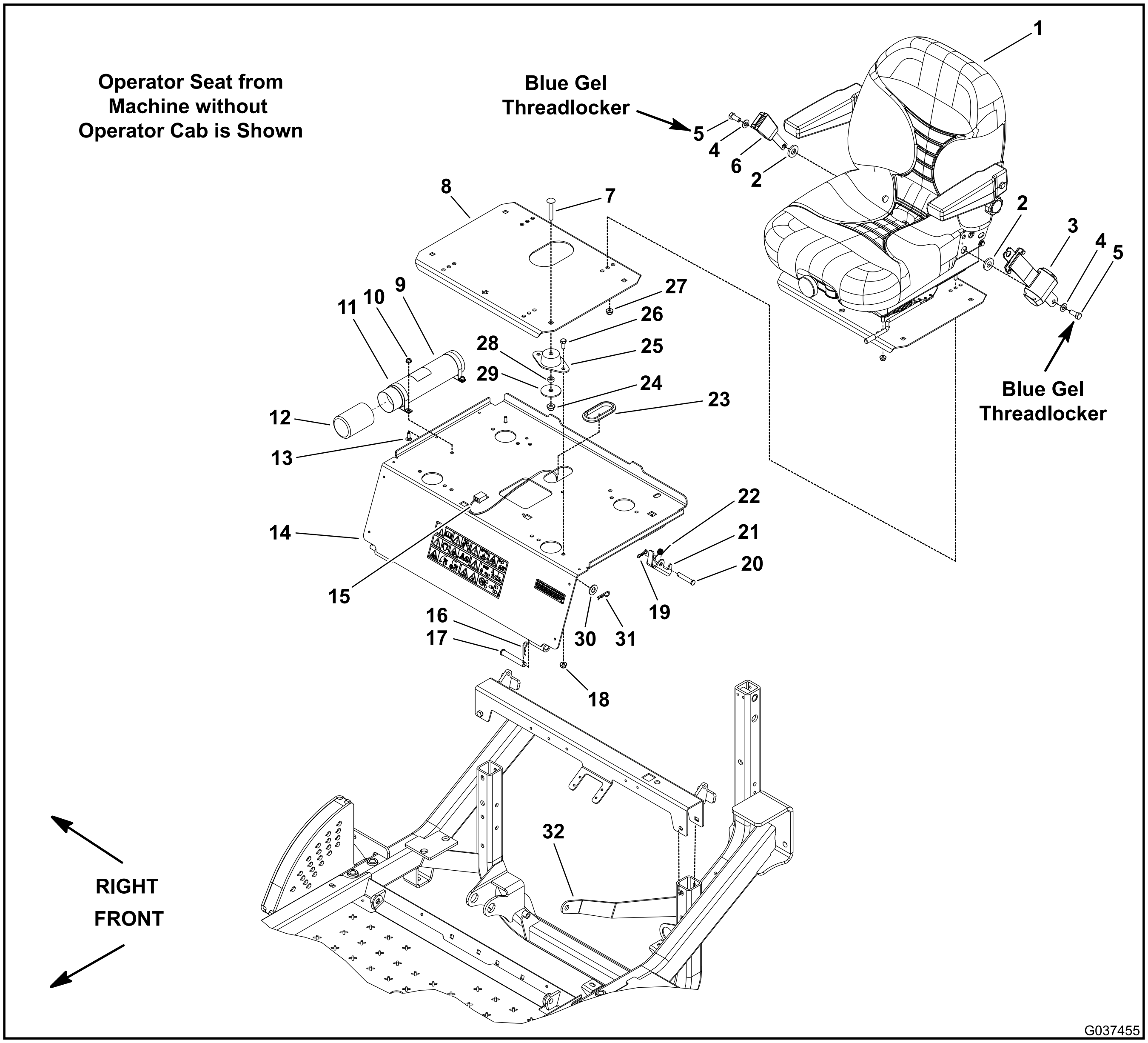
Removing the Power Center Assembly

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. Disconnect the battery cables from the battery. Remove the negative battery cable and then remove the positive cable; refer to Servicing the Battery (page 5–111).
3. Remove the operator seat from the machine; refer to Removing the Operator Seat (page 6–60).
4. Unlatch and remove the cover panel (item 24 in Figure 297).
5. To access the machine components below the power center assembly, do the following:
    - A. Remove the screws that secure the center tray assembly (item 15 in Figure 297) to the power center.
    - B. Remove the flange-head screws that attach the power center housing (item 21 in Figure 297) to the cab platform. Remove the housing from the machine.
    - C. Carefully raise and support the power center tray with all attached electrical components to get access below the power center.
6. If complete removal of the power center tray is necessary, do the following:
    - A. For assembly purposes, label all the wire harness connectors.
    - B. Disconnect all the wire harness connectors from the electrical components attached to the power center tray.
    - C. Carefully separate wire harness from power center tray and electrical components on tray. Remove power center tray from machine.

Installing the Power Center Assembly

1. If the power tray was removed, do the following:
    - A. Carefully position the electrical harness to the center tray components and install the center tray to the machine.
    - B. Connect all the wire harness connectors to the components on the power center.
2. Place the power center housing to the machine. Secure the tray to the housing and then the housing to the cab platform.
3. Install and secure the cover panel with the 4 swell latches (item 1 in Figure 297).
4. Install the operator seat; refer to Installing the Operator Seat (page 6–61).
5. Connect the battery cables to the battery. Connect the positive cable and then connect the negative cable; refer to Servicing the Battery (page 5–111).

Operator Seat



g037455

Figure 298

1.	Operator seat (without operator cab)	9.	Manual tube	17.	Clevis pin (2 each)	25.	Mount (4 each)
2.	Flat washer (2 each)	10.	Flange nut (2 each)	18.	Flange nut (2 each per mount)	26.	Bolt (2 each per mount)
3.	Seat belt	11.	R-clamp (2 each)	19.	Cotter pin	27.	Flange nut (4 each)
4.	Flat washer (2 each)	12.	Manual tube cover	20.	Clevis pin	28.	Spacer (4 each)
5.	Bolt (2 each)	13.	Carriage screw (2 each)	21.	Seat latch	29.	Flat washer (4 each)
6.	Seat belt latch	14.	Seat plate	22.	Torsion spring	30.	Flat washer (2 each)
7.	Carriage screw (4 each)	15.	Seat switch wire harness	23.	Grommet	31.	Hairpin (2 each)
8.	Upper seat plate	16.	Hairpin cotter (2 each)	24.	Flange nut (4 each)	32.	Prop strap

Removing the Operator Seat

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. Unlatch the operator seat and raise it.

⚠ CAUTION ⚠

To prevent injury, do not attempt to reach the seat switch through the openings in the seat plate.

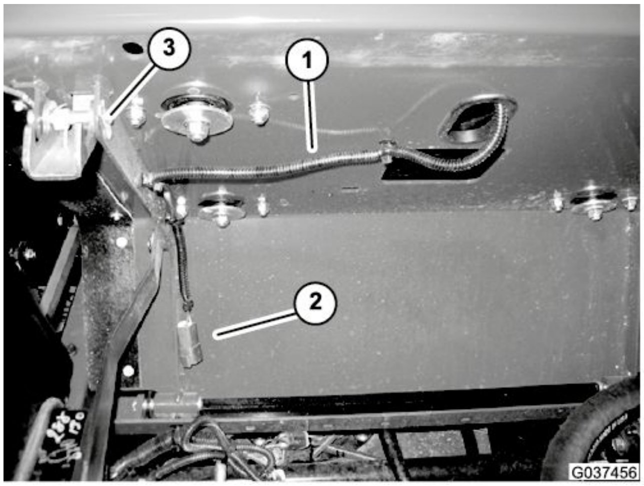
If seat switch service is necessary, remove the seat from the seat plate to access the switch.

3. Disconnect the machine wire harness electrical connector from the seat switch harness connector (Figure 299). Note the routing of the seat wire harness for assembly purposes.

⚠ CAUTION ⚠

The weight of the seat assembly is approximately 55 N·m (121 lb).

Support the seat assembly when removing it to prevent it from falling and causing personal injury.



g037456

Figure 299

1. Seat wire harness
2. Seat harness connector
3. Seat latch

4. Remove entire seat assembly from the machine as follows:
   A. Remove the hairpin and flat washer that secure the prop strap to the seat plate.
   B. Disconnect the prop strap from the seat plate and then lower the seat assembly.
   C. Remove the hairpins and clevis pins that secure the seat plate to the machine.
   D. Lift entire seat assembly from the machine and place it on a suitable work surface.

Removing the Operator Seat (continued)

5. Support the seat and upper seat plate (item 8 in Figure 298) to prevent them from shifting during seat removal.
6. Remove the 4 carriage screws (item 7 in Figure 298) and 4 flange nuts that secure the seat and upper seat plate assembly to the seat plate, and remove the seat and upper seat plate from the machine.
7. Remove the seat parts as shown in Figure 298.

Installing the Operator Seat

1. Install all the removed seat parts (Figure 298).
2. If the seat belt (item 3 in Figure 298) or seat belt latch were removed from the seat assembly, apply blue gel thread locker (or equivalent) to the threads of the bolt before installing the screw.
3. If the seat plate (item 14 in Figure 298) was removed, secure the seat plate to the machine as shown in Figure 298.
4. Position the seat and upper seat plate assembly to the seat plate. Secure the assembly with the 4 carriage screws (item 7 in Figure 298) and 4 flange nuts.
5. Install the seat assembly to machine as follows:
   A. Position entire seat assembly onto the machine and secure with the clevis pins and hairpins.
   B. Raise the seat and connect the prop strap to the seat plate.
   C. Secure the prop strap to the seat plate with the flat washer and hairpin.
6. Connect the wire harness electrical connector to the seat switch harness (Figure 299).
7. Lower the seat and latch it.
8. Check the operation of the operator seat switch.

Servicing the Operator Seat (Machines without Operator Cab)

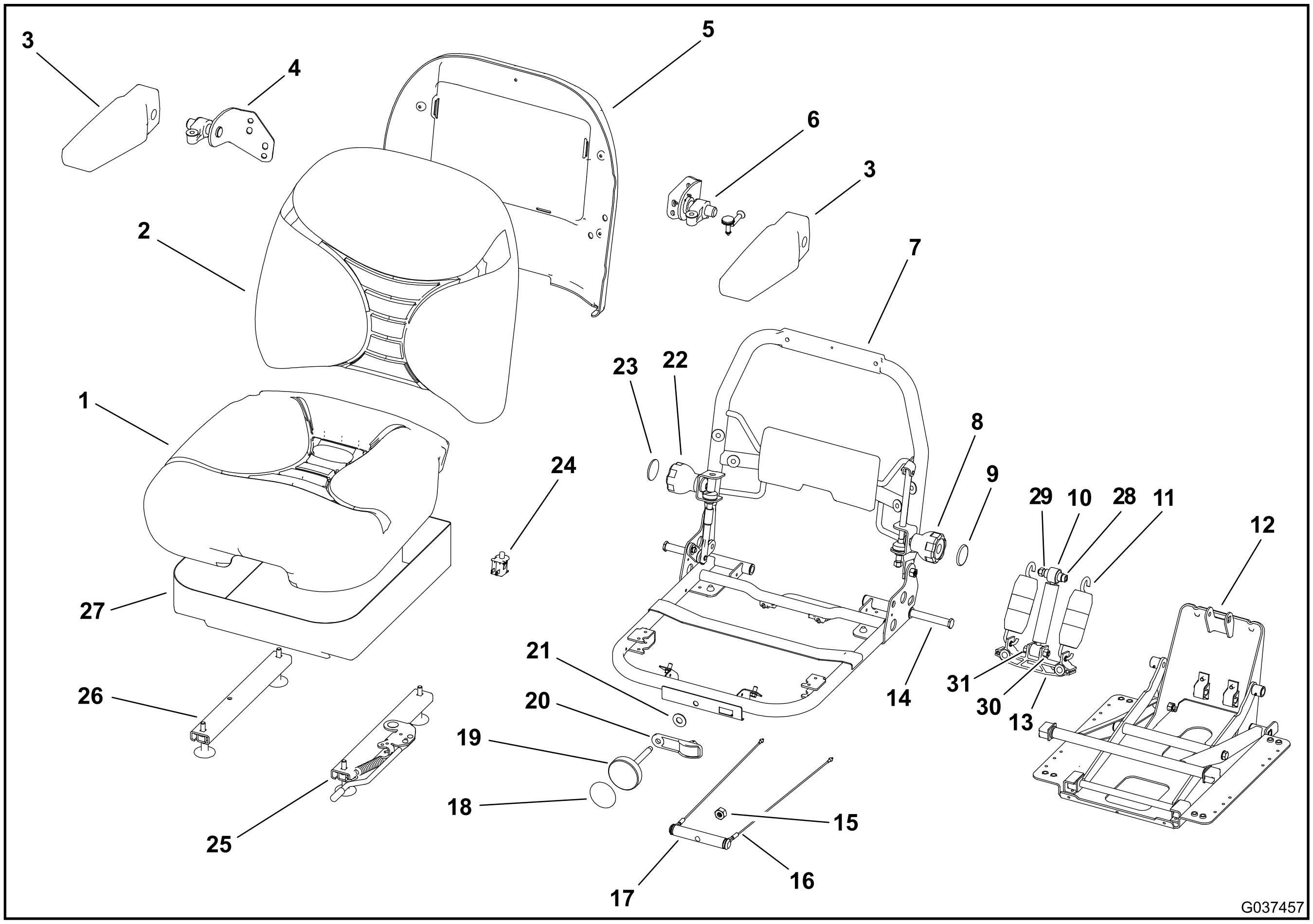


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Figure 300

1. Bottom cushion
2. Back cushion
3. Armrest
4. Right armrest mount assembly
5. Back panel
6. Left armrest mount assembly
7. Seat frame assembly
8. Lumbar support knob
9. Label
10. Shock absorber assembly
11. Suspension spring (2 each)
12. Suspension base
13. Spring saddle
14. Bearing shaft
15. Hex nut
16. Cable (2 each)
17. Weight adjust bar
18. Label
19. Weight adjustment knob
20. Weight indicator
21. Washer
22. Backrest knob
23. Label
24. Seat switch
25. Seat adjuster
26. Seat adjuster (slave)
27. Seat boot
28. Bolt
29. Nut
30. Nut
31. Bolt

Disassembling the Operator Seat

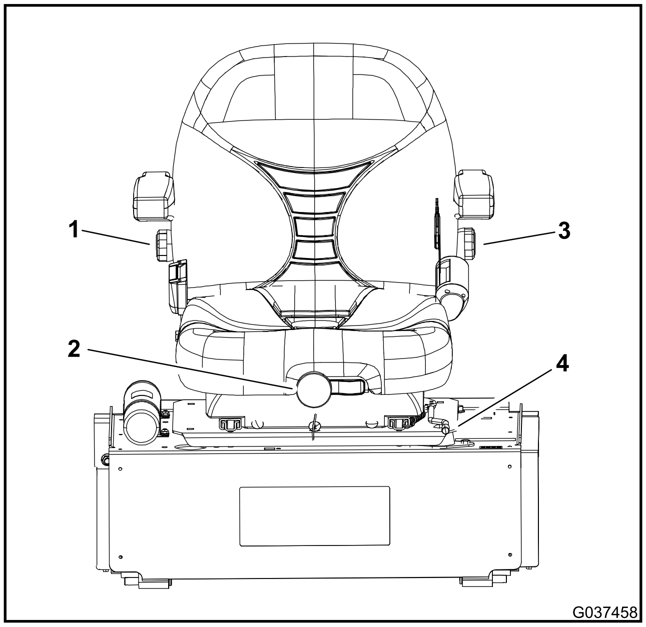

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Figure 301

1. Backrest knob	3. Lumbar support knob
2. Seat suspension knob	4. Seat position lever

1. Remove the operator seat from the machine; refer to Removing the Operator Seat (page 6–60).
2. Remove the armrest assemblies and then the back panel (item 5 in Figure 300) from the back of the seat.
3. Carefully peel the label from the backrest knob, and remove the nut and knob from the seat frame (Figure 301).
4. Remove the 6 push clips that attach the back cushion (item 2 in Figure 300) to the seat frame, and remove the back cushion.
5. Remove the 2 bolts that attach the bottom cushion (item 1 in Figure 300) to the seat frame, and remove the bottom cushion.
6. Remove the hex nut (item 15 in Figure 300) that secures the weight adjustment knob to the weight adjust bar. Remove the adjustment knob from the weight adjust bar to remove the tension of the cable. Remove the cables from the spring saddle.
7. Remove the 18 push clips from the seat frame and separate the seat boot (item 27 in Figure 300) from the frame.
8. Remove the 2 roll pins that attach the bearing shafts (item 14 in Figure 300) to the seat frame, and remove the bearing shafts and split nylon bushings from the frame.
9. Lift the seat frame from the suspension base (item 12 in Figure 300).
10. Remove the nut and bolt that attach the top of the shock absorber (item 10 in Figure 300) to the suspension base, and separate the top of the shock absorber from the suspension base.
11. Slide the spring saddle (item 13 in Figure 300) from the spring arm while you disengage the springs at top of the suspension base.
12. Remove the springs from the spring saddle. Note the orientation of the springs and spring saddle for assembly purposes.

Disassembling the Operator Seat (continued)

13. Remove the nut and bolt that attach the bottom of the shock absorber to the spring saddle, and remove the shock absorber.

Assembling the Operator Seat

1. Attach the bottom of the shock absorber to the spring saddle with the nut and bolt.
2. Install the springs to the spring saddle in the same orientation that you noted during removal.
3. Position the spring saddle on the spring arm and slide the saddle down. Hook the spring ends on the top of the suspension base.
4. Use the suspension base as a prypoint and place a prybar on the top of the spring saddle. Pry the saddle down to elongate the springs enough so that the bolt can be installed into the top of the shock absorber and suspension base mount. Install nut on the bolt to secure the shock absorber.
5. Position the seat frame to the suspension base.
6. Align the bearing blocks on the frame with receivers on the suspension base and guide frame into the suspension base.
7. Insert the 2 bearing shafts and split nylon bushings to the suspension base and frame. Secure the bearing shafts with the 2 roll pins.
8. Position the cables under the seat frame bars and on the top of the suspension base and insert the cable ends in the spring saddle slots.
9. Pass the weight adjustment knob shaft through the weight indicator, washer, and seat frame hole.
10. Turn the knob shaft into the weight adjust bar and install the hex nut on the knob shaft.
11. Position the seat boot to the seat frame and attach with the 18 push clips.
12. Position the bottom cushion to the seat frame and attach with the 2 bolts.
13. Position the back cushion to the seat frame and attach with the 6 push clips.
14. Assemble the back rest knob to the seat and attach with the nut. Attach the label to the knob.
15. Assemble the back panel and then the armrest assemblies to the seat.
16. Install the operator seat on the machine; refer to Installing the Operator Seat (page 6–61).

Servicing the Operator Seat (Machines with Operator Cab)

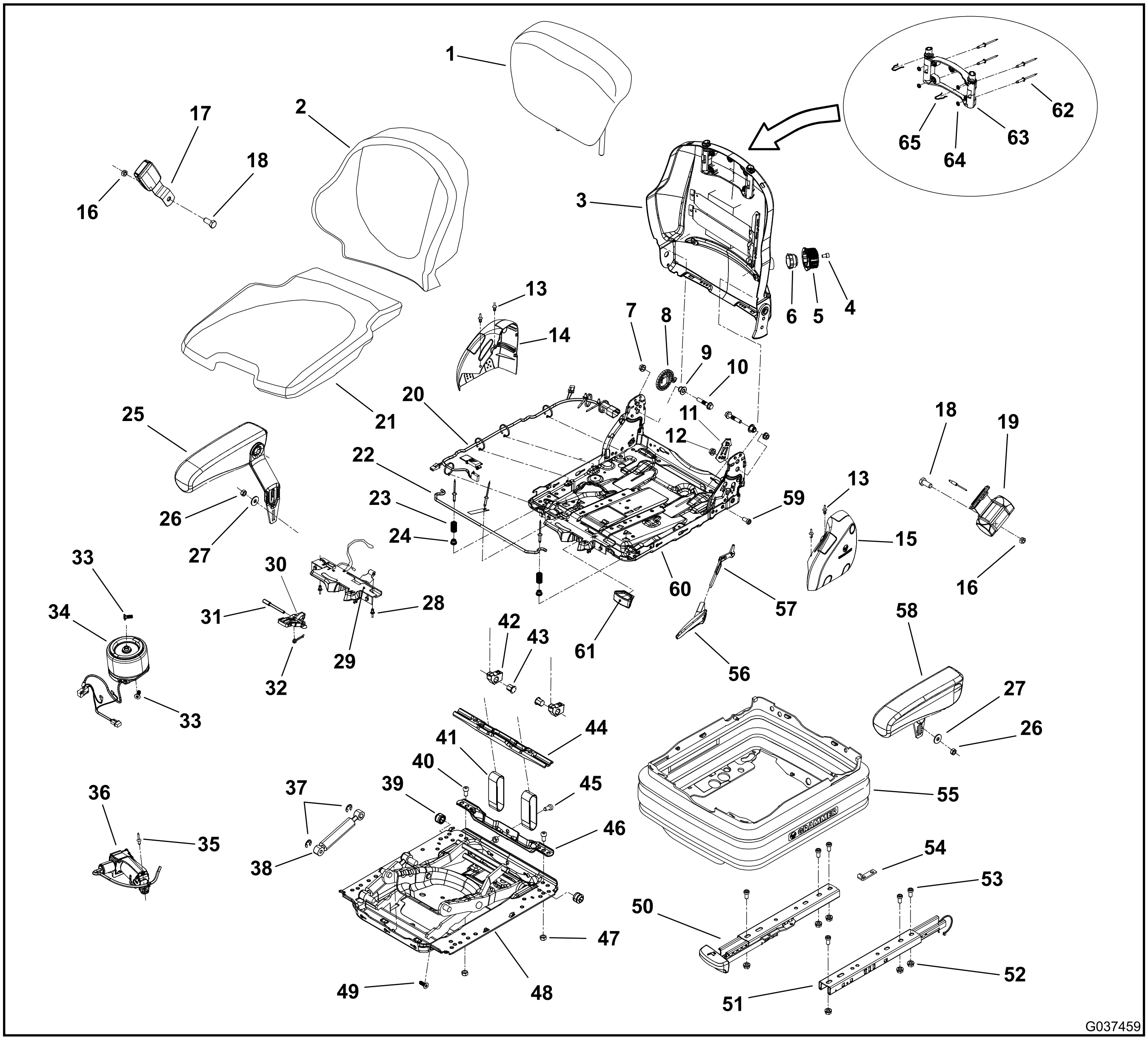

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Figure 302

Figure 302 (continued)

1. Back extension
2. Back cushion
3. Back panel
4. Screw
5. Handle
6. Knob
7. Flange nut
8. Spring
9. Bushing
10. Screw
11. Bracket
12. Nut
13. Rivet
14. Right cover
15. Left cover
16. Nut
17. Seat belt latch
18. Bolt
19. Seat belt
20. Seat wire harness
21. Seat cushion
22. Adjuster rod
23. Spring
24. Spring seat
25. Right armrest
26. Nut
27. Washer
28. Rivet
29. Handle assembly
30. Lever
31. Pin
32. Spring
33. Torx screw
34. Air spring assembly
35. Rivet
36. Compressor assembly
37. Retaining ring
38. Shock absorber
39. Suspension pivot bushing
40. Socket-head screw
41. Band
42. Suspension pivot
43. Bushing
44. Bracket
45. Bolt
46. Bracket
47. Nut
48. Suspension assembly
49. Screw
50. Right seat adjuster
51. Left seat adjuster
52. Flange nut (6 each)
53. Screw (6 each)
54. Bracket
55. Bellows
56. Backrest handle
57. Backrest lever
58. Left armrest
59. Screw
60. Seat base assembly
61. Handle
62. Rivet
63. Extension bracket
64. Washer
65. Clip

Note: Refer to your *Parts Catalog* for the operator seat components that are available.

Disassembling the Operator Seat

1. If necessary, remove the operator seat from the machine; refer to Removing the Operator Seat (page 6–60).
2. Disassemble the operator seat as shown in Figure 302.

Assembling the Operator Seat

1. Assemble the operator seat as shown in Figure 302.
2. If the operator seat was removed from the machine, secure the seat to the machine; refer to Installing the Operator Seat (page 6–61).

Hood

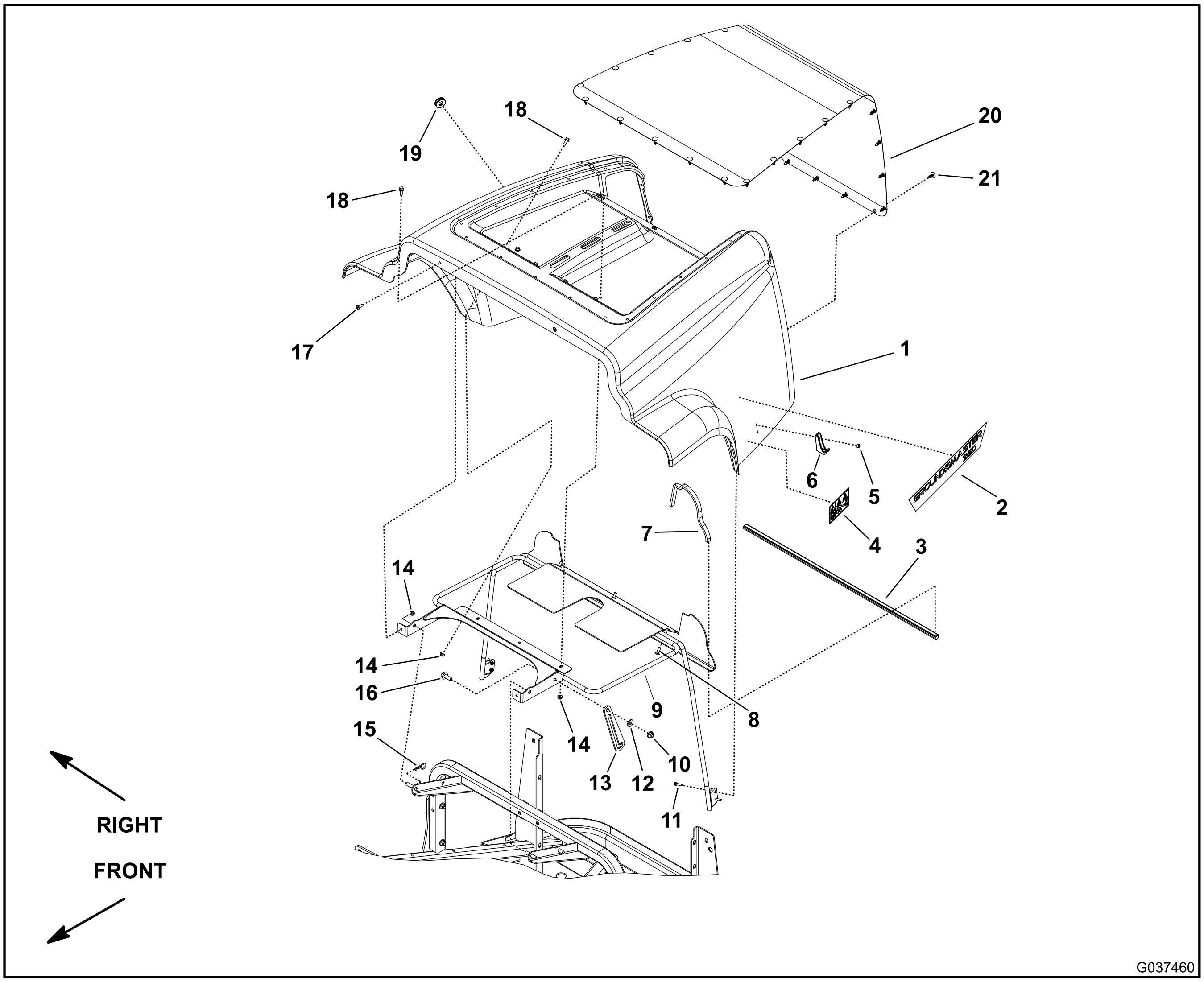

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Figure 303

1. Hood
2. Decal
3. Bulb seal
4. Decal
5. Locknut (4 each)
6. Catch latch (2 each)
7. Foam seal (2 each)
8. Carriage bolt (3 each)
9. Hood mount assembly
10. Flange nut
11. Washer-head screw (4 each)
12. Friction washer
13. Prop rod
14. Flange nut (11 each)
15. Hairpin cotter
16. Flange-head screw
17. Button-head screw (2 each)
18. Flange-head screw (6 each)
19. Grommet
20. Hood screen
21. Plastic plug (27 each)

Removing the Hood

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. Unlatch the hood and raise it.
3. Remove the hairpin cotter (item 15 in Figure 303) from the left side frame rod.
4. Slide the hood to the left side of the machine to free the hood support from the frame rods.
5. Remove the hood from the machine.
6. If necessary, remove the hood components (Figure 303).
7. Check the condition of all the seals on the frame and hood. Replace all seals that are damaged or missing.

IMPORTANT

If there is a significant amount of unwanted material on the radiator, verify the sealing of the radiator area.

Installing the Hood

1. Install all the hood components that were removed (Figure 303).

   Note: If the intake screen was removed from the hood, ensure that the hood mount assembly (item 9 in Figure 303) is attached to the hood before you install the screen. Secure the screen to the hood with the 27 plastic plugs.
2. Check that no gaps exist between the hood components and the hood. If any gaps are found, seal them with silicone sealant.
3. Position the hood to the machine and slide the hood support onto the frame rods.
4. Secure the hood to the machine with the hairpin cotter (item 15 in Figure 303).
5. Close the hood and latch it.

Chapter 7

Cutting Deck

Table of Contents

General Information

Specifications

Several cutting decks are available for Groundsmaster 360 machine. Refer to the *Cutting Deck Operator's Manual* for specifications and optional accessories for the cutting deck used on your machine.

Note: This chapter gives information about troubleshooting and repair of 60, 62, and 72 inch cutting decks. The 100 inch cutting deck information is not covered in this chapter.

Cutting Deck Operator's Manual

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

Factors That Can Affect Cutting Performance

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

Remember that the effective or actual height-of-cut depends on the cutting deck weight and turf conditions.

Factor	Possible Problem/Correction
1. Maximum governed engine speed	Check that the engine is running at the correct high-idle speed; refer to Chapter 3: Diesel Engine (page 3–1). Always mow at high engine speed.
2. Blade speed	All the cutting deck blades should rotate at the same speed.
3. Tire pressure	Check the air pressure of all the tires. Adjust to the pressures specified in the *Operator's Manual*.
4. Blade condition	Sharpen the blades if their cutting edges are dull or nicked. Inspect the blade sail for wear or damage. Replace the blade if necessary.
5. Mower housing condition	Ensure that the cutting chamber is in good condition. Keep the underside of the deck clean. The unwanted material buildup can reduce the cutting performance.
6. Height-of-cut	Adjust the deck as specified in the *Cutting Deck Operator's Manual*. The effective (actual) height-of-cut may be different than the bench set height-of-cut.
7. Cutting deck alignment and ground following	Check the lift arms for wear, damage, or binding. Also, inspect for bent or damaged pivot shafts.
8. Anti-scalp roller condition	All anti-scalp rollers should rotate freely. Replace the rollers or roller shafts if they are worn or damaged.
9. Grass conditions	Mow when the grass is dry for best cutting results. Also, remove only 2.5 cm (1 inch) or 1/3 of the grass blade when cutting.
10. Machine traction speed	Mowing at too fast of a traction speed will result in poor after cut appearance and missed patches of grass.

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 solenoid coil connector from the wire harness to prevent the PTO clutch from engaging unintentionally.

⚠ CAUTION ⚠

Do not work on the cutting deck with the engine running.

Always shut off the engine and remove the key from the key switch before working on the cutting deck.

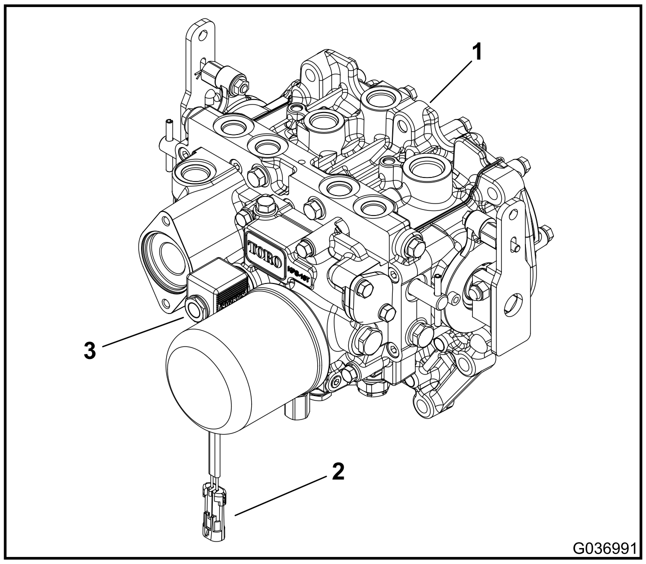

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Figure 304

1. Transmission
2. Coil connector
3. Solenoid valve and coil

Before servicing the cutting deck, disconnect the PTO solenoid coil connector from the wire harness to prevent unintentional engagement of the PTO clutch.

Blade Stopping Time

The blades of the cutting deck should come to a complete stop in less than 7 seconds after you disengage the PTO switch.

Note: When checking the blade stopping time, ensure that the deck is lowered onto a clean section of turf or hard surface to prevent dust and unwanted material.

To check the blade stopping time, instruct a second person to stay away from the machine at a safe distance and monitor the blades on the cutting deck. When the machine operator disengages the cutting deck, record the time that it takes for the blades to come to a complete stop. If this time is more than 7 seconds, inspect the PTO brake assembly in the transmission; refer to PTO Circuit Problems (page 4–37).

Cutting Deck

Refer to specific *Cutting Deck Operator's Manual* for cutting deck removal and installation procedure.

Idler Assembly

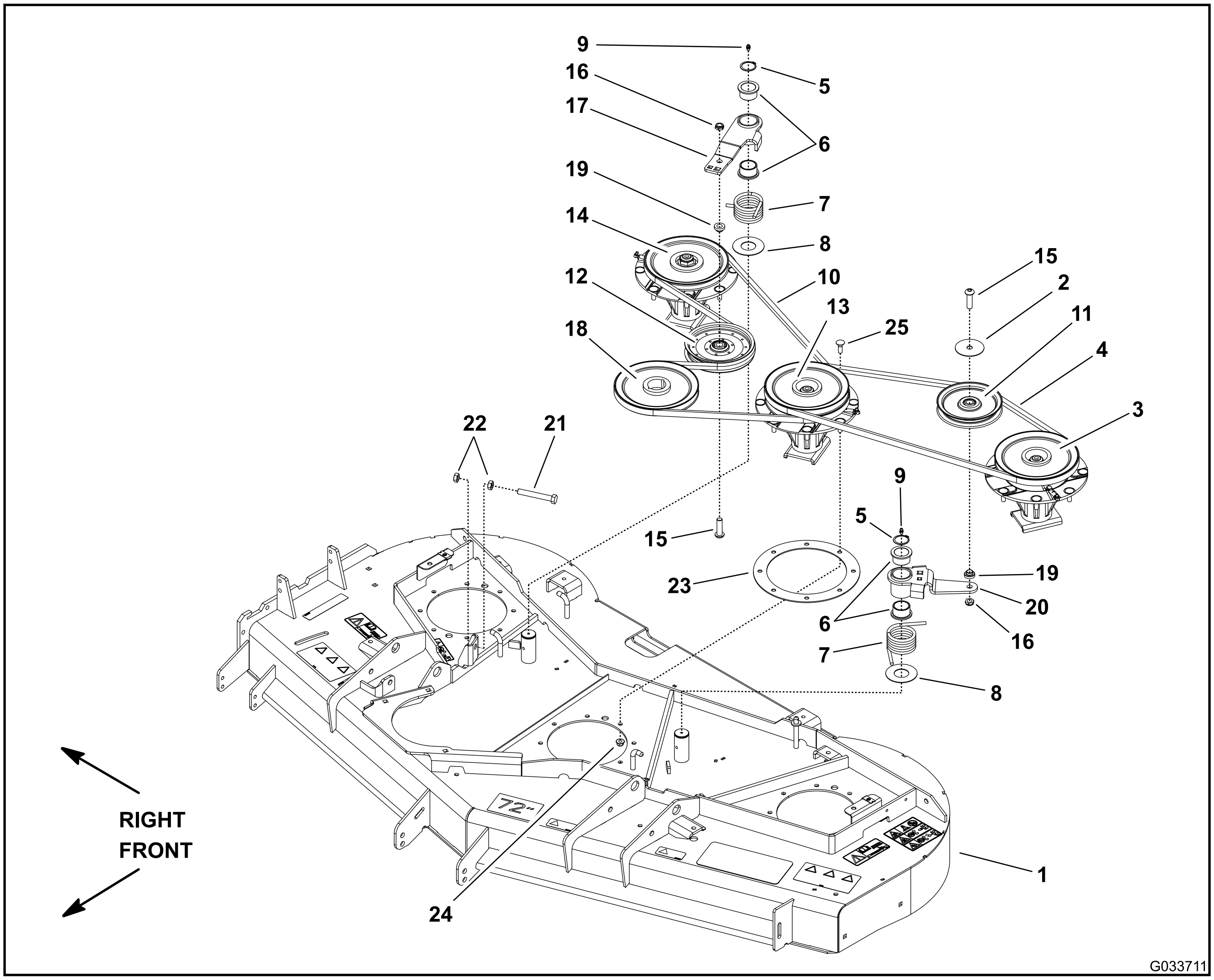

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Figure 305

1.	Cutting deck	10.	Drive belt	19.	Idler spacer (2 each)
2.	Flat washer	11.	Idler pulley	20.	Left idler arm
3.	Left spindle assembly	12.	Idler pulley	21.	Stop bolt
4.	Drive belt	13.	Center spindle assembly	22.	Jam nut (2 each)
5.	Snap ring (2 each)	14.	Right spindle assembly	23.	Doubler ring (3 each)
6.	Flange bushing	15.	Socket-head screw (2 each)	24.	Flange nut (24 each)
7.	Torsion spring (2 each)	16.	Locknut (2 each)	25.	Ribbed neck bolt (24 each)
8.	Washer (2 each)	17.	Right idler arm		
9.	Grease fitting (2 each)	18.	Drive pulley		

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. Lift the footrest to get access to the top of the cutting deck and support the footrest with the prop rod.
3. Remove the deck covers from the top of the cutting deck.
4. Loosen the 2 jam nuts (item 22 in Figure 305) that attach the idler stop bolt to the cutting deck to allow clearance between the idler arm and stop bolt.
5. Remove the drive belt from the deck pulleys.
6. Insert a nut driver or small piece of pipe onto the torsion spring end of the idler arm.

⚠ CAUTION ⚠

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

Be careful when removing the tension from the torsion spring of the idler arm.

7. Carefully push the torsion spring end down and away from the idler arm to unhook the spring from the arm.
8. Remove the snap ring that retains the idler arm assembly to the cutting deck.
9. Remove the idler components as shown in Figure 305.

Installing the Idler Assembly

1. Install the idler components that were removed, and secure the idler arm assembly to the cutting deck with the snap ring (Figure 305).
2. Insert a nut driver or small piece of pipe onto the torsion spring end of the idler arm.

⚠ CAUTION ⚠

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

Be careful when applying the tension to the torsion spring of the idler arm.

Installing the Idler Assembly (continued)

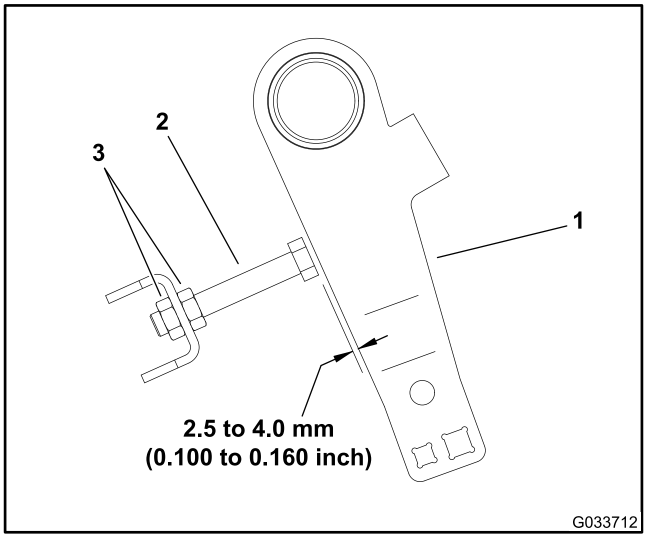

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Figure 306

1. Idler arm
2. Stop bolt
3. Jam nuts

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3. Carefully push down on the torsion spring end to get the spring under the idler arm mounting plate. Then release the spring slowly to lock it in place.
4. Install the drive belt onto the pulleys.
5. If the idler arm on the right side of cutting deck was removed, check that the clearance between the idler arm and stop bolt is **2.5 to 4.0 mm (0.100 to 0.160 inch)** (Figure 306).

   Note: If necessary, adjust the location of the jam nuts on the stop bolt to allow proper clearance.
6. Install the deck covers to the cutting deck.
7. Lower the footrest.

Blade Spindle

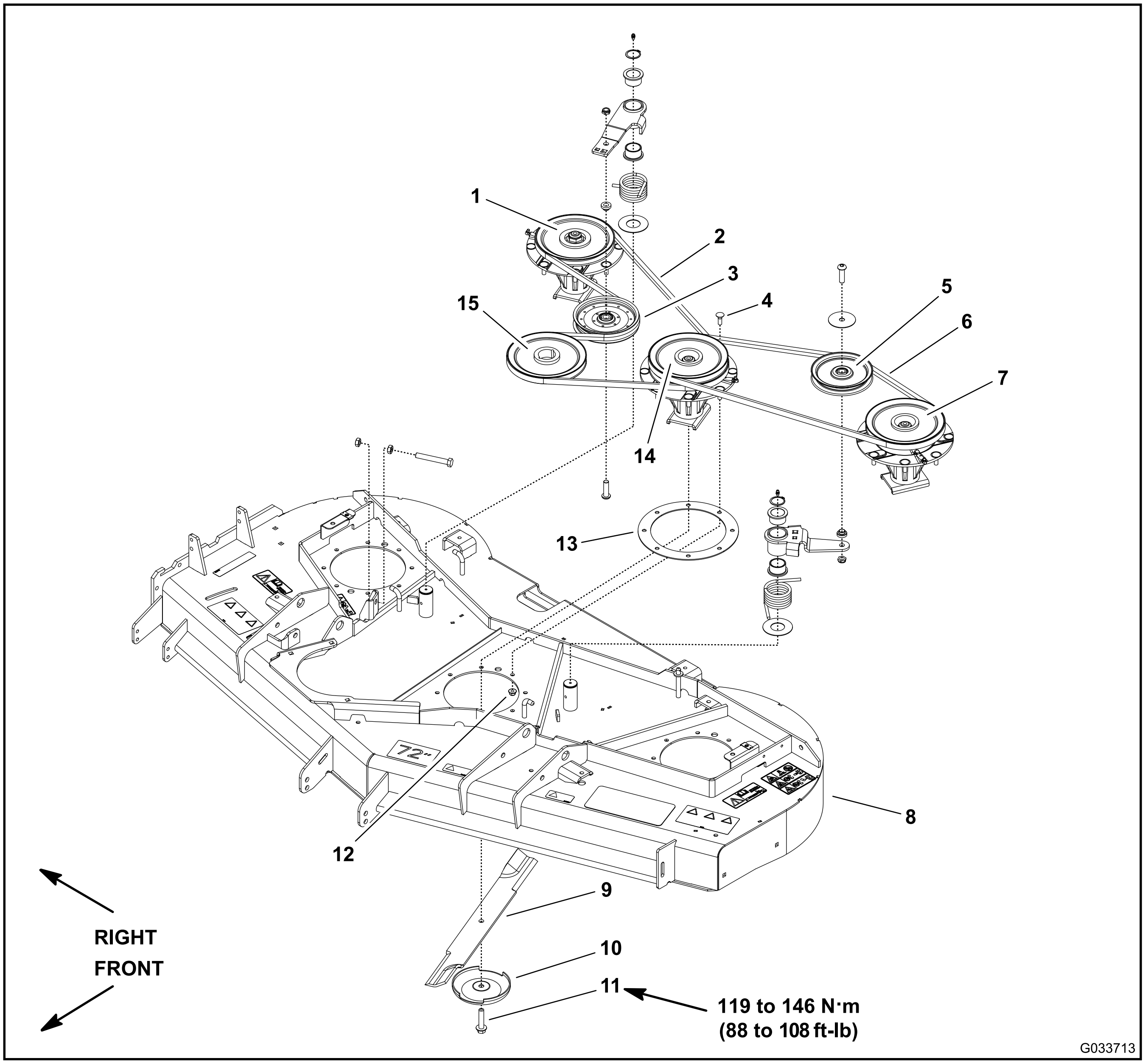

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Figure 307

1. Right spindle assembly
2. Drive belt
3. Idler pulley
4. Ribbed neck bolt (24 each)
5. Idler pulley
6. Drive belt
7. Left spindle assembly
8. Cutting deck
9. Blade (3 each)
10. Anti-scalp cup (3 each)
11. Blade bolt (3 each)
12. Flange nut (24 each)
13. Doubler ring (3 each)
14. Center spindle assembly
15. Drive pulley

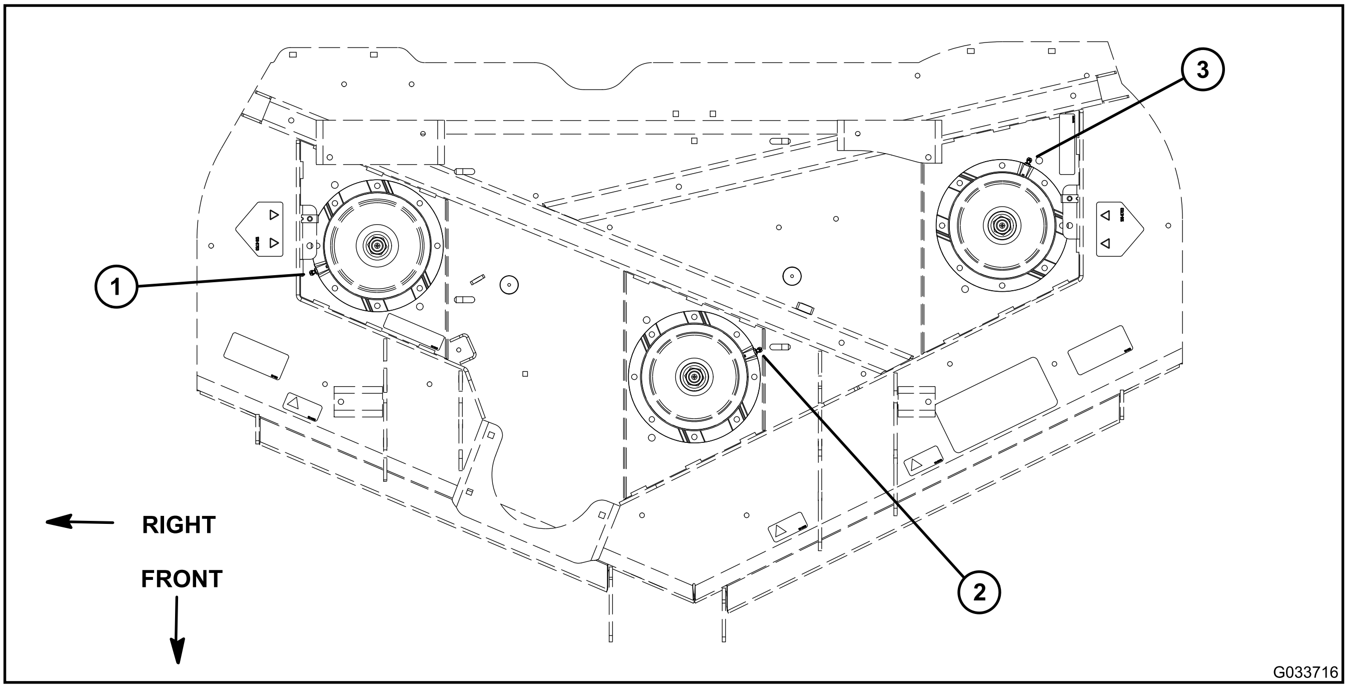

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Figure 308

1. Right spindle grease fitting
2. Center spindle grease fitting
3. Left spindle grease fitting

Removing the Blade Spindle

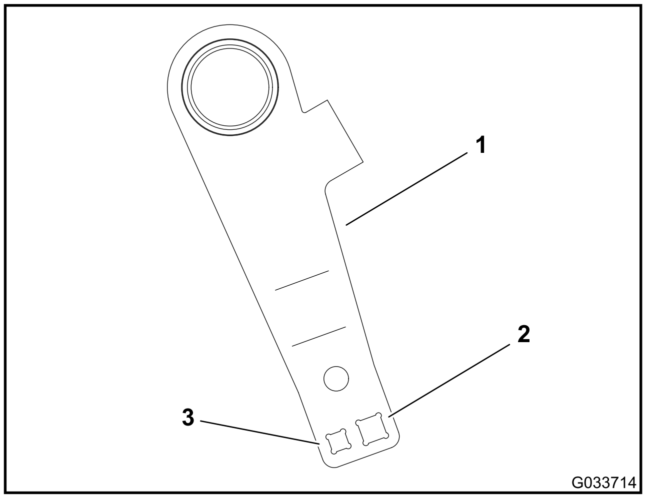

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Figure 309

1. Idler arm (right)
2. 1/2 inch square drive
3. 3/8 inch square drive

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. Lift the footrest to get access to the top of the cutting deck and support the footrest with the prop rod.
3. Remove the belt covers from the top of the cutting deck.

   Note: When removing the deck drive belt, use the breaker bar in the idler arm square drive holes to rotate the idler pulley away from the belt (Figure 309).

Removing the Blade Spindle (continued)

4. Remove the drive belt from the deck pulleys; refer to the *Cutting Deck Operator's Manual*.
5. Remove the cutting blade, anti-scalp cup, and blade bolt from the spindle (Figure 307).
6. Remove the 8 ribbed neck bolts and 8 flange nuts that attach the spindle assembly to the deck, and remove the spindle assembly from the deck.

Installing the Blade Spindle

1. Position the spindle on the cutting deck and note the orientation of the grease fitting (Figure 308). Attach the spindle assembly to the deck with the 8 ribbed neck bolts and 8 flange nuts.
2. Install the cutting blade, anti-scalp cup, and blade bolt (Figure 307); torque the blade bolt to **119 to 146 N·m (88 to 108 ft-lb)**.
3. Slowly rotate the cutting blades to check that the blades do not contact any deck component(s).
4. Install the drive belt to the deck pulleys.
5. Lubricate the spindle grease fittings.
6. Install the belt covers to the cutting deck.
7. Lower the footrest.

Servicing the Blade Spindle

Disassembling the Blade Spindle

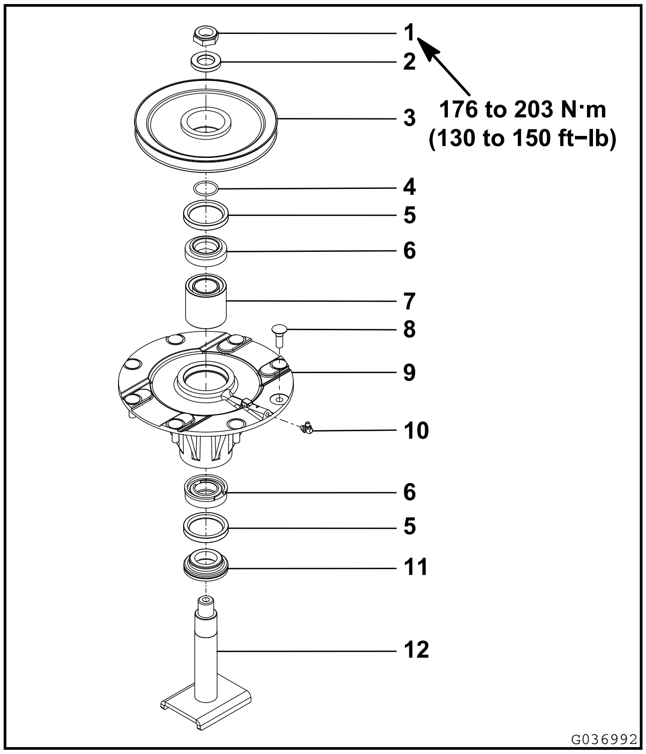

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Figure 310

1. Locknut
2. Special hardened washer
3. Pulley
4. O-ring
5. Oil seal (2 each)
6. Bearing set
7. Bearing spacer
8. Ribbed neck bolt (8 each)
9. Spindle housing
10. Grease fitting
11. Shaft spacer
12. Spindle shaft

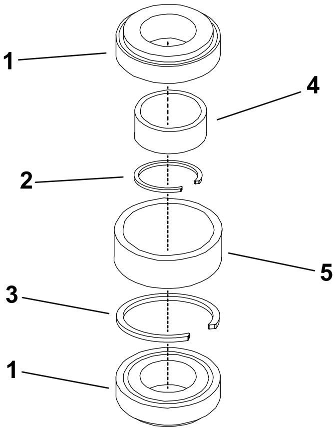

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Figure 311

1. Bearing
2. Spacer ring
3. Large snap ring
4. Inner spacer
5. Outer spacer

1. Remove the locknut from the top of the spindle shaft.

Disassembling the Blade Spindle (continued)

2. Remove the special hardened washer and pulley from the shaft.
3. Use an arbor press to remove the spindle shaft from the spindle housing.

   Note: Ensure that the spindle shaft spacer remains on the spindle shaft while removing the shaft.
4. Remove the oil seals from the spindle housing.
5. Remove the bearing cones, O-ring, inner bearing spacer, and spacer ring from the spindle housing.
6. Use an arbor press to remove the 2 bearing cups and outer bearing spacer from the housing.

   Note: The large snap ring can remain inside the spindle housing. Removing the large snap ring is very difficult.

Assembling the Blade Spindle

Note: A replacement spindle bearing set contains 2 bearings, a spacer ring, and a large snap ring (items 1, 2, and 3 in Figure 311). You cannot purchase these parts separately. Also, do not mix the bearing set components from one deck spindle to the another.

Note: A replacement bearing spacer set includes the inner spacer and outer spacer (items 4 and 5 in Figure 311). Do not mix the bearing spacers from one deck spindle to the another.

IMPORTANT

If new bearings are installed into a used spindle housing, it is not necessary to replace the original large snap ring. If the original snap ring is in good condition with no sign of damage (e.g., spun bearing), leave the snap ring in the housing and discard the snap ring that comes with the new bearings. If the large snap ring is damaged, replace the snap ring.

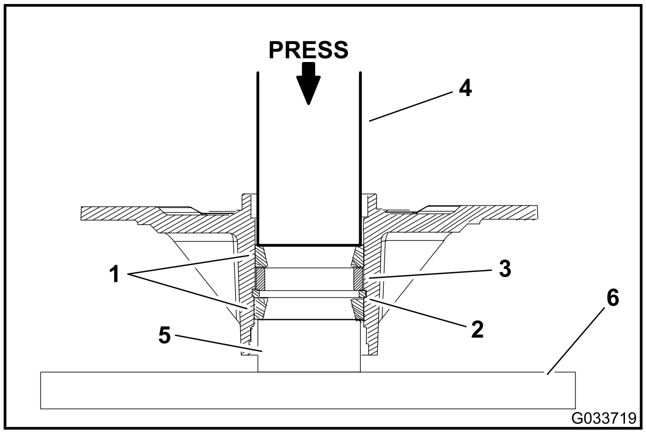

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Figure 312

1. Bearing cup	4. Arbor press
2. Large snap ring	5. Support
3. Outer spacer	6. Arbor press base

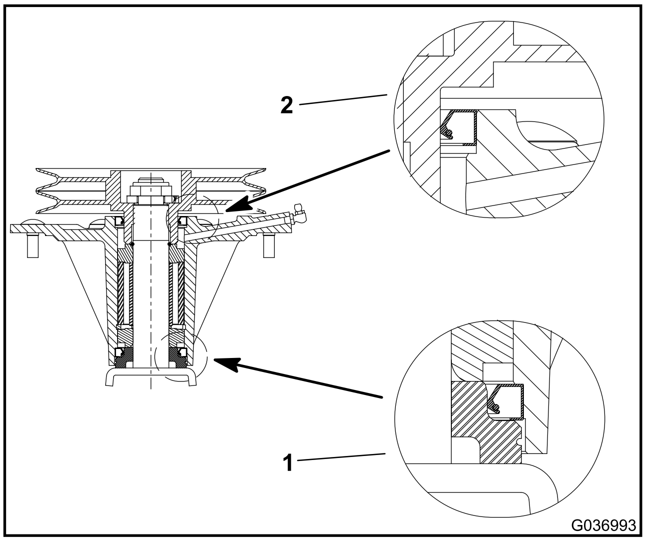

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Figure 313

1. Bottom seal installation	2. Upper seal installation

1. If the large snap ring was removed from the spindle housing, install the snap ring into the housing groove.

   Note: Ensure that the snap ring is fully seated in the housing groove.

2. Install the outer spacer into the top of the spindle housing.

   Note: Ensure that the outer spacer fits against the snap ring.

3. Use an arbor press to push the bearing cups into the top and bottom of the spindle housing.

   Note: The top bearing cup must contact the outer spacer that was previously installed, and the bottom bearing cup must contact the snap ring.

   Note: Ensure that the assembly is correct by supporting the first bearing cup and pressing the second bearing cup against it; refer to Figure 312.

4. Pack the bearing cones with grease. Apply a film of grease on the lips of the oil seals and O-ring.

5. Install the lower bearing cone and oil seal into the bottom of the spindle housing.

   Note: The bottom seal must have the lip facing out (down). This seal installation allows grease to purge from the spindle during the lubrication process (Figure 313).

IMPORTANT

If you are replacing the bearings, ensure that you use the spacer ring that is included with a new bearing set (Figure 311).

6. Slide the spacer ring and inner bearing spacer into the spindle housing, then install the upper bearing cone and oil seal into the top of the housing.

   Note: The upper seal must have the lip facing in (down). Also, install upper seal so it is flush to **2.0 mm (0.080 inch)** recessed to the housing surface (Figure 313).

Assembling the Blade Spindle (continued)

7. Examine the spindle shaft and shaft spacer to ensure that there are no burrs or nicks that could damage the oil seals. Lubricate the shaft and spacer with grease.
8. Install the spindle shaft spacer onto the shaft. Place a thin sleeve or tape on the spindle shaft splines to prevent damage of the seal during the installation of the shaft.
9. Carefully slide the spindle shaft with the spacer up through the spindle housing.

   Note: The bottom oil seal and spindle spacer fit together when the spindle is fully installed.

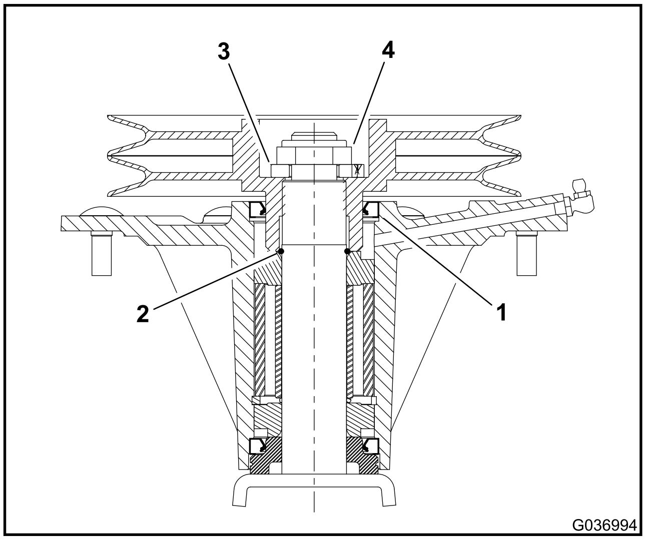

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Figure 314

1. Upper seal
2. O-ring
3. Hardened washer
4. Locknut

---

10. Install the O-ring to the top of the spindle shaft (Figure 314).
11. Install the pulley (hub down), special hardened washer, and locknut to the spindle shaft (Figure 314); torque the locknut to **176 to 203 N·m (130 to 150 ft-lb)**.

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.

12. Attach a hand pump grease gun to the grease fitting on the housing and fill the housing cavity with grease until the grease starts to come out of the lower seal.
13. Rotate the spindle shaft to ensure that it turns freely.

Gearbox

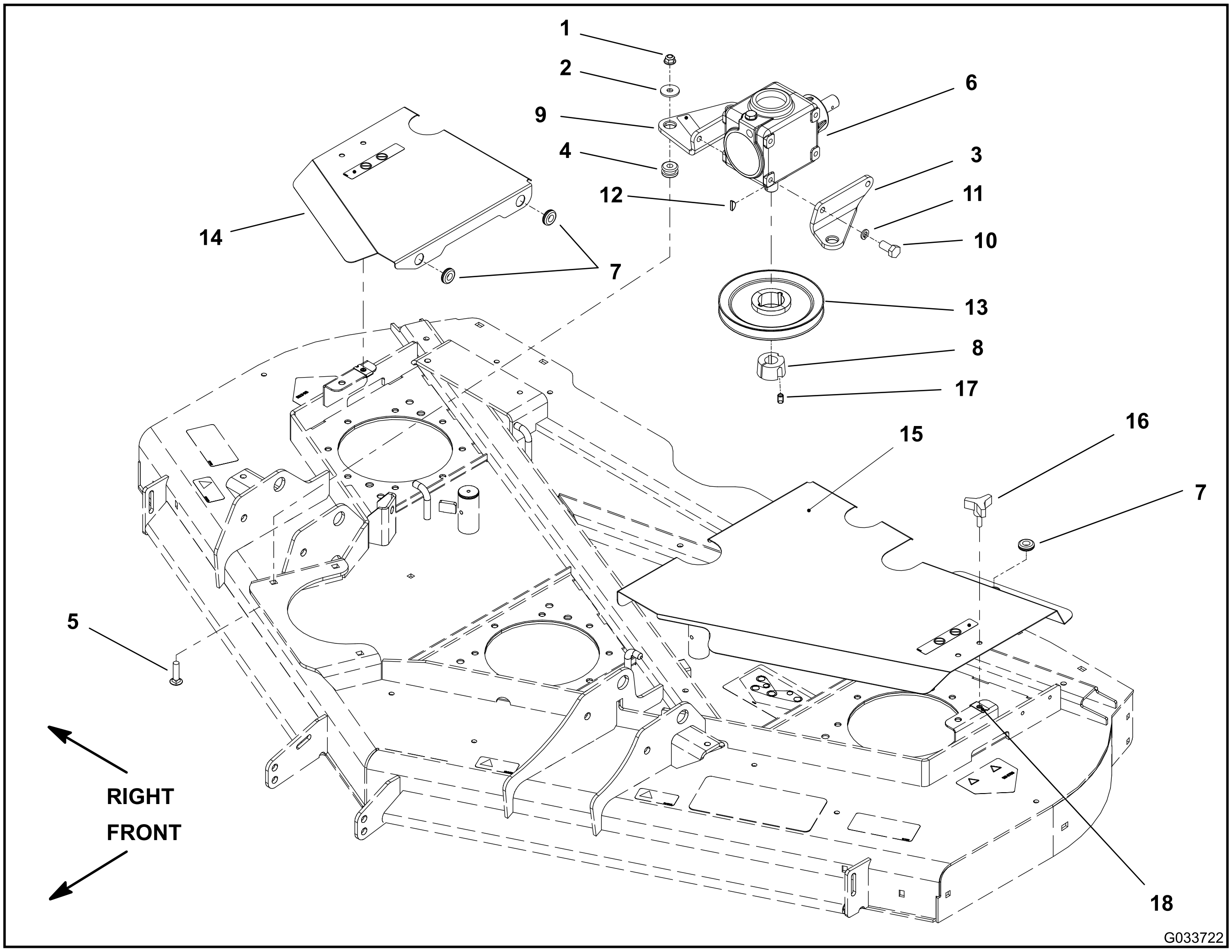

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Figure 315

1. Flange nut (3 each)
2. Washer (3 each)
3. Left gearbox bracket
4. Mount (3 each)
5. Carriage screw (3 each)
6. Gearbox
7. Grommet (5 each)
8. Taper lock bushing
9. Right gearbox bracket
10. Bolt (4 each)
11. Lock washer (4 each)
12. Woodruff key
13. Deck drive pulley
14. Right deck cover
15. Left deck cover
16. Knob (2 each)
17. Set screw (2 each)
18. Retainer nut (2 each)

Removing the Gearbox

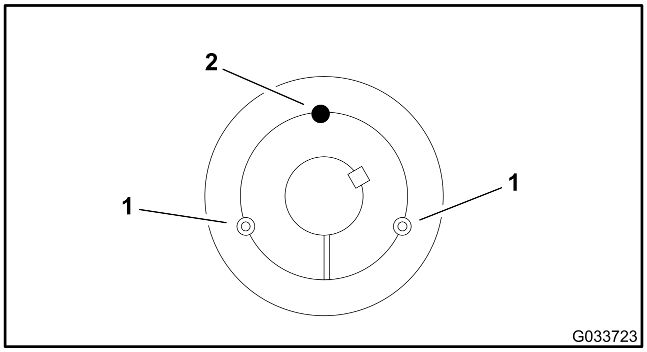

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Figure 316

1. Set screw installation position	2. Set screw removal position

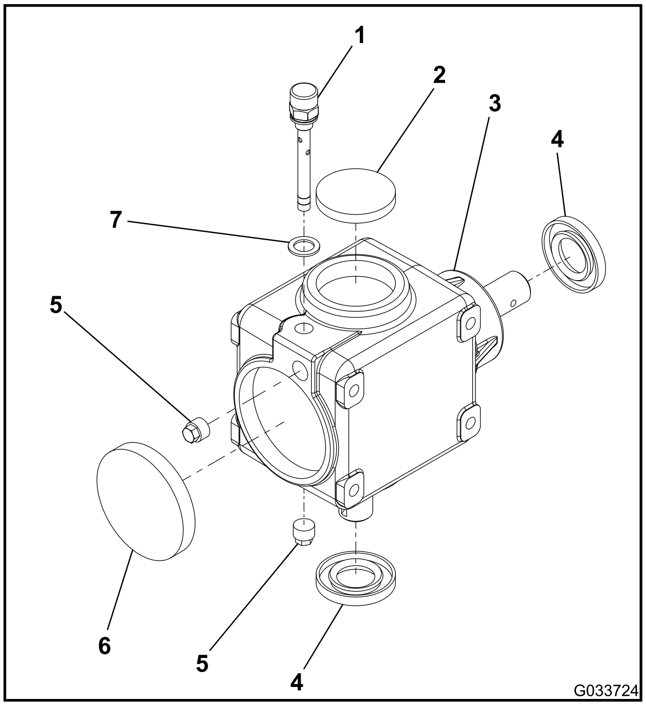

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Figure 317

1. Breather plug	5. Plug
2. Oil cap	6. Oil cap
3. Gearbox	7. Washer
4. Oil seal	

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. Lift the footrest to get access to the top of the cutting deck.
3. Support the raised footrest with the prop rod.
4. Remove the deck covers from the top of the cutting deck.
5. Remove the drive belt from the deck pulleys.
6. Disconnect the PTO driveshaft from the gearbox; refer to Removing the PTO Driveshaft (page 6–44).
7. Remove the 4 bolts (item 10 in Figure 315) and 4 lock washers that attach the gearbox assembly to the gearbox brackets.

Removing the Gearbox (continued)

8. Remove the 3 carriage screws, 3 flange nuts, 3 washers, and 3 mounts that attach the left and right gearbox brackets (items 3 and 9 in Figure 315) to the deck mounting plate, and remove the brackets from the deck.
9. Remove the gearbox assembly (with the drive pulley attached) from the deck. Drain the lubricant from the gearbox.
10. Remove the 2 set screws that attach the taper lock bushing to the drive pulley on the gearbox shaft.
11. Install 1 of the removed set screws into the threaded hole of the bushing. Tighten the set screw to loosen the bushing from the pulley hub (Figure 316).
12. Slide the bushing and pulley from the gearbox shaft.
13. Locate and retrieve the woodruff key.
14. If necessary, remove and replace the oil seals and oil caps in the gearbox (Figure 317).

    Note: If internal gearbox wear or damage occurs, gearbox replacement is necessary. The internal gearbox components are not available.

Installing the Gearbox

1. If oil seals or oil caps were removed from the gearbox, install new seals and caps to the gearbox.
2. Clean the gearbox output shaft, pulley ID (inner diameter), and taper lock bushing.
3. Position the woodruff key, pulley, and then the taper lock bushing to the gearbox output shaft. Slide the bushing to the shoulder on the shaft. Align the threaded holes of the pulley with the non-threaded holes of the bushing.
4. Apply oil to the threads of the set screws and install the screws into the threads of the pulley (Figure 316). Alternately and evenly torque the set screws to **20 to 28 N·m (180 to 250 in-lb)**.
5. Fill the allen recess in the set screws and bushing threads with grease to prevent dirt from packing into the crevices.
6. Position the gearbox assembly (with the drive pulley attached) to the deck.
7. Position and attach the left and right gearbox brackets (items 3 and 9 in Figure 315) to the deck mounting plate with the 3 carriage screws, 3 flange nuts, 3 washers, and 3 mounts.
8. Secure the gearbox assembly to the gearbox brackets with the 4 bolts (item 10 in Figure 315) and 4 lock washers.
9. Connect the PTO driveshaft to the gearbox; refer to Installing the PTO Driveshaft (page 6–46).
10. Install the drive belt and deck covers to the cutting deck.
11. Torque the plug in the gearbox to **19.8 N·m (175 in-lb)**. Fill the gearbox with approximately 355 ml (12 fl oz) of SAE 80W90 gear lubricant.
12. Lower the footrest.

Cutting Deck Pull Links

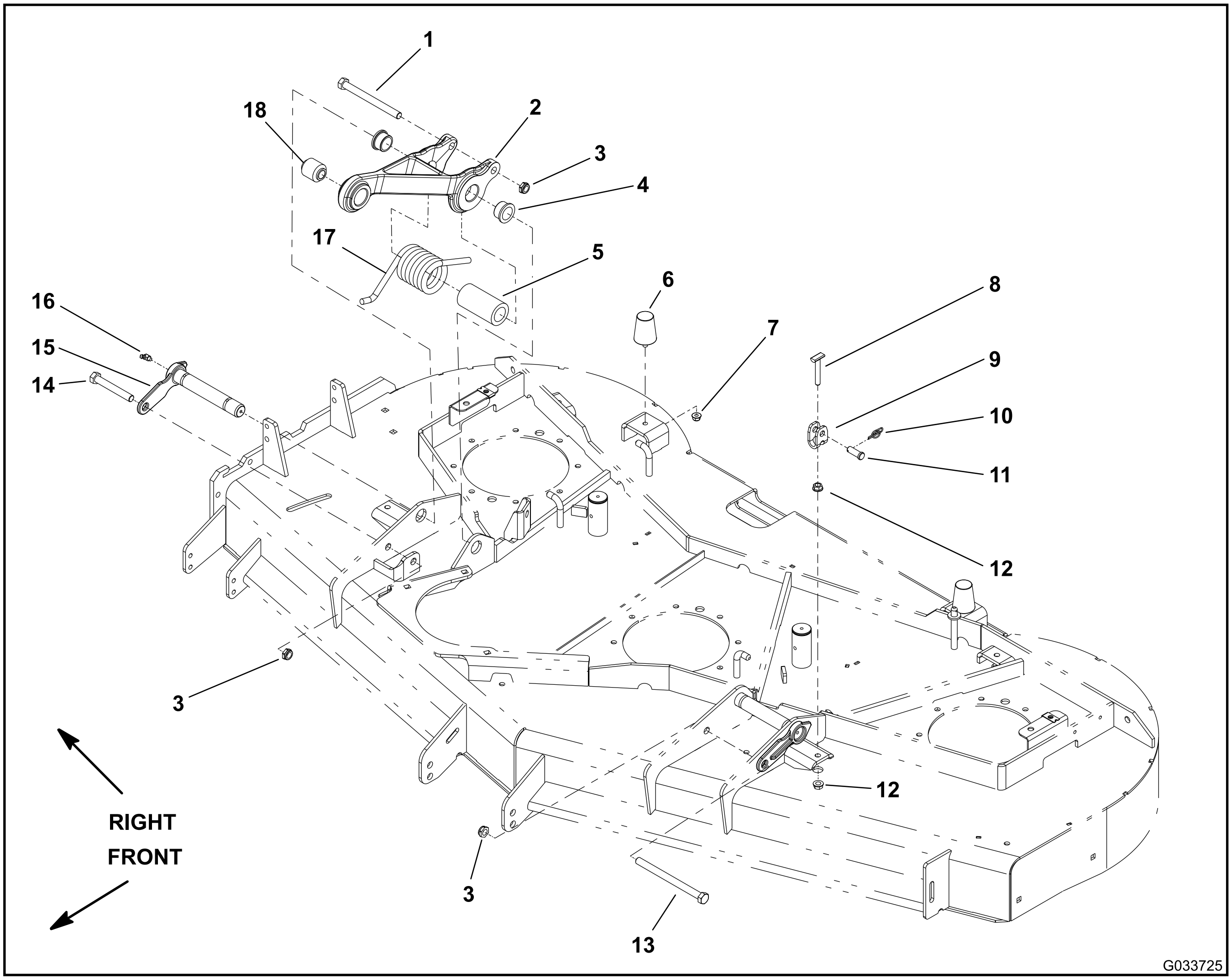

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Figure 318

1.	Bolt (2 each)	7.	Flange nut (2 each)	13.	Bolt
2.	Pull link assembly (2 each)	8.	T-bar (4 each)	14.	Bolt
3.	Locknut (4 each)	9.	Clevis yoke (4 each)	15.	Retainer pin (2 each)
4.	Flange bushing (4 each)	10.	Cotter pin (4 each)	16.	45° lube fitting (2 each)
5.	Plain spacer (2 each)	11.	Clevis pin (4 each)	17.	Torsion spring (2 each)
6.	Bumper (2 each)	12.	Flange nut (8 each)	18.	Bushing (2 each)

Disassembling the Cutting Deck Pull Links

1. Remove the cutting deck from the machine; refer to the *Cutting Deck Operator's Manual*.

⚠ CAUTION ⚠

The pull link torsion springs can cause some rotation of the pull links during the removal process, causing personal injury.

Be careful when removing the pull links from the cutting deck.

Disassembling the Cutting Deck Pull Links (continued)

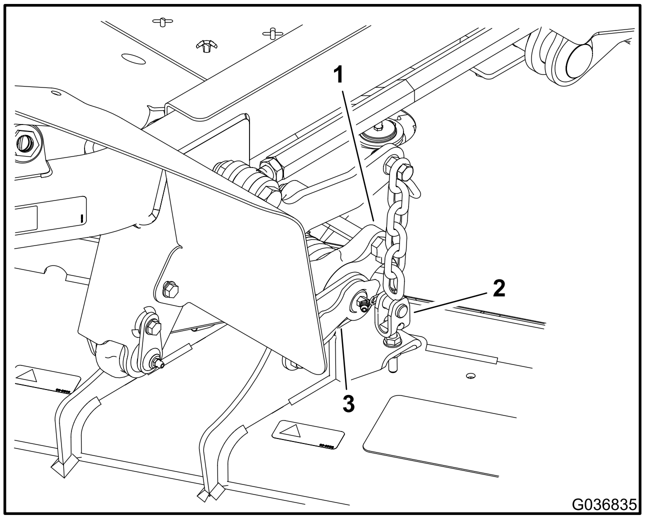

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Figure 319

1. Pull link (raised)
2. Clevis yoke
3. Retainer pin

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2. Remove the clevis yoke from the deck so that the retainer pin (item 3 in Figure 319) can be accessed.
   A. Remove the flange nut (item 12 in Figure 318) that secures the clevis yoke to the deck.
   B. Remove the clevis yoke from the deck.
3. Remove the bolt and locknut that secure the retainer pin (item 15 in Figure 318) to the deck.
4. Slide the retainer pin (item 15 in Figure 318) from the deck and pull link.
5. Remove the pull link with the torsion spring (item 17 in Figure 318) and plain spacer from the deck.
6. Inspect all the bushings (items 4 and 18 in Figure 318) in the pull link.

   Note: Replace the bushings if they are worn or damaged.

Assembling the Cutting Deck Pull Links

Note: For 62 inch cutting decks, the torsion spring (item 17 in Figure 318) is painted red. The torsion spring on 72 inch decks is painted black.

1. Place the plain spacer (item 5 in Figure 318) inside the torsion spring and then fit the spring and spacer into the pull link. Ensure that the torsion spring end is below the bolt (item 1 in Figure 318) in the pull link.
2. Position the pull link to the cutting deck.
3. Slide the retainer pin (item 15 in Figure 318) through the cutting deck, pull link, and spacer.
4. Ensure that the torsion spring end is below the bolt. Secure the retainer pin to the deck with the bolt and locknut.
5. Secure the clevis yoke to the deck with the flange nut.
6. Install the cutting deck to the machine; refer to the *Cutting Deck Operator's Manual*.
7. Lubricate the pull link grease fittings.
8. Check the cutting deck mismatch and pitch. Adjust the cutting deck if necessary.

Chapter 8

Operator Cab

Table of Contents

Additional Reference Materials

Valeo Compressor Service Manual

General Information

The information in this chapter pertains to the operator cab of the Groundsmaster 360 machine.

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.

Electrical Components and Schematic

Information regarding the Groundsmaster 360 electrical cab components (switches and relays) are included in Chapter 5: Electrical System (page 5–1). The Electrical Schematics and Wire Harness Drawings for the operator cab in Appendix A (page A–1)—Foldout Drawings.

Air Conditioning System

The air conditioning system used on the Groundsmaster 360 machine consists of the following components:

1. A compressor mounted on the right side of the engine and driven by a V-belt.
2. A condenser assembly and 2 condenser fans located at the rear of the cab roof assembly.
3. An evaporator core, a drier-receiver, and an expansion valve mounted in the headliner of the cab.
4. The necessary hoses and tubes that connect the air conditioning system components.
5. A blower fan motor that provides air movement through the evaporator and into the cab. The fan motor is a component of the mixing box located in the cab headliner and is also used for the cab heating system.
6. The operator controls to turn the air conditioning on to adjust the fan speed, and to control the cab air temperature.

Cab Heater System

The cab heater system used on the Groundsmaster 360 machine consists of the following components:

1. A heater core located in the headliner of the cab.
2. The hoses to allow a circuit for engine coolant to circulate through the heater core.
3. A blower fan motor that provides air movement through the heater core and into the cab. The fan motor is a component of the mixing box located in the cab headliner and is also used for the air conditioning system.
4. The operator controls to adjust the fan speed and to control the cab air temperature.

Air Conditioning System Performance

There are a number of factors that can affect the performance of the air conditioning system of your Groundsmaster 360 machine.

To ensure the best system operation, inspect the following components:

1. Ensure that the heater control fully closes the heater valve in the cab headliner.
2. Ensure that the condenser and evaporator fins are clean.
3. Check that the refrigerant charge quantity and system operating pressures are correct.
4. Ensure that the exposed metal surfaces inside the cab are insulated.
5. If the ambient temperatures exceeds 43°C (110°F), apply additional window tinting to lower solar heat load to the cab.

Service and Repairs

General Precautions for Removing and Installing the Air Conditioning System Components

⚠ WARNING ⚠

Do not let the refrigerant contact your skin or eyes as there is a possibility of serious injury.

Always wear safety goggles or a face shield when you work with the air conditioning system components.

⚠ CAUTION ⚠

Loosening any air conditioning system fitting or component allows the pressurized refrigerant to escape, causing possible injury.

Do not loosen any system fitting or component until a certified air conditioning service technician discharges the system completely.

⚠ CAUTION ⚠

In some conditions, the pressurized mixtures of the refrigerant and air are combustible.

Do not use compressed air for leak test or pressure test of the air conditioning system.

1. Before you service any air conditioning system components, park the machine on a level surface, set the parking brake, lower the cutting deck or attachments, and shut off the engine. Remove the key from the key switch.
2. Clean the machine before you disconnect, remove, or disassemble any air conditioning system components. Clean the system to prevent the system contamination while you perform the service procedures.
3. Before you loosen or remove any air conditioning system hoses or other components, have a certified air conditioning service technician collect the system refrigerant and then evacuate the air conditioning system completely. It is illegal to open the refrigerant to the atmosphere.
4. Install caps or plugs on any lines, fittings, or components that are left open or exposed to prevent moisture and contaminants from entering into the system.
5. Label all the disconnected system lines and hoses for proper installation after repairs are completed.
6. If you remove the compressor from the machine, keep the compressor in the same orientation as it was in the installed position. This prevents the compressor oil from filling the compressor cylinders.
7. Note the position of the fittings (especially elbow fittings) before removal.

   Note: Mark the parts, if necessary, and ensure that they are aligned correctly when installing the hoses and tubes.

General Precautions for Removing and Installing the Air Conditioning System Components (continued)

8. Always use a DOT approved tank to store the used and recycled refrigerants.
9. The Groundsmaster 360 air conditioning system uses R134a refrigerant. Do not use other refrigerants in the system.

   Note: The capacity of the air conditioning system is 1.55 kg (3.43 lb) of R134a refrigerant.
10. The refrigerant containers (either full or empty) are under pressure and the pressure increases if you heat them. Do not expose the refrigerant containers to high-heat sources or flame.
11. Ensure that the work area is properly ventilated to prevent any accumulation of the refrigerant or other fumes.
12. Ensure that the caps are always placed on the pressure hose ports. These caps prevent refrigerant leakage from the system.
13. The air conditioning drier-receiver component is used to collect moisture that reduces the air conditioning performance. If the air conditioning system is opened for the component repair or replacement, ensure that the drier-receiver ports are plugged to prevent damage to the drier-receiver. If either the compressor or air conditioning expansion valve is replaced, replace the drier-receiver.
14. After you install the air conditioning components, have a certified air conditioning service technician evacuate the air conditioning system completely, properly recharge the system with R134a refrigerant, and perform the leak test on the system.

Air Conditioning Compressor

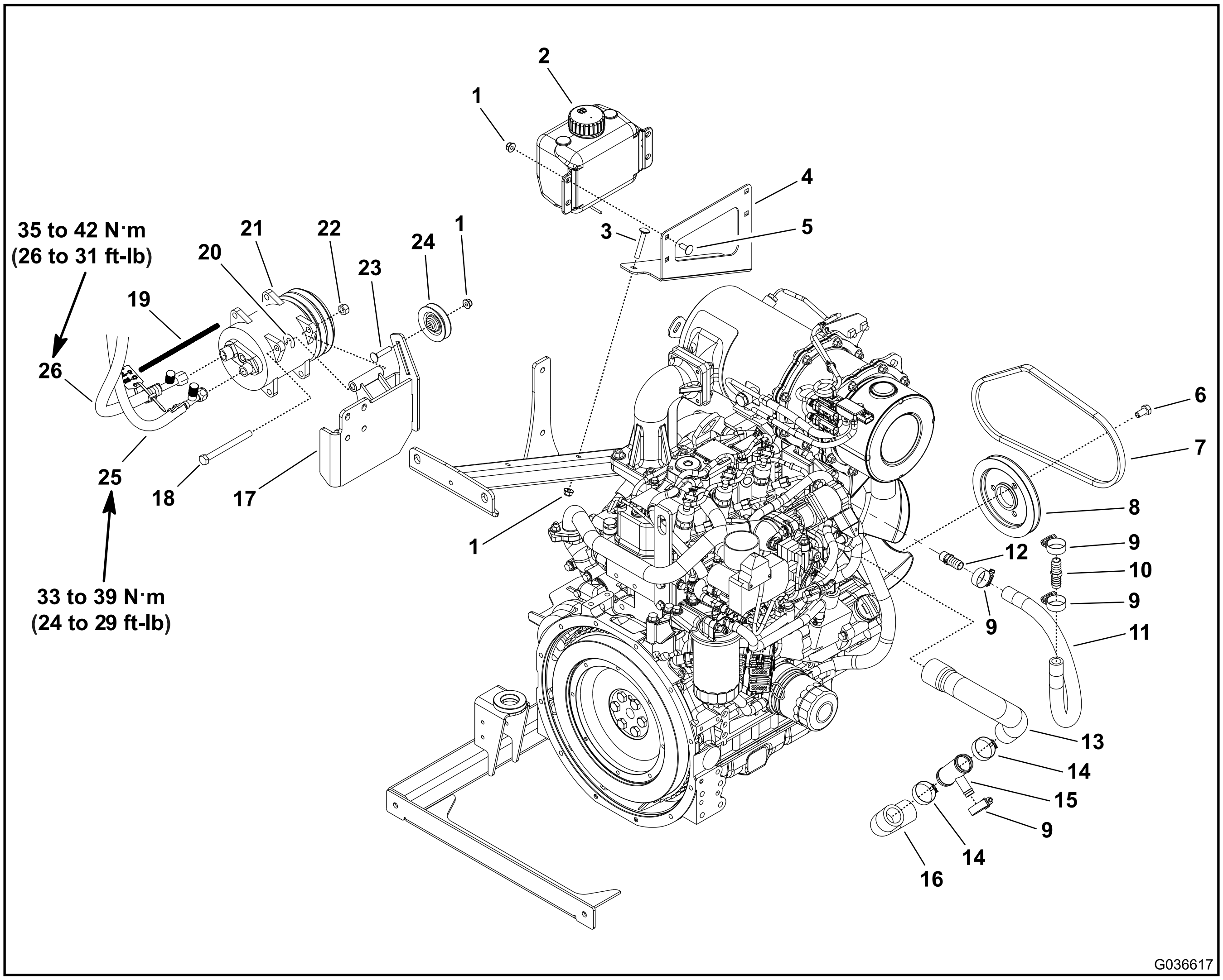


Figure 320

1.	Flange nut (7 each)	10.	Straight fitting	19.	Convoluted conduit
2.	Washer fluid tank	11.	Heater hose	20.	Shim
3.	Carriage screw (2 each)	12.	Straight fitting	21.	Compressor assembly
4.	Washer fluid tank bracket	13.	Lower radiator hose	22.	Locknut (2 each)
5.	Carriage screw (4 each)	14.	Hose clamp (2 each)	23.	Carriage screw
6.	Screw (3 each)	15.	Radiator fitting	24.	Idler pulley
7.	V-belt	16.	Lower radiator hose	25.	Discharge hose fitting
8.	Compressor pulley	17.	Compressor bracket	26.	Suction hose fitting
9.	Hose clamp (4 each)	18.	Screw (2 each)		

Removing the Air Conditioning Compressor

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 the hood to get access to the engine and air conditioning compressor.
3. Remove the battery and battery tray from the machine; refer to Removing and Installing the Battery (page 5–111).
4. Remove the compressor shield behind the battery.

Removing the Air Conditioning Compressor (continued)

5. Loosen the nut that secures the drive belt idler pulley, and remove the drive belt.
6. Disconnect the compressor electrical connector from the machine wire harness.
7. Read the General Precautions for Removing and Installing the Air Conditioning System Components (page 8–4).

⚠ CAUTION ⚠

Loosening any air conditioning system fitting or component allows the pressurized refrigerant to escape, causing possible injury.

Do not loosen any system fitting or component until a certified air conditioning service technician discharges the system completely.

8. Have a certified air conditioning service technician evacuate the refrigerant from the air conditioning system.
9. Label and remove the hoses from the compressor. Immediately install the caps on the hoses and fittings to prevent moisture and contaminants from entering into the system.
10. Support the compressor to prevent it from shifting or falling.

    Note: There may be shims (item 20 in Figure 320) mounted between the compressor mounting flanges and compressor bracket. When you remove the compressor, note the location and quantity of the shim for assembly purposes.

11. Note the orientation of the compressor for assembly purposes. Remove the 2 screws (item 18 in Figure 320) and 2 locknuts that secure the compressor to the compressor bracket.

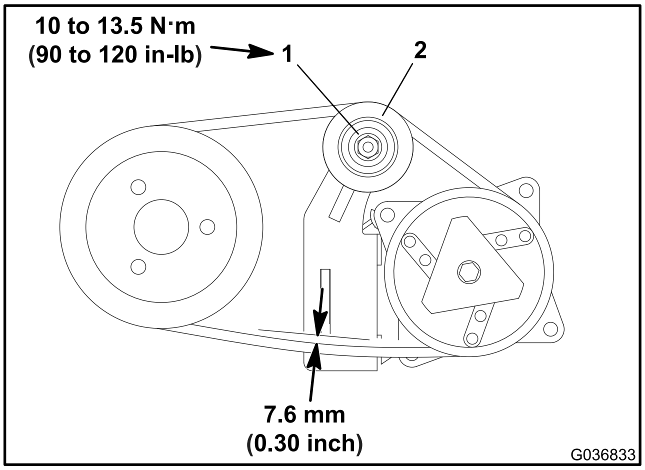
IMPORTANT

To prevent the compressor oil from filling the compressor cylinders, keep the compressor in the same orientation as it was in the installed position.

12. Carefully remove the compressor from the engine and machine.

    Note: Replace the air conditioning drier-receiver whenever you service or replace the air conditioning compressor.

Installing the Air Conditioning Compressor



g036833

Figure 321

1. Flange nut
2. Idler pulley

IMPORTANT

The compressor must be positioned with the larger (suction) port toward the outside of the machine.

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1. Position the compressor to the compressor mount on the machine frame.
2. Ensure that the clearance between the compressor mounting flanges and compressor bracket is less than 0.10 mm (0.004 inch). If necessary, install shims between the compressor flanges and bracket to adjust clearance.
3. Position the compressor with smaller refrigerant port closest to the engine and secure the compressor to the compressor mount with the 2 screws (item 18 in Figure 320) and 2 locknuts.

IMPORTANT

After the compressor is installed, ensure that you rotate the compressor driveshaft several times to correctly distribute the oil in the compressor. Perform this procedure to prevent damage of the compressor because of the oil slugging.

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4. Manually rotate the compressor driveshaft at least 10 revolutions to ensure that there is no compressor oil in the compressor cylinders.
5. Install the air conditioning compressor drive belt. Adjust the drive belt tension until the belt deflection is **7.6 mm (0.30 inch)** at 10 kg (22 lb) force applied half way between the engine and compressor pulleys, and tighten the nut that secures the idler pulley (Figure 321).
6. Remove the caps that you placed on the hoses and fittings during the removal process. Use the labels that you attached during removal to correctly attach the hoses to the compressor. Torque the discharge hose fitting (smaller fitting) and suction hose fitting (larger fitting) as shown in Figure 320.
7. Connect the compressor electrical connector to the machine wire harness.

Installing the Air Conditioning Compressor (continued)

8. Have a certified air conditioning service technician evacuate the air conditioning system completely, correctly recharge the system with R134a refrigerant, and perform the leak test on the system.

   Note: The capacity of the air conditioning system is 1.55 kg (3.43 lb) of R134a refrigerant.

9. Install the compressor shield behind the battery.
10. Install the battery tray and battery to the machine; refer to Removing and Installing the Battery (page 5–111).
11. Lower the hood and secure it.

Roof Assembly

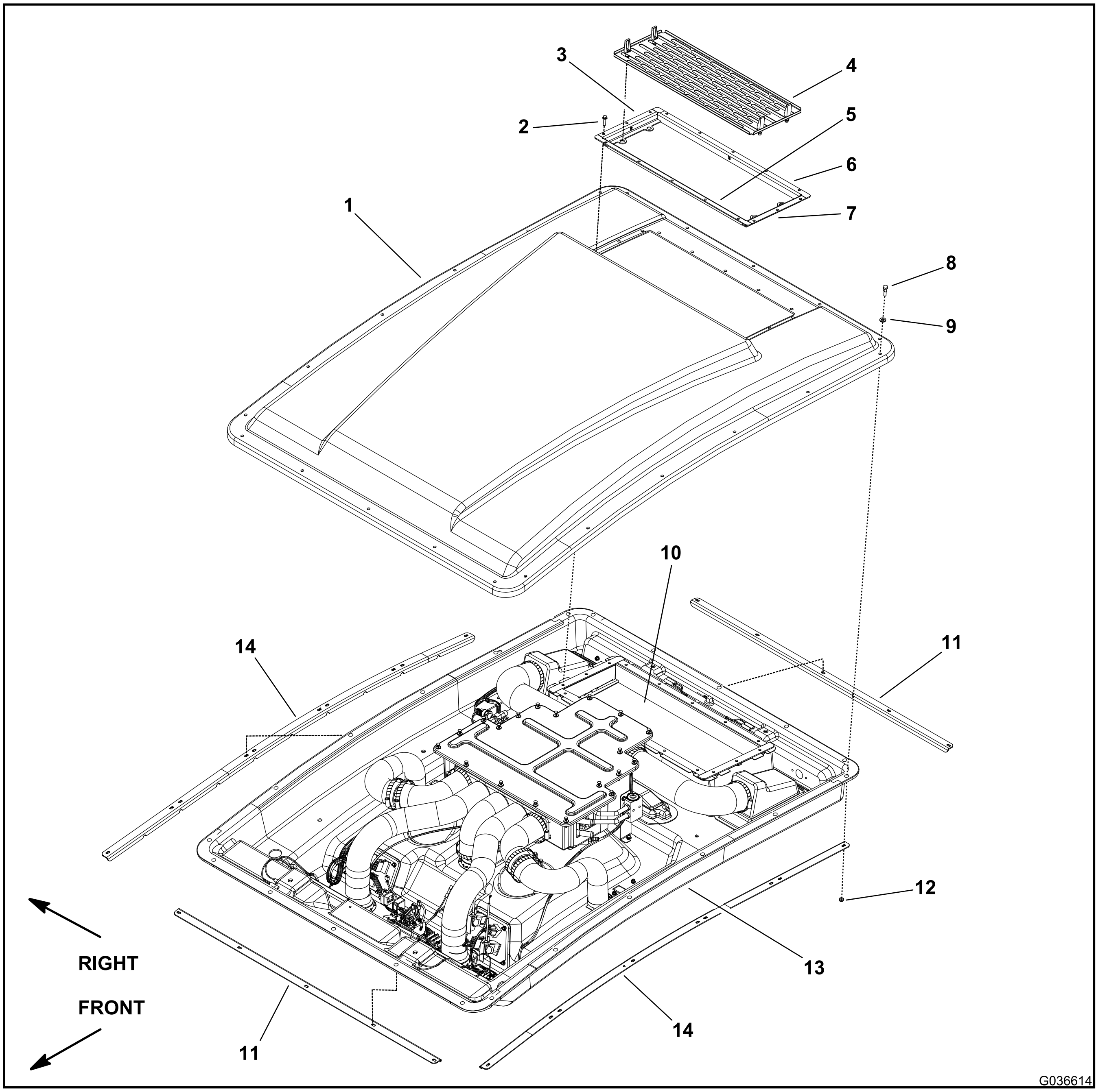

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Figure 322

1.	Roof panel	6.	Rear condenser seal	11.	Front/rear cab strap (2 each)
2.	Flange-head screw (16 each)	7.	Left condenser seal	12.	Flange nut (22 each)
3.	Right condenser seal	8.	Shoulder screw (22 each)	13.	Headliner assembly
4.	Condenser screen	9.	Flat washer (22 each)	14.	Side cab strap (2 each)
5.	Front condenser seal	10.	Condenser assembly		

Get access to the heater core and air conditioning components by removing the roof panel.

Removing the Roof 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.

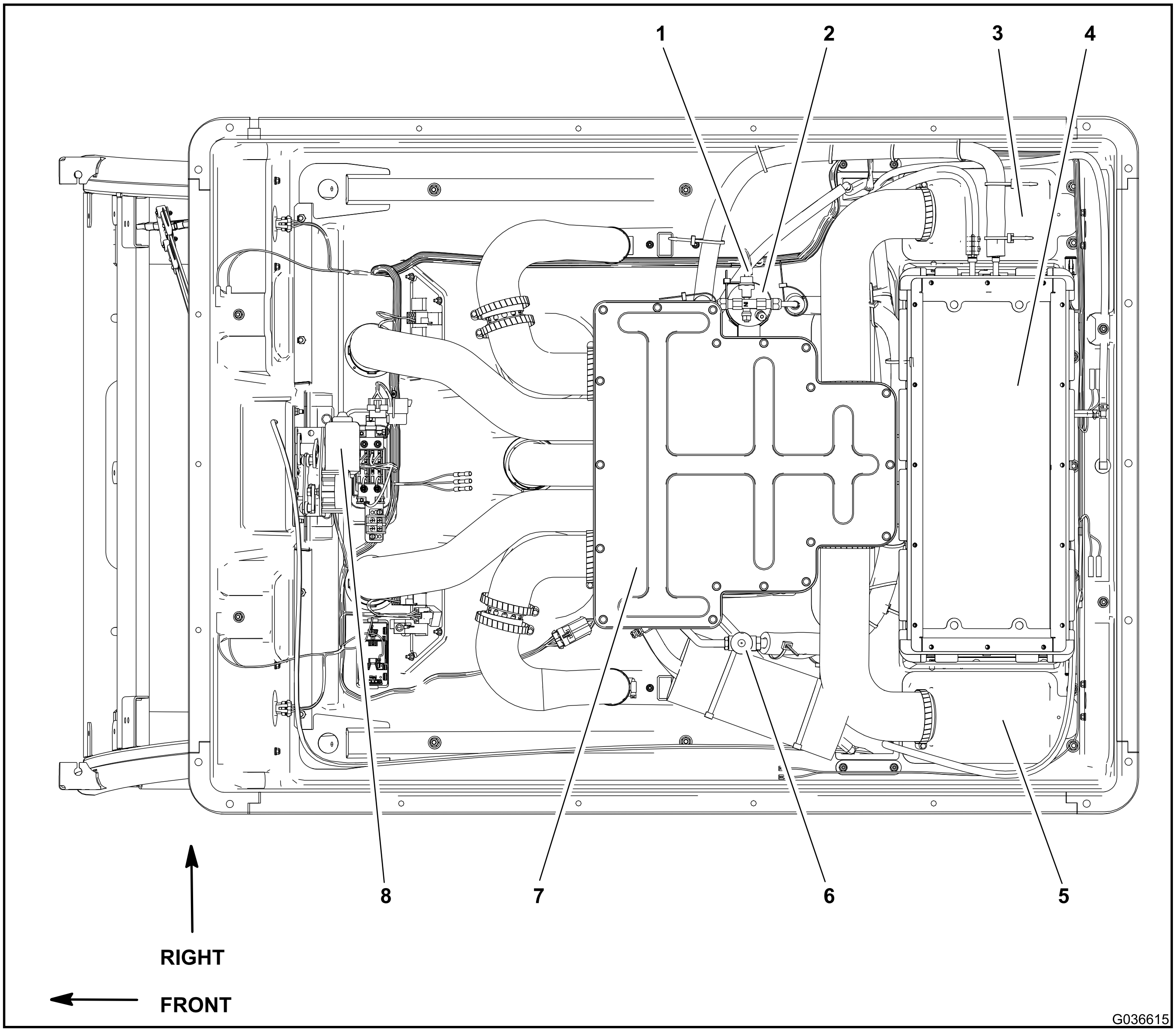
Removing the Roof Assembly (continued)

2. Release the 4 swell latches and lift the condenser screen (item 4 in Figure 322) from the roof assembly.
3. Remove the 16 flange-head screws (item 2 in Figure 322) that secure the condenser seals (items 3, 5, 6, and 7) to the roof and air conditioning condenser assembly.
4. Remove the 22 shoulder screws (item 8 in Figure 322), 22 flat washers, and 22 flange nuts that secure the roof and cab straps to the headliner.
5. Carefully lift the roof from the headliner and cab.
6. Inspect all the roof seals for wear or damage. Replace the roof seals as necessary.

Installing the Roof Assembly

1. Ensure that all the components in the headliner are installed and secure.
2. Position the roof onto the headliner. Ensure that all the roof mounting holes are correctly aligned with the headliner and air conditioning condenser assembly.
3. Secure the roof to the headliner with the 22 shoulder screws (item 8 in Figure 322), 22 flat washers, cab straps, and 22 flange nuts that were removed.
4. Secure the condenser seals to the roof and air conditioning condenser assembly with the 16 flange-head screws that were removed.
5. Install and secure the condenser screen to the roof assembly with the 4 swell latches.

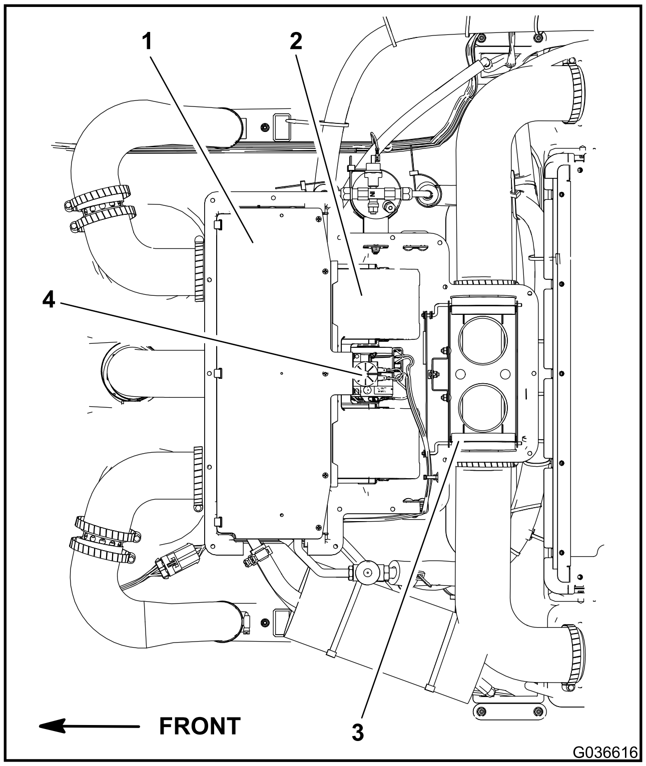
Heating and Air Conditioning Components



g036615

Figure 323

1.	Air conditioning binary switch	4.	Air conditioning condenser assembly	7.	Heat and air conditioning mixing box assembly
2.	Air conditioning drier-receiver	5.	Left intake air filter	8.	Wiper motor assembly
3.	Right intake air filter	6.	Air conditioning expansion valve		



g036616

Figure 324

1.	Evaporator/heater cores	3.	Air diverter assembly
2.	Blower fan	4.	Air conditioning freeze switch

Get access to the cab heating and air conditioning components by removing the cab roof; refer to Removing the Roof Assembly (page 8–10). After you remove the cab roof, refer to Figure 323 and Figure 324 to identify the components used for heating and cooling the operator cab.

Note: Figure 324 shows the heat and air conditioning mixing box assembly with the mixing box cover removed.

Note: The capacity of the air conditioning system is 1.55 kg (3.43 lb) of R134a refrigerant.

Air Conditioning Condenser Fan Assembly

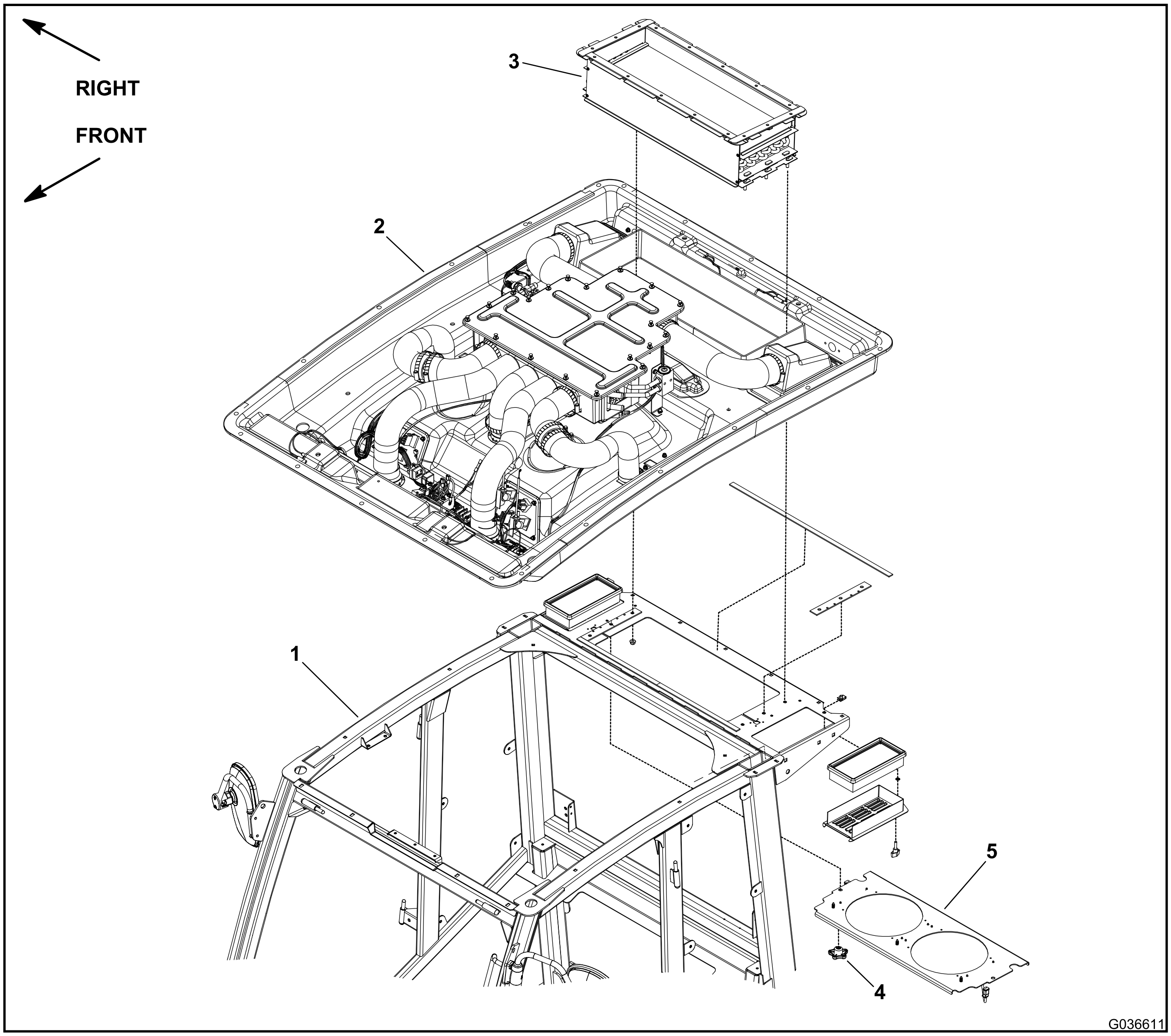


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Figure 325

1.	Cab frame	3.	Air conditioning condenser assembly	5.	Condenser fan assembly
2.	Cab headliner assembly	4.	Knob (2 each)		

Removing the Air Conditioning Condenser Fan Assembly

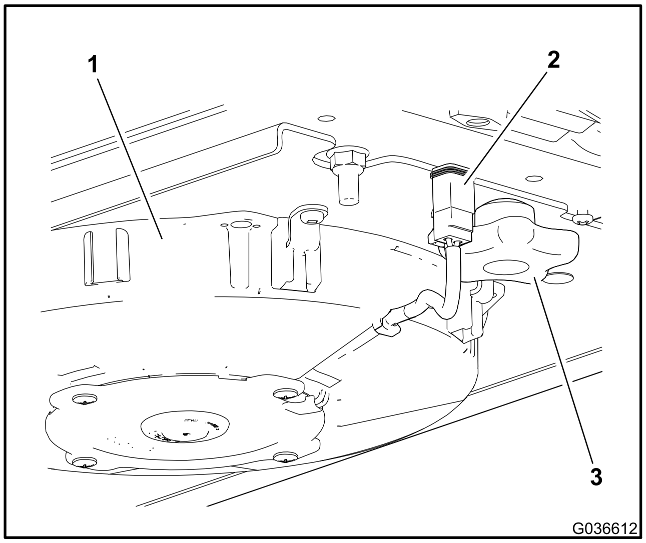

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Figure 326

1.	Condenser fan (2 each)	3.	Knob (2 each)
2.	Fan plug (2 each)		

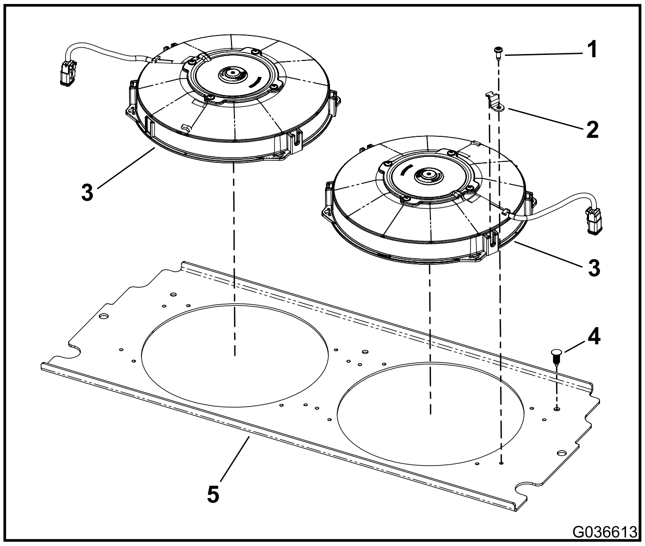

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Figure 327

1.	Screw (4 each per fan)	4.	Plug (3 each)
2.	Fan tab (4 each per fan)	5.	Fan mount plate
3.	Condenser fan (2 each)		

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 the air conditioning condenser fan assembly that is secured to the frame under the rear of the cab headliner.
3. Disconnect the 2 condenser fan plugs (item 2 in Figure 326) from the wire harness connectors that are attached to the cab frame.
4. Support the condenser fan assembly to prevent it from falling.
5. Remove the 2 knobs (item 3 in Figure 326) that secure the condenser fan assembly to the machine.

Removing the Air Conditioning Condenser Fan Assembly (continued)

6. Lower the condenser fan assembly from the machine.
7. If necessary, disassemble the condenser fan assembly (Figure 327).

Installing the Air Conditioning Condenser Fan Assembly

1. If the condenser fan assembly was disassembled, secure the fans to the fan mount plate (Figure 327).
2. Raise and support the fan assembly to the cab frame.
3. Secure the fan assembly to the machine with the 2 knobs.
4. Connect the 2 condenser fan plugs to the wire harness connectors that are attached to the cab frame.

Air Conditioning Condenser Assembly

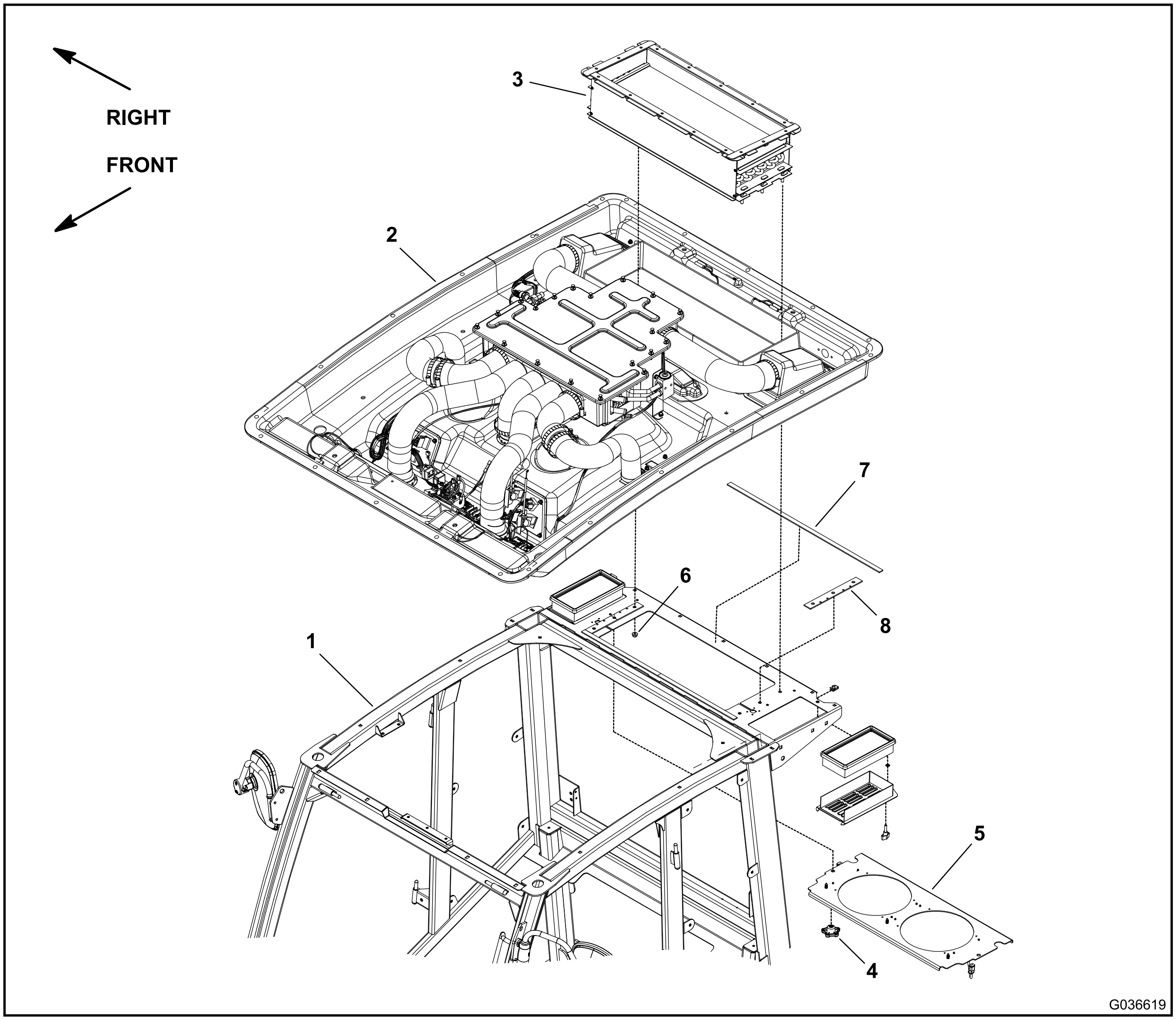

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Figure 328

1.	Cab frame	4.	Knob (2 each)	7.	Strip seal (2 each)
2.	Cab headliner assembly	5.	Condenser fan assembly	8.	Edge seal (2 each)
3.	Air conditioning condenser assembly	6.	Flange nut (4 each)		

Removing the Air Conditioning Condenser 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 roof panel from the top of the cab to get access to the air conditioning condenser assembly; refer to Removing the Roof Assembly (page 8–10).
3. Remove the condenser fan assembly from the machine; refer to Removing the Air Conditioning Condenser Fan Assembly (page 8–15).
4. Read the General Precautions for Removing and Installing the Air Conditioning System Components (page 8–4).

Removing the Air Conditioning Condenser Assembly (continued)

CAUTION

Loosening any air conditioning system fitting or component allows the pressurized refrigerant to escape, causing possible injury.

Do not loosen any system fitting or component until a certified air conditioning service technician discharges the system completely.

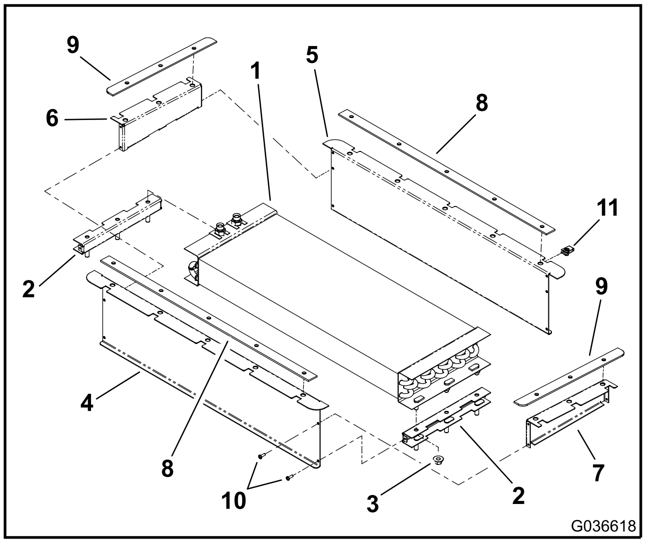

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Figure 329

1. Condenser core
2. Lower leg (2 each)
3. Hex nut (6 each)
4. Front wall
5. Back wall
6. Right side wall
7. Left side wall
8. Strip seal (2 each)
9. Edge seal (2 each)
10. Screw (12 each)
11. Clip (16 each)

5. Have a certified air conditioning service technician evacuate the refrigerant from the air conditioning system.
6. Label and remove the hoses from the condenser core. Immediately install the caps on the hoses and fittings to prevent moisture and contaminants from entering into the system.
7. Remove the 4 flange nuts (item 6 in Figure 328) that secure the air conditioning condenser assembly to the cab frame.
8. Carefully raise the condenser assembly from the headliner and remove the assembly from the machine.
9. Inspect the seals (items 7 and 8 in Figure 328) on the top of the cab frame for wear or damage and replace the seals if necessary.
10. If necessary, disassemble the condenser assembly (Figure 329).
11. Inspect the seals (items 8 and 9 in Figure 329) on the top of the condenser assembly walls for wear or damage and replace the seals if necessary.

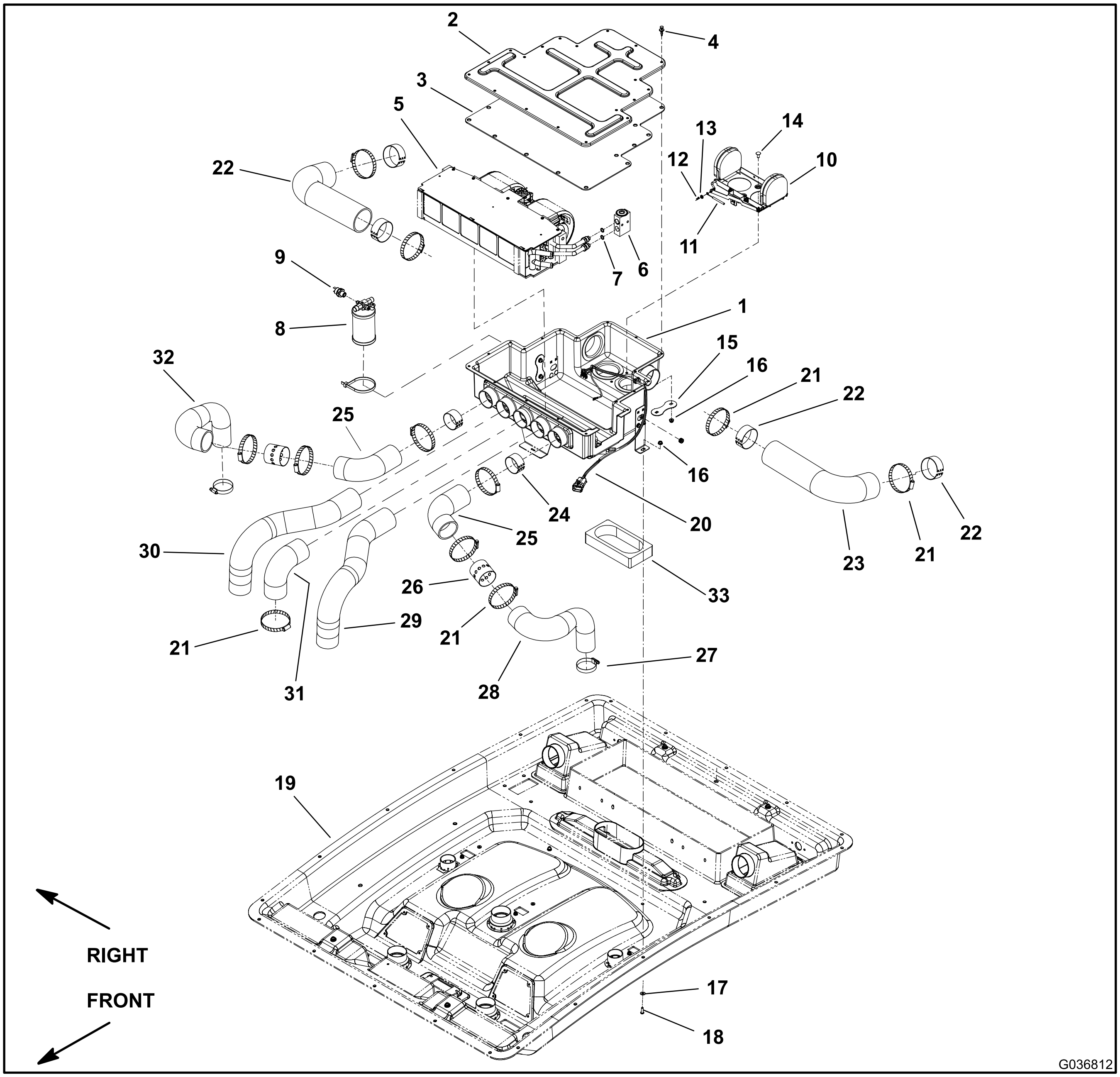
Installing the Air Conditioning Condenser Assembly

1. If the condenser assembly was disassembled, do as follows:
   A. To properly seal the condenser core, apply RTV sealant to all mating surfaces of walls, lower legs, and condenser core before assembly.
   B. Assemble all the condenser assembly components as shown in Figure 329.

      Note: Ensure that the strip and edge seals are in good condition after assembly.
2. Carefully lower the air conditioning condenser assembly through the headliner and onto the cab frame.
3. Secure the air conditioning condenser assembly to the cab frame with the 4 flange nuts.
4. Remove the caps that were placed on the hoses and fittings during the removal process. Use the labels that you attached during removal to correctly connect the hoses to the condenser core.
5. Secure the condenser fan assembly to the machine; refer to Installing the Air Conditioning Condenser Fan Assembly (page 8–16).
6. Ensure that all the machine air conditioning components are installed and secure.
7. Have a certified air conditioning service technician evacuate the air conditioning system completely, properly recharge the system with R134a refrigerant, and perform the leak test on the system.

   Note: The capacity of the air conditioning system is 1.55 kg (3.43 lb) of R134a refrigerant.
8. When you complete the service in the cab headliner, secure the roof panel to the top of the cab; refer to Installing the Roof Assembly (page 8–11).

Mixing Box Assembly



g036812

Figure 330

1. Mixing box
2. Mixing box cover
3. Cover insulation
4. Rivet (19 each)
5. Heater core/ air conditioning evaporator/fan assembly
6. Expansion valve
7. O-ring (2 each)
8. Air conditioning drier-receiver
9. Binary switch
10. Air diverter assembly
11. Control cable
12. Hairpin
13. Flat washer
14. Carriage screw (2 each)
15. Support plate
16. Flange nut (4 each)
17. Flat washer (2 each)
18. Button-head screw (2 each)
19. Cab headliner
20. Mixing box wire harness
21. Hose clamp (11 each)
22. Tube support (4 each)
23. Vent hose (2 each)
24. Tube support (2 each)
25. Vent hose (2 each)
26. Adapter (2 each)
27. Hose clamp (2 each)
28. Vent hose
29. Vent hose
30. Vent hose
31. Vent hose
32. Vent hose
33. Mixing box inlet foam

Removing the Mixing Box 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 roof panel from the top of the cab to get access to the mixing box assembly; refer to Removing the Roof Assembly (page 8–10).
3. Remove the cover from the mixing box assembly as follows:
   A. Carefully use a small prybar to raise the head of the pin in the center of each rivet that secures the mixing box cover.

   B. Lift the rivets from the cover and mixing box.

   C. Remove the mixing box cover.

   Note: If the heater core, air conditioning evaporator core, or blower fan need to be removed from the mixing box, the box does not have to be removed from the cab headliner. Refer to Heater and Air Conditioning Evaporator Cores (page 8–24) or Blower Fan (page 8–27) for information on removing and installing these components.
4. Disconnect the electrical connectors from the mixing box wire harness and binary switch on the drier-receiver.
5. Read the General Precautions for Removing and Installing the Air Conditioning System Components (page 8–4). Ensure that these instructions are followed if any air conditioning hoses are loosened or if any air conditioning components are to be removed from the cab headliner.

⚠ **CAUTION** ⚠

Loosening any air conditioning system fitting or component allows the pressurized refrigerant to escape, causing possible injury.

Do not loosen any system fitting or component until a certified air conditioning service technician discharges the system completely.

6. Remove the mixing box components as shown in Figure 330 and Figure 331.

   Note: Replace the air conditioning drier-receiver whenever you replace the expansion valve.

Installing the Mixing Box Assembly

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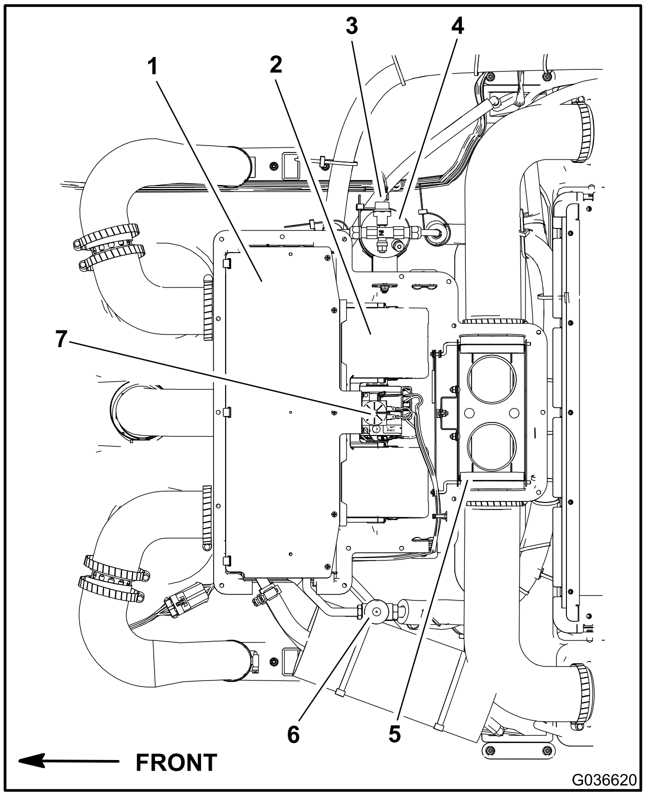

Figure 331

1. Evaporator and heater core	5. Air diverter assembly
2. Blower fan	6. Air conditioning expansion valve
3. Air conditioning binary switch	7. Air conditioning freeze switch
4. Air conditioning drier-receiver	

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1. Install all the mixing box components that were removed (Figure 330 and Figure 331).

   Note: Ensure that the expansion valve is covered with insulating tape to prevent condensation issues.

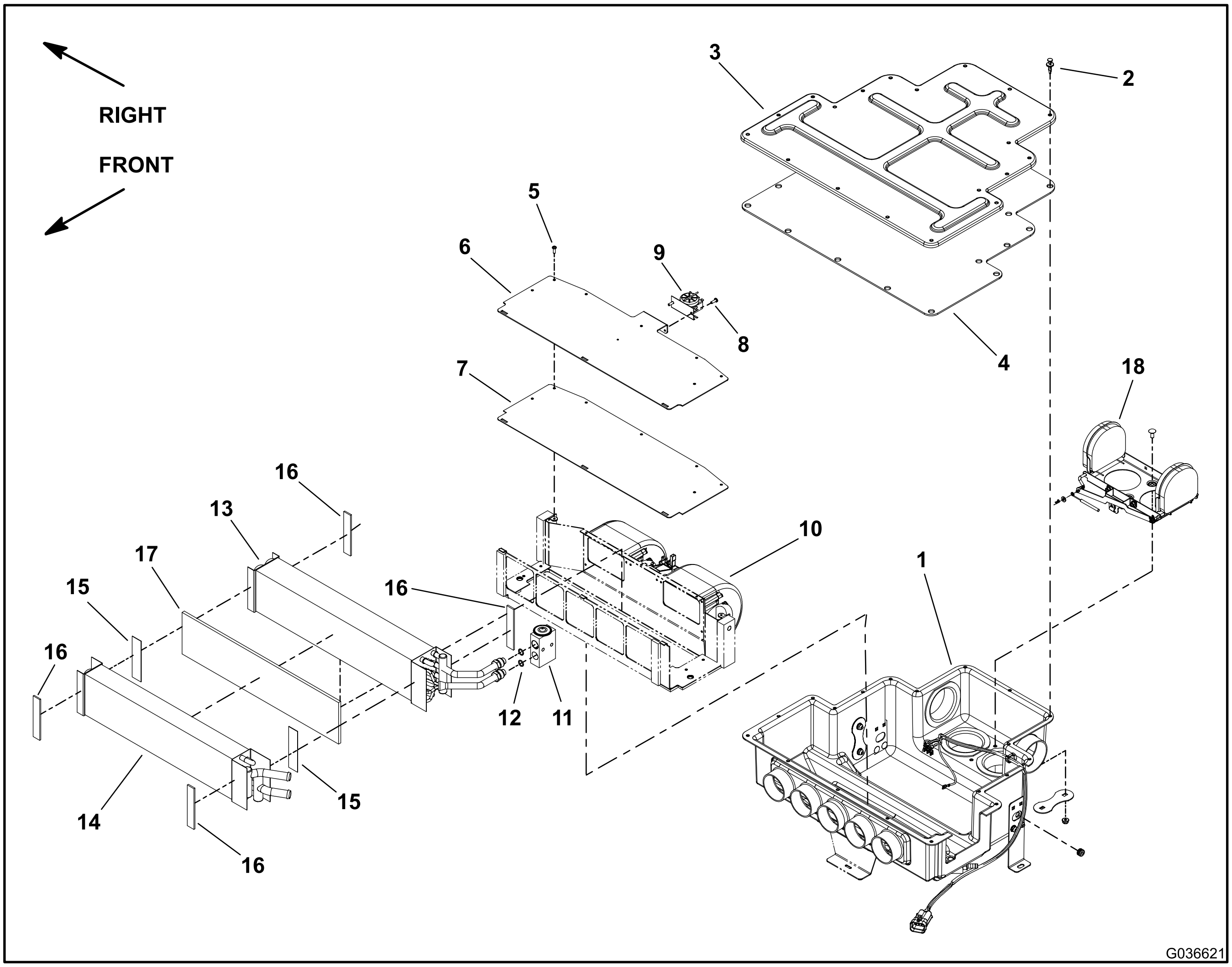
2. Ensure that the condensation hoses are secured to the drain fittings on the bottom of the mixing box assembly. Also, route the hoses to the cab frame for proper draining of the condensate.
3. Ensure to connect the electrical connectors from the mixing box wire harness and binary switch on the air conditioning drier-receiver.
4. If any air conditioning system components were removed from the cab headliner, ensure that all the machine air conditioning components are installed and secure.
5. Have a certified air conditioning service technician evacuate the air conditioning system completely, properly recharge the system with R134a refrigerant, and perform the leak test on the system.

   Note: The capacity of the air conditioning system is 1.55 kg (3.43 lb) of R134a refrigerant.

Installing the Mixing Box Assembly (continued)

6. Secure the cover to the mixing box assembly as follows:
   A. Position the mixing box cover to the mixing box. Ensure that the wire harness is routed through recess in side of the mixing box.
   B. With the rivet pin in a raised position, insert the rivets through the cover and into the hole in the mixing box. Press the pin into the rivet to secure the rivet in place.
7. Operate the heater system to ensure that there are no coolant leaks in the cab headliner.
8. When you complete all the service in the cab headliner, secure the roof panel to the top of the cab; refer to Installing the Roof Assembly (page 8–11).

Heater and Air Conditioning Evaporator Cores



g036621

Figure 332

1. Mixing box
2. Rivet (19 each)
3. Mixing box cover
4. Cover insulation
5. Screw (5 each)
6. Mount bracket cover
7. Cover gasket
8. Screw (2 each)
9. Freeze switch
10. Mount bracket (shown with fan)
11. Expansion valve
12. O-ring (2 each)
13. Air conditioning evaporator core
14. Heater core
15. Double sided tape (2 each)
16. Gasket (4 each)
17. Condensation catch foam
18. Air diverter assembly

Note: The heater and evaporator cores can be removed and installed with the mixing box (item 1 in Figure 332) attached to the cab headliner.

Removing the Heater and Air Conditioning Evaporator Cores

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 roof panel from the top of the cab to get access to the heater and air conditioning evaporator cores; refer to Removing the Roof Assembly (page 8–10).
3. Read the General Precautions for Removing and Installing the Air Conditioning System Components (page 8–4).

⚠ CAUTION ⚠

Loosening any air conditioning system fitting or component allows the pressurized refrigerant to escape, causing possible injury.

Do not loosen any system fitting or component until a certified air conditioning service technician discharges the system completely.

4. Have a certified air conditioning service technician evacuate the air conditioning system.
5. Disconnect both the evaporator core swivel fittings from the front ports of the expansion valve. Immediately install the caps on the tubes and expansion valve ports to prevent moisture and contaminants from entering into the system. Position the expansion valve with attached hoses away from the mixing box.
6. For assembly purposes, label the heater hoses. Loosen the hose clamps and disconnect both the heater hoses from the tubes on the heater core.
7. Remove the mixing box cover as follows:
   A. Carefully use a small prybar to raise the head of the pin in the center of each rivet that secures the mixing box cover.
   B. Lift the rivets from the cover and mixing box.
   C. Remove the mixing box cover.
8. Locate the wire from the freeze switch that is inserted into the air conditioning evaporator core through the mount bracket cover. Carefully pull the wire from the cover and position it away from the cover.
9. Remove the 5 screws (item 5 in Figure 332) that secure the mount bracket cover to the mount bracket. Lift the cover and position it away from the mount bracket to ensure that you do not damage the freeze switch or wires connected to the switch.
10. Carefully lift the heater and air conditioning evaporator core assembly from the frame.
11. Separate the heater and air conditioning evaporator cores (Figure 332). The cores are secured to each other with double sided tape (item 15 in Figure 332).
12. Inspect the seals, gaskets, and insulation in the mixing box assembly for tears or other damage. Replace all the sealing components that were damaged.

Installing the Heater and Air Conditioning Evaporator Cores

1. Assemble the heater and air conditioning evaporator cores (Figure 332).
2. Carefully install the heater and air conditioning evaporator core assembly into the frame in the mixing box.

   Note: Do not damage the freeze switch or wires connected to the switch during assembly of the mount bracket cover.
3. Position the mount bracket cover to the mount bracket. Secure the cover to the mount bracket with the 5 screws (item 5 in Figure 332).
4. Insert the wire from the freeze switch into the air conditioning evaporator core through the mount bracket cover.

   Note: The wire should be inserted 51 mm (2 inches) through the cover.
5. Secure the cover to the mixing box assembly as follows:

Installing the Heater and Air Conditioning Evaporator Cores (continued)

   A. Position the mixing box cover to the mixing box. Ensure that the wire harness is routed through recess in side of the mixing box.
   B. With the rivet pin in a raised position, insert the rivets through cover and into the hole in the mixing box. Press the pin into the rivet to secure the rivet in place.

6. Use the labels that you attached during removal, connect both the heater hoses to the tubes on the heater core, and secure the heater hoses with the hose clamps.
7. Remove the caps that were placed on the evaporator core tubes and expansion valve ports during the removal process. Position the expansion valve with attached hoses to the evaporator core tubes. Properly secure the evaporator core swivel fittings to the front ports of the expansion valve.
8. Ensure that all the machine air conditioning components are installed and secure.
9. Ensure that the expansion valve is covered with insulating tape to prevent condensation issues.
10. Have a certified air conditioning service technician evacuate the air conditioning system completely, properly recharge the system with R134a refrigerant, perform the leak test on the system.

    Note: The capacity of the air conditioning system is 1.55 kg (3.43 lb) of R134a refrigerant.

11. Operate the heater system to ensure that there are no coolant leaks in the headliner.
12. Secure the roof panel to the top of the cab; refer to Installing the Roof Assembly (page 8–11).

Blower Fan

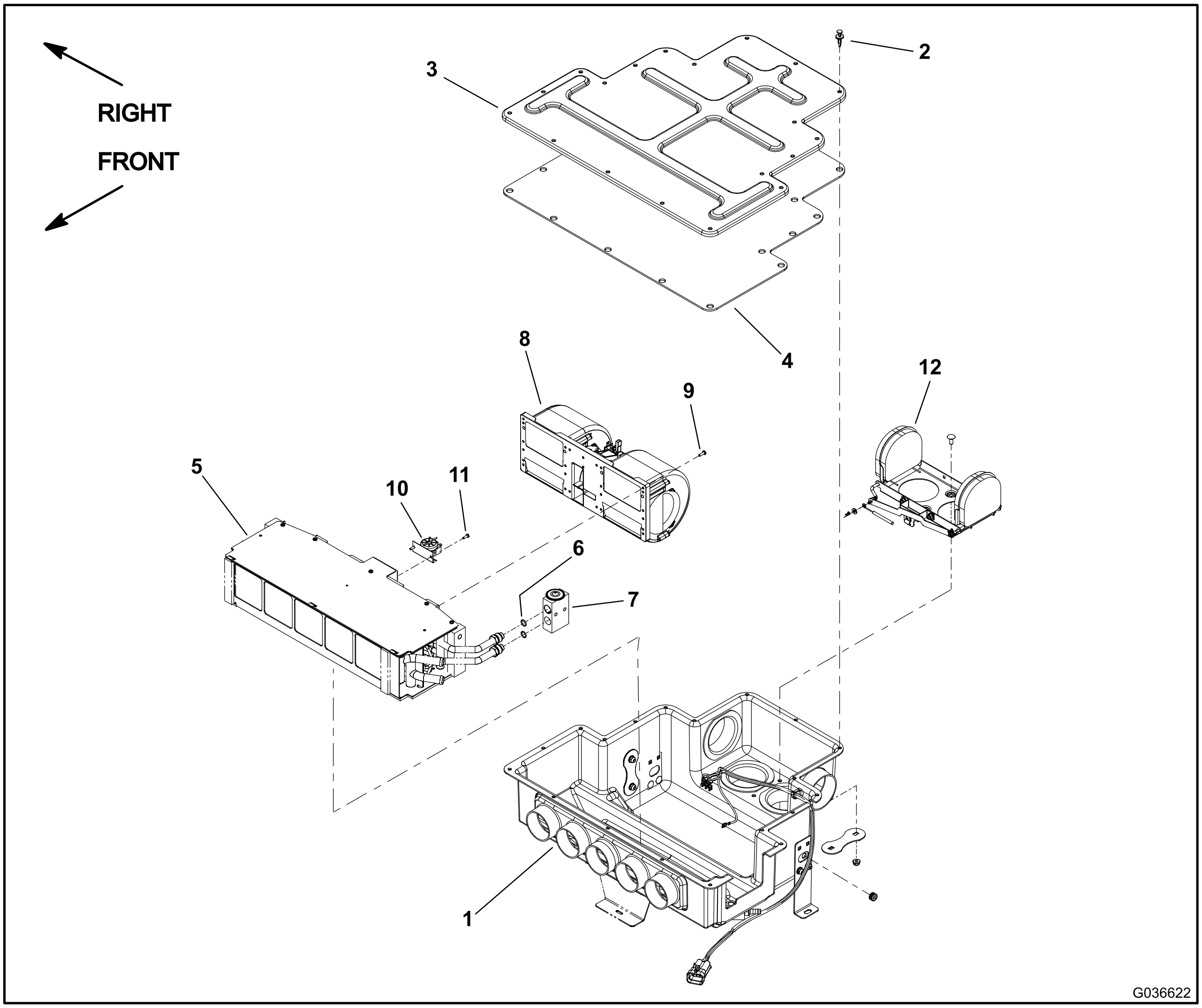


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Figure 333

1.	Mixing box	5.	Heater core/air conditioning evaporator assembly	9.	Screw (6 each)
2.	Rivet (19 each)	6.	O-ring (2 each)	10.	Freeze switch
3.	Mixing box cover	7.	Expansion valve	11.	Screw (2 each)
4.	Cover insulation	8.	Blower fan	12.	Air diverter assembly

Note: The blower fan can be removed and installed with the mixing box (item 1 in Figure 333) attached to the cab headliner.

Removing the Blower Fan

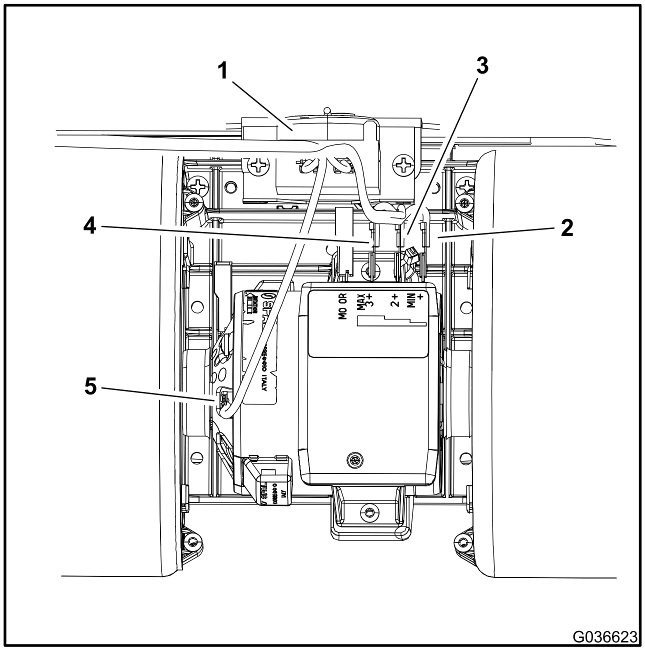
1. Park the machine on a level surface, lower the cutting deck, shut of the engine, set the parking brake, and remove the key from the key switch.
2. Remove the roof panel from the top of the cab to get access to the blower fan; refer to Removing the Roof Assembly (page 8–10).
3. Read the General Precautions for Removing and Installing the Air Conditioning System Components (page 8–4).

⚠ CAUTION ⚠

Loosening any air conditioning system fitting or component allows the pressurized refrigerant to escape, causing possible injury.

Do not loosen any system fitting or component until a certified air conditioning service technician discharges the system completely.

4. Have a certified air conditioning service technician evacuate the refrigerant from the air conditioning system.
5. Disconnect both evaporator core swivel fittings from front ports of expansion valve. Immediately cap tubes and expansion valve ports to prevent moisture and contaminants from entering the system. Position expansion valve with attached hoses away from the mixing box.



g036623

Figure 334

1. Freeze switch
2. MIN terminal (violet)
3. Terminal 2 (brown)
4. Terminal 3 (orange)
5. Ground terminal (black)

6. Label heater hoses for assembly purposes. Loosen hose clamps and disconnect both heater hoses from tubes on heater core.
7. Remove the mixing box cover as follows:
    A. Carefully use a small prybar to raise the head of the pin in the center of each rivet that secures the mixing box cover.
    B. Lift the rivets from the cover and mixing box.
    C. Remove the mixing box cover.
8. Note the location of the wire harness connectors on the freeze switch and blower fan assembly (Figure 334), disconnect the wire harness connectors from the switch and fan.
9. Carefully raise the heater core/air conditioning evaporator assembly with attached blower fan from the mixing box.

Removing the Blower Fan (continued)

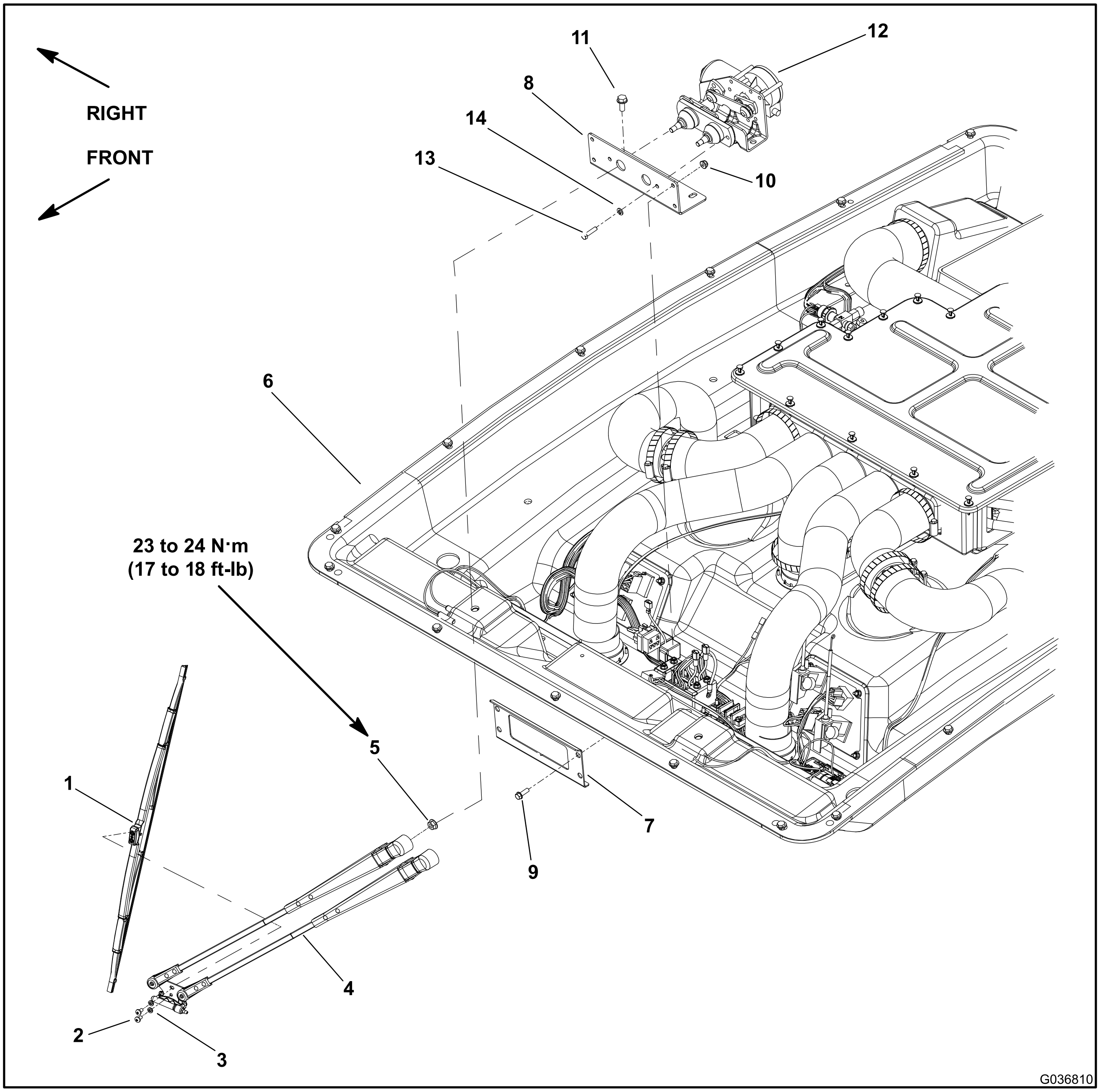
10. Remove the 6 screws (item 9 in Figure 333) that secure the blower fan to the heater core/air conditioning evaporator assembly, and remove the blower fan.

Installing the Blower Fan

1. Position the blower fan to the heater core/air conditioning evaporator assembly and secure the fan with the 6 screws.
2. Carefully lower the heater core/air conditioning evaporator assembly with attached blower fan into the mixing box.
3. Connect the wire harness connectors to the freeze switch and blower fan assembly (Figure 334).
4. Secure the mixing box cover as follows:
    A. Position the mixing box cover to the mixing box. Ensure that the wire harness is routed through recess in side of the mixing box.
    B. With the rivet pin in a raised position, insert the rivets through cover and into the hole in the mixing box. Press the pin into the rivet to secure the rivet in place.
5. Use the labels that you attached during removal, connect both the heater hoses to the tubes on the heater core, and secure the heater hose with the hose clamps.
6. Remove the caps that were placed on the evaporator core tubes and expansion valve ports during the removal process. Position the expansion valve with attached hoses to the evaporator core tubes. Properly secure the evaporator core swivel fittings to the front ports of the expansion valve.
7. Ensure that all the machine air conditioning components are installed and secure.
8. Have a certified air conditioning service technician evacuate the air conditioning system completely, properly recharge the system with R134a refrigerant, perform the leak test on the system.

    Note: The capacity of the air conditioning system is 1.55 kg (3.43 lb) of R134a refrigerant.
9. Operate the heater system to ensure that there are no coolant leaks in the headliner.
10. Secure the roof panel to the top of the cab; refer to Installing the Roof Assembly (page 8–11).

Windshield Wiper Assembly



g036810

Figure 335

1. Wiper blade
2. Bolt (2 each)
3. Lock washer (2 each)
4. Wiper arm assembly
5. Flange nut (2 each)
6. Cab headliner
7. Washer plate
8. Wiper bracket
9. Washer-head screw (4 each)
10. Flange nut (4 each)
11. Washer-head screw (2 each)
12. Wiper motor
13. Bolt
14. Lock washer

Disassembling the Windshield Wiper 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 2 bolts (item 2 in Figure 335) and 2 lock washers that secure the wiper blade to the wiper arm assembly, and remove the wiper blade.
3. If necessary, remove the wiper arm assembly as follows:
   A. Disconnect the washer hose from the wiper assembly.
   B. Lift the caps at the top of the wiper arms and remove the flange nuts that secure the wiper arms to the wiper motor.
   C. Use a suitable puller to remove the tapered wiper arm sockets from the wiper motor shafts.
4. If access to the wiper motor is necessary, remove the roof panel from the top of the cab to get access to the wiper motor assembly; refer to Removing the Roof Assembly (page 8–10).
5. Remove the wiper motor components as shown in Figure 335.

Assembling the Windshield Wiper Assembly

1. If required, install the wiper motor components that were removed (Figure 335) and do the following:
   A. If the wiper bracket (item 8 in Figure 335) was removed, apply bead of RTV sealant around the wiper opening on inside of the headliner before you install the bracket.
   B. Ensure that the wiper motor electrical connector is secured to the cab wire harness.
   C. Secure the roof panel to the top of the cab; refer to Installing the Roof Assembly (page 8–11).
2. If the wiper arm assembly was removed, do the following:
   A. Clean the tapered wiper arm sockets and wiper motor shafts.
   B. Slide the wiper arm sockets onto the wiper motor shafts and secure the wiper arm sockets with the flange nuts. Install the wiper arm caps over the flange nuts.
   C. Connect the washer hose to the wiper assembly.
3. If the wiper blade was removed, secure the blade to the wiper arm assembly with the 2 bolts and 2 lock washers.

Foldout Drawings

Table of Contents

Electrical Drawing Designations

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

Wire Color

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

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

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

Wire Size

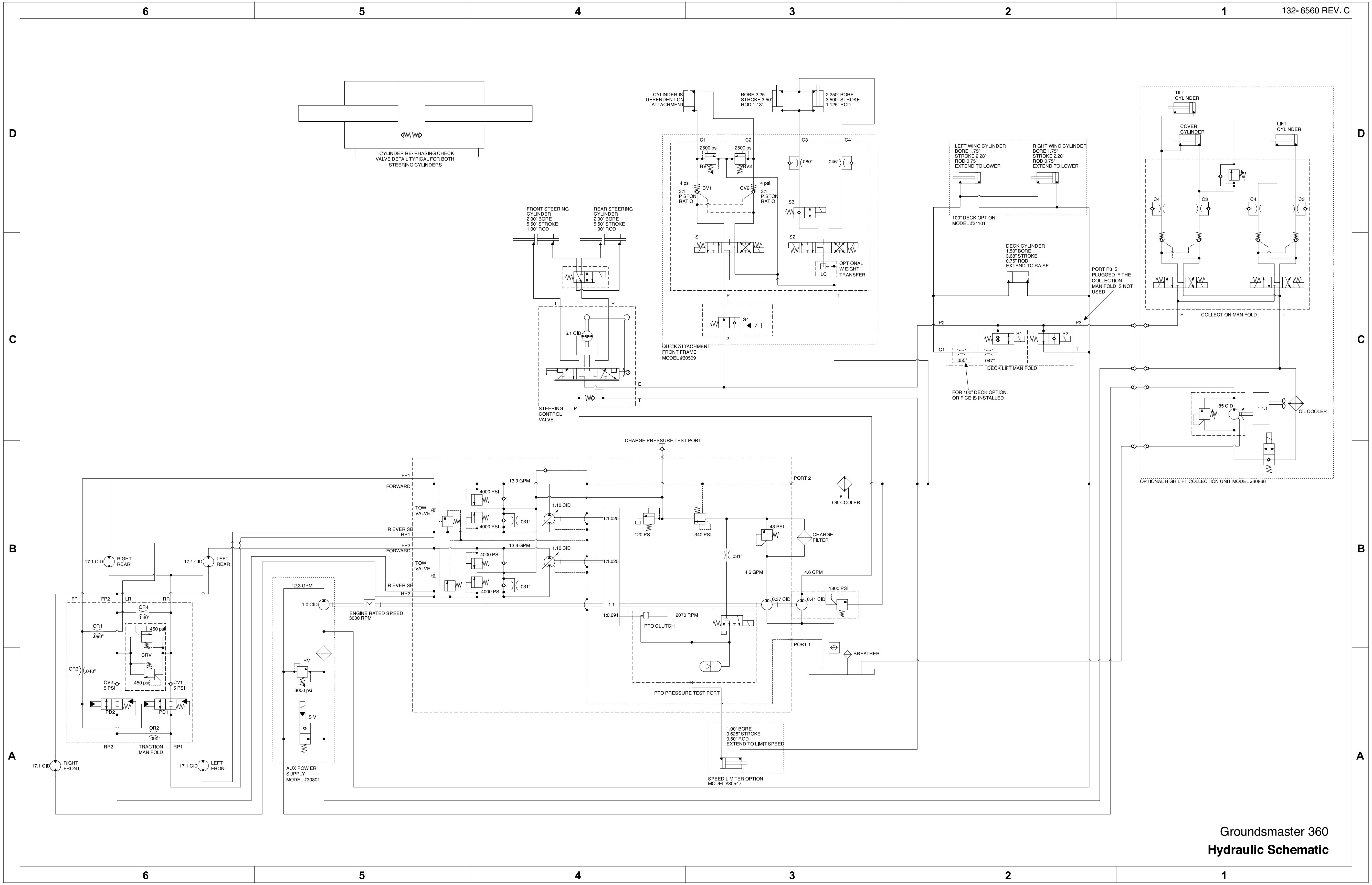
The individual wires of the electrical harness diagrams in this chapter identify both the wire color and the wire size.

Examples:

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

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

Hydraulic Schematic



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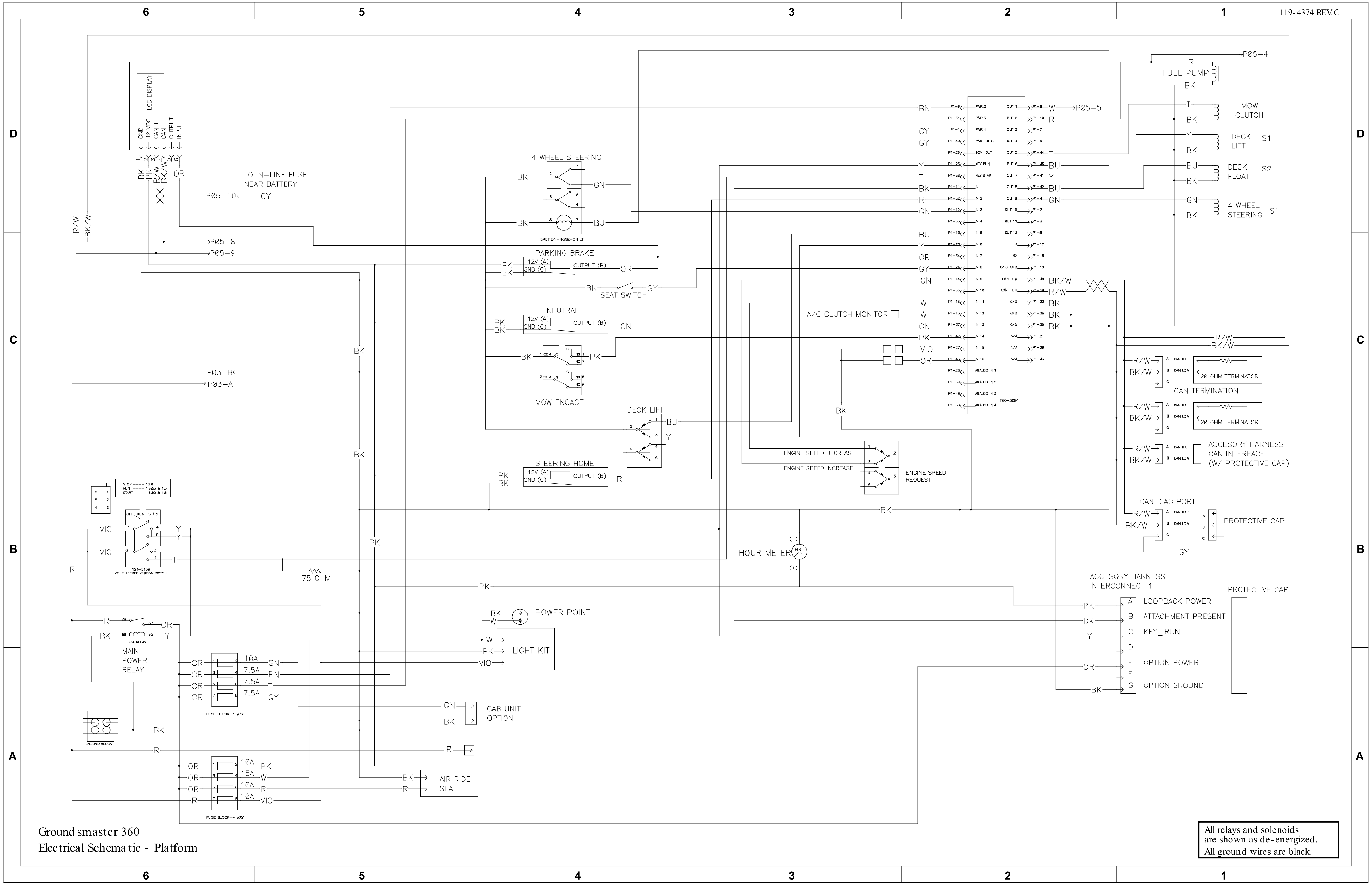
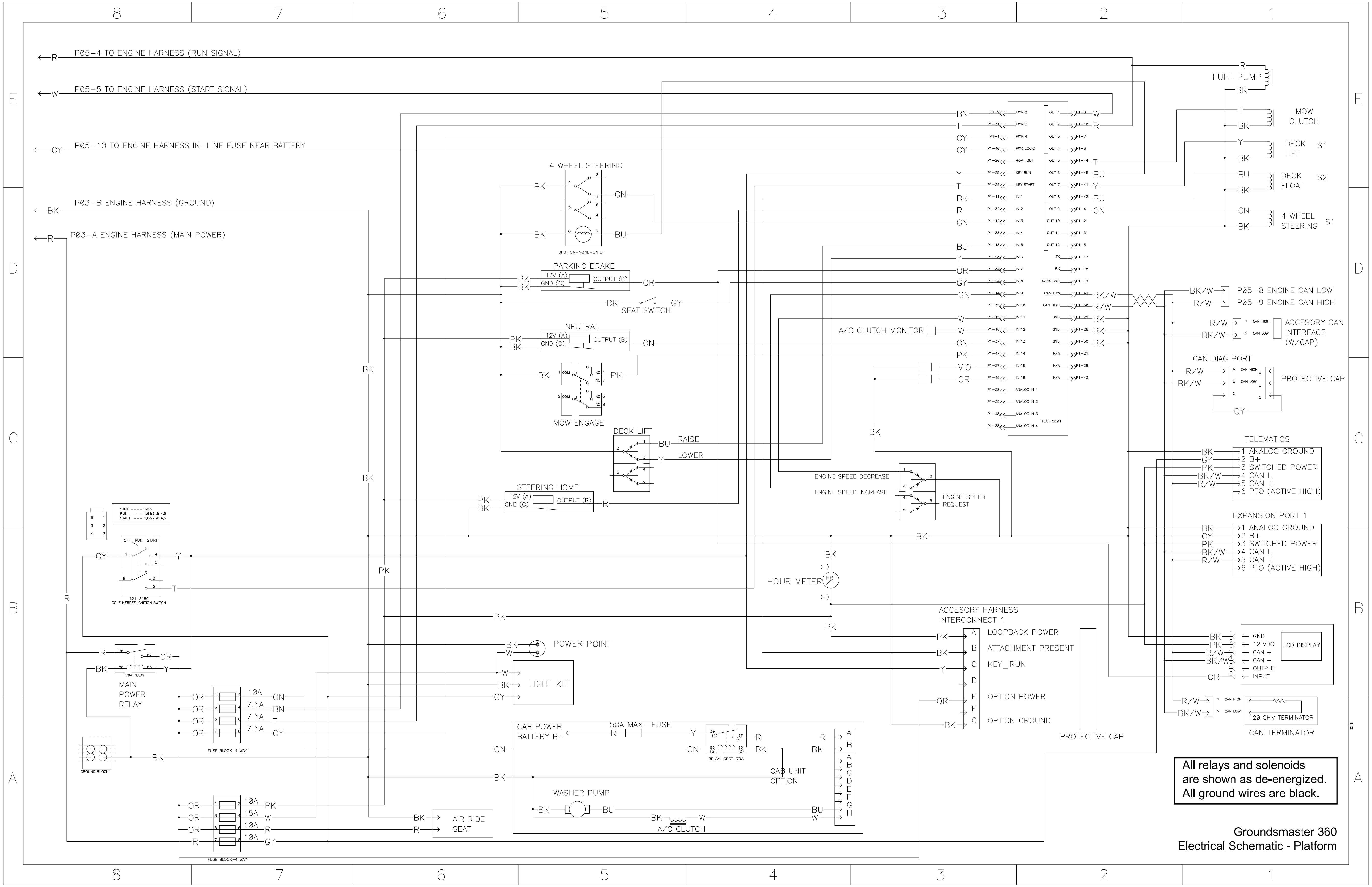
Electrical Schematic - Platform (Serial Numbers Below 403400000)



g186017

Electrical Schematic - Platform (Serial Numbers Above 403400001)



All relays and solenoids are shown as de-energized. All ground wires are black.

Groundsmaster 360
Electrical Schematic - Platform

g330222

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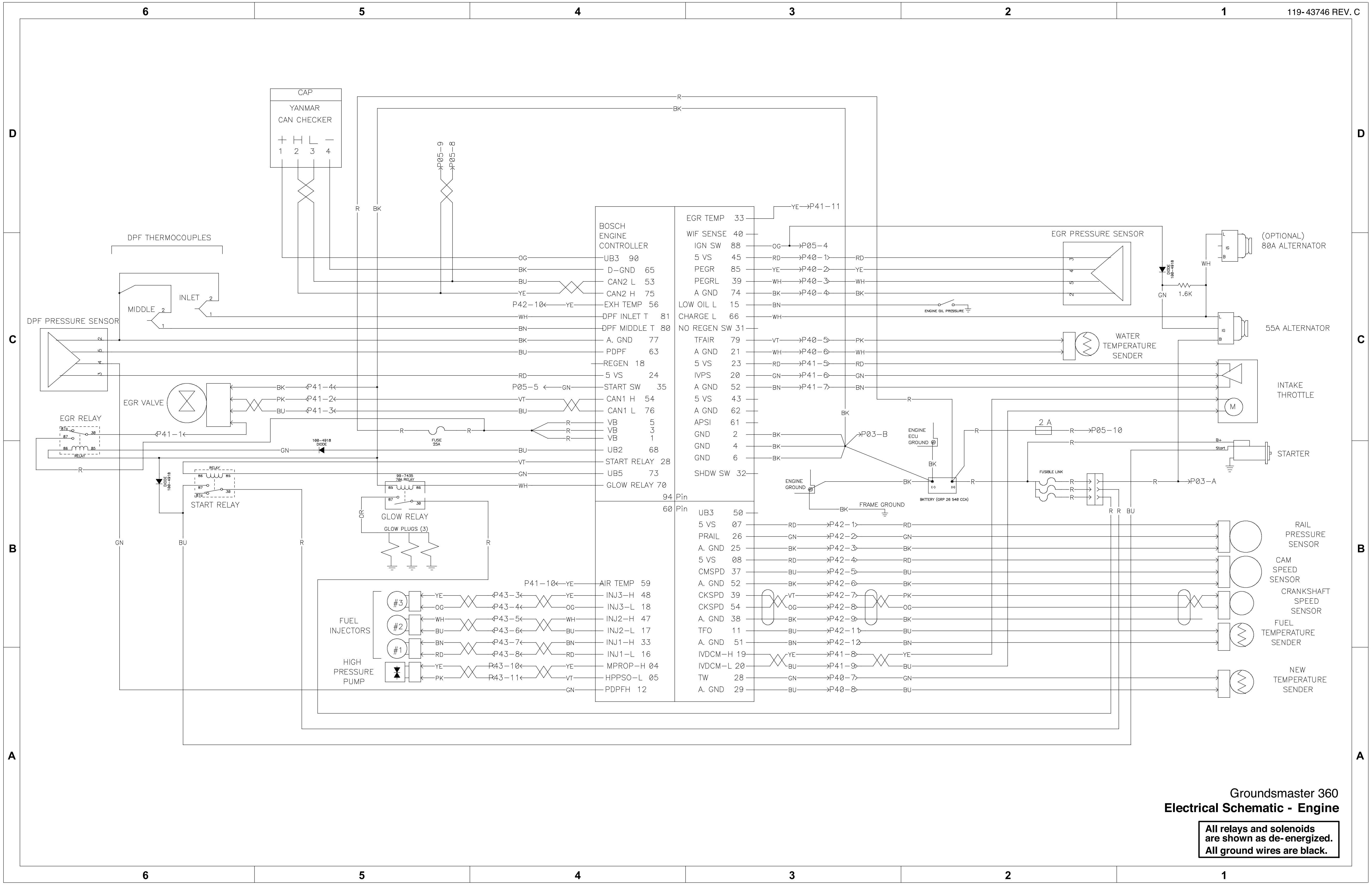
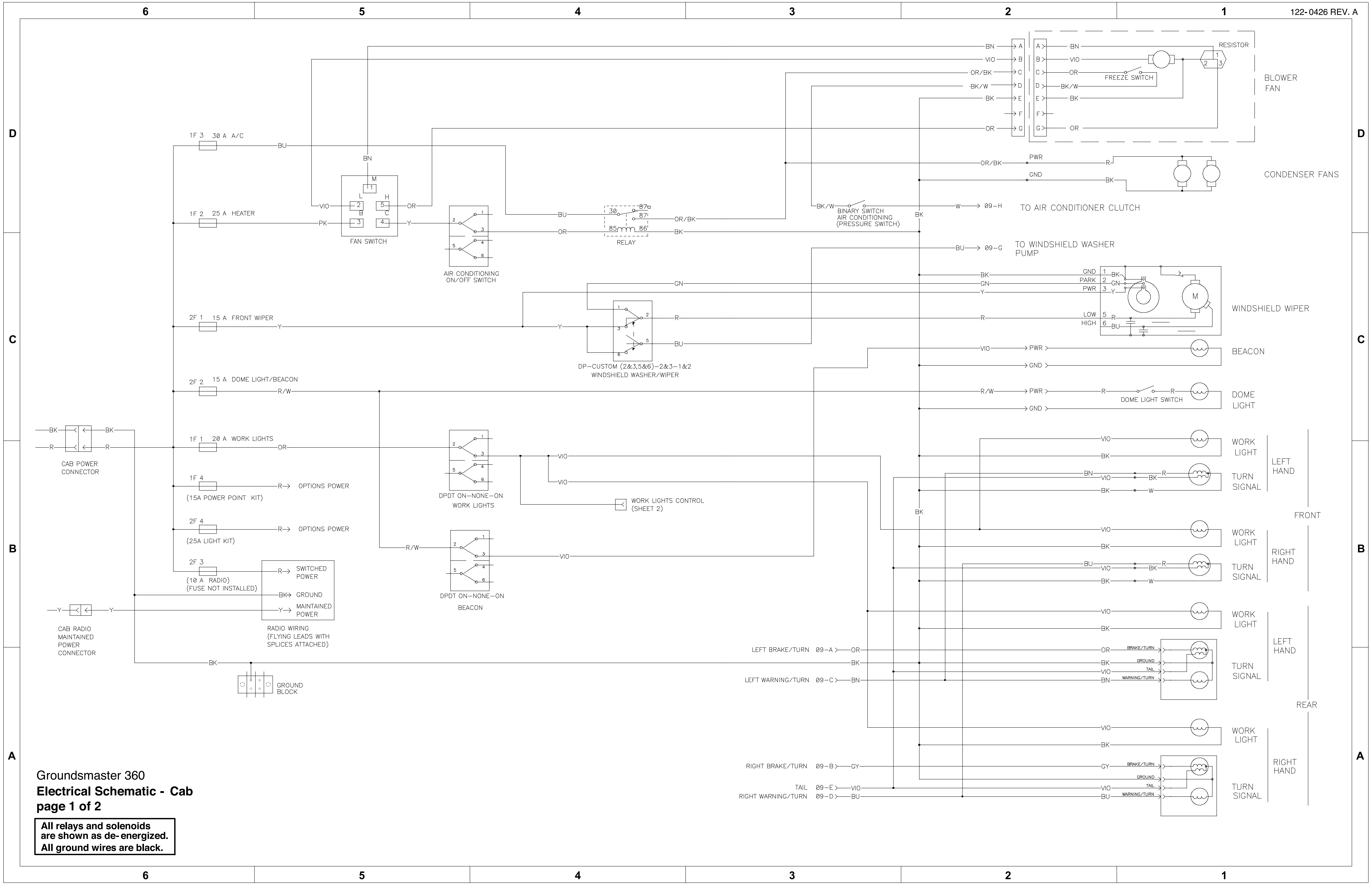
g326106

Electrical Schematic - Engine



g186162

Electrical Schematic - Cab (page 1 of 2)



Groundsmaster 360

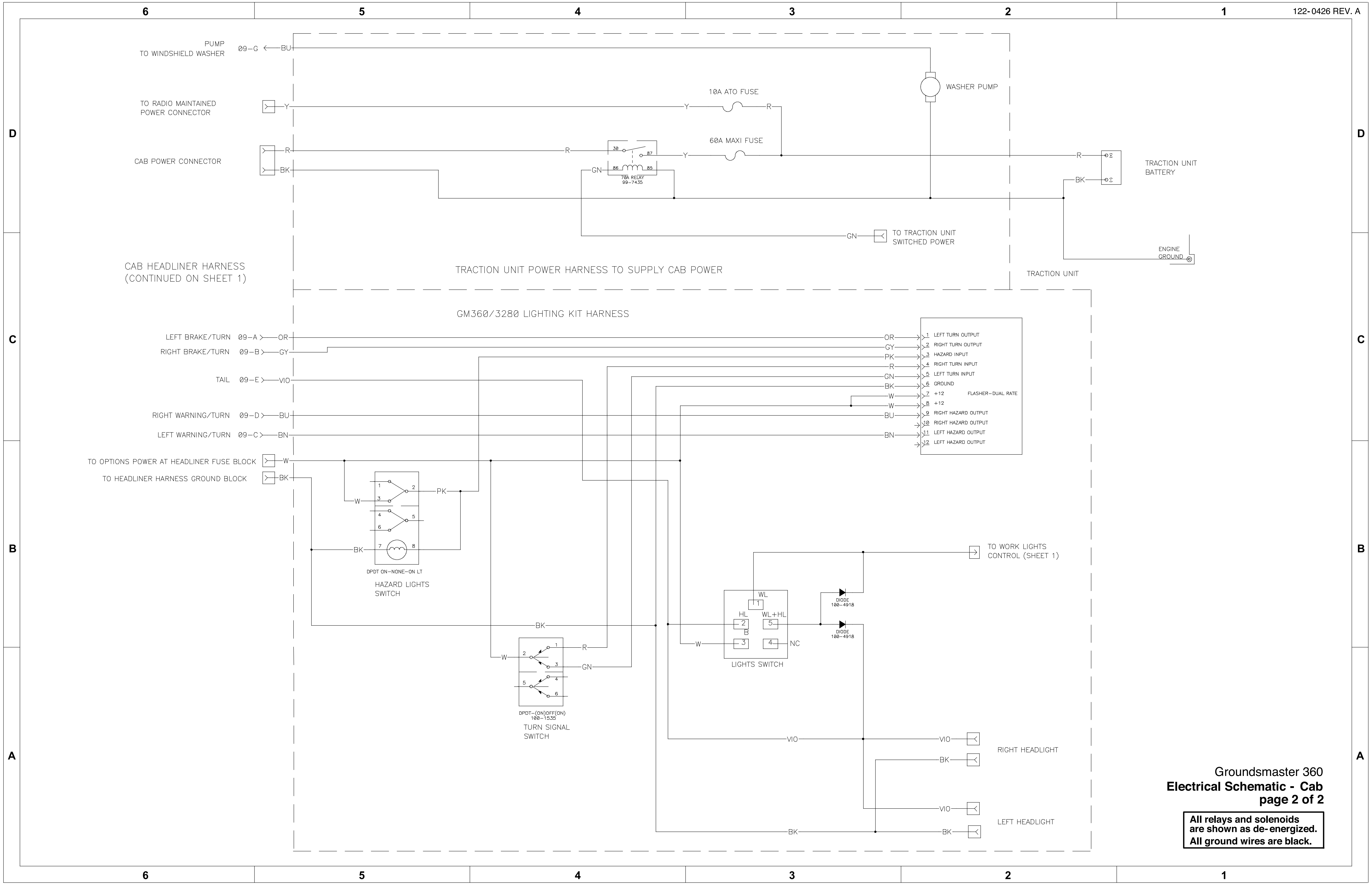
Electrical Schematic - Cab

page 1 of 2

All relays and solenoids are shown as de-energized. All ground wires are black.

g186160

Electrical Schematic - Cab (page 2 of 2)



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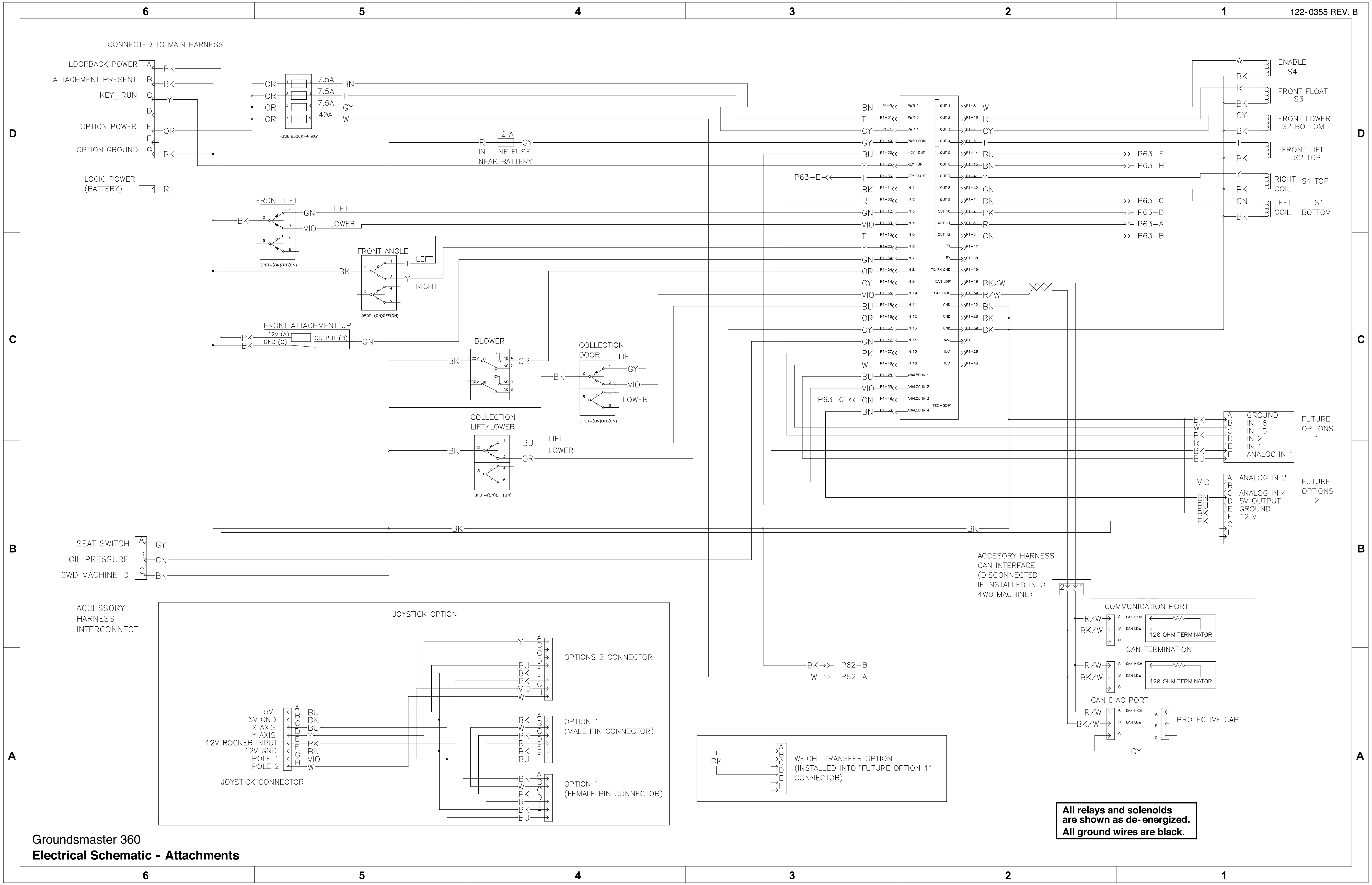
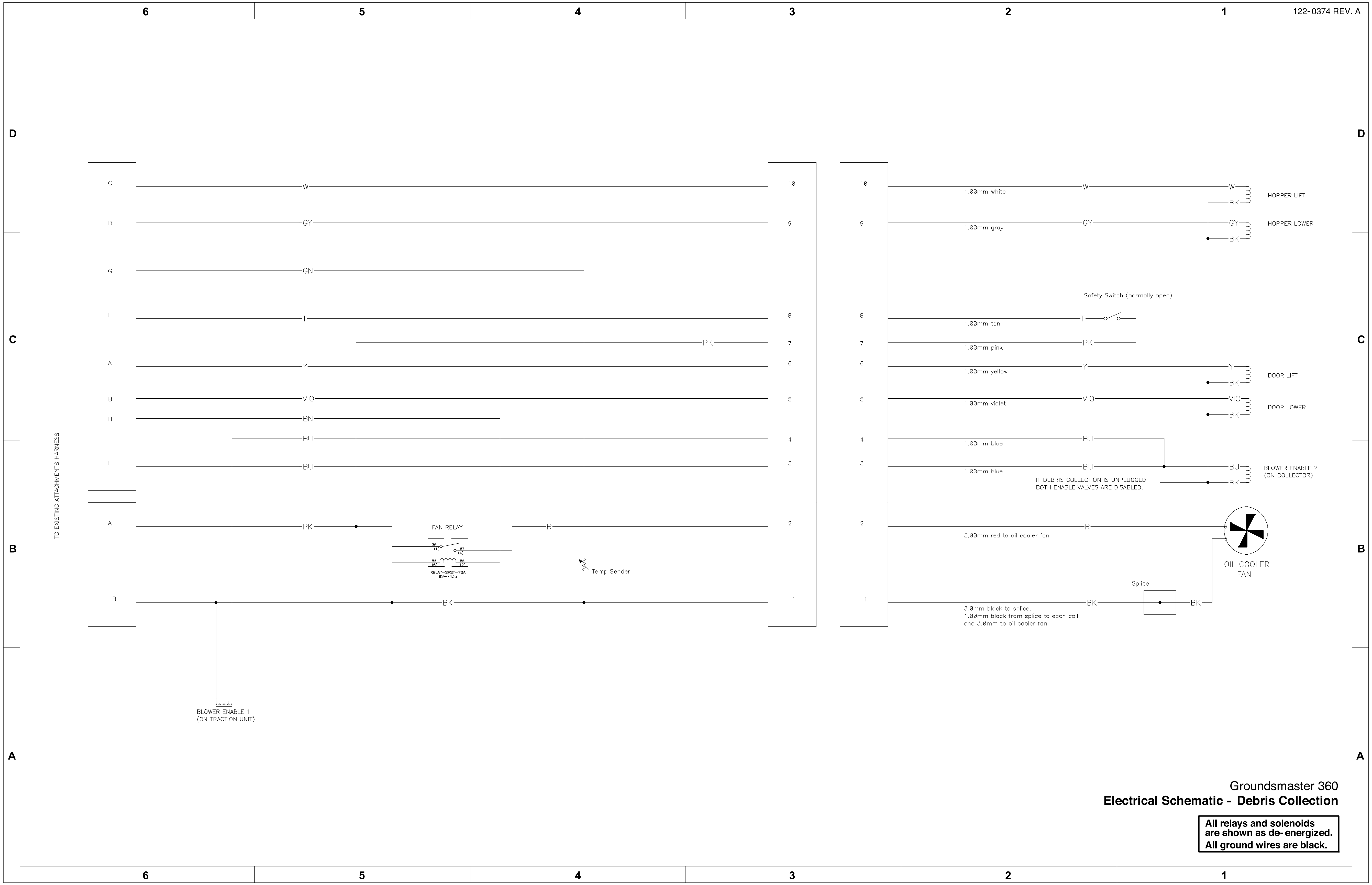
g186161



All relays and solenoids are shown as de-energized.
All ground wires are black.

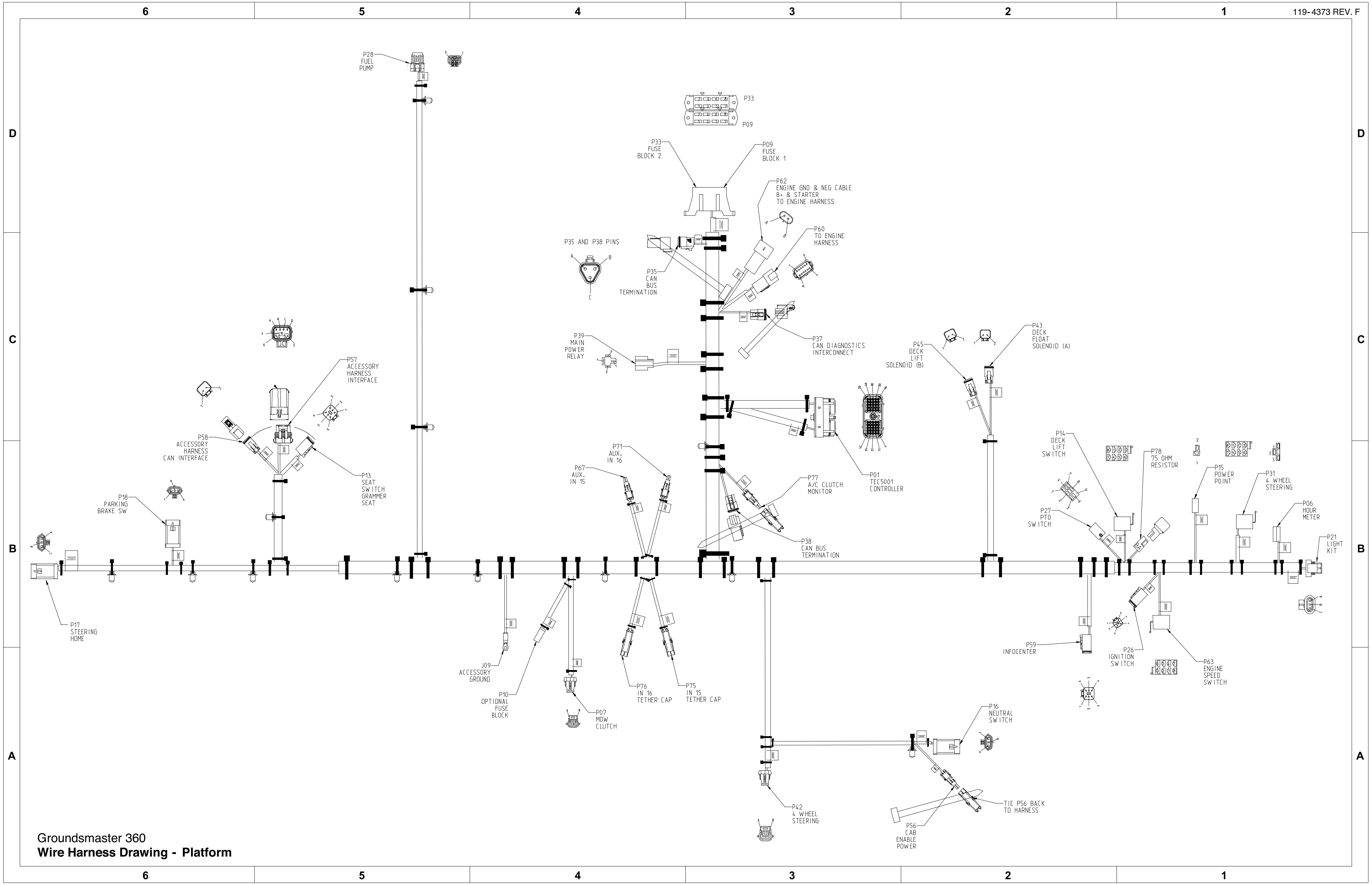
g187136

Electrical Schematic - Debris Collection



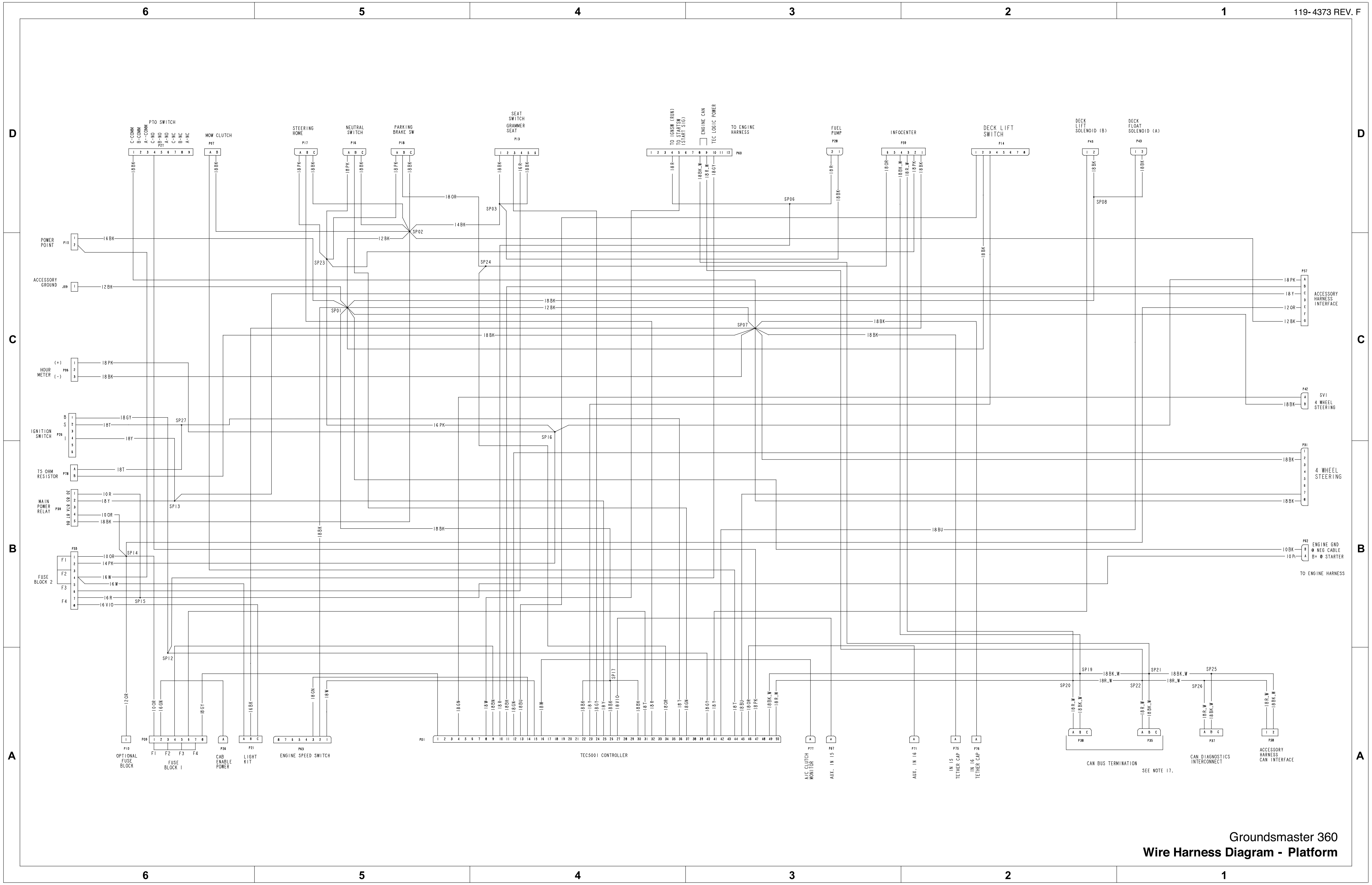
g187137

Wire Harness Drawing - Platform (Serial Numbers Below 403400000)



g186171

Wire Harness Diagram - Platform (Serial Numbers Below 403400000)

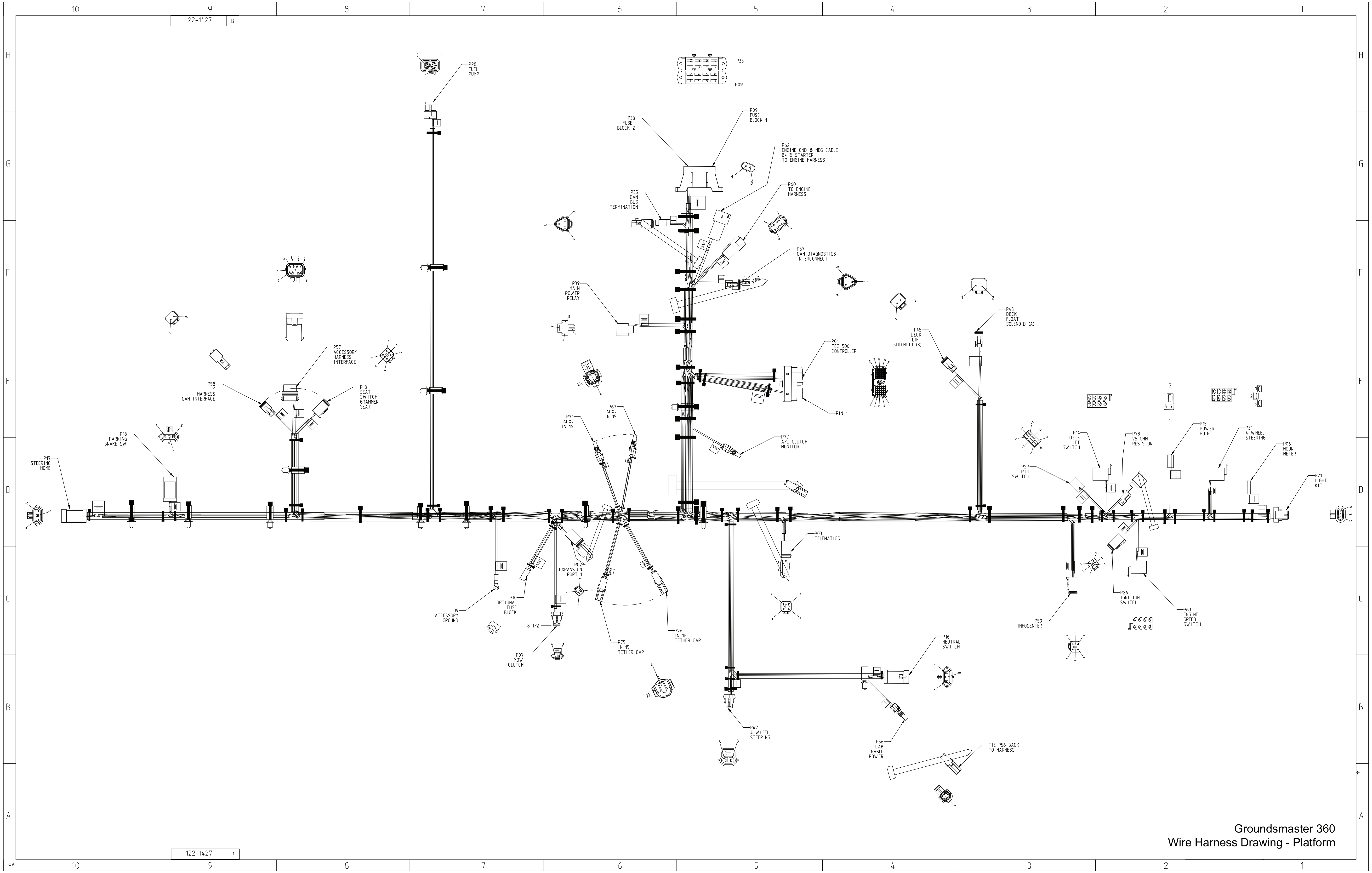


Groundsmaster 360

Wire Harness Diagram - Platform

g186167

Wire Harness Drawing - Platform (Serial Numbers Above 403400001)



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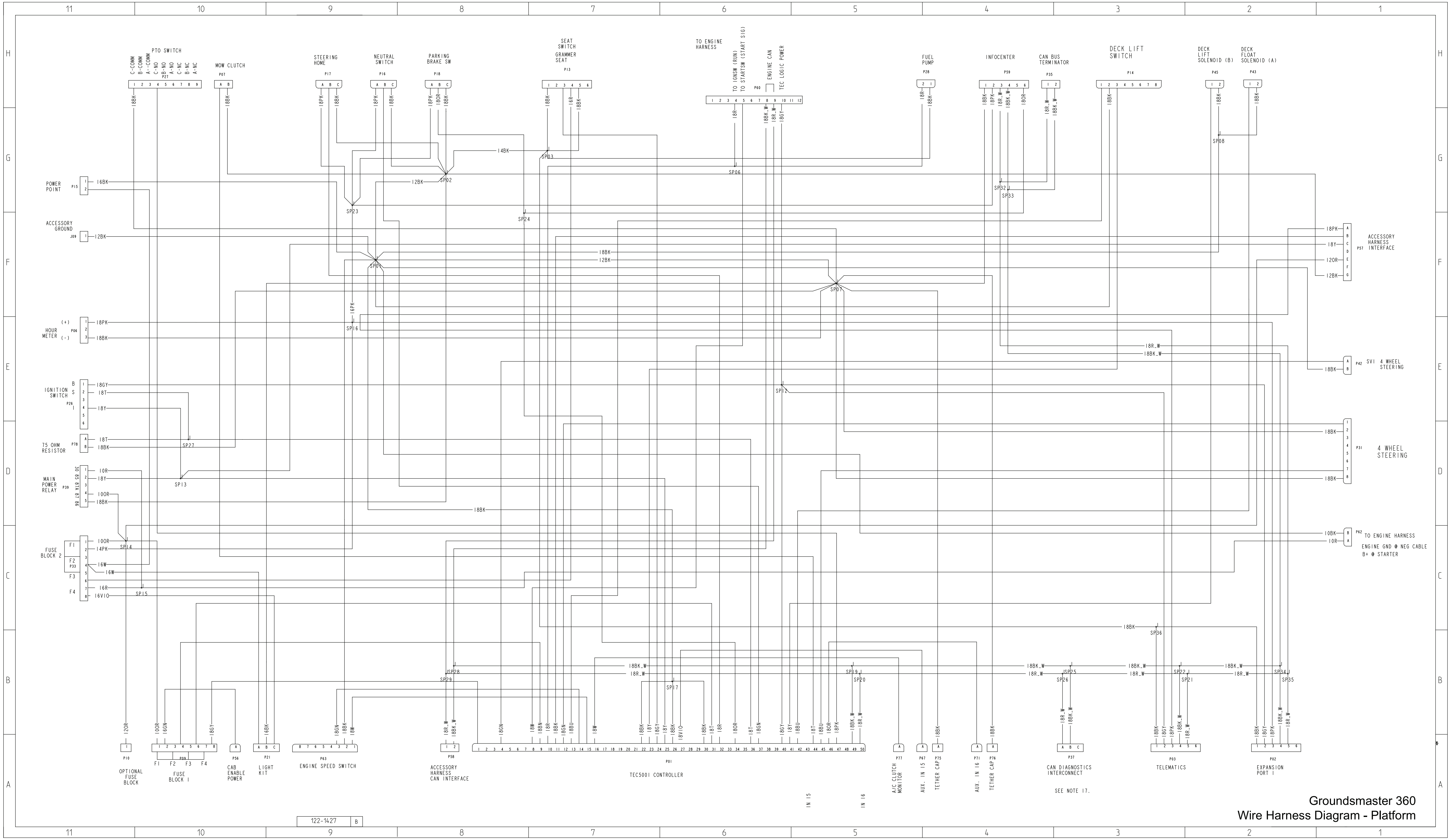
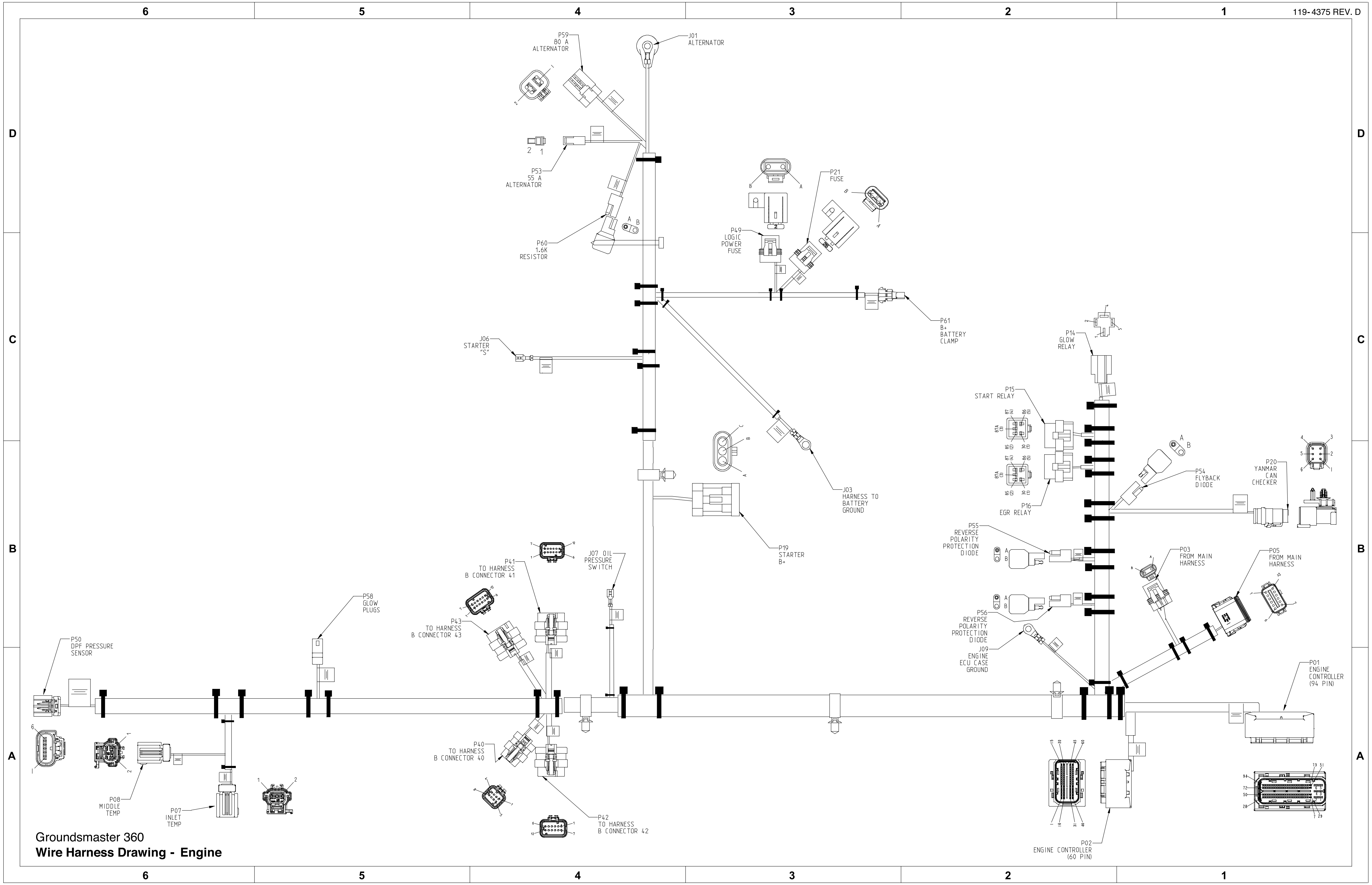
Wire Harness Diagram - Platform (Serial Numbers Above 403400001)



Groundsmaster 360
Wire Harness Diagram - Platform

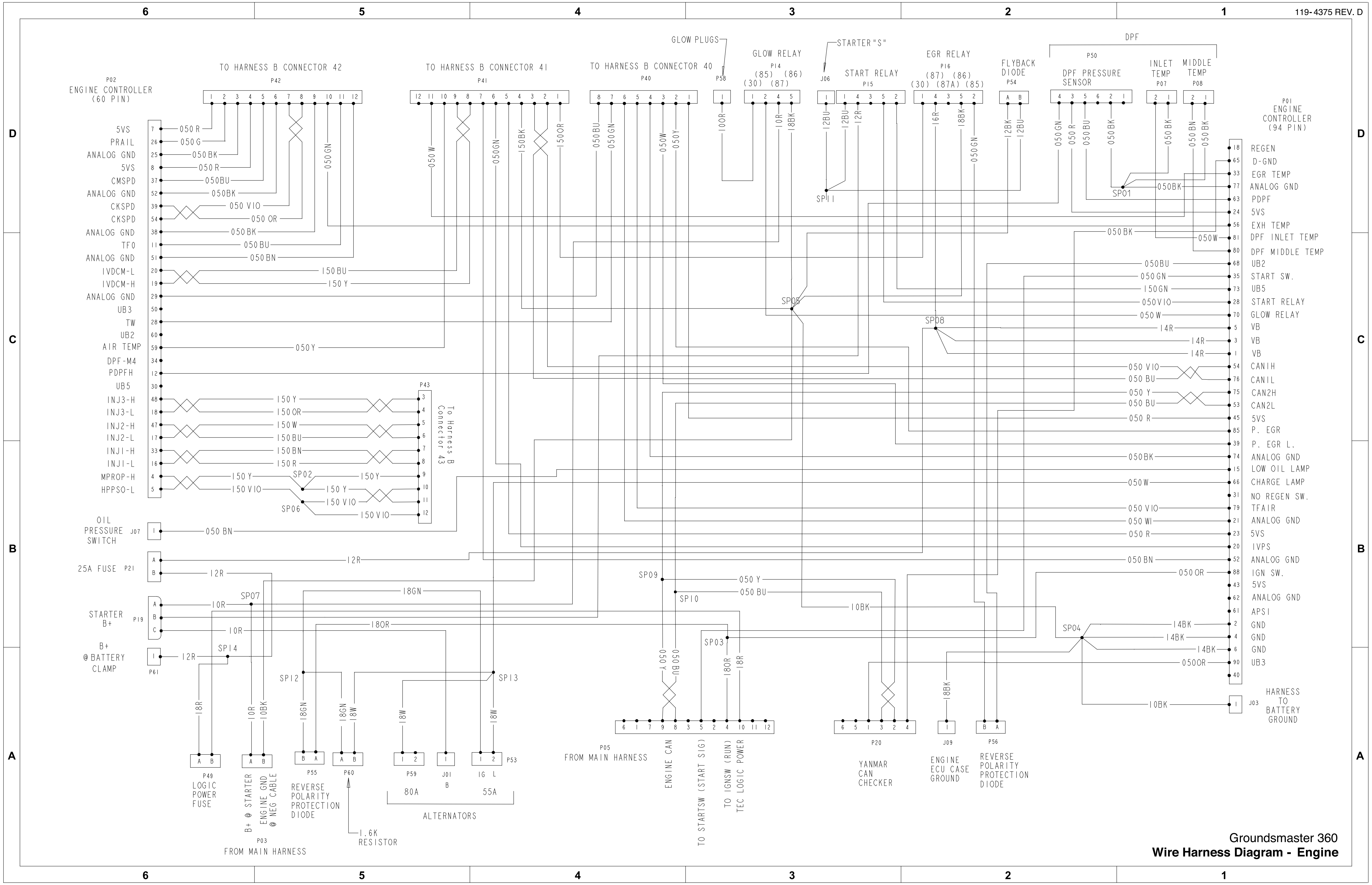
g330224

Wire Harness Drawing - Engine



g186170

Wire Harness Diagram - Engine



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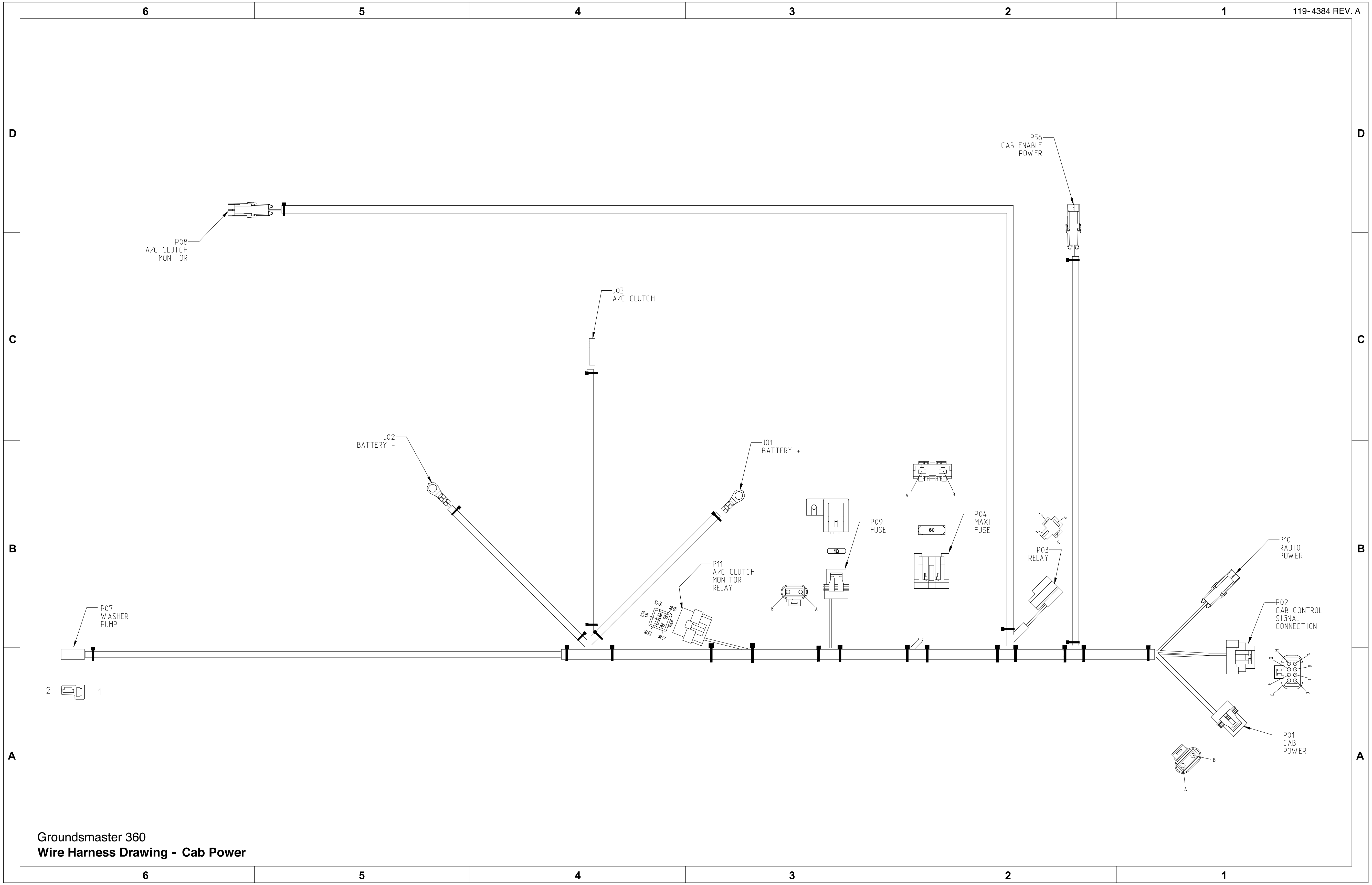
Wire Harness Drawing - Cab Power (Serial Numbers Below 403330000)

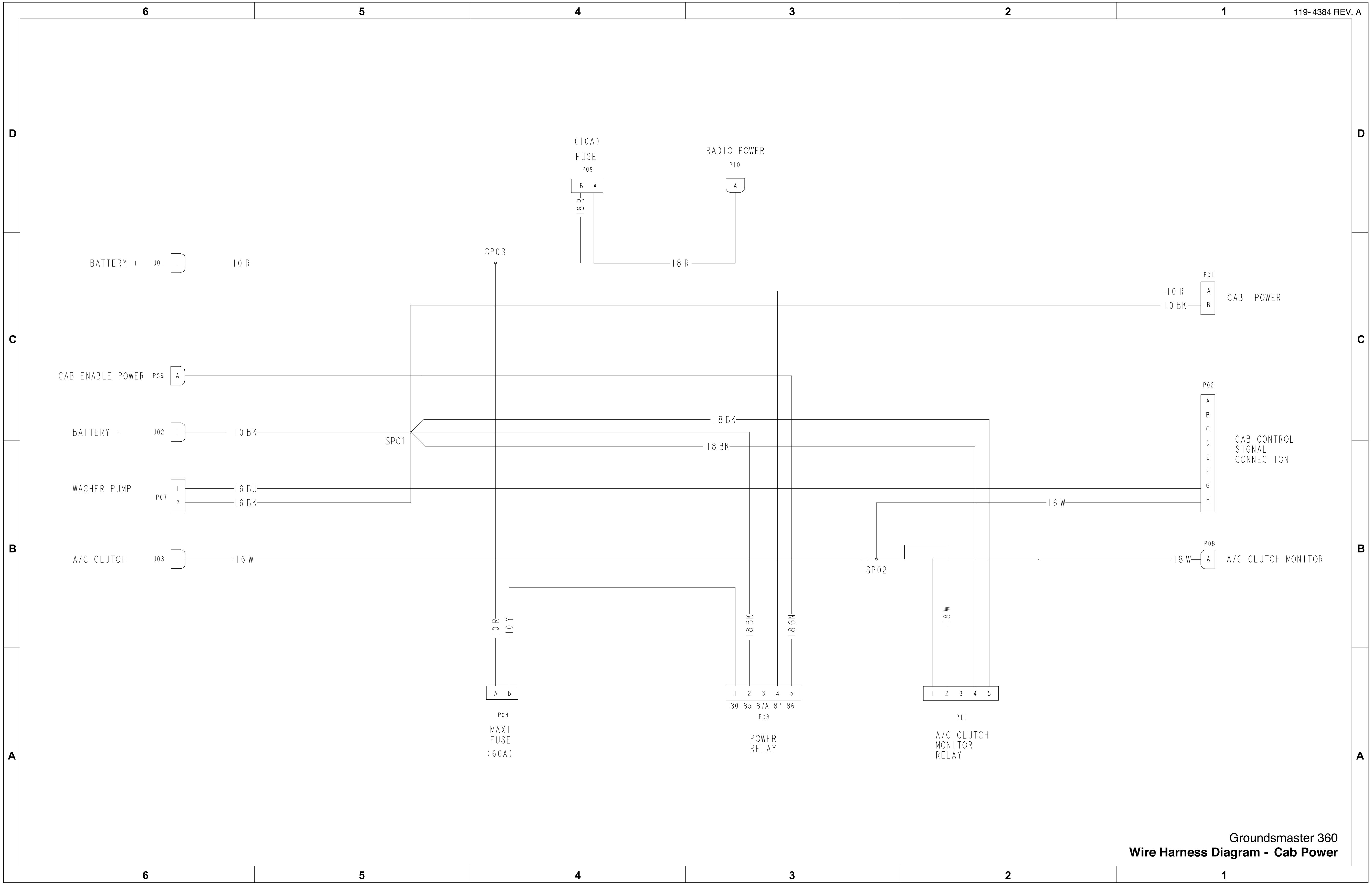


Groundsmaster 360

Wire Harness Drawing - Cab Power

g186169

Wire Harness Diagram - Cab Power (Serial Numbers Below 403330000)



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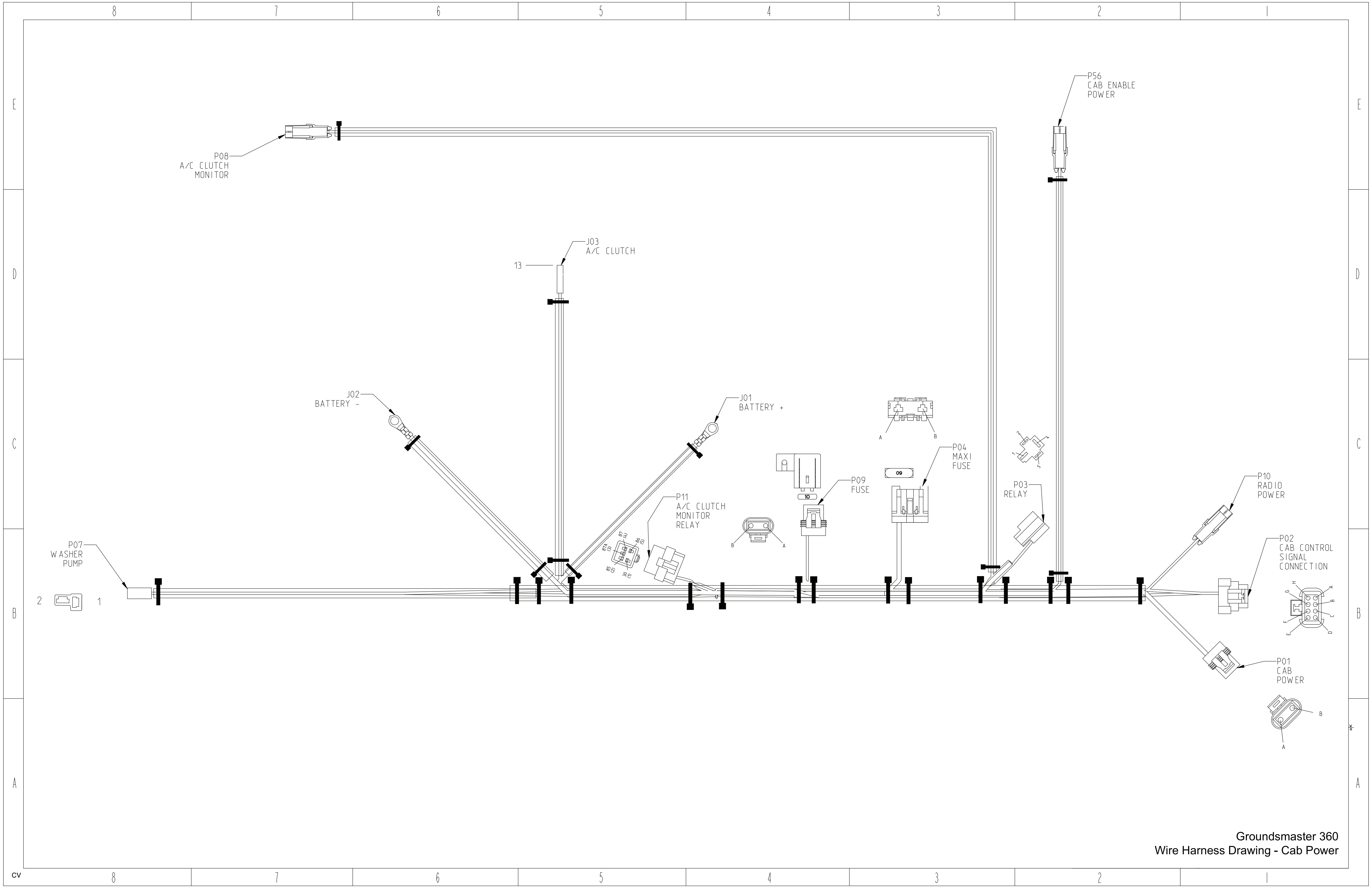
Wire Harness Drawing - Cab Power (Serial Numbers Above 403330001)



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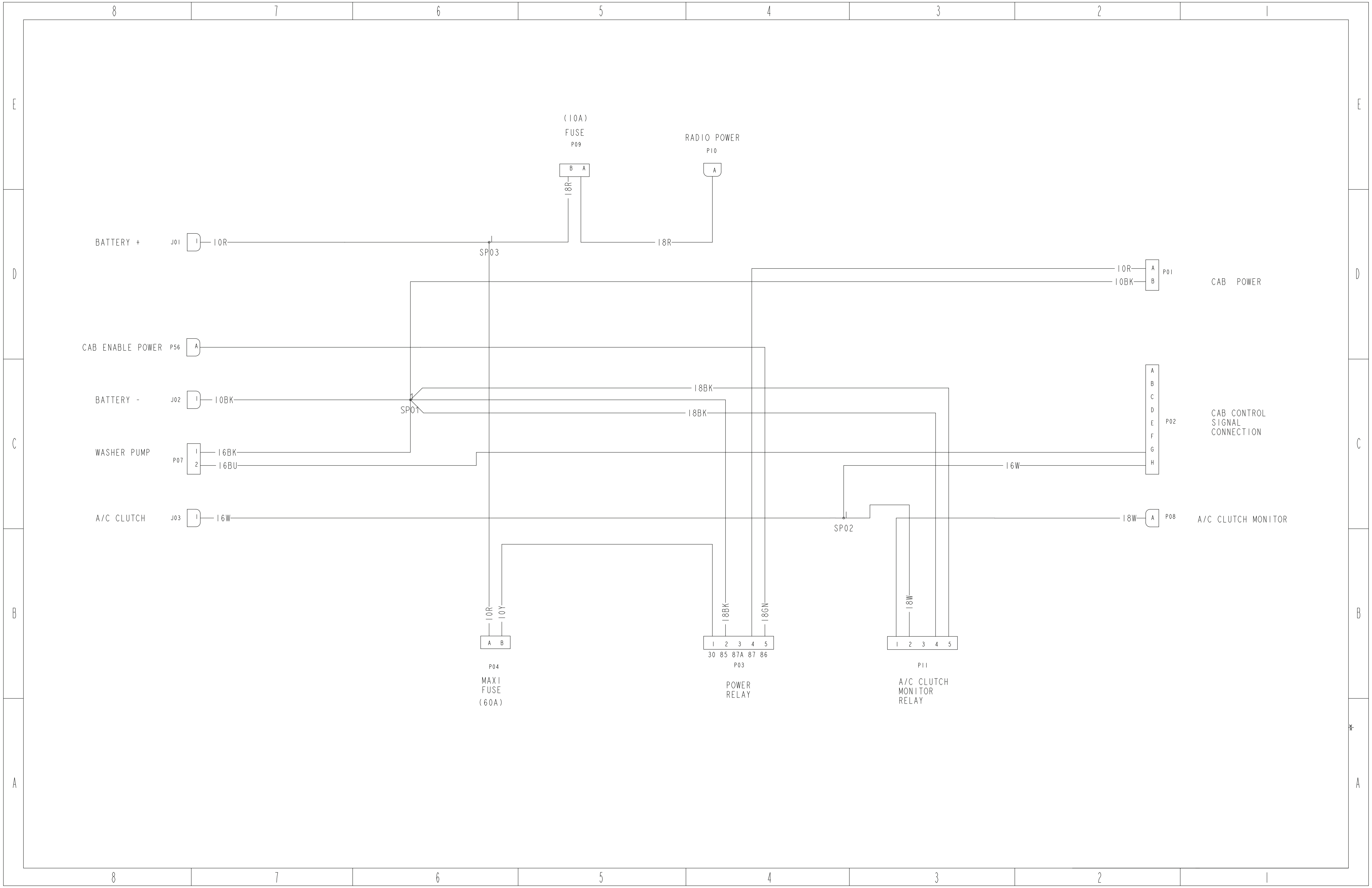
Wire Harness Diagram - Cab Power (Serial Numbers Above 403330001)



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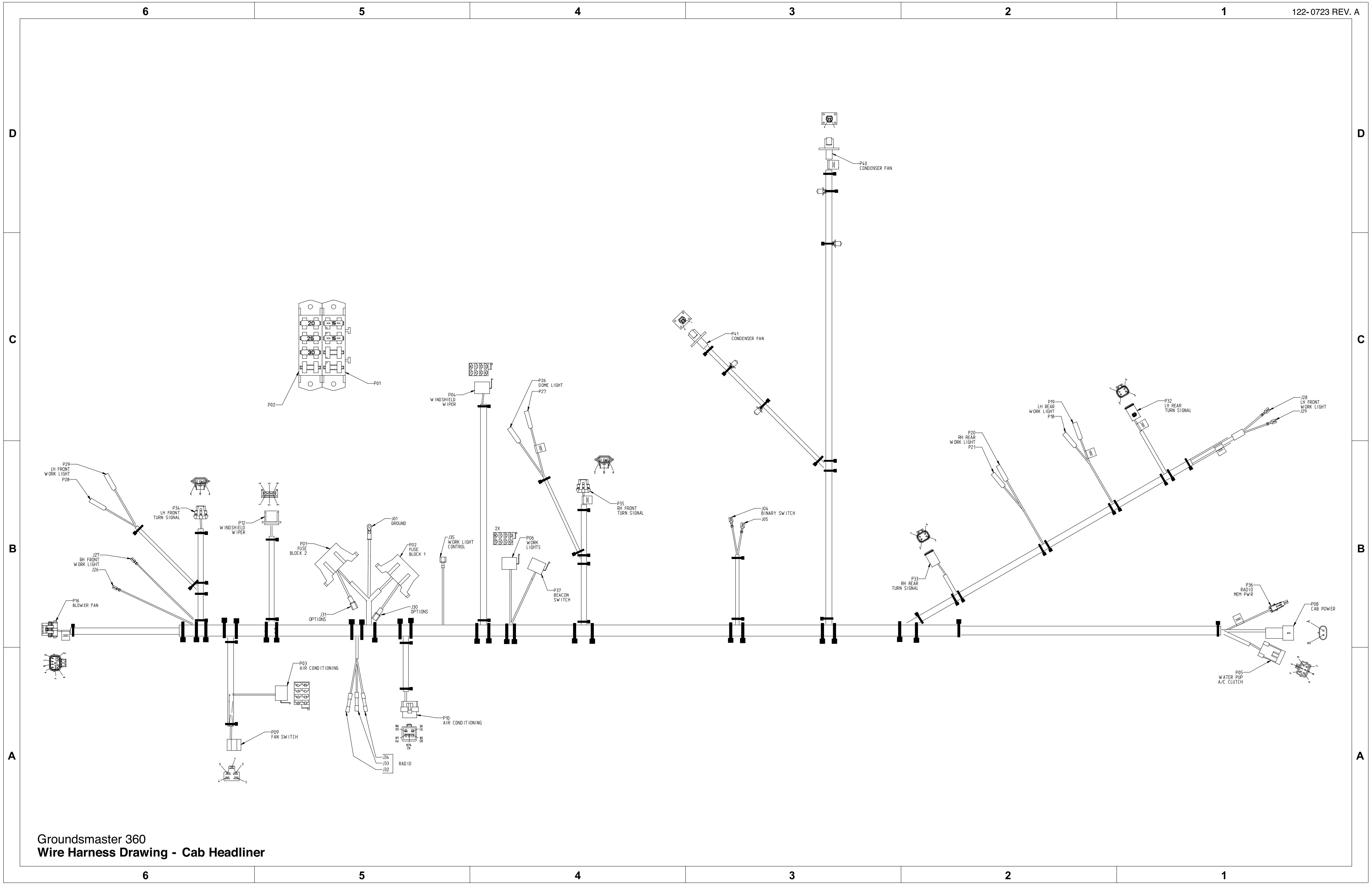
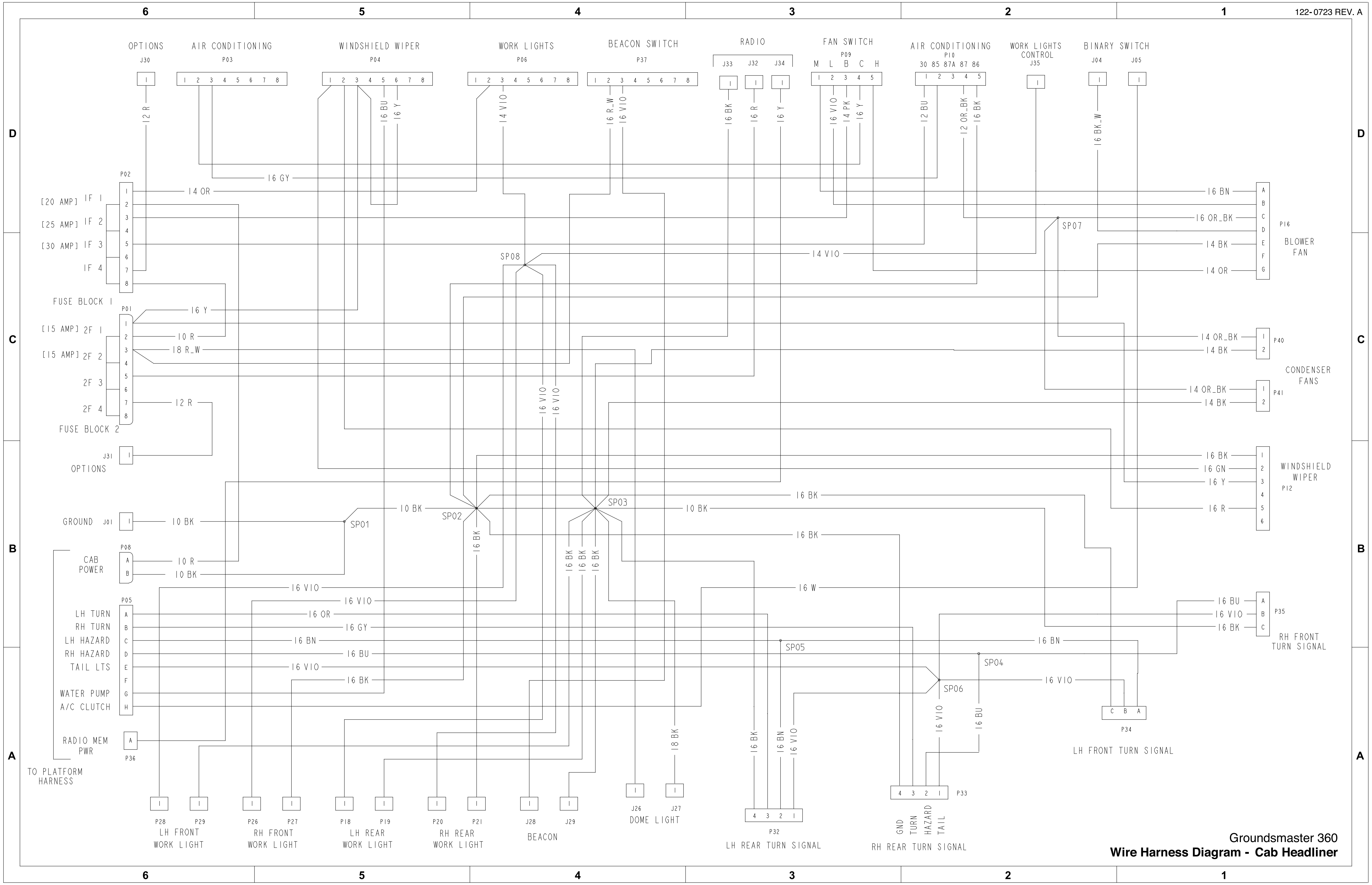


Groundsmaster 360

Wire Harness Drawing - Cab Headliner

g186168

Wire Harness Diagram - Cab Headliner



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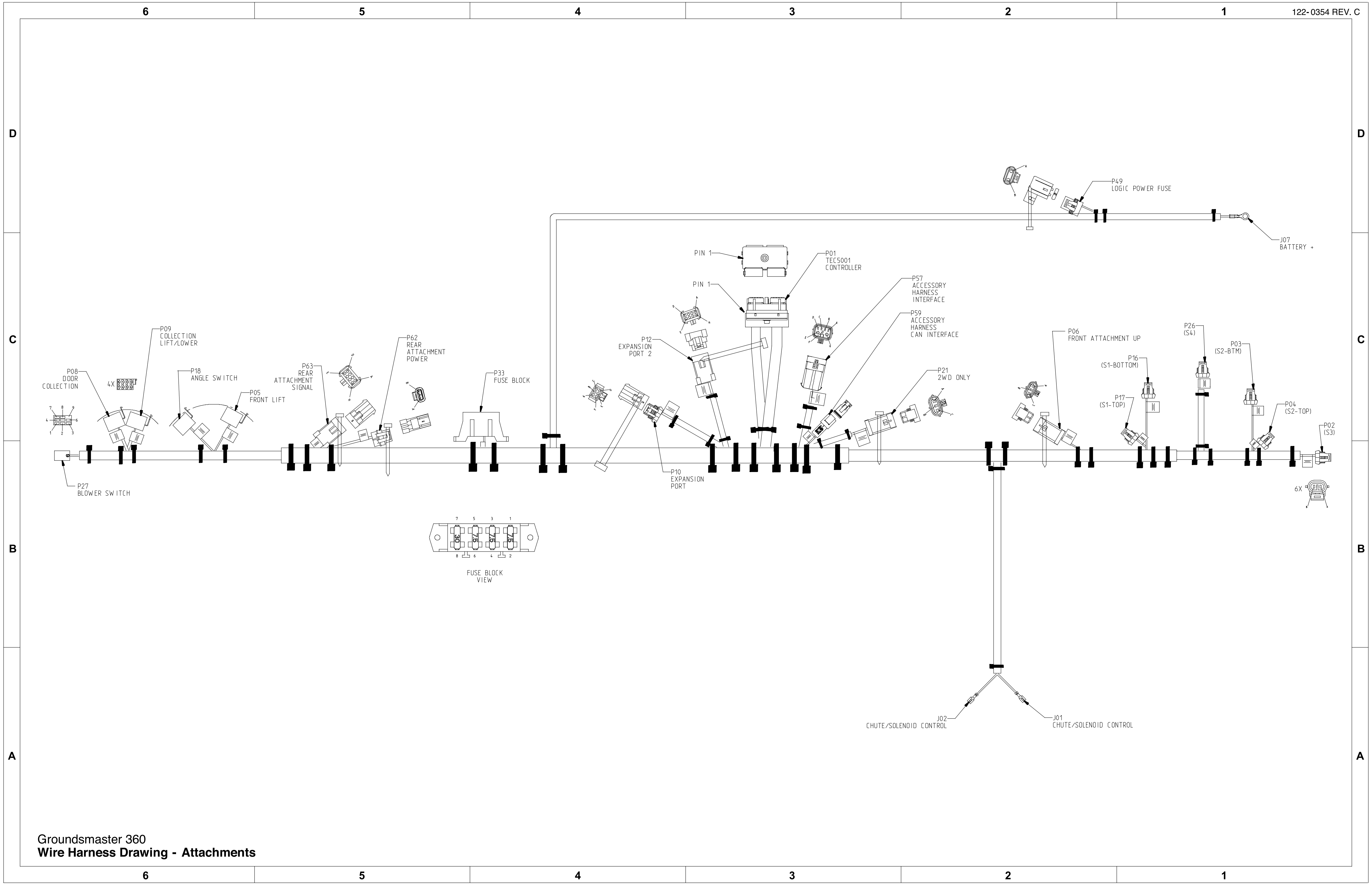
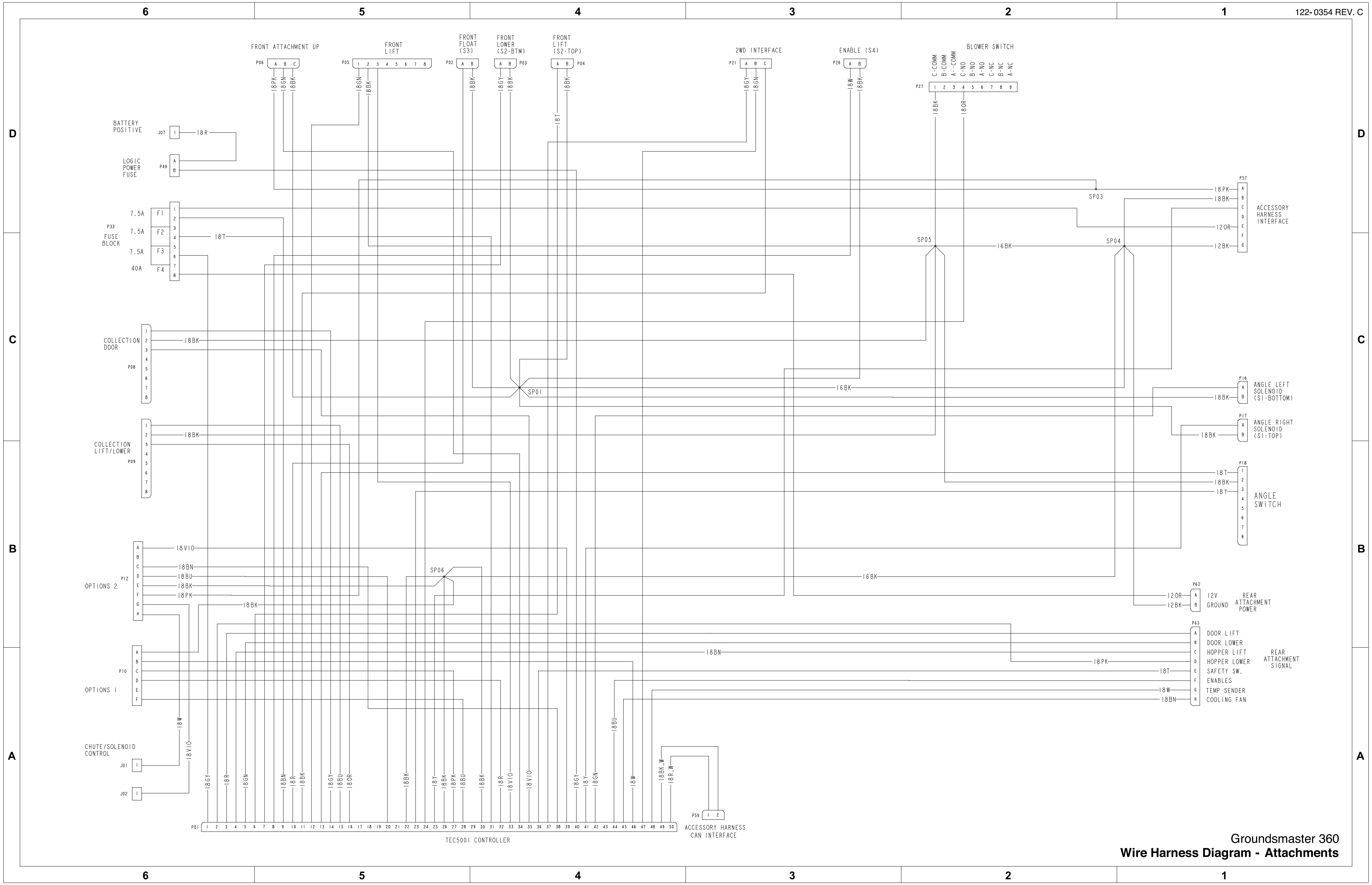


Groundsmaster 360

Wire Harness Drawing - Attachments

g187157

Wire Harness Diagram - Attachments



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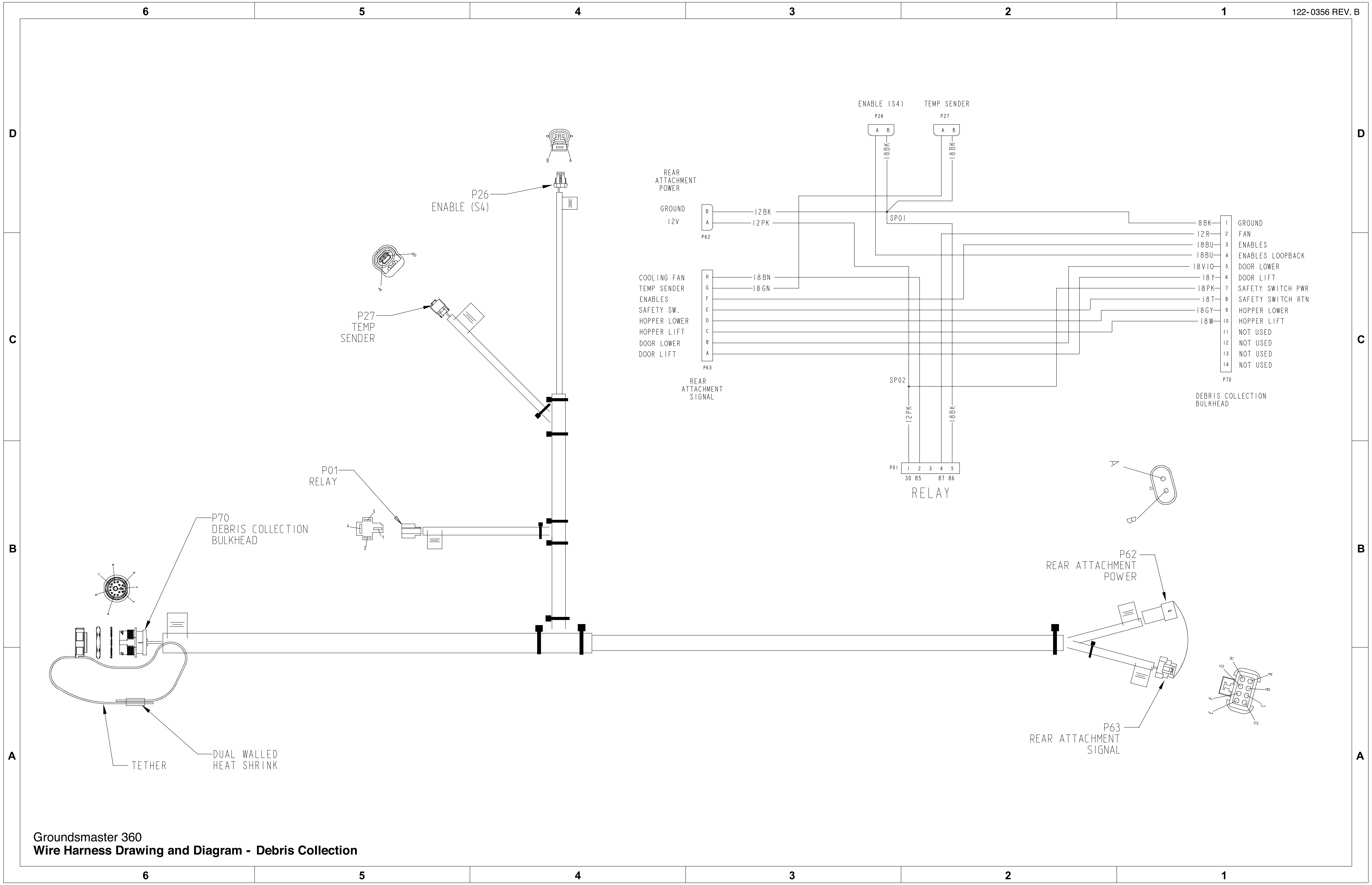
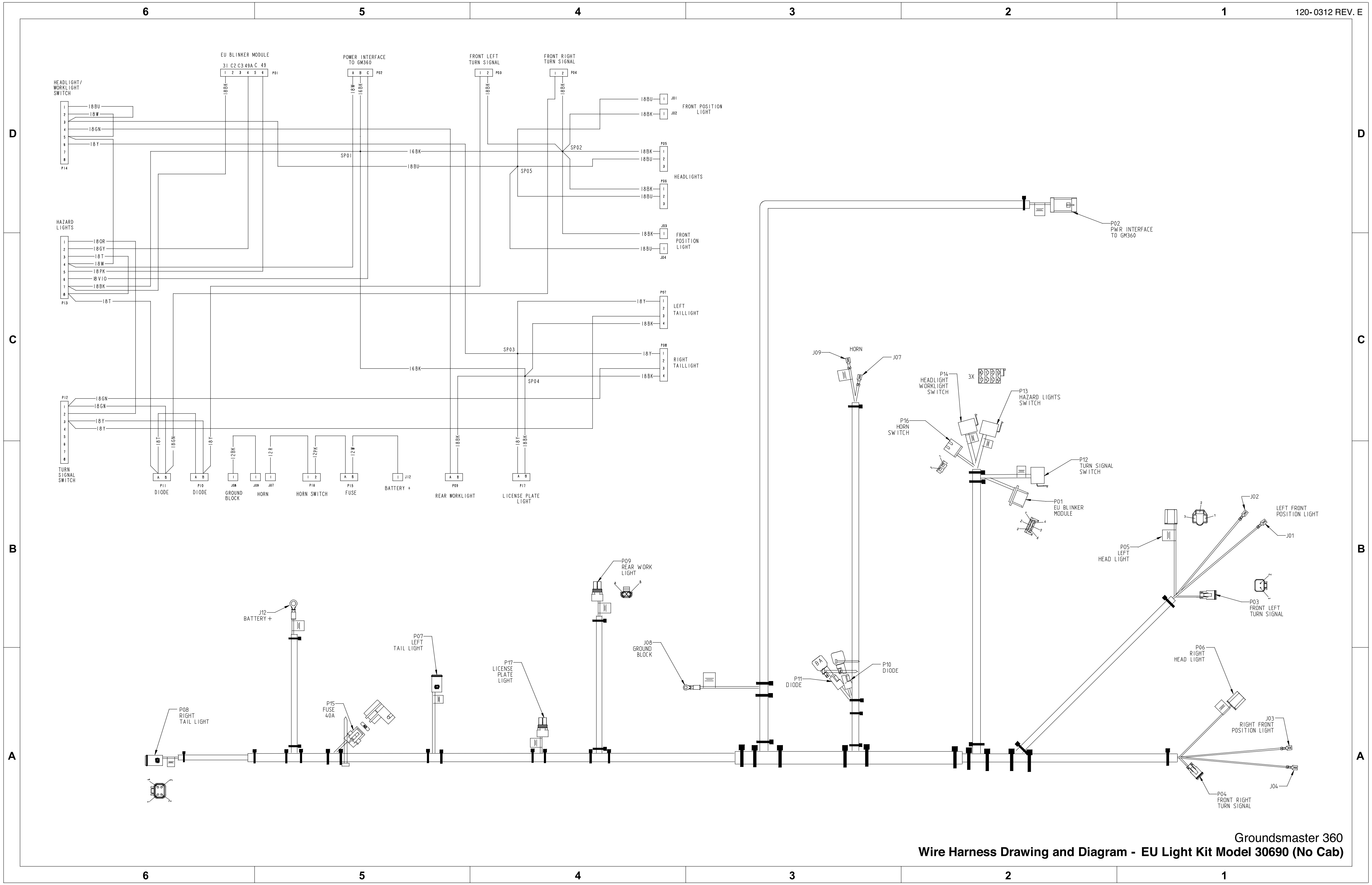


Groundsmaster 360

Wire Harness Drawing and Diagram - Debris Collection

g187158

Wire Harness Drawing and Diagram - EU Light Kit Model 30690 (No Cab)



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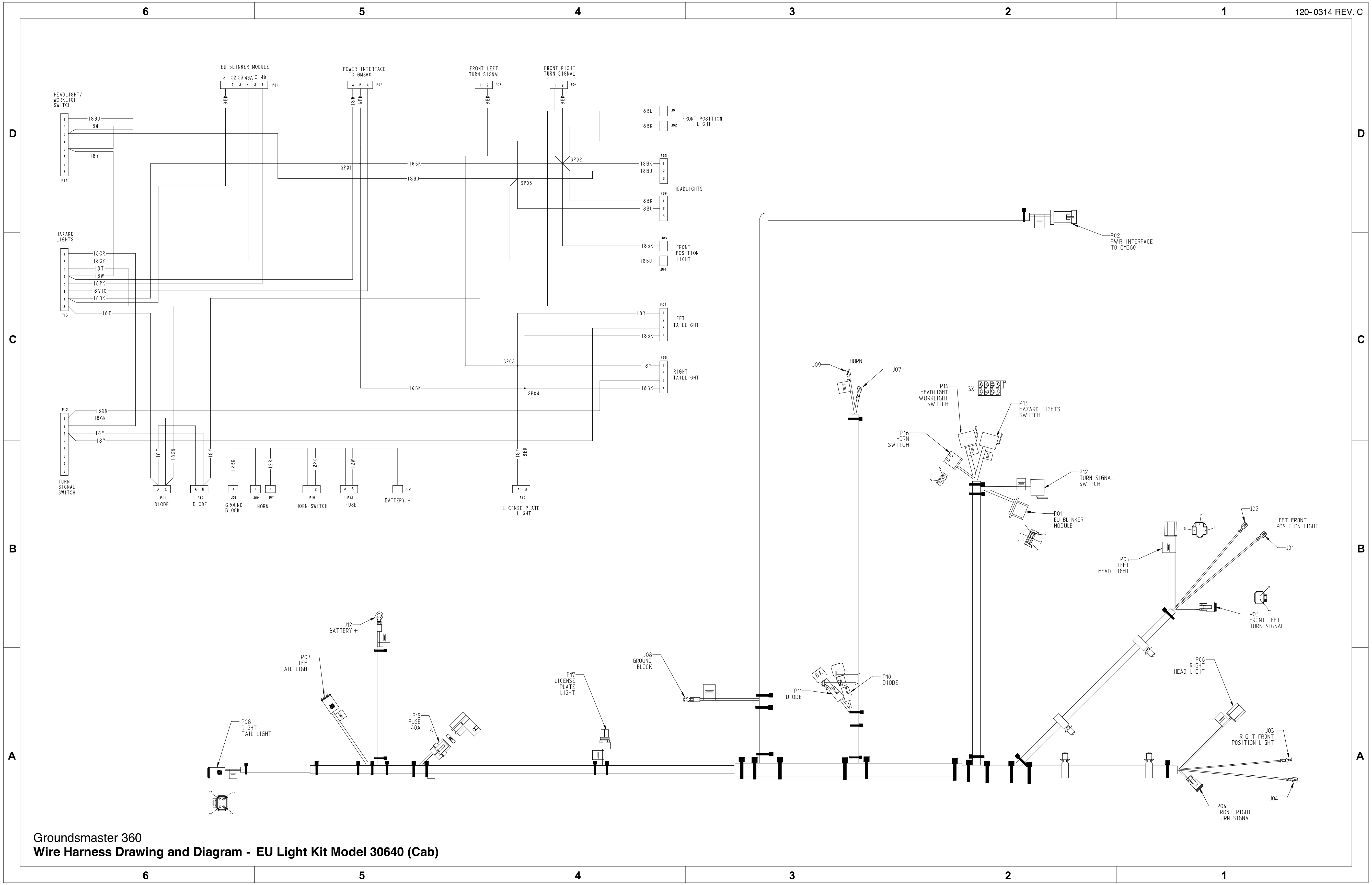
Wire Harness Drawing and Diagram - EU Light Kit Model 30640 (Cab)

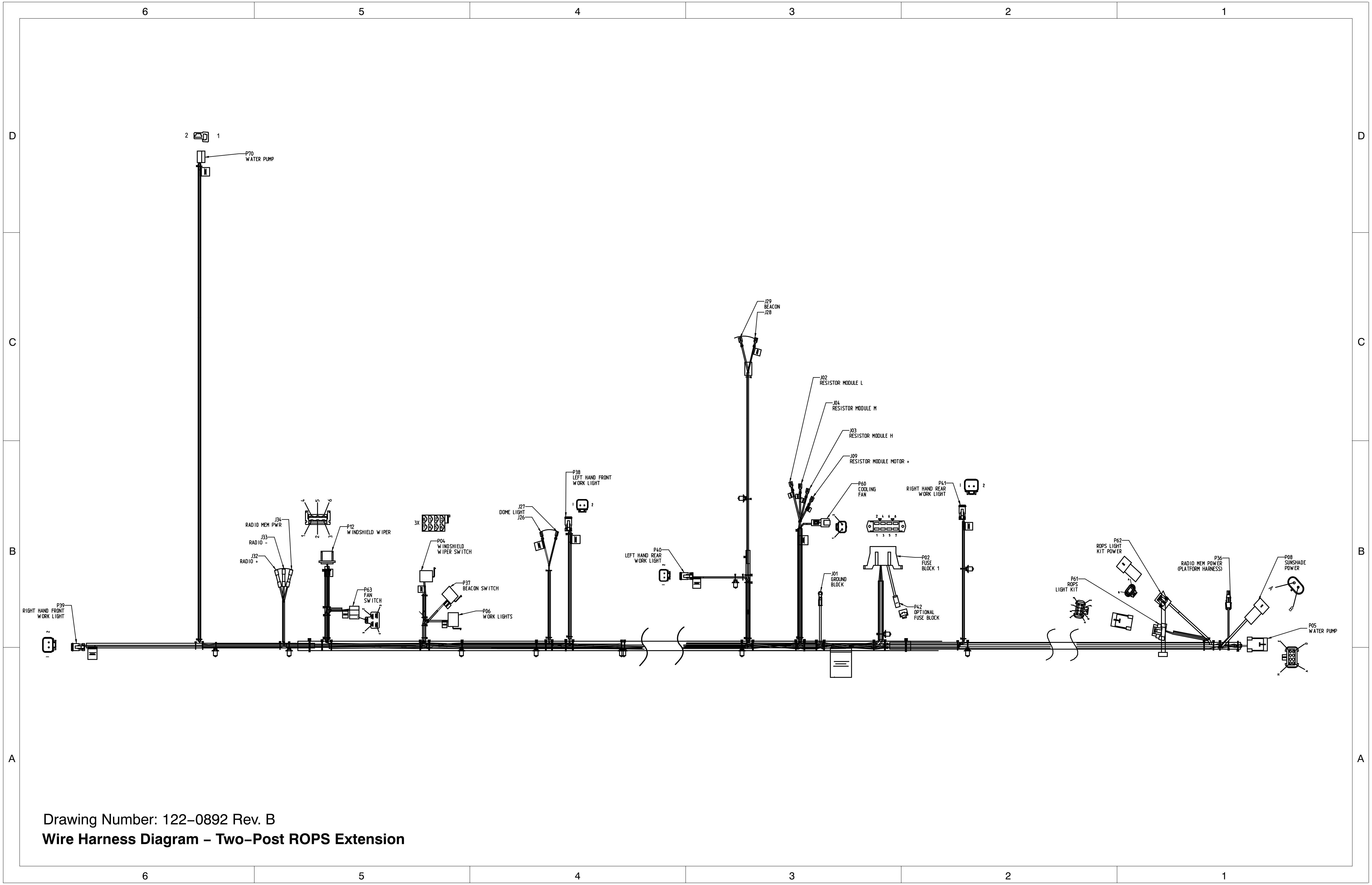


Groundsmaster 360

Wire Harness Drawing and Diagram - EU Light Kit Model 30640 (Cab)

g187138

Wire Harness Diagram − Two−Post ROPS Extension (sheet 1 of 2)



Drawing Number: 122−0892 Rev. B

Wire Harness Diagram – Two−Post ROPS Extension

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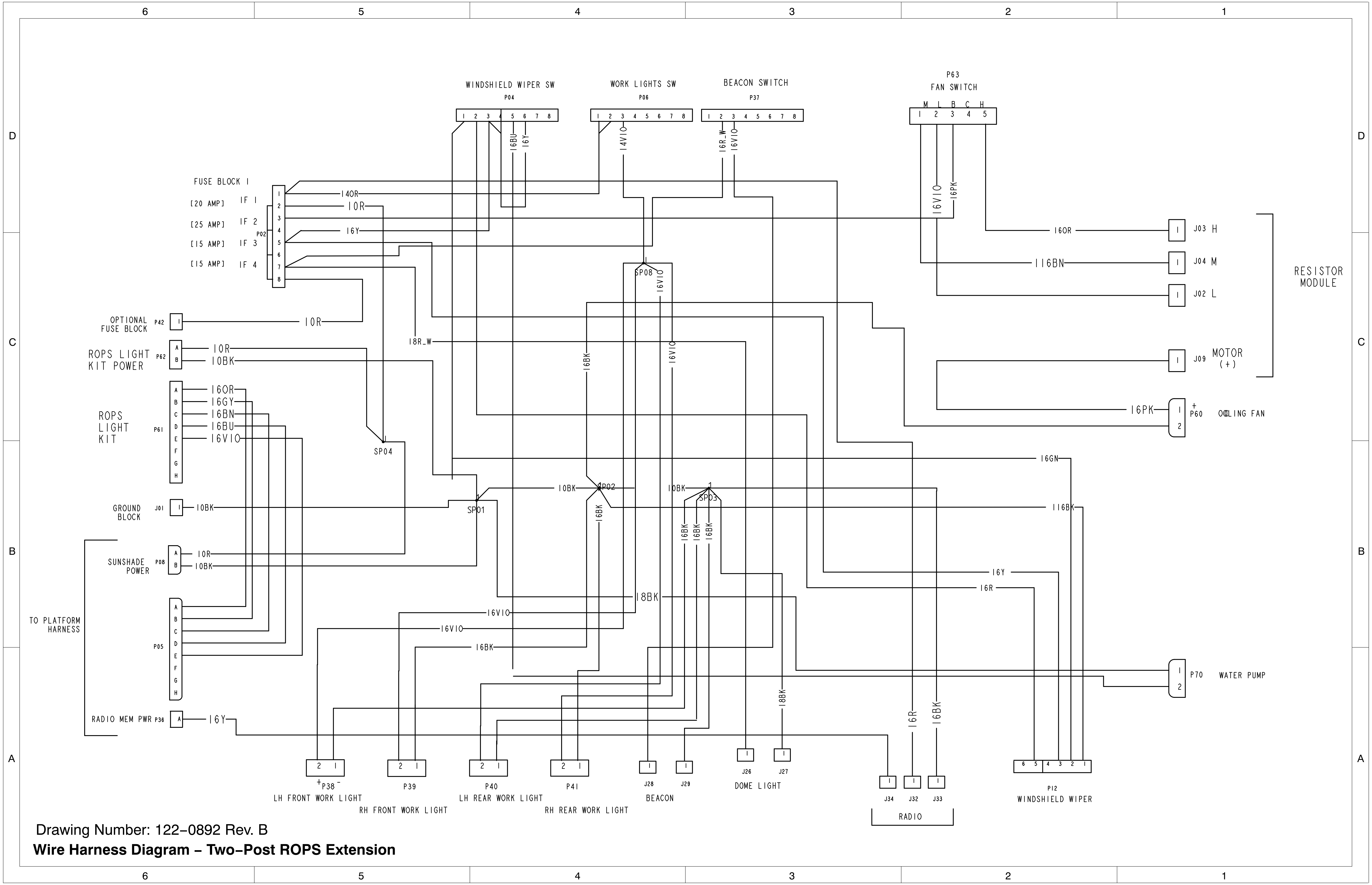
Wire Harness Diagram – Two–Post ROPS Extension (sheet 2 of 2)



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Wire Harness Diagram – Two–Post ROPS Extension

g250224

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