



Count on it.

Service Manual

Groundsmaster® 3280-D/3320

**(Models 30307, 30308, 30309, 30343, 30344,
and 30345)**

Reader Comments

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

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NOTES:

Preface

The purpose of this publication is to provide the service technician with the information for troubleshooting, testing, and repair of the major systems and components on the Groundsmaster 3280-D and Groundsmaster 3320.

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.



g221829

Figure 1

Service Procedure Icons

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



Critical Process

This icon is used to highlight:

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



Critical Torque

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



Fluid Specifications

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

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

Table of Contents

Preface	5
Chapter 1: Safety	1-1
Safety Instructions	1-2
Jacking Instructions	1-6
Safety and Instructional Decals	1-6
Chapter 2: Specifications and Maintenance	2-1
Specifications	2-2
Torque Specifications	2-5
Shop Supplies	2-11
Special Tools	2-13
Chapter 3: Gasoline Engine	3-1
Specifications	3-2
General Information	3-4
Adjustments	3-6
Service and Repairs	3-9
Chapter 4: Diesel Engine.....	4-1
Specifications	4-2
General Information	4-4
Adjustments	4-6
Service and Repairs	4-7
Chapter 5: Hydraulic System.....	5-1
Specifications	5-3
General Information	5-4
Hydraulic Schematics	5-15
Hydraulic Flow Diagrams	5-19
Special Tools.....	5-39
Troubleshooting.....	5-44
Testing the Hydraulic System.....	5-47
Adjustments	5-75
Service and Repairs	5-77
Chapter 6: Electrical System	6-1
General Information	6-2
Special Tools.....	6-6
Troubleshooting.....	6-8
Electrical System Quick Checks.....	6-14
Adjustments.....	6-16
Testing the Electrical Components	6-19
Service and Repairs	6-75
Chapter 7: Chassis.....	7-1
Specifications	7-2
General Information	7-3
Service and Repairs	7-4
Chapter 8: Drive Axles.....	8-1
Specifications	8-2
General Information	8-3
Special Tools.....	8-5
Service and Repairs	8-6
Chapter 9: PTO System	9-1
General Information	9-2
Service and Repairs	9-3
Chapter 10: Cutting Units	10-1
General Information	10-2
Troubleshooting.....	10-3
Adjustments	10-4
Service and Repairs	10-5
Chapter 11: Operator Cab	11-1

General Information	11-2
Service and Repairs	11-3
Appendix A	A-1
Hydraulic Schematic-3280-D (Serial Numbers below 270000400) and 3320 (Serial Numbers below 280000000)	A-5
Hydraulic Schematic-3280-D (Serial Numbers 270000400 to 311000000) and 3320 (Serial Numbers 280000000 to 311000000)	A-6
Hydraulic Schematic-3280-D (Serial Numbers 311000001 through 316000000)	A-7
Hydraulic Schematic-3280-D (Machine Serial Numbers after 316000000)	A-8
Electrical Schematic-3320	A-9
Electrical Schematic (Machine Serial Number before 311000000)	A-10
Electrical Schematic (Machine Serial Number 311000000 and Up)	A-11
Electrical Schematic-Operator Cab	A-12
Electrical Schematic-Operator Cab	A-13
Wire Harness Drawing-Main-3320 (Serial Numbers below 260000000)	A-14
Wire Harness Diagram-Main-3320 (Serial Numbers below 260000000)	A-15
Wire Harness Drawing-Main-3320 (Serial Numbers above 260000000)	A-16
Wire Harness Diagram-Main-3320 (Serial Numbers above 260000000)	A-17
Wire Harness Drawing-Main-3280-D (Serial Numbers below 260000000)	A-18
Wire Harness Diagram-Main-3280-D (Serial Numbers below 260000000)	A-19
Wire Harness Drawing-Main-3280-D (Machine Serial Number 260000000 to 270000600)	A-20
Wire Harness Diagram-Main-3280-D (Machine Serial Number 260000000 to 270000600)	A-21
Wire Harness Drawing-Main-3280-D (Machine Serial Number 270000601 to 311000000)	A-22
Wire Harness Diagram-Main-3280-D (Machine Serial Number 270000601 to 311000000)	A-23
Wire Harness Drawing-Main-3280-D (Machine Serial Number 311000000 to 316000000)	A-24
Wire Harness Diagram-Main-3280-D (Machine Serial Number 311000000 to 316000000)	A-25
Wire Harness Drawing-Main-3280-D (Machine Serial Number 316000000 to 400000000)	A-26
Wire Harness Diagram-Main-3280-D (Machine Serial Number 316000000 to 400000000)	A-27
Wire Harness Drawing-Main-3280-D (Machine Serial Number 400000000 and Up)	A-28
Wire Harness Diagram-Main-3280-D (Machine Serial Number 400000000 and Up)	A-29
Wire Harness Drawing-Cab Model 30298 Power	A-30
Wire Harness Diagram-Cab Model 30298 Power	A-31
Wire Harness Drawing-Cab Model 30298 Headliner	A-32
Wire Harness Diagram-Cab Model 30298 Headliner	A-33
Wire Harness Drawing-Cab Model 30298 Front Mount Accessory Power Supply	A-34
Wire Harness Diagram-Cab Model 30298 Front Mount Accessory Power Supply	A-35

Wire Harness Drawing-Cab Model 30298 Heat/Air Conditioning Blower.....	A-36
Wire Harness Diagram-Cab Model 30298 Heat/Air Conditioning Blower.....	A-37
Wire Harness Drawing-Light Kit Model 30405 (Machines without Cab).....	A-38
Wire Harness Diagram-Light Kit Model 30405 (Machines without Cab).....	A-39
Wire Harness Drawing-North American Light Kit Model 30701 (Machines Serial Number 315000000 and Up).....	A-40
Wire Harness Diagram-North American Light Kit Model 30701 (Machines Serial Number 315000000 and Up).....	A-41

Additional Reference Materials

BRIGGS AND STRATTON/DAIHATSU REPAIR MANUAL FOR 3-CYLINDER, LIQUID-COOLED, GASOLINE ENGINES

KUBOTA 05-E2B SERIES WORKSHOP MANUAL

KUBOTA 05-E3B SERIES WORKSHOP MANUAL

KUBOTA 05-E4B SERIES WORKSHOP MANUAL

DANFOSS DDC20 AXIAL PISTON PUMP SERVICE MANUAL

DANFOSS SERIES 15 AXIAL PISTON PUMPS, MOTORS AND TRANSMISSIONS REPAIR MANUAL

DANFOSS SERIES 15 AXIAL PISTON PUMPS, MOTORS AND TRANSMISSIONS SERVICE MANUAL

EATON MODEL 74111 AND 74118 FIXED AXIAL PISTON MOTOR REPAIR INFORMATION

DANFOSS STEERING UNIT TYPE OSPM SERVICE MANUAL



Table of Contents

Safety Instructions	1-2
Supervisor's Responsibilities	1-2
Before Operating the Machine	1-2
While Operating the Machine	1-3
Maintenance and Service.....	1-4
Jacking Instructions	1-6
Raising the Front of the Machine.....	1-6
Raising the Rear of the Machine	1-6
Safety and Instructional Decals	1-6

Safety Instructions

The Groundsmaster 3280-D and 3320 machines meet or exceeds safety standard specifications when weights are installed according to information in the *Operator's Manual*. Although hazard control and accident prevention are partially dependent upon the design and configuration of the machine, these factors are also dependent upon the awareness, concern, and proper training of the personnel involved in the operation, transport, maintenance, and storage of the machine. Improper use or maintenance of the machine can result in injury or death.



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.

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, and the PTO switch is in the OFF (disengaged) position.
- 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.
 - After refueling the machine, install the fuel tank and fuel container caps.
 - If you spill fuel, do not attempt to start the engine but move the machine away from the spill. Avoid creating any source of ignition until fuel vapors have dissipated. Wipe up any spilled fuel.

While Operating the Machine

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

IMPORTANT

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

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

Before starting the machine



DANGER



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

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

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

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



CAUTION



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

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

Before stopping the machine

1. Ensure that the traction pedal is in the NEUTRAL position.
2. Lower and disengage the cutting deck (or implement) 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 (or implement), 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, shutting off the engine, and then using all of the hydraulic controls (pressing the traction pedal, turning the steering wheel, and pressing the lift switch to both raise and lower).
- Use care when checking or servicing the cutting deck. Wear gloves and use caution when servicing the deck.
- To reduce potential fire hazards, keep the engine area free of excessive grease, grass, leaves, and dirt. Clean the protective screen on the machine frequently.
- If you must run the engine to perform maintenance or to make an adjustment, keep your hands, feet, clothing, and other parts of the body away from the cutting deck and other moving parts. Keep bystanders away.
- Do not overspeed the engine by changing the engine governor setting. To ensure safety and accuracy, check the maximum engine speed with a 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.
- 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 \(page 1–6\)](#).
- If major repairs are necessary, contact your Authorized Toro Distributor.

Maintenance and Service (continued)

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

Jacking Instructions



CAUTION



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

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

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

Raising the Front of the Machine

1. Set the parking brake and block the 2 rear wheels with chocks to prevent the machine from moving.
2. Position the jack securely under the frame (not the axle), just to the inside of the front wheel.
3. Use a jack to raise the front of the machine.
4. Position jack stands or hardwood blocks under the frame as close to the wheel as possible to support the machine.

Raising the Rear of the Machine

1. Set the parking brake and block the 2 front wheels with chocks to prevent the machine from moving.
2. Position the jack securely under the frame (not the axle) directly in front of the rear axle.
3. Jack rear of the machine off the ground.
4. Position the jack stands or hardwood blocks under the frame to support 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.



Specifications and Maintenance

Table of Contents

Specifications	2-2
Decimal and Millimeter Equivalents	2-3
U.S. to Metric Conversions	2-4
Torque Specifications	2-5
Identifying the Fastener.....	2-5
Calculating the Torque Values When Using a Drive-Adapter Wrench	2-7
Standard Torque for Dry, Zinc Plated, and Steel Fasteners (Inch Series).....	2-8
Standard Torque for Dry, Zinc Plated, and Steel Fasteners (Metric Fasteners).....	2-9
Other Torque Specifications	2-10
Conversion Factors	2-10
Shop Supplies	2-11
Special Tools	2-13

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 Groundsmaster 3280-D and Groundsmaster 3320 are covered in the *Operator's Manuals*. Refer to this publication when performing the regular equipment maintenance. Several maintenance procedures have break-in intervals identified in the *Operator's Manual*. Refer to the *Engine Operator's Manual* for additional engine specific maintenance procedures.

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

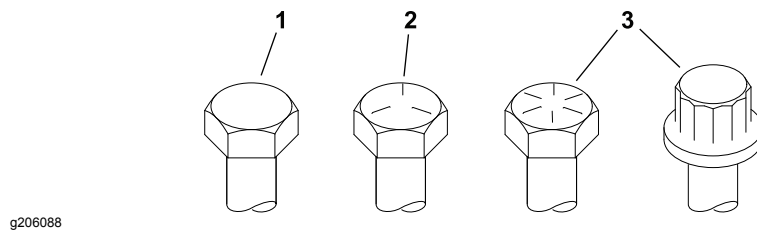
The recommended fastener torque values are listed in the following tables. For critical applications, as determined by Toro, either the recommended torque or a torque that is unique to the application is clearly identified and specified in this *Service Manual*.

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., Nylocknut), hardness of the surface underneath the head of the fastener, or similar condition which affects the installation.

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

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

Identifying the Fastener

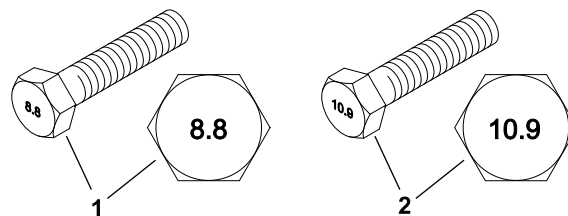


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Figure 2

Inch Series Bolts and Screws

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



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Figure 3

Metric Bolts and Screws

1. Class 8.8
2. Class 10.9

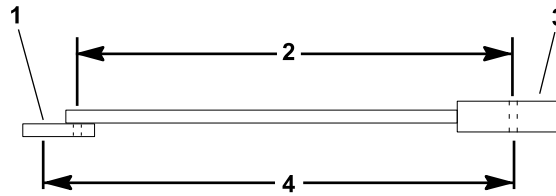
IMPORTANT

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

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

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

Calculating the Torque Values When Using a Drive-Adapter Wrench



g211753

Figure 4

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

Using a drive-adapter wrench (e.g., crowfoot wrench) in any position other than 90° and 270° to the frame of the torque wrench will affect the torque value measured by the torque wrench because of the effective length (lever) of the torque wrench changes. When using a torque wrench with a drive-adapter wrench, multiply the listed torque recommendation by the calculated torque conversion factor (Figure 4) 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: Reduce the torque values listed in the table above by 25% for lubricated fasteners. Lubricated fasteners are defined as threads coated with a lubricant, such as engine oil, or a thread sealant, such as Loctite.

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

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

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

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

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

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

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

Other Torque Specifications

SAE Grade 8 Steel Set Screws

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

Thread Cutting Screws (Zinc Plated Steel)

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

Wheel Bolts and Lug Nuts

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

*For steel wheels and non-lubricated fasteners

Thread Cutting Screws (Zinc Plated Steel)

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

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

Conversion Factors

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

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

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

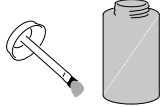
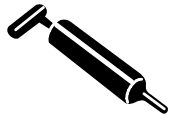
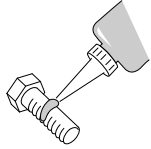
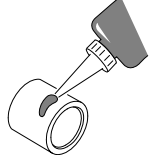

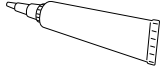
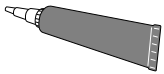

$$\text{N}\cdot\text{m} \times 0.7376 = \text{ft-lb}$$

Shop Supplies

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

IMPORTANT

Always follow manufacturers instructions when using or storing shop supplies.

<p>Anti-seize lubricant</p> <p>Used to prevent corrosion, galling, and seizure between metal parts. Most often applied to shafts and bores during assembly. Unless otherwise specified, high viscosity regular grade lithium-graphite based anti-seize lubricant should be used.</p>	
<p>Grease</p> <p>Can be used to pre-fill (pack) bearings, boots, and seals 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 <i>Operator's Manual</i> or <i>Installation Instructions</i> for grease specifications.</p>	
<p>Thread locking compound (Threadlocker)</p> <p>Used to lock threaded fasteners in position. Available in low, medium, and high strength for various size fasteners and applications. Most thread locking compounds are applied immediately 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.</p> <p>Note: Some fasteners have a dry thread locking compound pre-applied (patch-loc) so no additional thread locking compound is necessary when installing a new fastener. These fasteners are designed to be removed and re-installed only once before applying additional thread locking compound is necessary.</p>	
<p>Retaining compound (bearings and sleeves)</p> <p>An adhesive used to secure bearings, bushings, and cylindrical parts into housings or onto shafts. When cured, bearing and sleeve retaining compound fills the gap between mating parts with a hard resin that increases load distribution and protects against corrosion.</p>	
<p>Adhesive</p> <p>Used to secure a variety of components immediately prior to assembly. May be recommended for installing new components or when reusing a component that had a pre-applied adhesive such as hood seals, mouldings, and weather-stripping.</p>	
<p>Thread sealant</p> <p>Used to seal threaded fittings and sensors from air, fuel, and oil pressure leaks and prevent galling and seizure between threaded parts. A thread sealant in paste form is preferred over sealant tape. The sealant should remain semi-pliable to allow for component removal with standard tools. Some thread sealants may require the use of a cleaner or primer before use.</p>	
<p>Gasket compound</p> <p>Used to create a seal between mating parts. Gasket compounds may be used with or without the presence of a pre-formed gasket. Gasket compounds may be solvent or silicone based, and cure when exposed to air or designed to cure in an air-less environment (anaerobic). Most gasket compounds are designed to be applied to clean surfaces free of oil, chemical residue and previously used gaskets or gasket compounds.</p>	
<p>Silicone sealant</p> <p>Designed for a broad variety of sealing and bonding requirements, silicone sealants are usually room temperature vulcanizing (RTV) which form a flexible silicone rubber that bonds to a wide variety of smooth or porous materials when cured. Standard silicone sealants are designed to perform in temperatures from -51°F to 232°C (-60°F to 400°F), while high temperature variants can perform in temperatures up to 343°C (650°F).</p>	

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.



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.



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

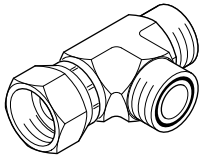
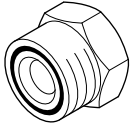
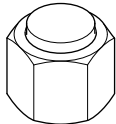

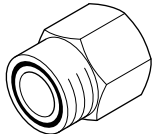
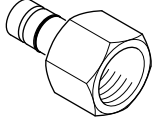
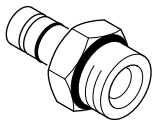
This kit includes the fittings and hoses that are used to connect high flow hydraulic filter kit (TOR6011) to the machine hydraulic traction system components.



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 \(page 2–14\)](#).

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



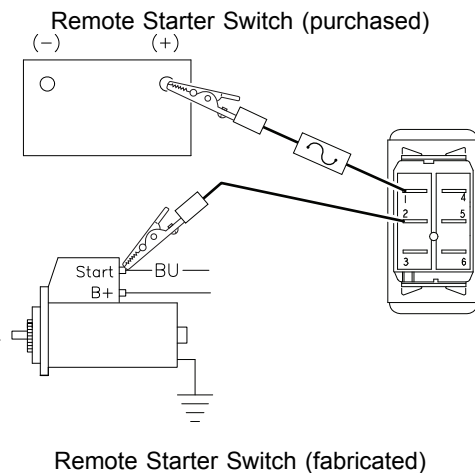
Remote Starter Switch

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 starter 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.

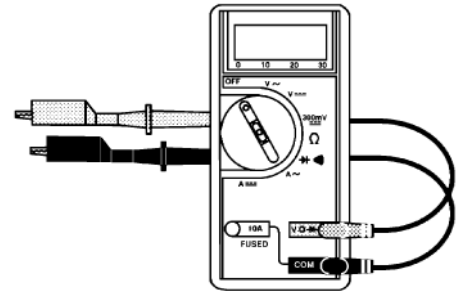


Multimeter

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.





Table of Contents

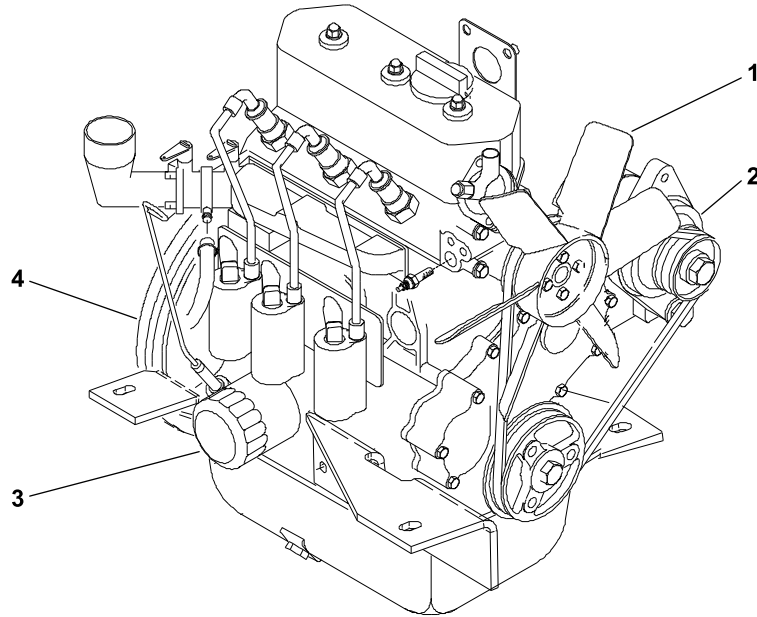
Specifications 3-2
Engine - Groundsmaster 3320-G 3-2
General Information 3-4
Adding Oil to Engine 3-5
Adjustments 3-6
Adjust Throttle Control 3-6
Adjust Choke Control 3-6
Adjust Engine Speed 3-8
Service and Repairs 3-9
Fuel System 3-9
Air Cleaner 3-12
Radiator 3-13
Engine 3-15

Additional Reference Materials

BRIGGS AND STRATTON/DAIHATSU REPAIR MANUAL FOR 3-CYLINDER, LIQUID-COOLED, GASOLINE ENGINES

Specifications

Groundsmaster 3320-G



g243929

Figure 5

- | | |
|-----------------------|----------------------|
| 1. Engine cooling fan | 3. Engine oil filter |
| 2. Alternator | 4. Flywheel |

Engine - Groundsmaster 3320-G

Item	Description
Make/Designation	Briggs and Stratton/Daihatsu, 4-stroke, Liquid Cooled, OHV, Gasoline
Number of Cylinders	3
Bore x Stroke mm (inches)	72 x 78 (2.834 x 3.07)
Total Displacement cm ³ (in ³)	952 (58.1)
Compression Ratio	8.6:1
Firing Order	1 - 2 - 3
Dry Weight (approximate) kg (lb)	62 (137)
Fuel	Unleaded, regular grade (87 octane minimum)
Carburetor	Single barrel, float feed, 12 VDC shut-off solenoid
Fuel Tank Capacity L (US gallons)	48.5 (12.8)
Governor	Mechanical
Idle Speed (no load)	1,400 to 1,550 rpm
High Idle (no load)	3,100 to 3,250 rpm
Engine Oil	API Service Classification SE or better; refer to the <i>Traction Unit Operator's Manual</i> for viscosity
Oil Pump	Gear driven trochoid type
Crankcase-Oil Capacity L (US qt)	3.3 (3.5) with filter

Engine - Groundsmaster 3320-G (continued)

Item	Description
Water Pump	Belt driven centrifugal type
Cooling System Capacity (including reserve tank) L (US qt)	4.3 (4.5)
Starter	12 VDC 1.2 KW
Alternator/Regulator	12 VDC 40 A

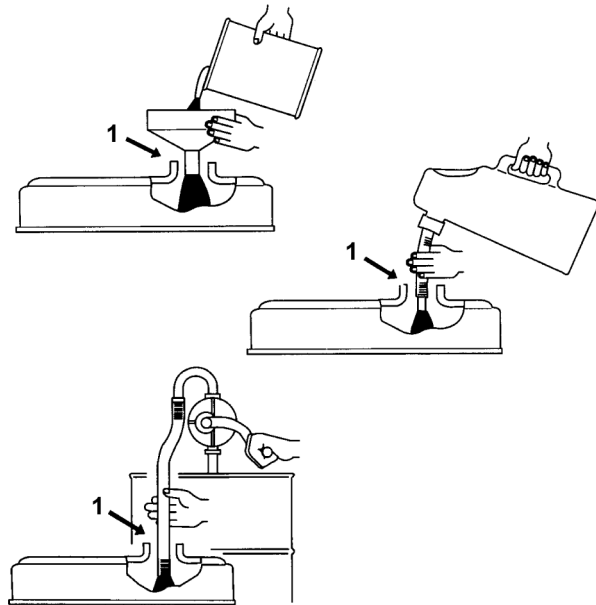
General Information

This Chapter gives information about specifications, troubleshooting, testing, and repair of the Briggs and Stratton/Daihatsu gasoline engine used in the Groundsmaster 3320.

Most repairs and adjustments require tools which are commonly available in many service shops. The use of some specialized test equipment is explained in the engine service manual found at the end of this chapter. 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 Briggs and Stratton/Daihatsu gasoline engines are supplied through your local Toro Distributor. If no parts list is available, be sure to provide your distributor with the Toro model and serial number.

Adding Oil to Engine



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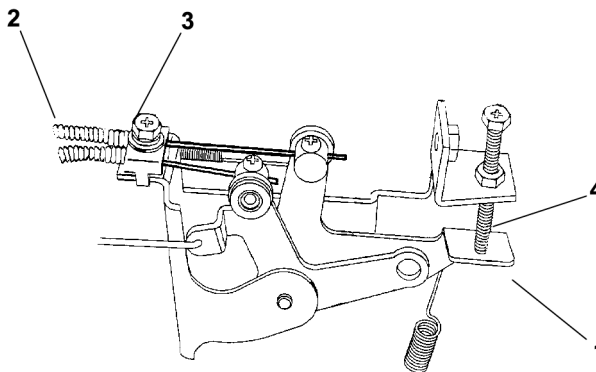
Figure 6

1. Note clearance

When adding oil to the engine, maintain clearance between the oil fill device and the oil fill opening in the valve cover (Figure 6). This clearance is necessary to allow venting when adding engine oil which will prevent oil from running into the breather tube and intake system.

Adjustments

Adjust Throttle Control



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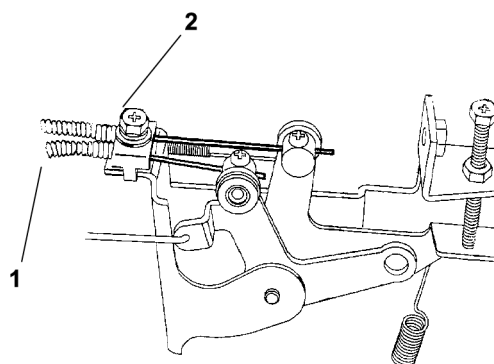
Figure 7

- | | |
|---------------------------|----------------------|
| 1. Speed control lever | 3. Cable clamp screw |
| 2. Throttle control cable | 4. High speed screw |

Proper throttle operation is dependent upon proper adjustment of throttle control. Ensure that the throttle control is operating properly.

1. Move remote throttle control lever to FAST position.
2. Check position of speed control lever on governor bracket. Speed control lever should be contacting high speed screw when throttle control lever is in FAST position.
3. If necessary, throttle control can be adjusted by loosening cable clamp screw and repositioning control cable until speed control lever contacts high speed screw when throttle control lever is in FAST position.

Adjust Choke Control



g230314

Figure 8

- | | |
|----------------|----------------------|
| 1. Choke cable | 2. Cable clamp screw |
|----------------|----------------------|

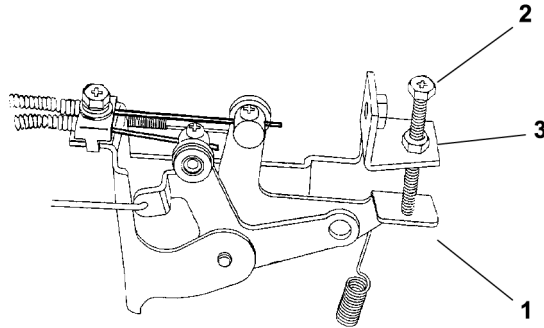
Proper cold engine starting is dependent upon proper adjustment of choke control. Ensure that the choke control is operating properly.

Adjust Choke Control (continued)

1. Move choke control lever to START position.
2. Check position of choke lever on carburetor. Choke lever should be fully closed when choke lever is in START position.
3. If necessary, choke control can be adjusted by loosening cable clamp screw and repositioning choke cable until carburetor choke lever is fully closed when choke control lever is in START position.

Adjust Engine Speed

1. Allow engine to reach operating temperature before checking or adjusting engine speed. Ensure that the throttle control is adjusted properly before adjusting engine speed; refer to [Adjust Throttle Control \(page 3–6\)](#).
2. Park machine on a level surface, lower cutting deck (or implement), and engage parking brake. Ensure that the PTO switch is OFF. Raise hood to gain access to engine controls.
3. With engine running, move remote throttle control lever to FAST position.
4. Using a tachometer, check that the engine is operating at 3,100 to 3,250 rpm.



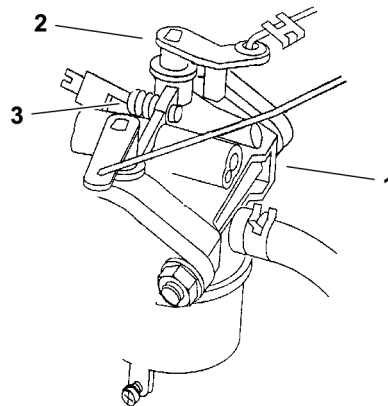
g230315

Figure 9

1. Speed control lever
2. High speed screw
3. Locknut

If high idle speed is incorrect, adjust high speed screw on governor bracket ([Figure 9](#)).

- A. Loosen locknut on high speed screw.
 - B. Adjust high speed screw to obtain 3,100 to 3,250 rpm.
 - C. Tighten locknut. Check high speed.
5. Move remote throttle control lever to SLOW position.



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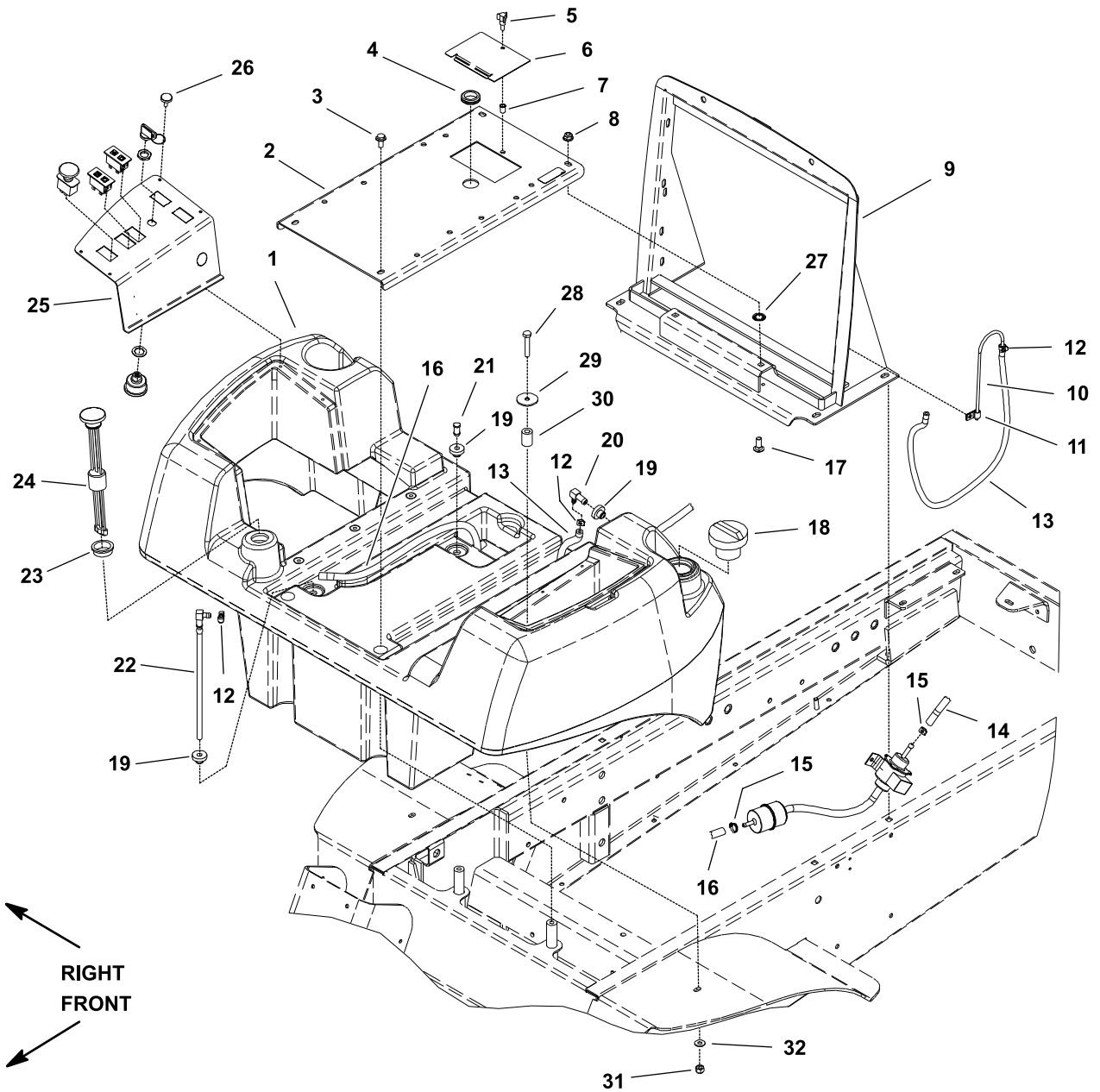
Figure 10

1. Carburetor
2. Throttle lever
3. Idle speed screw

6. Rotate and hold carburetor throttle lever against the idle speed screw ([Figure 10](#)). Using a tachometer, check that the engine idle speed is 1,400 to 1,550 rpm. If idle speed is incorrect, adjust carburetor idle speed screw to obtain 1,400 to 1,550 rpm.

Service and Repairs

Fuel System



g230317

Figure 11

- | | | |
|-------------------------------|---|--------------------------|
| 1. Fuel tank | 12. Hose clamp | 23. Grommet |
| 2. Seat plate | 13. Fuel hose (tank venting) | 24. Fuel gauge |
| 3. Flange-head screw (2 each) | 14. Fuel hose (fuel pump to carburetor) | 25. Control panel |
| 4. Grommet | 15. Hose clamp | 26. Thumb screw (4 each) |
| 5. Knob | 16. Fuel hose (fuel supply) | 27. Retaining ring |
| 6. Bypass cover | 17. Carriage screw (2 each) | 28. Bolt |
| 7. Threaded insert | 18. Fuel cap | 29. Flat washer |
| 8. Flange nut (2 each) | 19. Grommet | 30. Spacer |
| 9. Radiator support | 20. Elbow fitting | 31. Locknut |
| 10. Vent tube | 21. Grommet plug | 32. Flat washer |
| 11. R-clamp | 22. Stand pipe | |



DANGER



Because gasoline is highly flammable, use caution when storing or handling it. Do not smoke while filling the fuel tank. Do not fill fuel tank while engine is running, hot, or when machine is in an enclosed area. Always fill fuel tank outside and wipe up any spilled fuel before starting the engine. Store fuel in a clean, safety-approved container and keep cap in place. Use gasoline for the engine only; not for any other purpose.

Check Fuel Lines and Connections

Check fuel lines and connections periodically as recommended in the *Traction Unit Operator's Manual*. Check lines for deterioration, damage, leaking, or loose connections. Replace hoses, clamps, and connections as necessary.

Drain and Clean Fuel Tank

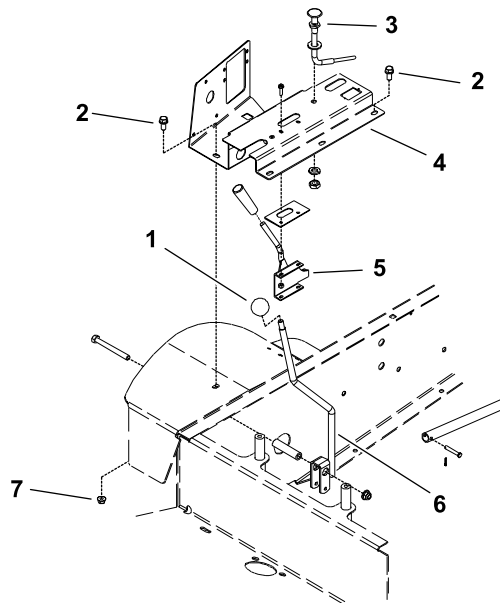
Drain and clean the fuel tank periodically as recommended in the *Traction Unit Operator's Manual*. Also, drain and clean the fuel tank if the fuel system becomes contaminated or if the machine is to be stored for an extended period.

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

Removing the Fuel Tank

1. Park machine on a level surface, lower cutting deck (or implement), shut off the engine, engage parking brake, and remove key from the key switch. Open hood.
2. Unplug seat switch from machine wire harness.
3. Remove seat and seat suspension from machine; refer to [Removing the Operator Seat \(page 7–20\)](#).
4. Remove seat plate (item 2 in [Figure 11](#)) from machine.
5. Remove thumb screws that secure control panel (item 25 in [Figure 11](#)) to fuel tank. Unplug wire harness connections from panel components and remove panel.

Removing the Fuel Tank (continued)



g230318

Figure 12

- | | | |
|----------------------|------------------------|---------------|
| 1. Knob | 4. Lower control panel | 7. Flange nut |
| 2. Flange-head screw | 5. Throttle control | |
| 3. Choke control | 6. Lift control lever | |

6. Remove flange-head screws and flange nut that secure lower control panel to machine (Figure 12).
7. Remove locknut (item 31 in Figure 11) and flat washer from left fender.
8. Use a fuel transfer pump to remove fuel from the fuel tank and into a suitable container.
9. Disconnect fuel hoses from standpipe (item 22 in Figure 11) and elbow fitting on the top of the fuel tank.
10. Remove fuel tank (Figure 11).

Installing the Fuel Tank

1. Install fuel tank to frame (Figure 11).
2. Connect fuel hoses to standpipe (item 22 in Figure 11) and elbow fitting on the top of the fuel tank. Secure hoses with clamps.
3. Secure lower control panel to machine with flange-head screws and flange nut (Figure 12).
4. Secure tank to left fender with flat washer (item 32 in Figure 11) and locknut.
5. Position control panel to fuel tank, connect wire harness to panel components, and secure panel to machine with thumb screws.
6. Install seat plate to machine.
7. Install seat suspension and seat to machine; refer to [Installing the Operator Seat \(page 7–20\)](#).
8. Connect seat switch to machine wire harness. Close hood.
9. Fill fuel tank; refer to the *Traction Unit Operator's Manual*.

Air Cleaner

Removing the Air Cleaner

1. Remove air cleaner components as necessary (Figure 13).
2. Refer to the *Traction Unit Operator's Manual* for air cleaner service procedures.

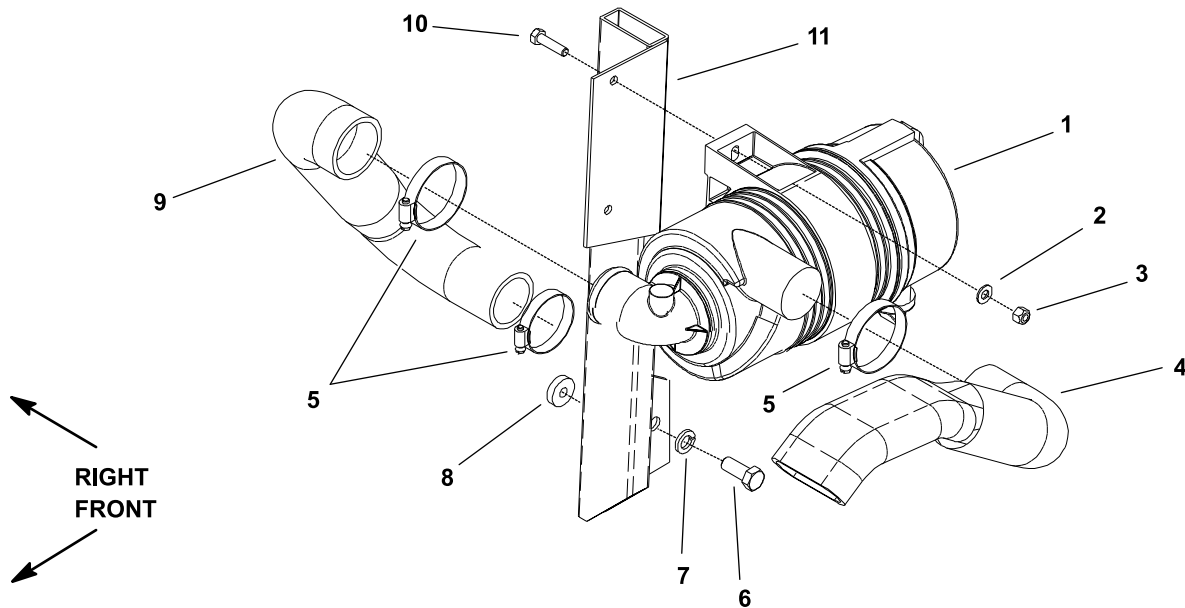


Figure 13

- | | | |
|-------------------------|-------------------------|----------------------|
| 1. Air cleaner assembly | 5. Hose clamp | 9. Air inlet hose |
| 2. Flat washer (2 each) | 6. Bolt (2 each) | 10. Bolt (2 each) |
| 3. Locknut | 7. Lock washer (2 each) | 11. Mounting bracket |
| 4. Air inlet hose | 8. Spacer | |

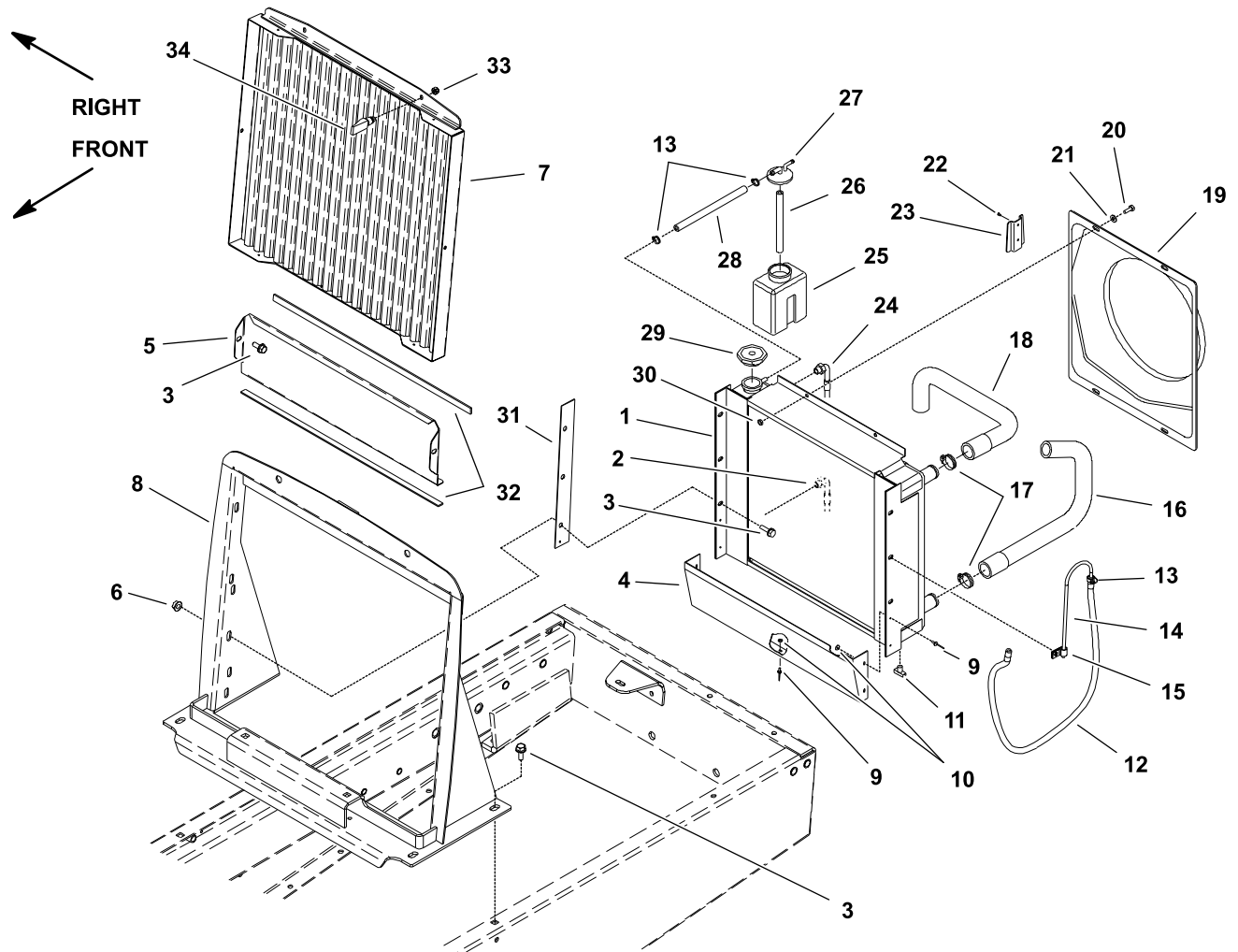
Installing the Air Cleaner

IMPORTANT

Any leaks in the air filter system will allow unfiltered air to enter engine and will cause serious engine damage. Ensure that the all air cleaner components are in good condition and are properly secured during assembly.

1. Assemble air cleaner system (Figure 13). Ensure that the vacuator valve is pointed down after assembly.

Radiator



g230307

Figure 14

- | | | |
|----------------------------|--------------------------|-----------------------|
| 1. Radiator | 13. Hose clamp | 25. Coolant reservoir |
| 2. Hydraulic hose | 14. Vent tube | 26. Hose |
| 3. Screw (8 each) | 15. Clamp (2 each) | 27. Reservoir cap |
| 4. Radiator shield | 16. Lower radiator hose | 28. Overflow hose |
| 5. Intake cover | 17. Hose clamp | 29. Radiator cap |
| 6. Flange nut (8 each) | 18. Upper radiator hose | 30. Locknut (4 each) |
| 7. Screen | 19. Fan shroud | 31. Radiator shim |
| 8. Radiator support | 20. Bolt (4 each) | 32. Foam strip |
| 9. Pop rivet (5 each) | 21. Flat washer (4 each) | 33. Locknut (2 each) |
| 10. Backup washer (5 each) | 22. Pop rivet (2 each) | 34. Latch (2 each) |
| 11. Draincock | 23. Reservoir bracket | |
| 12. Vent hose | 24. Hydraulic hose | |

Removing the Radiator

1. Park machine on a level surface, lower cutting deck (or implement), shut off the engine, engage parking brake, and remove key from the key switch.
2. Open hood; refer to the *Traction Unit Operator's Manual*.

Removing the Radiator (continued)



CAUTION



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

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

3. Drain coolant from radiator; refer to the *Traction Unit Operator's Manual*.
4. Remove screen from machine; refer to the *Traction Unit Operator's Manual*.



CAUTION



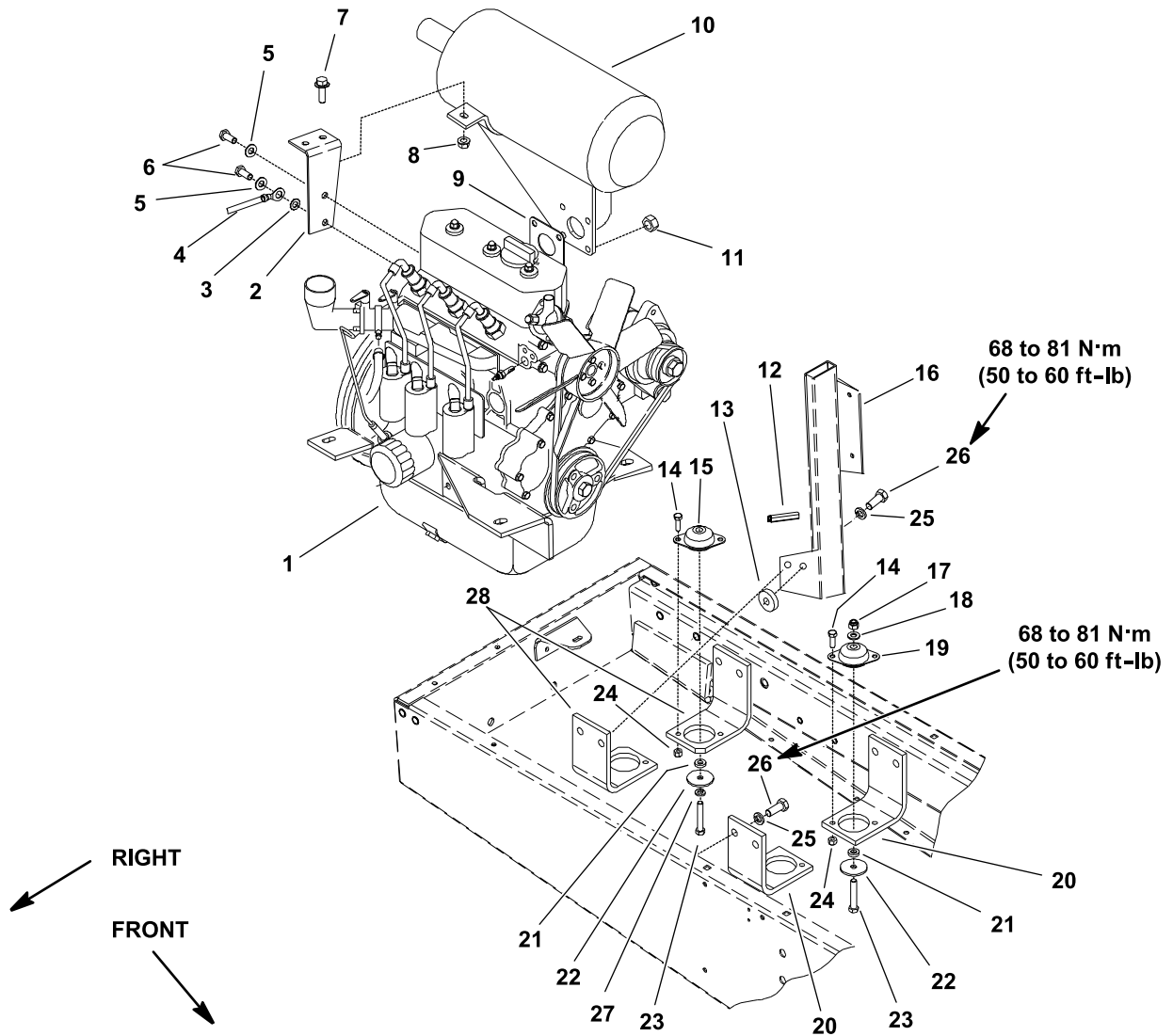
Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic fluid.

5. Disconnect hydraulic hoses from radiator. Position hoses away from radiator.
6. Disconnect radiator hoses (upper and lower) from the radiator.
7. Loosen hose clamp and remove overflow hose from radiator fill opening.
8. Remove coolant reservoir from bracket on fan shroud.
9. Remove 4 bolts, 4 flat washers, and 4 locknuts that secure fan shroud to radiator. Position fan shroud away from the radiator.
10. Support the radiator assembly before loosening mounting fasteners.
11. Remove screws and flange nuts that secure radiator to radiator support.
12. Carefully pull radiator assembly from the machine. Locate and retrieve radiator shim (item 31 in [Figure 14](#)). Plug radiator and hose openings to prevent contamination.

Installing the Radiator

1. Remove any plugs placed during the removal procedure.
2. Carefully position radiator assembly to the radiator support. Place radiator shim (item 31 in [Figure 14](#)) between radiator and support. Secure radiator with screws and flange nuts.
3. Position fan shroud to the radiator. Secure fan shroud to radiator with 4 bolts, 4 flat washers, and 4 locknuts. Ensure that a minimum of 6.4 mm (0.250 inch) clearance exists at all points between shroud and fan.
4. Apply hydraulic thread sealant to hydraulic hose fitting threads. Connect hydraulic hoses to radiator.
5. Connect upper and lower radiator hoses.
6. Install coolant reservoir to bracket on fan shroud.
7. Connect overflow hose to radiator fill opening and secure with hose clamp.
8. Ensure that the radiator drain plug is tight. Fill radiator with coolant; refer to the *Traction Unit Operator's Manual*.
9. Install screen to machine; refer to the *Traction Unit Operator's Manual*.
10. Close hood; refer to the *Traction Unit Operator's Manual*.

Engine



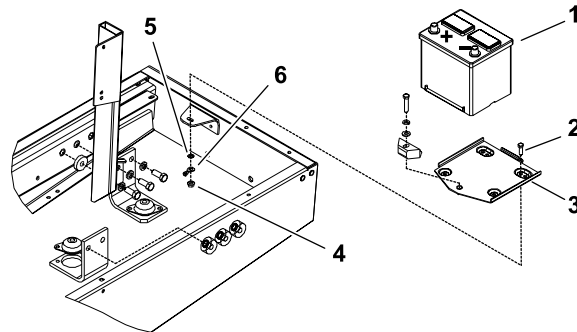
g230308

Figure 15

- | | | |
|---------------------------|------------------------------------|------------------------------------|
| 1. Engine | 11. Hex nut (4 each) | 21. Spacer (4 each) |
| 2. Muffler bracket | 12. Frame trim | 22. Rebound washer (4 each) |
| 3. Lock washer | 13. Spacer | 23. Bolt (4 each) |
| 4. Negative battery cable | 14. Bolt (2 each per mount) | 24. Locknut (2 each per mount) |
| 5. Flat washer | 15. Engine shock mount (red patch) | 25. Lock washer (2 each per mount) |
| 6. Bolt | 16. Air cleaner mounting bracket | 26. Bolt (2 each per mount) |
| 7. Flange-head screw | 17. Locknut (3 each) | 27. Lock washer (1 each) |
| 8. Flange nut | 18. Flat washer (3 each) | 28. Engine mount bracket |
| 9. Muffler gasket | 19. Engine shock mount (3 each) | |
| 10. Muffler | 20. Engine mount bracket | |

Removing the Engine

1. Park machine on a level surface, lower cutting deck (or implement), shut off the engine, and remove key from the key switch. Chock wheels to keep the machine from moving.
2. Open hood; refer to the *Traction Unit Operator's Manual*.
3. Disconnect negative (-) and then positive (+) battery cables at the battery.
4. Remove battery from machine; refer to [Servicing the Battery \(page 6–80\)](#).



g230309

Figure 16

- | | | |
|------------------|------------------------|-----------------|
| 1. Battery | 3. Battery base | 5. Lock washer |
| 2. Bolt (3 each) | 4. Flange nut (3 each) | 6. Ground cable |

5. Remove bolts and flange nuts that secure battery base to brackets. Remove battery base from machine ([Figure 16](#)).

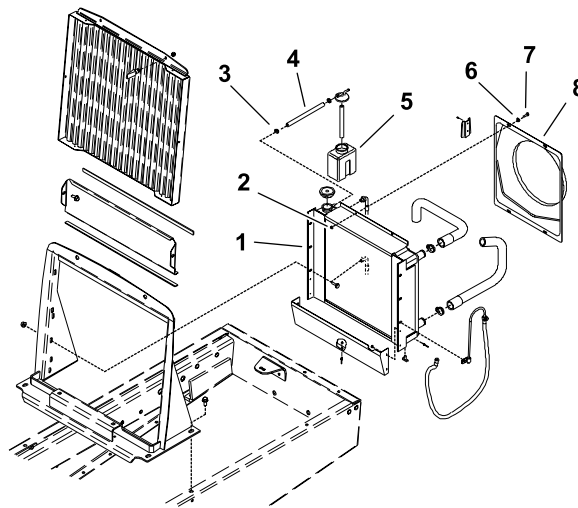
CAUTION

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

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

6. Drain coolant from radiator; refer to the *Traction Unit Operator's Manual*.

Removing the Engine (continued)

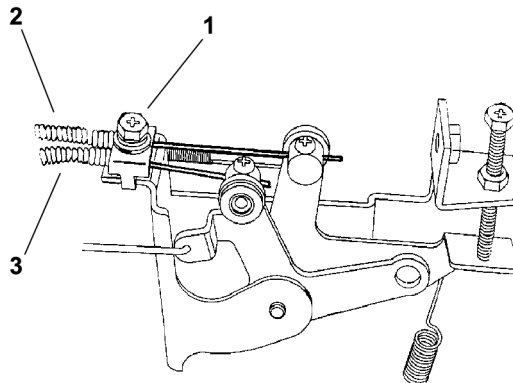


g230310

Figure 17

- | | | |
|---------------|----------------------|---------------|
| 1. Radiator | 4. Overflow hose | 7. Bolt |
| 2. Locknut | 5. Coolant reservoir | 8. Fan shroud |
| 3. Hose clamp | 6. Flat washer | |

7. Loosen hose clamp and remove overflow hose from radiator fill opening (Figure 17). Remove coolant reservoir from bracket on radiator fan shroud.
8. Remove 4 bolts, 4 flat washers, and 4 locknuts that secure fan shroud to radiator (Figure 17). Position fan shroud away from the radiator.
9. Remove PTO shaft from machine; refer to [Removing the PTO Shaft \(page 9–8\)](#).
10. Remove air cleaner; refer to [Removing the Air Cleaner \(page 3–12\)](#).



g230311

Figure 18

- | | | |
|----------------|-------------------|----------------|
| 1. Cable clamp | 2. Throttle cable | 3. Choke cable |
|----------------|-------------------|----------------|

11. Loosen screw that secures cable clamp to governor bracket (Figure 18). Remove throttle and choke cables from governor levers. Position cables away from the engine.

Removing the Engine (continued)

12. Disconnect hoses from engine.
 - A. Loosen clamps and disconnect upper and lower radiator hoses from the engine.
 - B. At carburetor, loosen hose clamp and disconnect fuel hose. Plug hose to prevent leakage and contamination.
13. Disconnect transmission driveshaft from engine pulley; refer to [Removing the Transmission Driveshaft \(page 5–87\)](#).
14. Remove cotter pin and clevis pin that secure hood cable to muffler bracket on rear of engine. Support hood in the open position.
15. Disconnect wire harness connectors from the following engine components:

Note: Label all electrical leads for reassembly purposes.

 - A. Alternator connector and stud.
 - B. High temperature shut down switch and temperature sender located on the water pump housing.
 - C. Fuel solenoid on carburetor.
 - D. Oil pressure switch located near the engine oil dipstick.
 - E. Ignition coils located on the right side of the engine.
 - F. Connector, fusible link connector, and positive battery cable from the starter motor.
 - G. Wire harness ground wire from the muffler bracket.
 - H. PTO clutch wire connector.
 - I. Crank position wire connector.
16. Remove engine from machine:
 - A. Attach short section of chain between lift tabs located on each end of the cylinder head.
 - B. Connect a hoist or chain fall at the center of the short section of chain. Apply enough tension on the short chain so that the engine will be supported.
 - C. Remove fasteners that secure the engine (with brackets) to the engine shock mounts and engine mount brackets.



CAUTION



One person should operate lift or hoist while the other person guides the engine out of the machine.

IMPORTANT

Ensure not to damage the engine, fuel hoses, hydraulic lines, electrical harness, or other parts while removing the engine.

- D. Raise engine and remove from machine.

Removing the Engine (continued)

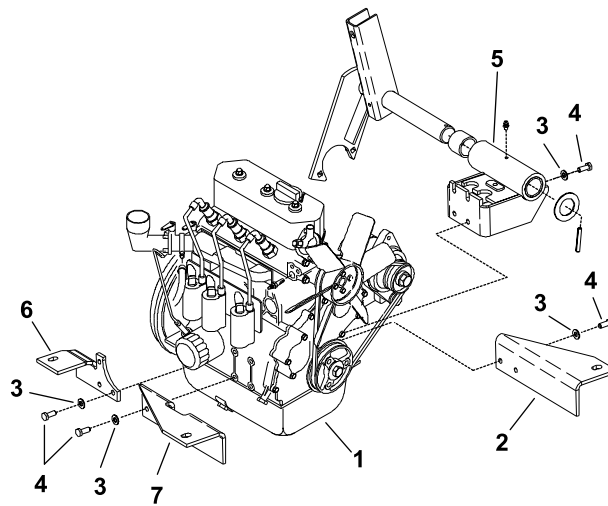


Figure 19

- | | | |
|--------------------|-------------------|-------------------|
| 1. Gasoline engine | 4. Bolt | 7. Engine bracket |
| 2. Engine bracket | 5. Pivot plate | |
| 3. Flat washer | 6. Engine bracket | |

17. If necessary, remove engine brackets from engine (Figure 19).

Installing the Engine

1. Locate machine on a level surface with cutting deck (or implement) lowered and key removed from the key switch. Chock wheels to keep the machine from moving.
2. Ensure that all parts removed from the engine during maintenance or building are installed to the engine.
3. If engine brackets were removed from the engine, install them to engine (Figure 19).
4. If engine mount brackets (items 20 and 28 in Figure 15) were removed from frame, secure them to frame with bolts and lock washers. Torque screws to **68 to 81 N·m (50 to 60 ft-lb)**.



IMPORTANT

The left, rear shock mount (item 15 in Figure 15) is different than the other 3 mounts. If shock mounts were removed from engine mount brackets on frame, ensure that the shock mount with red patch is correctly installed at left, rear position.

5. Position fan shroud around the engine fan.
6. Reinstall engine to machine.
 - A. Attach short section of chain between lift tabs located on each end of the cylinder head
 - B. Connect a hoist or chain fall at the center of the short section of chain. Apply enough tension on the short chain so that the engine can be supported.



CAUTION



One person should operate lift or hoist while the other person guides the engine into the machine.

IMPORTANT

Ensure not to damage the engine, fuel hoses, hydraulic lines, electrical harness, or other parts while installing the engine.

- C. Lower engine to the machine frame. Ensure that the engine bracket holes are aligned with the holes in the engine shock mounts.
- D. Secure engine to the engine mounts.
- 7. Install clevis pin and cotter pin to secure hood cable to muffler bracket.
- 8. Connect transmission driveshaft to engine pulley; refer to [Installing the Transmission Driveshaft \(page 5–89\)](#).
- 9. Reconnect all wire harness connectors to engine components.
- 10. Remove plugs installed in hoses during disassembly. Connect hoses to the engine.
 - A. Connect fuel hose to the carburetor inlet fitting. Secure with hose clamp.
 - B. Connect upper and lower radiator hoses to the engine. Secure with hose clamps.
- 11. Position throttle and choke cables to engine governor levers ([Figure 18](#)). Secure cables to governor bracket with cable clamp and screw. Adjust cables; refer to [Adjust Throttle Control \(page 3–6\)](#) and [Adjust Choke Control \(page 3–6\)](#).
- 12. Install air cleaner; refer to [Installing the Air Cleaner \(page 3–12\)](#).

IMPORTANT

Ensure that the clutch pulley and PTO pulley are aligned during PTO shaft installation.

- 13. Install PTO shaft to machine; refer to [Installing the PTO Shaft \(page 9–9\)](#).
- 14. Position fan shroud to radiator. Ensure that a minimum of 6.4 mm (0.250 inch) clearance exists at all points between shroud and fan. Secure fan shroud to radiator with 4 bolts, 4 flat washers, and 4 locknuts.
- 15. Install coolant reservoir to bracket on radiator fan shroud ([Figure 17](#)). Install overflow hose to radiator fill opening and secure with hose clamp.
- 16. Add coolant to radiator; refer to the *Traction Unit Operator's Manual*.

Note: Ensure to attach negative battery cable as battery base is installed.
- 17. Position battery base to brackets and secure with bolts and flange nuts ([Figure 16](#)).

Installing the Engine (continued)

18. Install battery to machine; refer to [Servicing the Battery \(page 6–80\)](#).
19. Check engine oil level; refer to the *Traction Unit Operator's Manual*.
20. Connect positive (+) and then negative (-) battery cables to the battery.
21. Close hood; refer to the *Traction Unit Operator's Manual*.



Table of Contents

Specifications	4-2
Engine - Groundsmaster 3280-D	4-2
General Information	4-4
Traction Unit Operator's Manual	4-4
Engine Identification.....	4-4
Kubota Engine Workshop Manuals.....	4-5
Adjustments	4-6
Adjusting the Throttle Control.....	4-6
Service and Repairs	4-7
Air Cleaner System	4-7
Exhaust System	4-9
Radiator	4-11
Fuel System.....	4-15
Engine.....	4-19

Additional Reference Materials

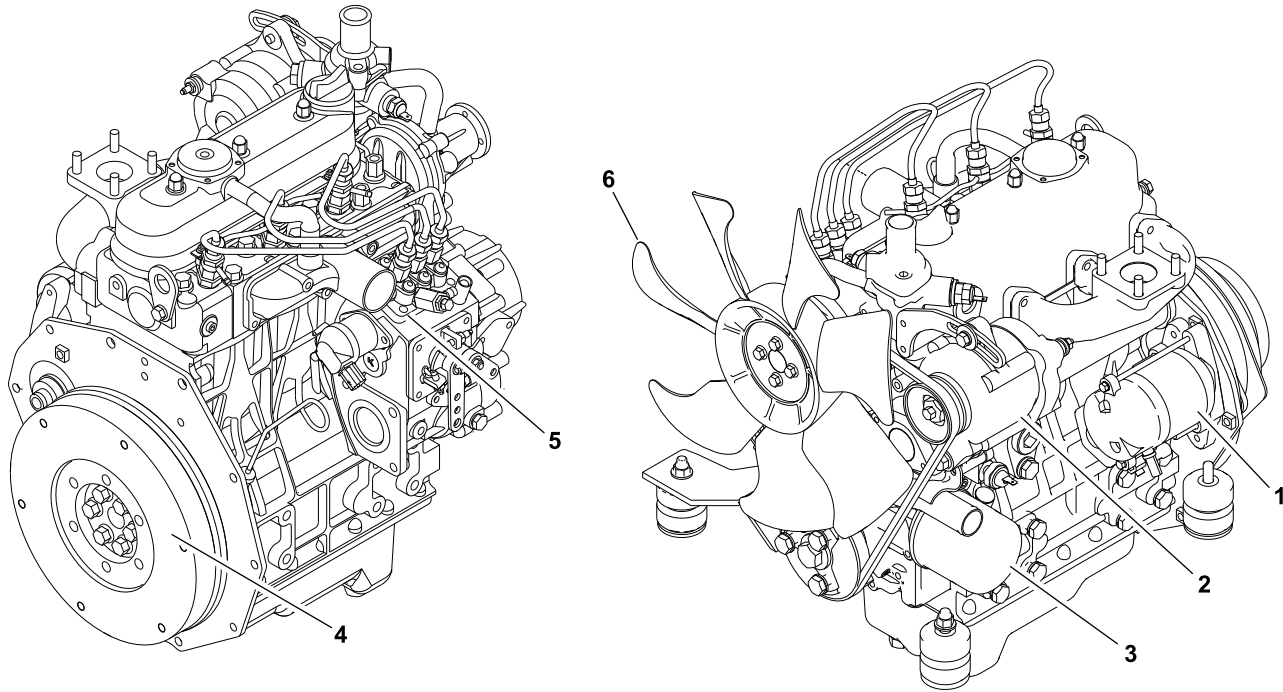
KUBOTA 05-E2B SERIES WORKSHOP MANUAL

KUBOTA 05-E3B SERIES WORKSHOP MANUAL

KUBOTA 05-E4B SERIES WORKSHOP MANUAL

Specifications

Groundsmaster 3280-D



g243928

Figure 20

- | | | |
|------------------|----------------------|------------------------|
| 1. Starter motor | 3. Engine oil filter | 5. Fuel injection pump |
| 2. Alternator | 4. Flywheel | 6. Engine cooling fan |

Engine - Groundsmaster 3280-D

Item	Description
Make/Designation	Kubota D1105: 4-cycle, 3 cylinder water cooled diesel. EPA Tier 4 compliant.
Bore	78 mm (3.07 inches)
Stroke	78.4 mm (3.09 inches)
Total displacement	1123 cm ³ (68.53 in ³)
Firing order	1 (front) - 2 - 3
Compression Ratio	22:1
Fuel	Diesel or Biodiesel fuel (up to B20)
Fuel tank capacity	42.8 L (11.3 US gallons)
Fuel injection pump	Bosch MD type mini
Fuel injector nozzle	Mini nozzle (DNOPD)
Governor	Centrifugal mechanical
Low idle (no load)	1,500 to 1,650 rpm
High idle (no load)	3,100 to 3,250 rpm
Engine oil	API classification CH-4, CI-4, or higher
Engine-oil viscosity	Refer to the <i>Operator's Manual</i>
Crankcase-oil capacity	3.8 L (4.0 US qt)

Engine - Groundsmaster 3280-D (continued)

Item	Description
Oil pump	Gear driven trochoid type
Coolant capacity	7.6 L (8 US qt)
Alternator/Regulator	12 VDC, 40 A
Engine weight (dry)	93 kg (205 lb)

General Information

This chapter gives information about specifications and repair of the Kubota D1105 diesel engine used in the Groundsmaster 3280-D 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 Kubota Engine Workshop 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 Kubota Engine Workshop 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 Kubota engines are supplied through your Authorized Toro Distributor. If the parts list is not available, provide your distributor with the Toro model and serial number of your machine as well as the Kubota engine model and serial numbers.

Traction Unit Operator's Manual

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

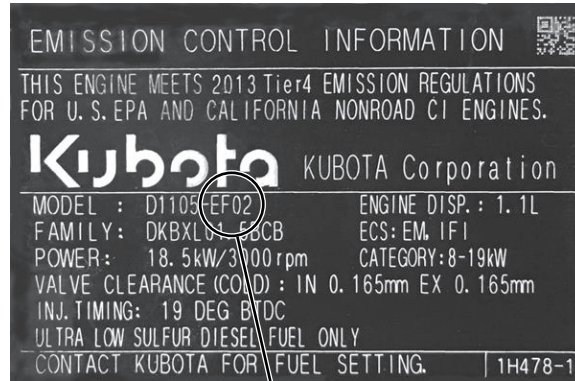
Engine Identification

The engine data label includes the engine model, serial, and code number. The emission control information label includes the year in which the engine met Tier 4 regulations, the year and month of engine manufacture, and a variety of engine specifications. The labels are located on the engine valve cover. Use the information on the labels to identify the correct parts and service information for the engine used in your machine.

Kubota Engine Workshop Manuals

The engine that powers your Groundsmaster 3280-D is a Kubota D1105 Tier 4 compliant engine. Kubota Engine Workshop Manuals are available for these engines. To ensure the correct engine workshop manual is used when servicing the engine on your machine, refer to the engine group code on the emission control information label to identify the "E" (emission) level; refer to [Engine Group Code \(page 4–5\)](#).

Engine Group Code



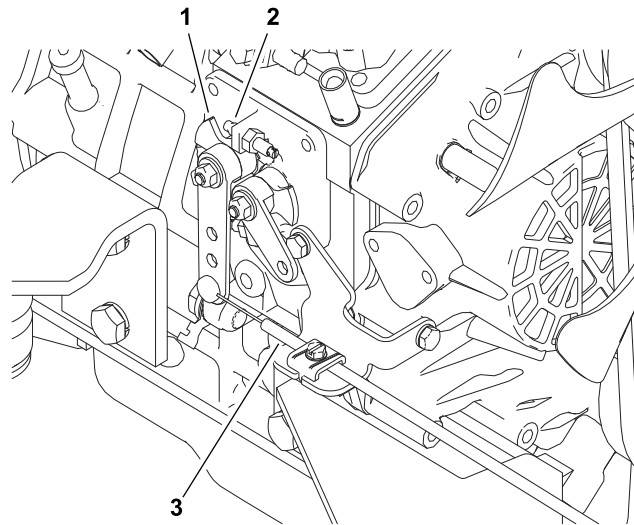
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1. Engine Group Code

Engine Group Code	"E" Emission Level and Workshop Manual
ES**	E2B
ET**	E3B
EF**	E4B

Adjustments

Adjusting the Throttle Control



g221634

Figure 21

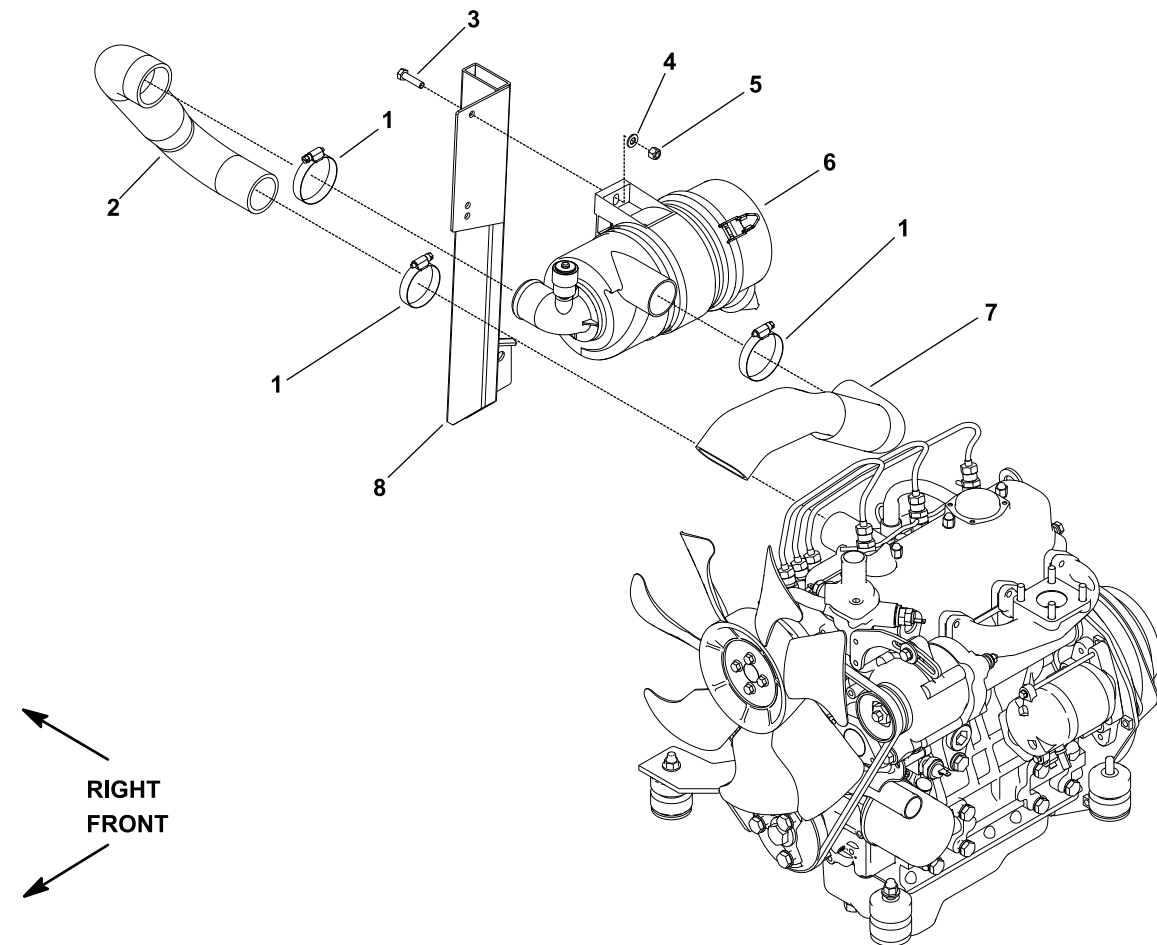
1. Speed control lever 2. High speed screw 3. Throttle cable
-

Proper throttle operation is dependent upon proper adjustment of the throttle control. Ensure that the throttle control is operating properly.

1. Move the remote throttle control lever to the FAST position
2. Check the position of speed control lever on the engine fuel injection pump. The speed control lever must be contacting the high speed screw when the throttle control lever is in the FAST position.
3. If necessary, the throttle control can be adjusted by loosening the cable clamp screw and positioning the control cable until the speed control lever contacts the high speed screw.

Service and Repairs

Air Cleaner System



g221635

Figure 22

- | | | |
|----------------------------|-------------------------|---------------------------|
| 1. Hose clamp (3 each) | 4. Flat washer (2 each) | 7. Air cleaner inlet hose |
| 2. Air cleaner outlet hose | 5. Locknut (2 each) | 8. Air cleaner mount |
| 3. Bolt (2 each) | 6. Air cleaner assembly | |

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 (or implement), 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 22](#).
4. Examine the air cleaner assembly (item 6 in [Figure 22](#)) 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.

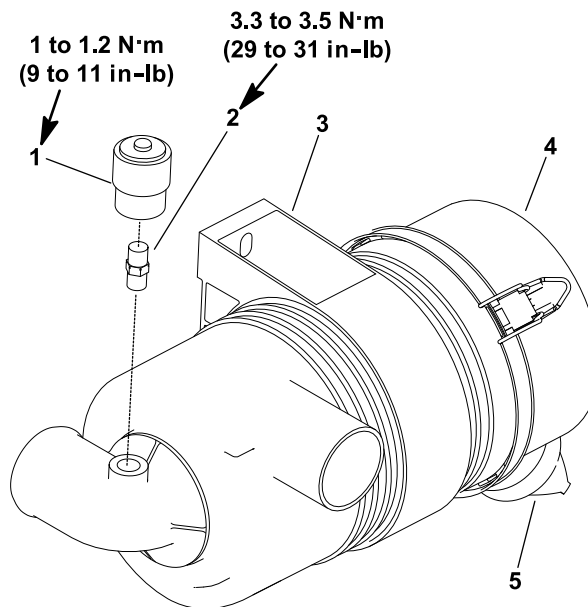
IMPORTANT

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 22](#).



- A. If the service indicator and adapter were removed, install the adapter and service indicator ([Figure 23](#)). Torque the adapter to **3.3 to 3.5 N·m (29 to 31 in-lb)**. Torque the service indicator to **1 to 1.2 N·m (9 to 11 in-lb)**.



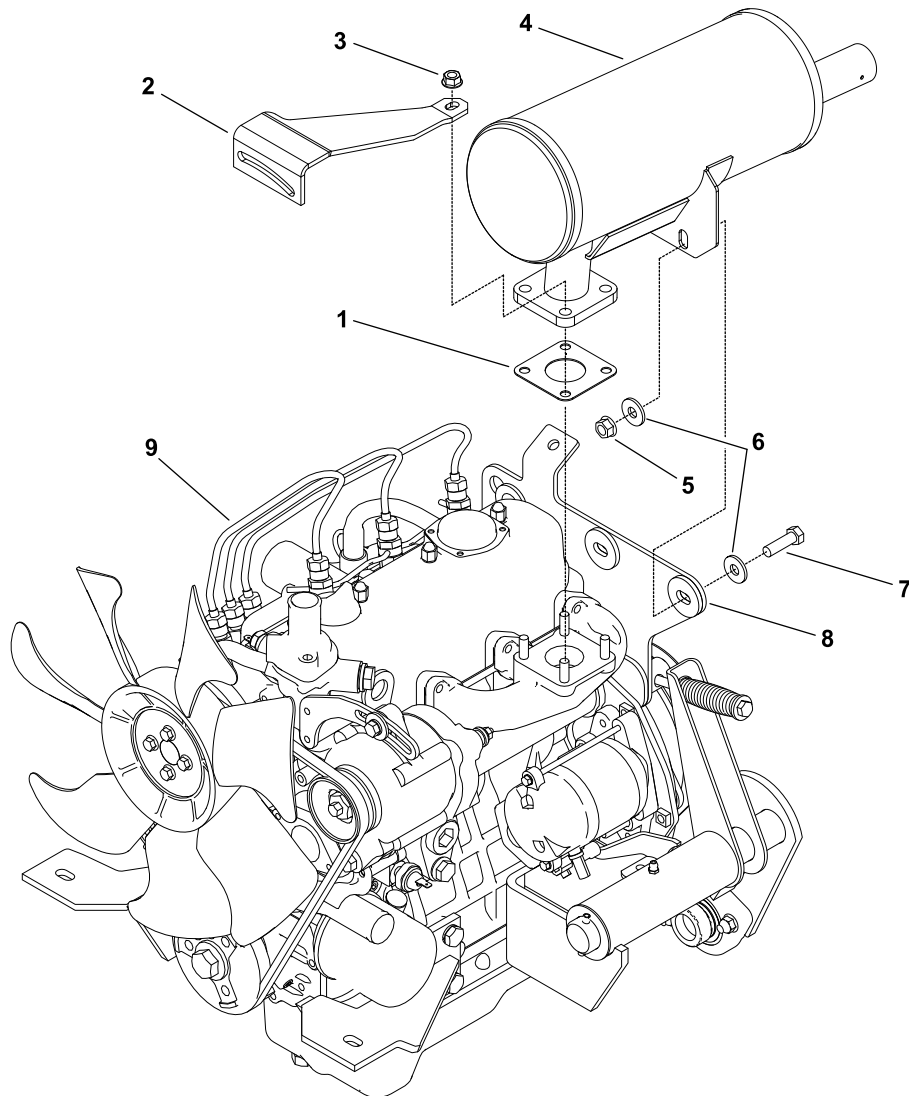
g221636

Figure 23

- | | |
|----------------------|-------------------------|
| 1. Service Indicator | 4. Air cleaner assembly |
| 2. Adapter | 5. Vacuumator valve |
| 3. Bracket | |

-
- B. Ensure that the vacuumator valve (item 5 in [Figure 23](#)) is pointed down after installation.
2. Lower the hood and secure it with the latches.

Exhaust System



g222270

Figure 24

- | | | |
|---------------------------|-----------------------------|------------------|
| 1. Gasket | 4. Exhaust muffer | 7. Bolt (2 each) |
| 2. Upper alternator brace | 5. Flange nut (2 each) | 8. Muffer mount |
| 3. Flange nut (4 each) | 6. Hardened washer (4 each) | 9. Engine |

Removing the Exhaust System



CAUTION



A hot engine and exhaust system can cause burns.

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

1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.
2. Unlatch the hood and raise it.

Removing the Exhaust System (continued)

3. Remove the 2 bolts (item 7 in [Figure 24](#)), 4 hardened washers, and 2 flange nuts that secure the exhaust muffler to the muffler mount.
4. Remove the 4 flange nuts (item 3 in [Figure 24](#)) from the exhaust manifold studs.
5. Loosen the alternator bolt, and move the upper alternator brace away from the muffler.
6. Remove the exhaust muffler from the machine.
7. Remove and discard the gasket (item 1 in [Figure 24](#)).

Installing the Exhaust System

Note: Ensure that the exhaust muffler flange and engine exhaust manifold sealing surfaces are free of debris or damage that may prevent a tight seal.

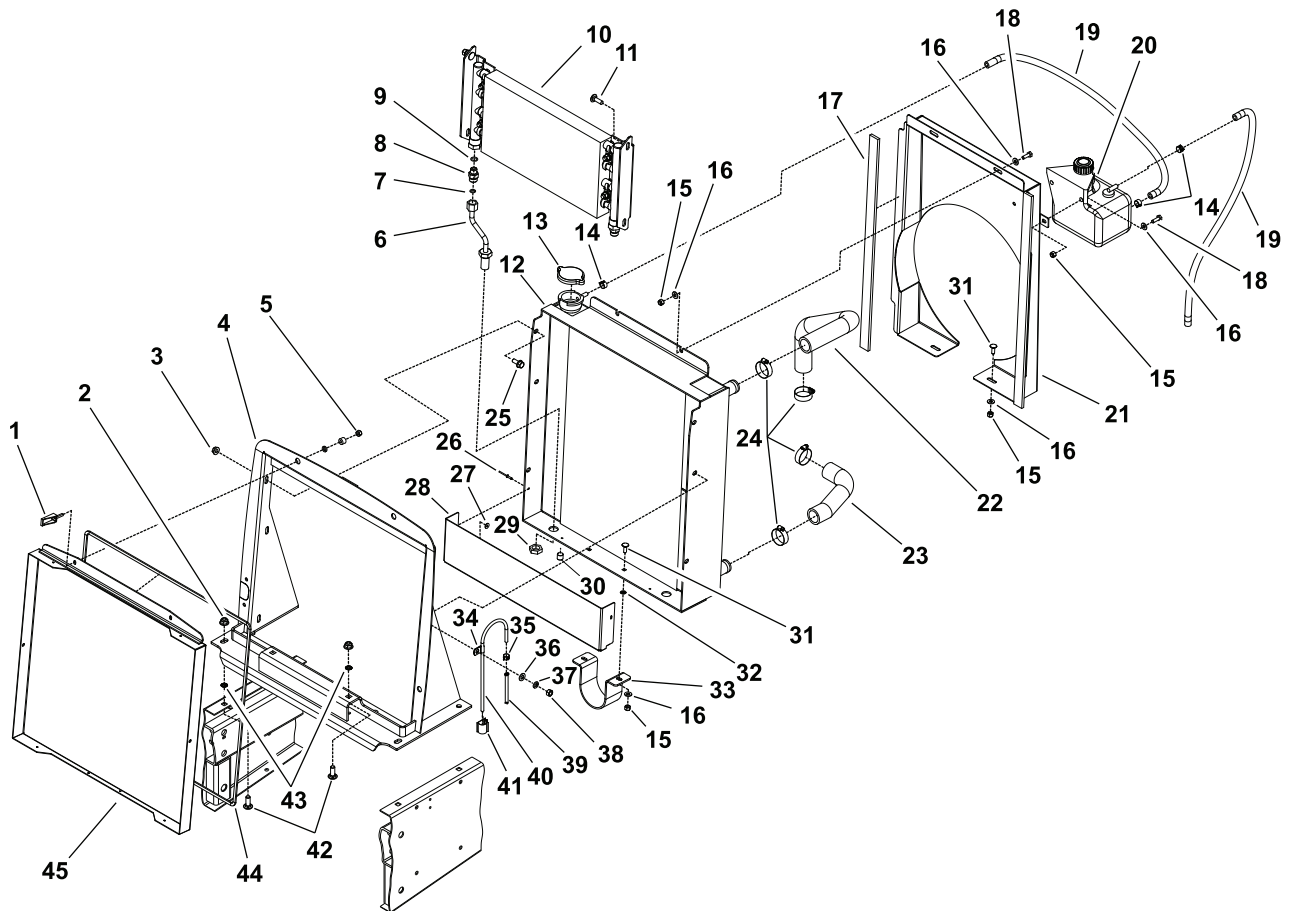
1. Place new gasket (item 1 in [Figure 24](#)) on the engine exhaust manifold.

IMPORTANT

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

2. Position the exhaust muffler and upper alternator brace to the engine exhaust manifold and loosely install the 4 flange nuts ([Figure 24](#)).
3. With the muffler flange tight to the engine exhaust manifold (no gaps visible), position the muffler so that the muffler is tight against the muffler mount (no gaps visible).
4. Tighten the 4 flange nuts to secure the muffler flange to the exhaust manifold.
5. Secure the exhaust muffler to the muffler mount with the 2 bolts (item 7 in [Figure 24](#)), 4 hardened washers, and 2 flange nuts.
6. Lower the hood and secure it with the latches.

Radiator



g221637

Figure 25

1. Swell latch (2 each)	13. Radiator cap	25. Flange-head screw (4 each)	37. Lock washer (6 each)
2. Flange nut (6 each)	14. Hose clamp (3 each)	26. Pop rivet (4 each)	38. Hex nut (6 each)
3. Flange nut (4 each)	15. Locknut (8 each)	27. Back washer (2 each)	39. Vent hose
4. Radiator frame	16. Flat washer (10 each)	28. Bottom radiator shield	40. Vent tube
5. Locknut (2 each)	17. Foam strip (2 each)	29. Bulkhead locknut (2 each)	41. Adhesive clamp
6. Hydraulic tube (2 each)	18. Bolt (4 each)	30. Pipe plug	42. Carriage screw (6 each)
7. O-ring (2 each)	19. Reservoir hose (2 each)	31. Carriage bolt (4 each)	43. Retaining ring (6 each)
8. Straight hydraulic fitting (2 each)	20. Coolant reservoir assembly	32. Retainer nut (2 each)	44. Foam seal
9. O-ring (2 each)	21. Fan shroud	33. Driveshaft loop	45. Radiator screen
10. Oil cooler assembly	22. Upper radiator hose	34. Clamp	
11. Carriage bolt (2 each)	23. Lower radiator hose	35. Hose clamp	
12. Radiator	24. Hose clamp (4 each)	36. Flat washer (6 each)	

Removing the Radiator

1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.
2. Unlatch the hood and raise it.



DANGER



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

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



WARNING



Ethylene-glycol antifreeze is poisonous.

Keep the coolant away from children and pets.

Keep the coolant in a labelled container.

Discard the coolant in accordance with local hazardous waste ordinances.

3. Drain the coolant from the radiator as follows:
 - A. Place a drain pan below the radiator pipe plug located at the bottom of the radiator. Ensure that the drain pan is large enough to hold the cooling system contents 7.6 L (8 US qt).
 - B. Remove the pipe plug and allow the coolant to drain from radiator.
-

IMPORTANT

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

4. Remove the radiator screen (item 45 in [Figure 25](#)) from the machine; refer to the *Operator's Manual*.
5. Remove the air cleaner inlet hose from the top of the radiator frame; refer to [Air Cleaner System \(page 4–7\)](#).
6. Disconnect the upper and lower radiator hoses (items 22 and 23 in [Figure 25](#)) from the radiator.
7. Loosen the hose clamp and remove the reservoir hose (item 19 in [Figure 25](#)) from the radiator fill opening.
8. Read the [General Precautions for Removing and Installing the Hydraulic System Components \(page 5–77\)](#).
9. Clean the hydraulic tube ends and oil cooler fittings to prevent hydraulic system contamination.
10. Disconnect the hydraulic tubes from the 2 straight hydraulic fittings (item 8 in [Figure 25](#)).
11. Cover or plug the hydraulic tubes to prevent contamination.

Removing the Radiator (continued)

12. Remove the 2 bolts, 2 flat washers, and 2 locknuts that secure the coolant reservoir assembly (item 20 in [Figure 25](#)) to the fan shroud. Carefully position the coolant reservoir away from the fan shroud.
13. Remove the 4 fasteners, 6 flat washers, and 4 locknuts that secure the fan shroud (item 21 in [Figure 25](#)) to the radiator. Position the fan shroud away from the radiator.
14. Support the radiator assembly before loosening the mounting fasteners.
15. Remove the oil cooler and radiator assembly from the radiator frame as follows:
 - A. Remove the 4 flange-head screws (item 25 in [Figure 25](#)) and 4 flange nuts.
 - B. Remove the 2 carriage bolts (item 11 in [Figure 25](#)), 2 lock washers, 2 plain washers, and 2 hex nuts.
 - C. Carefully remove the oil cooler and radiator assembly from the machine.
16. Cover or plug the openings in oil cooler and disconnected coolant and hydraulic tubes to prevent contamination from entering the system.
17. If necessary, remove the bottom radiator shield (item 28 in [Figure 25](#)) from the radiator.
18. If necessary, separate the oil cooler from the radiator as follows:
 - A. Remove the 4 lock washers, 4 plain 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 2 straight hydraulic fittings (item 8 in [Figure 25](#)) from the oil cooler as necessary and discard the O-rings from the fittings.
19. Inspect all foam seals on the radiator, fan shroud, and radiator frame. Replace any foam seals that are damaged.

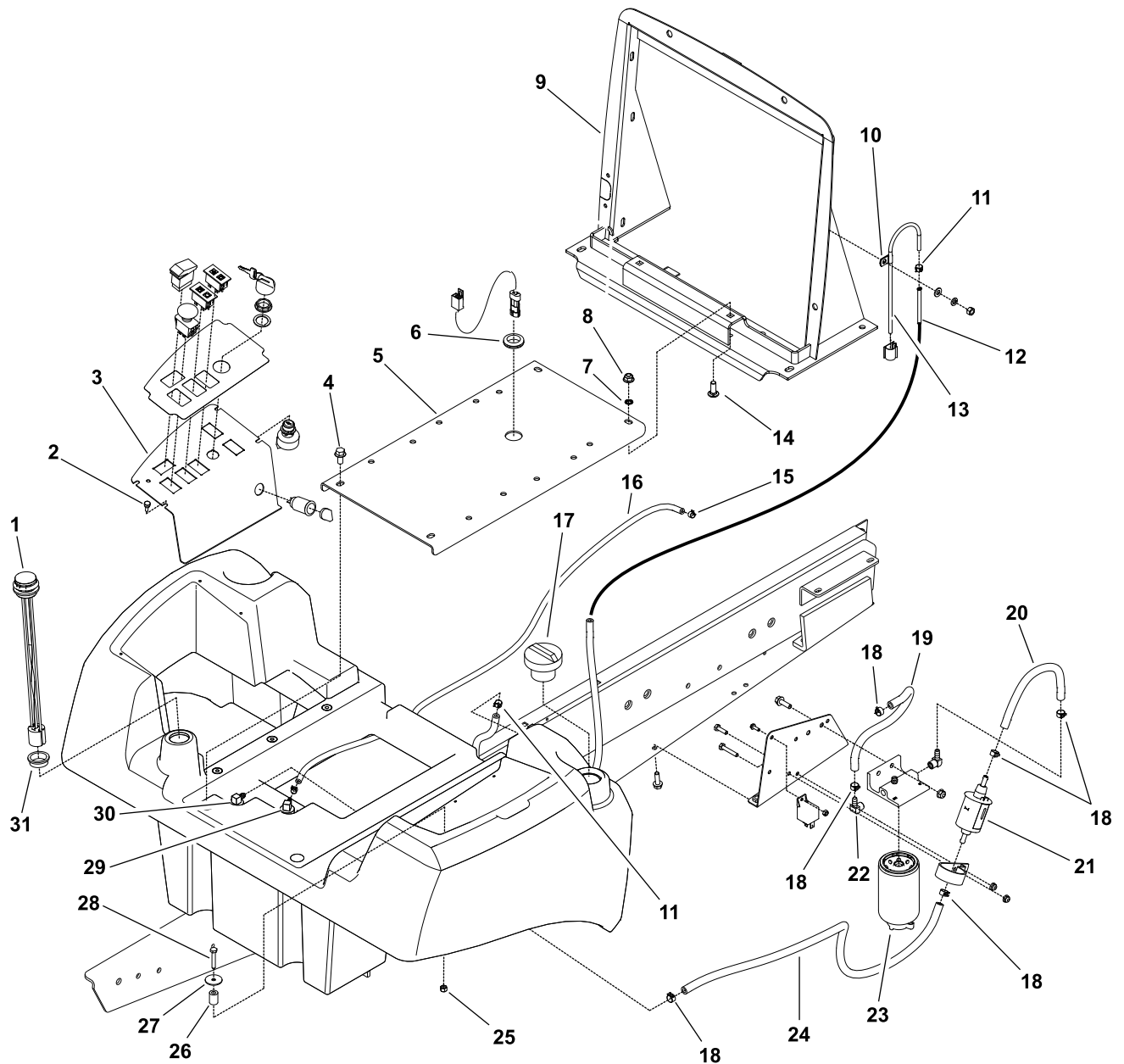
Installing the Radiator

1. If removed, install the bottom radiator shield to the radiator.
2. If separated, assemble the oil cooler to the radiator as follows:
 - A. If the 2 straight hydraulic fittings (item 8 in [Figure 25](#)) were removed from the oil cooler, lubricate and install new O-rings onto the fittings. Install the fittings into the oil cooler port openings and tighten the fittings; refer to [Installing the Hydraulic Fittings \(SAE Straight Thread O-Ring Fitting into the Component Port\)](#) (page 5–11).
 - B. Attach the oil cooler to the radiator with the 4 lock washers, 4 plain washers, and 4 hex nuts.
3. Install the oil cooler and radiator assembly to the radiator frame as follows:
 - A. Carefully position the oil cooler and radiator assembly to the radiator frame.
 - B. Secure the radiator to the frame with the 4 flange-head screws and 4 flange nuts.
 - C. Install the 2 carriage bolts, 2 lock washers, 2 plain washers, and 2 hex nuts that secure the oil cooler and radiator assembly to the radiator frame.

Installing the Radiator (continued)

4. Position the fan shroud (item 21 in [Figure 25](#)) to the radiator. Secure the fan shroud to the radiator with the 4 fasteners, 6 flat washers, and 4 locknuts. Ensure that at least **6.4 mm (0.250 inch)** clearance exists at all points between the fan shroud and the fan.
5. Position the coolant reservoir assembly (item 20 in [Figure 25](#)) to the fan shroud. Secure the coolant reservoir to the fan shroud with the 2 bolts, 2 flat washers, and 2 locknuts.
6. Remove the covers and plugs from the openings in the radiator and the oil cooler and the disconnected coolant and hydraulic tubes that were installed during removal.
7. Route the hydraulic tubes through the bottom radiator shield and secure with the bulkhead locknut. Lubricate the new O-rings and connect the tubes to the oil cooler.
8. Connect the upper and lower radiator hoses (items 22 and 23 in [Figure 25](#)) to the radiator and secure the hoses with the hose clamps.
9. Connect the reservoir hose (item 19 in [Figure 25](#)) to the radiator fill opening and secure the reservoir hose with the hose clamp.
10. Install and secure the air cleaner inlet hose; refer to [Air Cleaner System \(page 4–7\)](#).
11. Install the radiator pipe plug (item 30 in [Figure 25](#)) to the radiator. Fill the radiator with coolant; refer to the *Operator's Manual*.
12. Install the radiator screen (item 45 in [Figure 25](#)) to the machine; refer to the *Operator's Manual*.
13. Add hydraulic fluid to the transaxle reservoir as necessary to raise the hydraulic-fluid level to the operating range; refer to the *Operator's Manual*.
14. Start the engine and check for coolant and hydraulic fluid leaks. Repair any leaks as required before returning the machine to service.
15. Continue to run the engine to obtain the operating temperature. Check the coolant and hydraulic fluid levels and adjust as necessary.
16. Lower the hood and secure it with the latches.

Fuel System



g221626

Figure 26

1. Fuel gauge	9. Radiator frame	17. Fuel cap	25. Locknut
2. Thumb screw (4 each)	10. Clamp	18. Hose clamp (6 each)	26. Spacer
3. Control panel	11. Hose clamp	19. Fuel hose (separator to injector)	27. Flat washer
4. Flange-head screw (2 each)	12. Vent hose	20. Fuel hose (fuel pump to separator)	28. Bolt
5. Seat plate	13. Vent tube	21. Fuel pump	29. Elbow fitting (2 each)
6. Rubber grommet	14. Carriage screw (2 each)	22. Elbow fitting (2 each)	30. Stand pipe
7. Retaining ring (2 each)	15. Hose clamp (2 each)	23. Fuel/water separator	31. Grommet
8. Flange nut (2 each)	16. Fuel return hose	24. Fuel supply hose	



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.

Draining and Cleaning the Fuel Tank

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

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

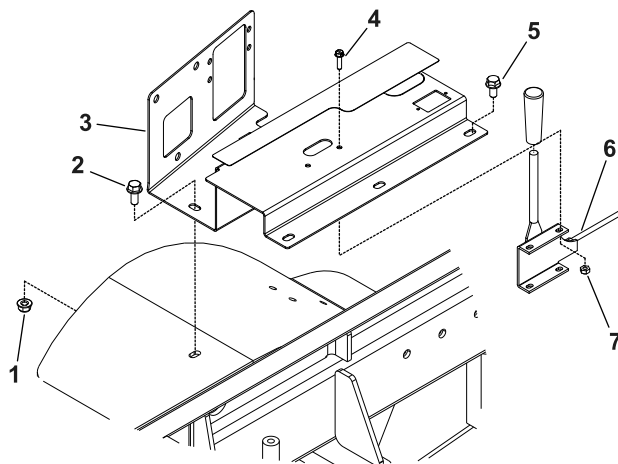
Priming the Fuel System

The fuel system needs to be primed before starting the engine for the first time, after running out of fuel, or after fuel system maintenance (e.g., draining the fuel/water separator, replacing the fuel filter or a fuel hose). To prime the fuel system, ensure that the fuel tank has fuel in it. 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 (or implement), 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. Unplug the seat switch from the machine wire harness.
6. Remove the seat and seat suspension from the machine; refer to [Operator Seat \(page 7–19\)](#).
7. Remove the seat plate (item 5 in [Figure 26](#)) from the machine.
8. Remove the 4 thumb screws (item 2 in [Figure 26](#)) that secure the control panel to the fuel tank. Unplug the wire harness connections from the panel components, and remove the panel from the machine.

Removing the Fuel Tank (continued)



g221627

Figure 27

- | | | |
|----------------------|-------------------------------|---------------------|
| 1. Flange nut | 4. Washer-head screw (2 each) | 7. Locknut (2 each) |
| 2. Flange-head screw | 5. Flange-head screw (3 each) | |
| 3. Console | 6. Throttle control | |

9. Remove the flange-head screws and flange nut that secure the lower control panel to the machine ([Figure 27](#)).
10. Remove the locknut (item 25 in [Figure 26](#)) from the left fender.
11. Use a fuel transfer pump to remove the fuel from the fuel tank and into a suitable container.
12. Loosen the hose clamps and carefully disconnect the fuel hoses from the standpipe and elbow fittings (items 30 and 29 in [Figure 26](#)) on the top of the fuel tank.
Note: Before removing the fuel hoses from the tank fittings, label the hoses for assembly purposes.
13. Cover or plug the fuel hoses or fitting openings to prevent contamination from entering the fuel system.
14. Remove the fuel tank as shown in [Figure 26](#).

Installing the Fuel Tank

1. Install the fuel tank to the frame ([Figure 26](#)).
2. Connect the fuel hoses to the standpipe and elbow fittings (items 30 and 29 in [Figure 26](#)) on the top of the fuel tank. Secure the fuel hoses with the hose clamps.
3. Secure the lower control panel to the machine with the flange-head screws and flange nuts ([Figure 27](#)).
4. Secure the tank to the left fender with a locknut (item 25 in [Figure 26](#)).
5. Position the control panel to the fuel tank, connect the wire harness to the panel components, and secure the panel to the machine with the 4 thumb screws.
6. Install the seat plate to the machine.
7. Install the seat suspension and seat to the machine; refer to [Operator Seat \(page 7–19\)](#).

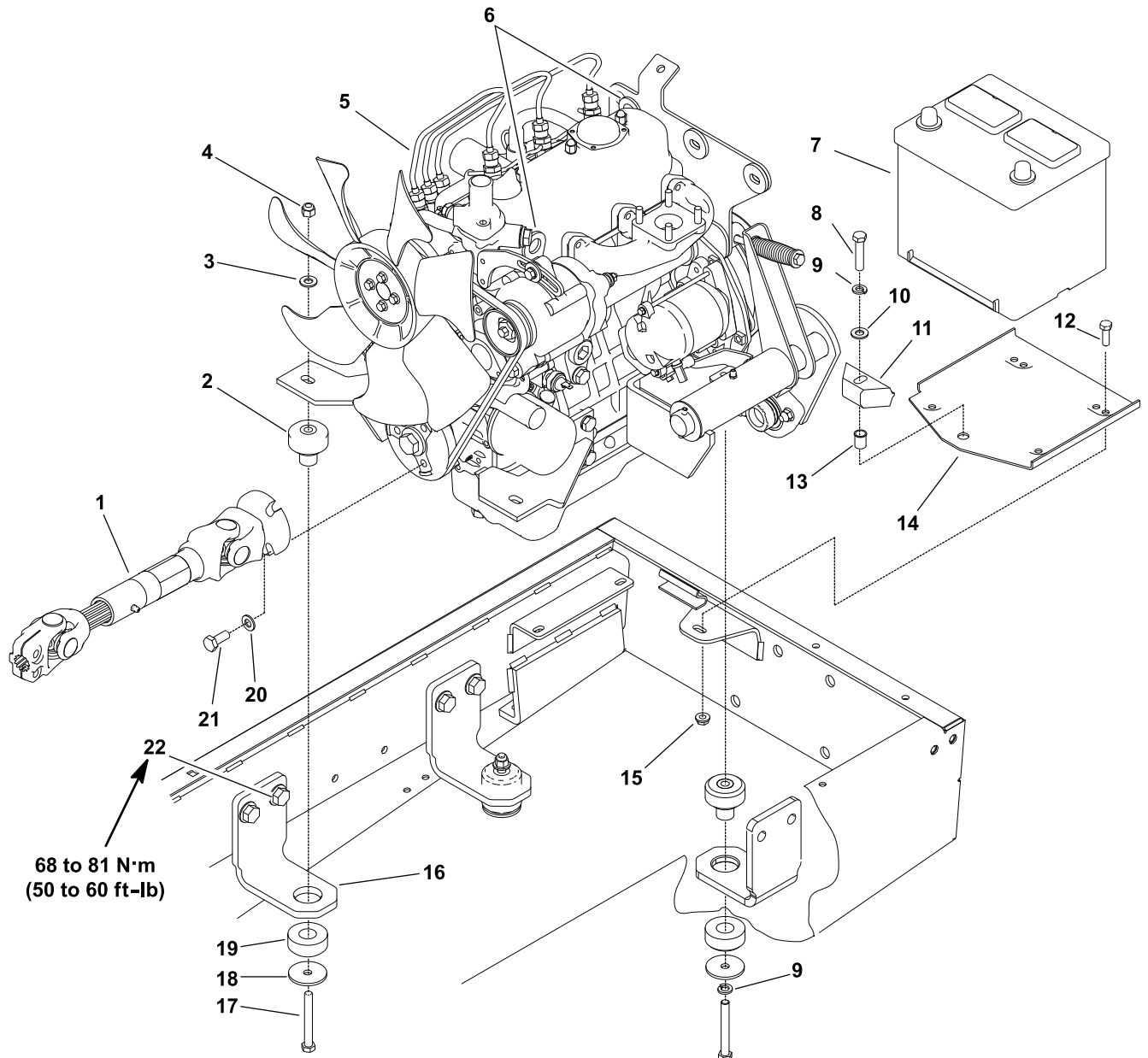
Installing the Fuel Tank (continued)

8. Connect the seat switch to the machine wire harness.
9. Connect the negative battery cable to the negative battery post.
10. Fill the fuel tank with clean fuel; refer to the *Operator's Manual*.
11. Prime the fuel system; refer to [Priming the Fuel System \(page 4–16\)](#).
12. Check the fuel hoses and fittings for leaks.

Note: Repair all fuel leaks before returning the machine to service.

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

Engine



g222271

Figure 28

- | | | |
|--------------------------------------|-----------------------------------|---------------------------------------|
| 1. Driveshaft assembly | 9. Lock washer (2 each) | 17. Bolt (4 each) |
| 2. Upper engine shock mount (4 each) | 10. Flat washer | 18. Rebound washer (4 each) |
| 3. Flat washer (3 each) | 11. Battery retainer | 19. Lower engine shock mount (4 each) |
| 4. Locknut (3 each) | 12. Bolt (3 each) | 20. Flat washer (3 each) |
| 5. Engine | 13. Threaded insert | 21. Bolt (3 each) |
| 6. Lift tabs | 14. Battery base | 22. Flange-head screw (8 each) |
| 7. Battery | 15. Flange nut (3 each) | |
| 8. Bolt | 16. Engine mount bracket (4 each) | |

Removing the Engine

1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.
2. Unlatch the hood and raise it.
3. Disconnect both the battery cables at the battery. Disconnect the negative battery cable and then the positive battery cable.
4. Remove the battery from the machine; refer to [Servicing the Battery \(page 6–80\)](#).
5. Remove the 3 bolts (item 12 in [Figure 28](#)) and 3 flange nuts that secure the battery base to the brackets, and remove the battery base from the machine.



DANGER



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

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



WARNING



Ethylene-glycol antifreeze is poisonous.

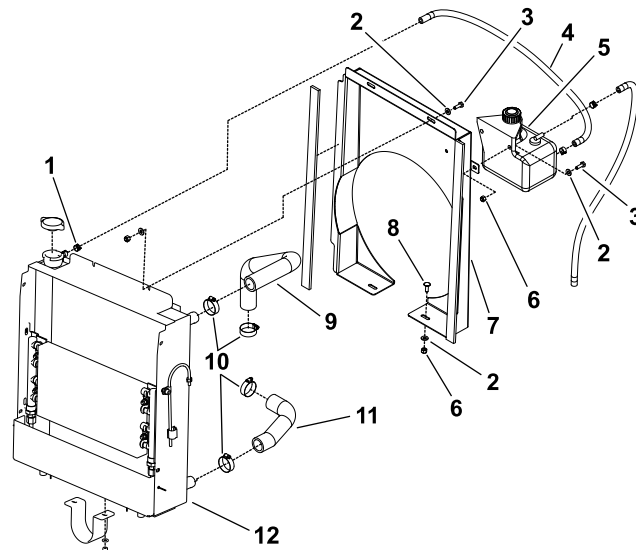
Keep the coolant away from children and pets.

Keep the coolant in a labelled container.

Discard the coolant in accordance with local hazardous waste ordinances.

6. Drain the coolant from the radiator; refer to the *Operator's Manual*.

Removing the Engine (continued)



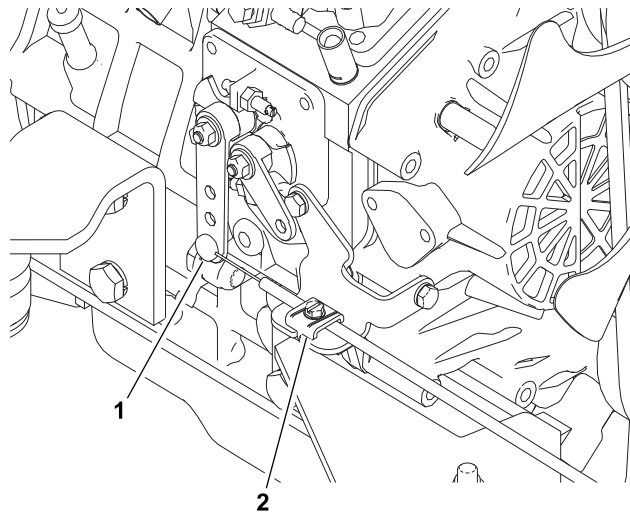
g221629

Figure 29

- | | | |
|-------------------------|-------------------------------|-------------------------|
| 1. Hose clamp | 5. Coolant reservoir assembly | 9. Upper radiator hose |
| 2. Flat washer (8 each) | 6. Locknut (6 each) | 10. Hose clamp (4 each) |
| 3. Bolt (4 each) | 7. Fan shroud | 11. Lower radiator hose |
| 4. Reservoir hose | 8. Carriage bolt (2 each) | 12. Radiator |

- Loosen the hose clamp and remove the reservoir hose from the radiator fill opening ([Figure 29](#)), and remove the coolant reservoir assembly from the radiator fan shroud.
- Remove the 4 fasteners, 6 flat washers, and 4 locknuts that secure the fan shroud to the radiator ([Figure 29](#)). Position the fan shroud away from the radiator.
- Remove the PTO shaft from the machine; refer to [Removing the PTO Shaft \(page 9–8\)](#).
- Remove the exhaust muffler from the engine; refer to [Exhaust System \(page 4–9\)](#).
- Remove the air cleaner assembly from the machine; refer to [Air Cleaner System \(page 4–7\)](#).

Removing the Engine (continued)



g221630

Figure 30

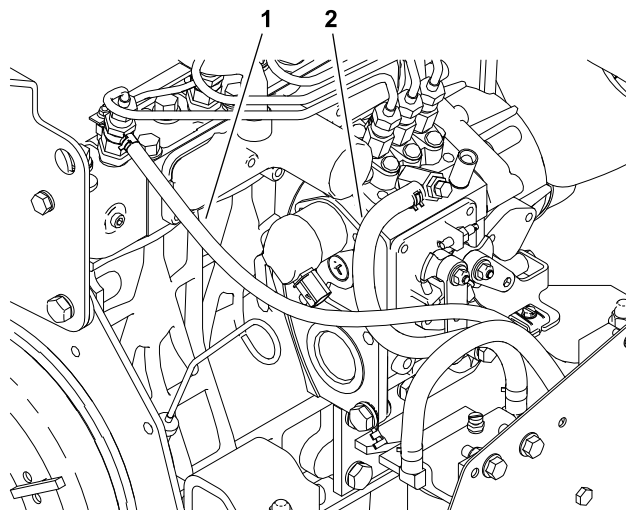
1. Cable end
2. Cable clamp

12. Remove the throttle cable from the injector pump (Figure 30) as follows:

- A. Remove the retaining ring that secures the throttle cable end to the injector pump control arm.
- B. Loosen the throttle cable clamp and remove the throttle cable from the injector pump.
- C. Position the throttle cable away from the engine.

13. Disconnect the hoses from the engine as follows:

- A. Loosen the hose clamps and remove the upper and lower radiator hoses (items 9 and 11 in Figure 29) from the engine.



g221631

Figure 31

1. Fuel return hose
2. Fuel supply hose

- B. For assembly purposes, label the fuel hoses. At injector pump, loosen the hose clamps and disconnect the fuel supply and return hoses from the pump fittings (Figure 31).

Removing the Engine (continued)

- C. Cover or plug the fuel hoses and pump fittings openings to prevent contamination. Position the disconnected hoses away from the engine.
- 14. Remove the hydraulic pump/transmission driveshaft; refer to [Removing the Hydraulic Pump Driveshaft \(page 5–97\)](#) or [Removing the Transmission Driveshaft \(page 5–87\)](#).
- 15. Remove the cotter pin and clevis pin that secure the hood cable to the muffler mount. Support the hood in open position.

IMPORTANT

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

- 16. For assembly purposes, note the location of the cable ties used to secure the wire harness to the machine. Disconnect the wires and/or electrical connections from the following engine electrical components:
 - A. Alternator connector and stud.
 - B. Oil pressure switch located near the engine oil filter.
 - C. Connector, fusible link connector, and positive battery cable from the starter motor.
 - D. High temperature shut down switch and temperature sender located on the water pump housing.
 - E. Fuel stop solenoid on the injector pump.
 - F. Negative battery cable from the injector pump.
 - G. Glow plug strip.
 - H. PTO clutch wire connector.



CAUTION



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

Use hoist equipment rated to lift the engine, which is approximately 93 kg (205 lb).

- 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.
- 18. Remove the fasteners that secure the engine (with brackets) to the engine shock mounts and engine mount brackets ([Figure 28](#)).



CAUTION



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

Removing the Engine (continued)

IMPORTANT

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

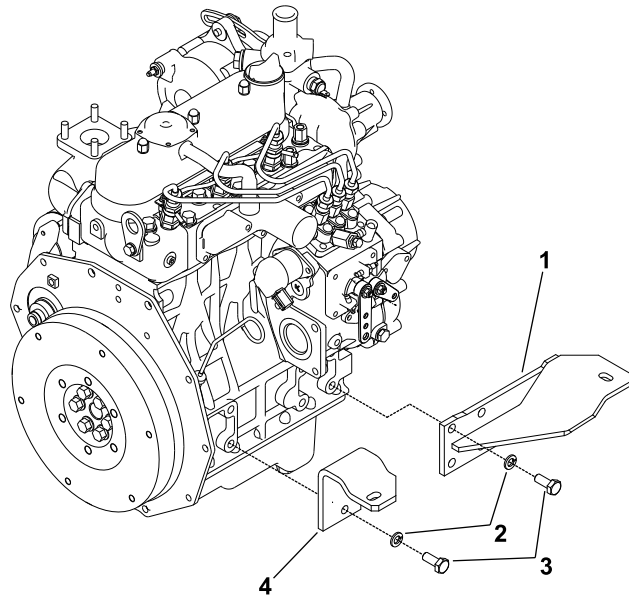
19. Carefully raise the engine and remove from the machine.
20. If necessary, remove the engine brackets from the engine ([Figure 32](#) and [Figure 33](#)).

Installing the Engine

IMPORTANT

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

1. Locate the machine on a level surface with the cutting deck (or implement) lowered and the key removed from the key switch. Block the wheels with chocks to prevent the machine from moving.

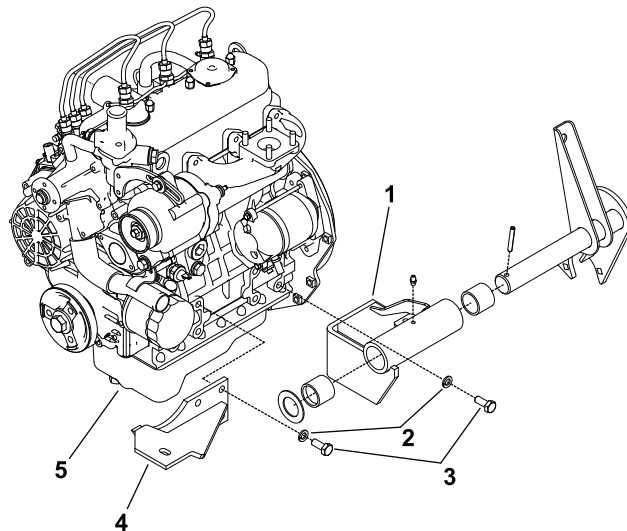


g221632

Figure 32

- | | |
|-------------------------------|------------------------------|
| 1. Right front engine bracket | 3. Bolt (6 each) |
| 2. Lock washer (6 each) | 4. Right rear engine bracket |
-

Installing the Engine (continued)



g221633

Figure 33

- | | |
|-----------------------------|------------------------------|
| 1. Left rear engine bracket | 4. Left front engine bracket |
| 2. Lock washer (8 each) | 5. Engine |
| 3. Bolt (8 each) | |

2. If the engine brackets were removed from the engine, install the brackets to the engine (Figure 32 and Figure 33).



3. If the engine mount brackets (item 16 in Figure 28) were removed from the frame, secure the mount brackets to the frame with the bolts. Torque the bolts to **68 to 81 N·m (50 to 60 ft-lb)**.

4. Position the fan shroud around the engine fan.



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 93 kg (205 lb).

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.



CAUTION



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

IMPORTANT

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

6. Carefully lower the engine to the machine frame. Ensure that the fastener holes of the engine brackets are aligned with the holes in the upper and lower engine shock mounts (items 2 and 19 in [Figure 28](#)).
7. Secure the engine to the engine mount brackets (item 16 in [Figure 28](#)).
8. Install the clevis pin and cotter pin to secure the hood cable to the muffler mount.
9. Install the hydraulic pump/transmission driveshaft; refer to [Installing the Hydraulic Pump Driveshaft \(page 5–98\)](#) or [Installing the Transmission Driveshaft \(page 5–89\)](#).
10. Connect all the wire harness connectors to the following engine components:
 - A. Alternator connector and stud.
 - B. Oil pressure switch located near the engine oil filter.
 - C. Connector, fusible link connector, and positive battery cable to the starter motor.
 - D. High temperature shut down switch and temperature sender located on the water pump housing.
 - E. Fuel stop solenoid on the injector pump.
 - F. Negative battery cable to the injector pump.
 - G. Glow plug strip.
 - H. PTO clutch wire connector.
11. Use the notes that you recorded during removal, secure the wires with cable ties in proper locations.
12. Remove all of the covers and plugs from the hoses and engine openings that you placed while removing the engine. Connect the hoses to the engine as follows:
 - A. Use the labels that you attached during removal to correctly connect the fuel supply and return hoses to the injector pump fittings ([Figure 31](#)). Secure the fuel hoses with the hose clamps.
 - B. Connect the upper and lower radiator hoses (items 9 and 11 in [Figure 29](#)) to the engine. Secure the radiator hoses with the hose clamps.
13. Connect the throttle cable to the injector pump as follows ([Figure 30](#)):
 - A. Route the throttle cable to the injector pump on the engine.
 - B. Install the throttle cable end into the lowest hole on the injector pump control arm. Secure the cable end with a retaining ring.
 - C. Position the cable under the cable clamp.
 - D. Adjust the throttle control; refer to [Adjusting the Throttle Control \(page 4–6\)](#).
14. Install the air cleaner assembly; refer to [Air Cleaner System \(page 4–7\)](#).
15. Install the exhaust muffler to the engine; refer to [Exhaust System \(page 4–9\)](#).

IMPORTANT

Ensure that the clutch pulley and PTO pulley are aligned during PTO shaft installation.

16. Install the PTO shaft to the machine; refer to [Installing the PTO Shaft \(page 9–9\)](#).
17. Position the fan shroud to the radiator. Ensure that a minimum of **6.4 mm (0.25 inch)** clearance exists at all points between the shroud and the fan. Secure the fan shroud to the radiator with the 4 fasteners, 6 flat washers, and 4 locknuts ([Figure 29](#)).
18. Install the coolant reservoir assembly to the bracket on the radiator fan shroud ([Figure 29](#)). Install the reservoir hose to the radiator fill opening and secure with the hose clamp.
19. Add coolant to the radiator; refer to the *Operator's Manual*.
20. Position the battery base to the brackets and secure with the 3 bolts (item 12 in [Figure 28](#)) and 3 flange nuts.
21. Install the battery to the machine; refer to [Servicing the Battery \(page 6–80\)](#).
22. Connect both the battery cables to the battery. Connect the positive battery cable and then the negative battery cable.
23. Ensure that all the wires, fuel lines, hydraulic hoses, and cables are clear of moving parts and secured to their original locations.
24. Check the engine-oil level and adjust as necessary; refer to the *Operator's Manual*.
25. Prime the fuel system; refer to [Priming the Fuel System \(page 4–16\)](#).
26. Start the engine and operate the hydraulic controls to properly fill the hydraulic and engine coolant systems; refer to [Charging the Hydraulic System \(page 5–85\)](#) and refer to proper coolant fill procedure.
27. Lower the hood and secure it with the latches.



Table of Contents

Specifications	5-3
Groundsmaster 3280-D and 3320-G	5-3
General Information	5-4
Checking the Hydraulic Fluid	5-4
Pushing or Towing the Traction Unit	5-5
Releasing Pressure from the Hydraulic System	5-6
Traction Circuit Component Failure	5-7
Hydraulic Hoses	5-8
Installing the Hydraulic Hose and Tube (O-Ring Face Seal Fitting)	5-9
Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fitting into the Component Port)	5-11
Hydraulic Schematics	5-15
Hydraulic Flow Diagrams	5-19
Traction Circuit (Machine Serial Number below 316000000)	5-19
Traction Circuit (Machine Serial Number above 316000000)	5-24
Lift Circuit (Machine Serial Number below 311000000)	5-27
Lift Circuit (Machine Serial Number above 311000000)	5-31
Steering Circuit (Machine Serial Number below 316000000)	5-35
Steering Circuit (Machine Serial Number above 316000000)	5-37
Special Tools	5-39
Hydraulic Pressure Testing Kit	5-39
15 GPM Hydraulic Tester Kit (Pressure and Flow)	5-39
40 GPM Hydraulic Tester (Pressure and Flow)	5-40
Hydraulic Hose Kit	5-40
Hydraulic Test Fitting Kit	5-41
O-Ring Kit	5-42
High Flow Hydraulic Filter Kit	5-42
Remote Starter Switch	5-43
Troubleshooting	5-44
General Hydraulic System Problems	5-44
Traction Circuit Problems	5-45
Lift/Lower Circuit Problems	5-46
Steering Circuit Problems	5-46
Testing the Hydraulic System	5-47
Charge Pressure Test (Using Pressure Gauge) (Machine Serial Numbers below 316000000)	5-49
Implement Relief Pressure Test (Using Pressure Gauge) (Machine Serial Numbers below 316000000)	5-51
Lift Cylinder Internal Leakage Test (Machine Serial Numbers below 316000000)	5-53
Steering Cylinder Internal Leakage Test (Machine Serial Numbers below 316000000)	5-55
Charge Pump Flow Test (Using Tester With Pressure Gauges and Flow Meter) (Machine Serial Numbers below 316000000)	5-57
Testing the Traction Circuit—Charge Pressure (Machine Serial Numbers above 316000000)	5-59
Testing the Traction Circuit—Hydraulic Pump Flow and Relief Pressure (Machine Serial Numbers above 316000000)	5-62
Testing the Steering Circuit—Steering Control Valve, Relief Valve Pressure, and Steering Cylinder (Machine Serial Numbers above 316000000)	5-66

Testing the Steering Circuit–Charge Pump Flow (Machine Serial Numbers above 316000000).....	5–69
Testing the Lift Circuit–Lift Cylinder Internal Leakage (Machine Serial Numbers above 316000000).....	5–72
Adjustments	5–75
Traction Pedal Friction Wheel (Machine Serial Number below 316000000).....	5–75
Service and Repairs	5–77
General Precautions for Removing and Installing the Hydraulic System Components	5–77
Checking the Hydraulic Lines and Hoses	5–78
Priming the Hydraulic Pump.....	5–79
Flushing the Hydraulic System.....	5–80
Filtering the Closed-Loop Traction Circuit (Machine Serial Number above 316000000).....	5–82
Charging the Hydraulic System.....	5–85
Transmission Driveshaft (Machine Serial Numbers below 316000000).....	5–87
Hydrostatic Transmission (Machine Serial Numbers below 316000000)	5–90
Servicing the Hydrostatic Transmission (Machine Serial Numbers below 316000000)	5–93
Hydrostatic Transmission Neutral Arm Assembly (Machine Serial Number below 316000000).....	5–95
Hydraulic Pump Driveshaft (Machine Serial Number above 316000000)	5–97
Hydraulic Pump (Machine Serial Number above 316000000)	5–100
Servicing the Hydraulic Pump (Machine Serial Number above 316000000)	5–103
Traction Neutral Arm Assembly (Machine Serial Number above 316000000).....	5–105
Front Axle Drive Motor (Machine Serial Number above 316000000)	5–107
Servicing the Front Axle Drive Motor (Machine Serial Number above 316000000)	5–109
Lift Cylinder	5–110
Steering Control Valve	5–113
Servicing the Steering Control Valve	5–116
Steering Cylinder (2-Wheel Drive).....	5–117
Servicing the Steering Cylinder (2-Wheel Drive)	5–120
Steering Cylinder (4-Wheel Drive).....	5–123
Servicing the Steering Cylinder (4-Wheel Drive)	5–125
Lift Control Valve (Machine Serial Numbers below 316000000)	5–127
Servicing the Lift Control Valve (Machine Serial Numbers below 311000000).....	5–130
Counterbalance Valve Manifold (Machine Serial Numbers below 311000000) (If Equipped).....	5–133
Lift Control Valve (Machine Serial Number above 311000000).....	5–136
Servicing the Lift Control Valve (Machine Serial Number above 311000000).....	5–139
Oil Cooler (Groundsmaster 3280-D)	5–142

Additional Reference Materials

DANFOSS DDC20 AXIAL PISTON PUMP SERVICE MANUAL

DANFOSS SERIES 15 AXIAL PISTON PUMPS, MOTORS AND TRANSMISSIONS REPAIR MANUAL

DANFOSS SERIES 15 AXIAL PISTON PUMPS, MOTORS AND TRANSMISSIONS SERVICE MANUAL

EATON MODEL 74111 AND 74118 FIXED AXIAL PISTON MOTOR REPAIR INFORMATION DANFOSS

STEERING UNIT TYPE OSPM SERVICE MANUAL

Specifications

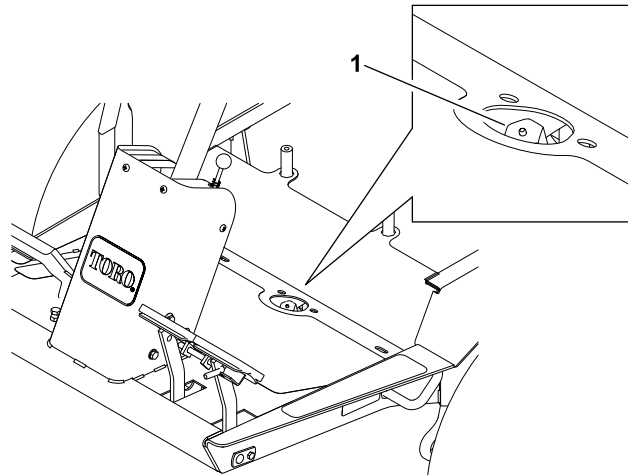
Groundsmaster 3280-D and 3320-G

Item	Description
Hydrostatic transmission (Machine Serial Number below 316000000)	Danfoss Series 15 U Style Axial Piston Transmission Gerotor Pump in Hydrostat Danfoss, DDC20 Axial Piston Pump Eaton 74118 Fixed Axial Piston Motor
Charge pump (Machine Serial Number below 316000000)	
Hydraulic pump (Machine Serial Number above 316000000)	
Hydraulic motor (Machine Serial Number above 316000000)	
Maximum pump displacement (per revolution)	
For Machine Serial Number below 316000000	15 cm ³ (0.9 in ³)
For Machine Serial Number above 316000000	20.3 cm ³ (1.24 in ³)
Traction circuit relief pressure (forward and reverse)	
For Machine Serial Number below 316000000	55,156 kPa (800 psi)
For Machine Serial Number above 316000000	32,495 kPa (4,713 psi)
Motor Displacement (per revolution)	
For Machine Serial Number below 316000000	15 cm ³ (0.9 in ³)
For Machine Serial Number above 316000000	20.3 cm ³ (1.24 in ³)
Charge pump displacement (per revolution)	
For Machine Serial Number below 316000000	4.9 cm ³ (0.3 in ³)
For Machine Serial Number above 316000000	5.4 cm ³ (0.33 in ³)
Charge pressure	
For Machine Serial Number below 316000000	482 to 1,034 kPa (70 to 150 psi)
For Machine Serial Number above 316000000	503 kPa (73 psi)
Steering valve	Danfoss Steering Unit, Type OSPM
Displacement (per revolution)	80 cm ³ (4.88 in ³)
Steering circuit relief pressure	
For Machine Serial Number below 316000000	5,515 kPa (800 psi)
For Machine Serial Number above 316000000	7,239 kPa (1,050 psi)
Lift control valve	
For Machine Serial Number below 316000000	Spool Type Directional Control Valve with Adjustable External Counterbalance Valve
For Machine Serial Number above 316000000	Spool Type Directional Control Valve with Adjustable Internal Counterbalance Valve
Counterbalance pressure (Machine Serial Number below 316000000)	Refer to the <i>Traction Unit Operator's Manual</i>
Lift circuit relief pressure	
For Machine Serial Number below 316000000	5,515 kPa (800 psi)
For Machine Serial Number above 316000000	690 kPa (100 psi)
Hydraulic filter	25 Micron spin-on cartridge type
Hydraulic fluid	Refer to the <i>Traction Unit Operator's Manual</i>
Hydraulic reservoir (front axle) capacity	5.7 L (1.5 US gallons)

General Information

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

Checking the Hydraulic Fluid



g224909

Figure 34

1. Hydraulic reservoir dipstick



The hydraulic system on your machine is designed to operate on high quality hydraulic fluid. The front axle housing acts as the hydraulic system reservoir and it holds approximately 5.7 L (1.5 US gallons) of hydraulic fluid ([Figure 34](#)). Refer to the *Operator's Manual* for the procedure on checking the hydraulic-fluid level and hydraulic fluid recommendations.

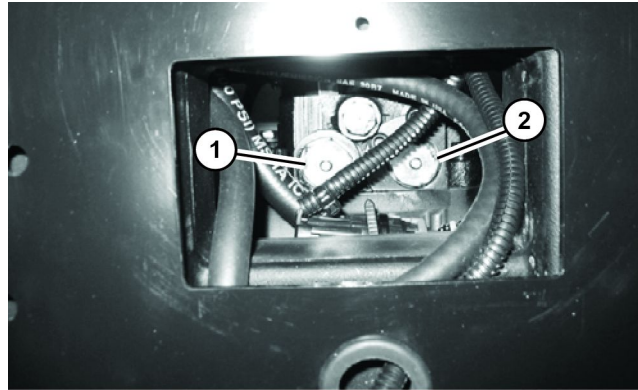
IMPORTANT

Check the hydraulic-fluid level daily.

Pushing or Towing the Traction Unit

IMPORTANT

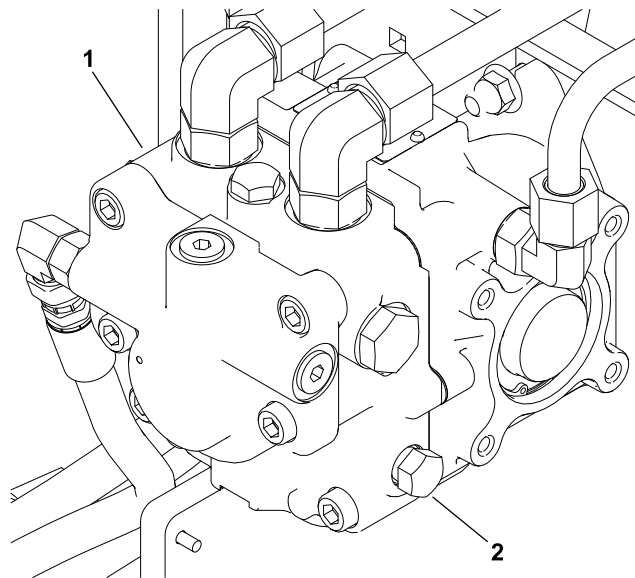
If towing limits are exceeded, severe damage to the hydraulic pump may occur.



g230813

Figure 35

1. Check valve location



g224908

Figure 36

1. Hydraulic pump (for Models 30344 and 30345)
2. Bypass valve

If it becomes necessary to tow or push the machine, tow or push at a speed below 4.8 km/h (3mph), and for a very short distance. If you must move the machine a considerable distance (more than a few feet), transport it on a truck or trailer. The transmission is equipped with two check valves that need to be pressed for towing or pushing (Figure 35). The hydraulic pump is equipped with a bypass valve that needs to be loosened for towing or pushing (Figure 36). Refer to the *Traction Unit Operator's Manual* for towing procedures.

Releasing Pressure from the Hydraulic System

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

System pressure in the cutting circuit is released when the cutting deck is disengaged.

Releasing the Hydraulic Pressure from the Traction Circuit

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.
4. Move the traction pedal in both the forward and reverse direction.

Releasing the Hydraulic Pressure from the Lift Circuit

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

Releasing the Hydraulic Pressure from the Steering Circuit

1. Park the machine on a level surface.
2. Lower the cutting deck.
3. Turn the key switch to the OFF position and allow the engine to stop.
4. After the engine has come to a complete stop, rotate the steering wheel in both directions.

Traction Circuit Component Failure

The traction circuit of the Groundsmaster 3280-D and 3320 machines is a closed loop system that includes the hydraulic pump and hydraulic motor. If a component failure occurs in the traction circuit (e.g., hydraulic pump or hydraulic 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 \(page 5–42\)](#). Use a high flow hydraulic-fluid filter when you connect hydraulic test gauges in order to test the traction circuit components or after you replace a failed traction circuit component (e.g., hydraulic pump or hydraulic motor). Using a high flow hydraulic-fluid filter will remove contaminants from the hydraulic fluid in the traction circuit, thereby preventing additional component damage.

After you have installed the Toro high flow hydraulic-fluid filter in the traction circuit, raise and support the machine with all the drive wheels off the ground. Then, operate the traction circuit to allow the hydraulic fluid to flow through the circuit. The filter removes contamination from the traction circuit during the circuit operation. Because the Toro high flow filter is bi-directional, the traction circuit can be operated in both the forward and reverse direction. When you are certain that the filter has removed the contaminants from the hydraulic fluid of the traction circuit, remove the filter. Refer to [Filtering the Closed-Loop Traction Circuit \(Machine Serial Number above 316000000\) \(page 5–82\)](#) 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.

Note: The hydraulic pump case drain could allow traction circuit contamination to contaminate other hydraulic circuits on the machine.

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 5–9).

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

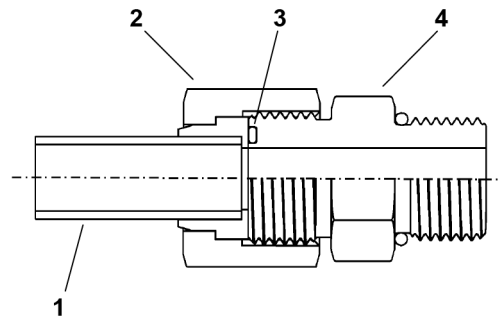


Release all pressure in the hydraulic system before performing any work on the system; refer to [Releasing Pressure from the Hydraulic System](#) (page 5–6).

- **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.
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.



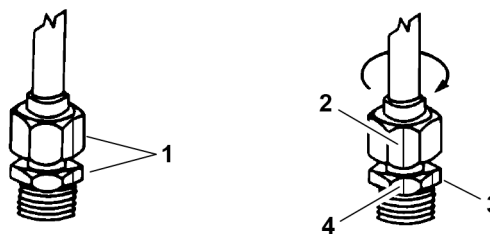
g221221

Figure 37

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

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 37).
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 \(page 5–10\)](#). 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 \(page 2–7\)](#).



g221222

Figure 38

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

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 38).



- A. Use a wrench to tighten the swivel nut onto the fitting until you feel light resistance with the wrench—approximately **3.39 N·m (30 in-lb)**.
- B. Put a mark on the swivel nut and body of the fitting. Hold the hose/tube in alignment with a wrench to prevent the hose/tube from turning.

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

- C. Use a second wrench to tighten the nut to the correct Flats From Wrench Resistance (FFWR); refer to the [Flats From Wrench Resistance Table](#) (page 5–10).

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)

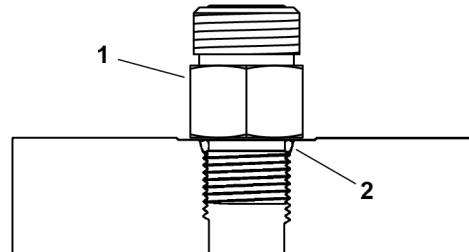
Flats From Wrench Resistance Table

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

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.



g221223

Figure 39

1. Fitting
2. O-ring

-
3. Lightly lubricate the O-ring with clean hydraulic fluid. Ensure that the threads of the fitting are clean with no lubricant applied ([Figure 39](#)).

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 \(page 5–12\)](#).

Note: It may be necessary to use a drive-adapter wrench (e.g., crowfoot wrench) to install a hydraulic fitting; refer to [Calculating the Torque Values When Using a Drive-Adapter Wrench \(page 2–7\)](#).

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 \(page 5–12\)](#) 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.

Installing the Non-Adjustable Fittings (continued)

Fitting Installation Torque Table

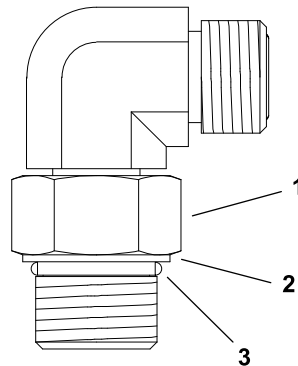
Fitting Dash Size	Fitting Port Side Thread Size (inch(es) - threads per inch)	Installation Torque Into Steel Port	Installation Torque Into Aluminum Port
4	7/16—20	21 to 25 N·m (15 to 19 ft-lb)	13 to 15 N·m (9 to 11 ft-lb)
5	1/2—20	25 to 29 N·m (18 to 22 ft-lb)	15 to 20 N·m (11 to 15 ft-lb)
6	9/16—18	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
12 (3/4 inch)	1.50 ± 0.25
16 (1 inch)	1.50 ± 0.25

Installing an Adjustable Fitting

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.

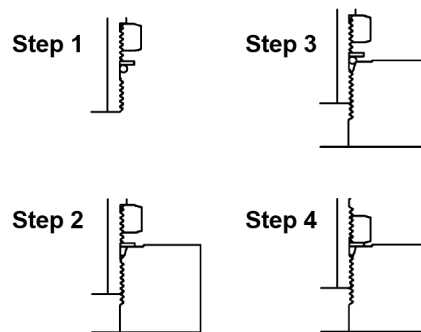


g221224

Figure 40

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

3. Lightly lubricate the O-ring with clean hydraulic fluid. Ensure that the threads of the fitting are clean with no lubricant applied.



g221225

Figure 41

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 41](#)).

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 41](#)).
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 41](#)). Do not rotate the adjustable fitting more than 1 turn counterclockwise.

Installing an Adjustable Fitting (continued)

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 \(page 5–12\)](#). This tightening procedure requires a drive-adapter wrench (e.g., crowfoot wrench).

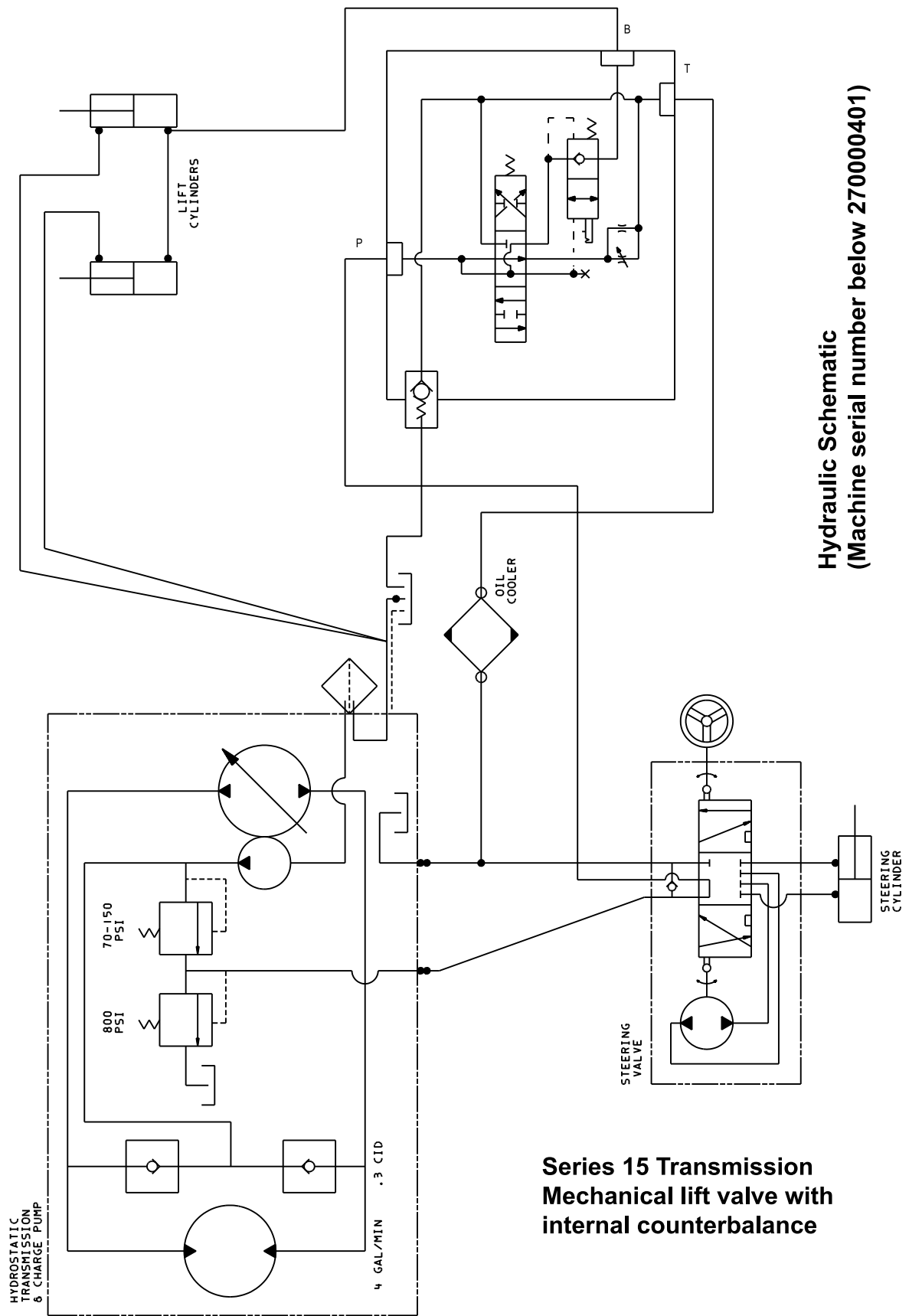
Note: It may be necessary to use a drive-adapter wrench (e.g., crowfoot wrench) to install a hydraulic fitting; refer to [Calculating the Torque Values When Using a Drive-Adapter Wrench \(page 2–7\)](#).

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 \(page 5–14\)](#) 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 41](#)).
 - B. If the port material is aluminum, tighten the fitting to 60% of the listed FFFT; refer to the [Flat From Finger Tight Table \(page 5–14\)](#).

Flat From Finger Tight Table

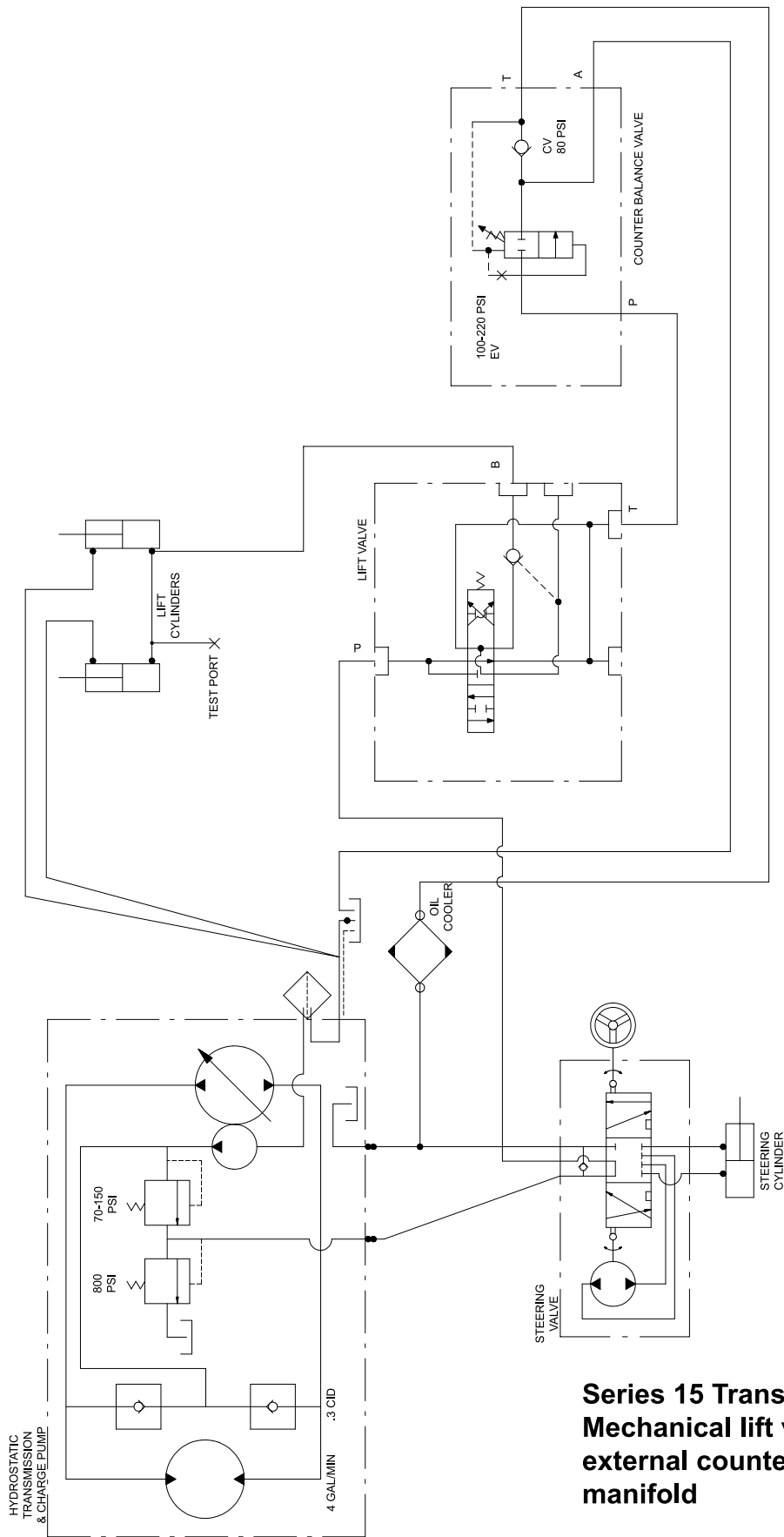
Size	FFFT
4 (1/4 inch nominal hose or tubing)	1.00 ± 0.25
6 (3/8 inch)	1.50 ± 0.25
8 (1/2 inch)	1.50 ± 0.25
10 (5/8 inch)	1.50 ± 0.25
12 (3/4 inch)	1.50 ± 0.25
16 (1 inch)	1.50 ± 0.25

Hydraulic Schematics



g243932

Figure 42

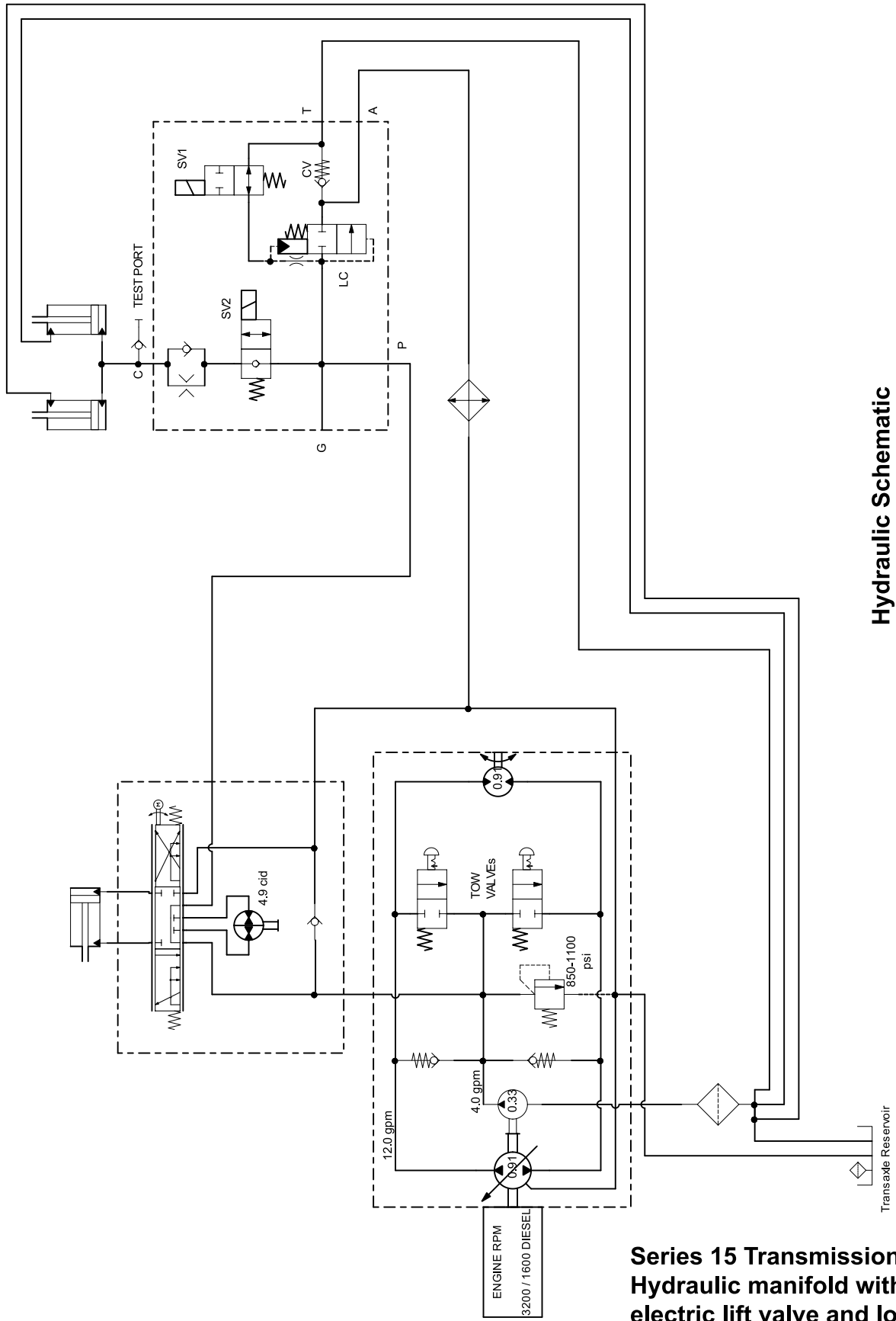


**Series 15 Transmission
Mechanical lift valve with
external counterbalance
manifold**

**Hydraulic Schematic
(Machine serial number 270000401 to 311000000)**

g229581

Figure 43



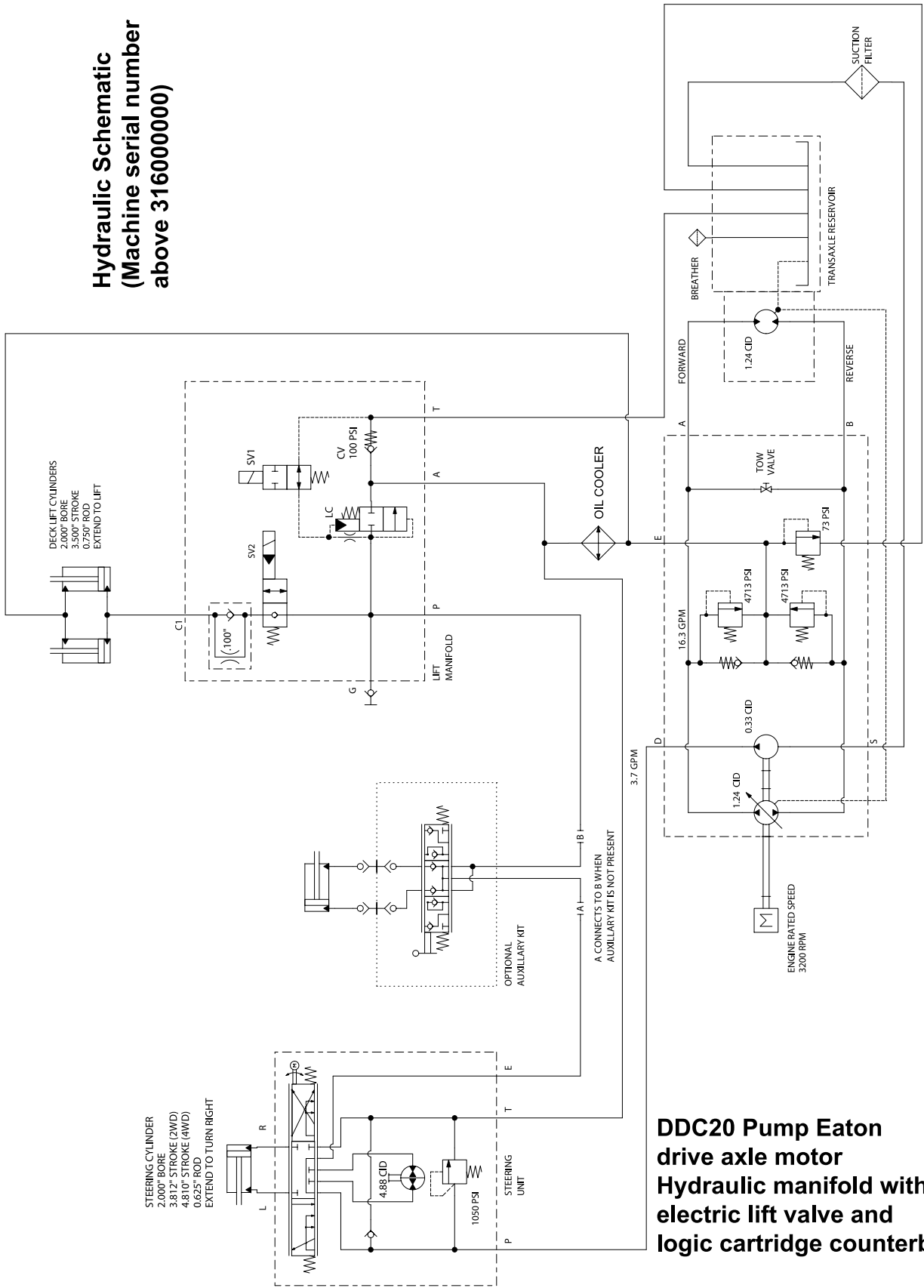
**Hydraulic Schematic
(Machine serial number 311000000 to 316000000)**

**Series 15 Transmission
Hydraulic manifold with
electric lift valve and logic
cartridge counterbalance**

g243934

Figure 44

**Hydraulic Schematic
(Machine serial number
above 316000000)**



NOTE: A Larger Hydraulic Schematic is included in Appendix-Foldout Drawings

**DDC20 Pump Eaton
drive axle motor
Hydraulic manifold with
electric lift valve and
logic cartridge counterbalance**

g224768

Figure 45

Hydraulic Flow Diagrams

Traction Circuit (Machine Serial Number below 316000000)

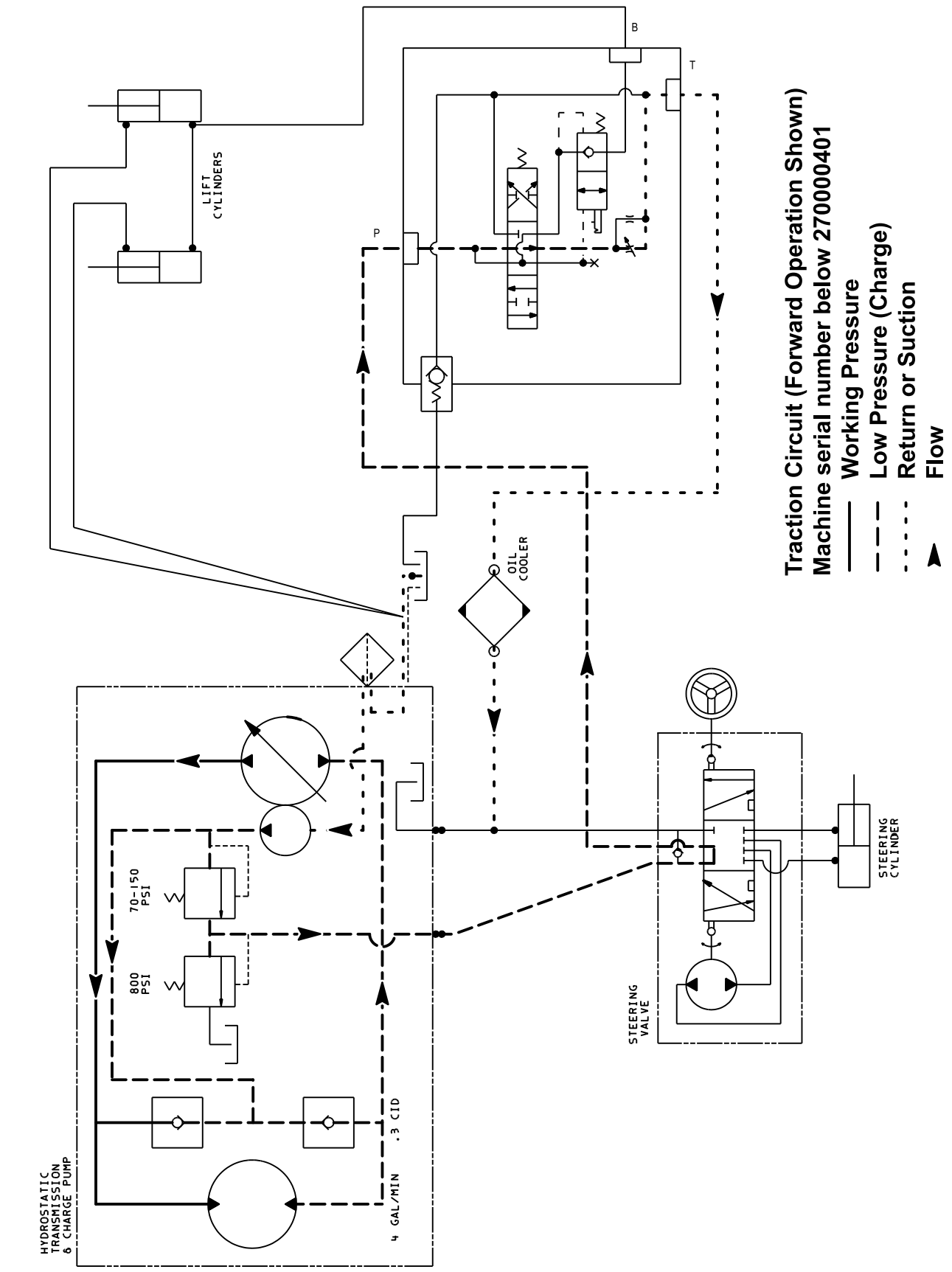
Forward Direction

The hydrostatic transmission input shaft is rotated by a driveshaft off the front of the engine crankshaft. Pushing the top of the traction pedal rotates the variable displacement pump swash plate in the transmission to create a flow of fluid. This fluid is directed to the fixed displacement motor in the transmission which turns the front axle input shaft to drive the front wheels in the forward direction.

Fluid flowing from the motor returns to the variable displacement pump and is continuously pumped through the closed traction circuit as long as the traction pedal is pushed.

A gerotor charge pump in the hydrostat provides a constant supply of charge fluid to the closed loop traction circuit for lubrication and to make up for fluid that is lost due to internal leakage in the transmission pump and motor. The charge pump takes its suction through a filter from the reservoir (front axle). Charge pump flow is directed to the low pressure side of the closed loop traction circuit. Charge pressure is limited to 482 to 1,034 kPa (70 to 150 psi) by the charge pressure relief valve in the transmission. Charge pressure can be monitored at the transmission charge pump test port. Charge pump flow in excess of traction circuit charge needs provides hydraulic flow for the steering and lift circuits.

Forward Direction (continued)



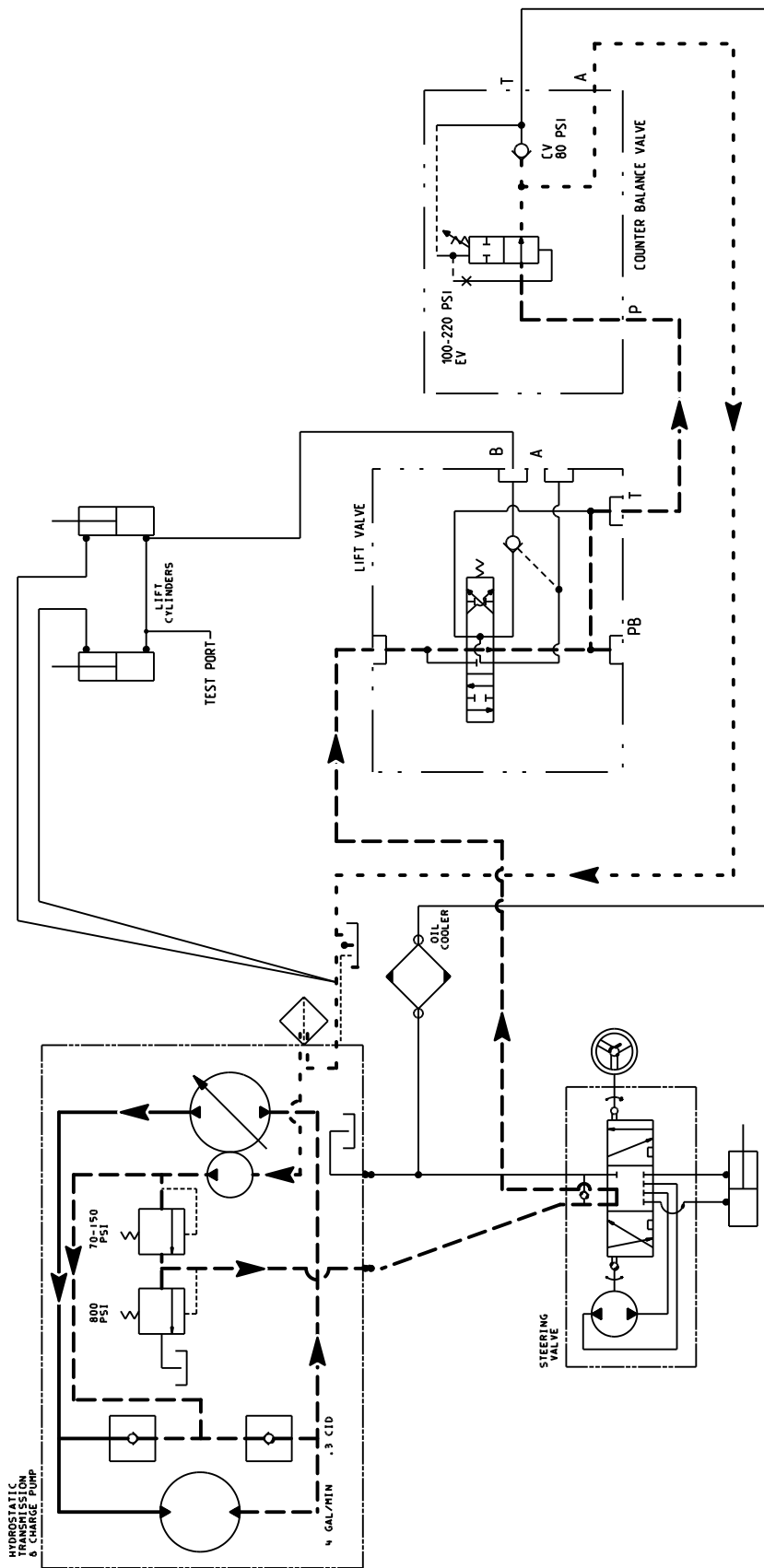
Traction Circuit (Forward Operation Shown)

Machine serial number below 270000401

- Working Pressure
- Low Pressure (Charge)
- Return or Suction
- Flow

Figure 46

Forward Direction (continued)



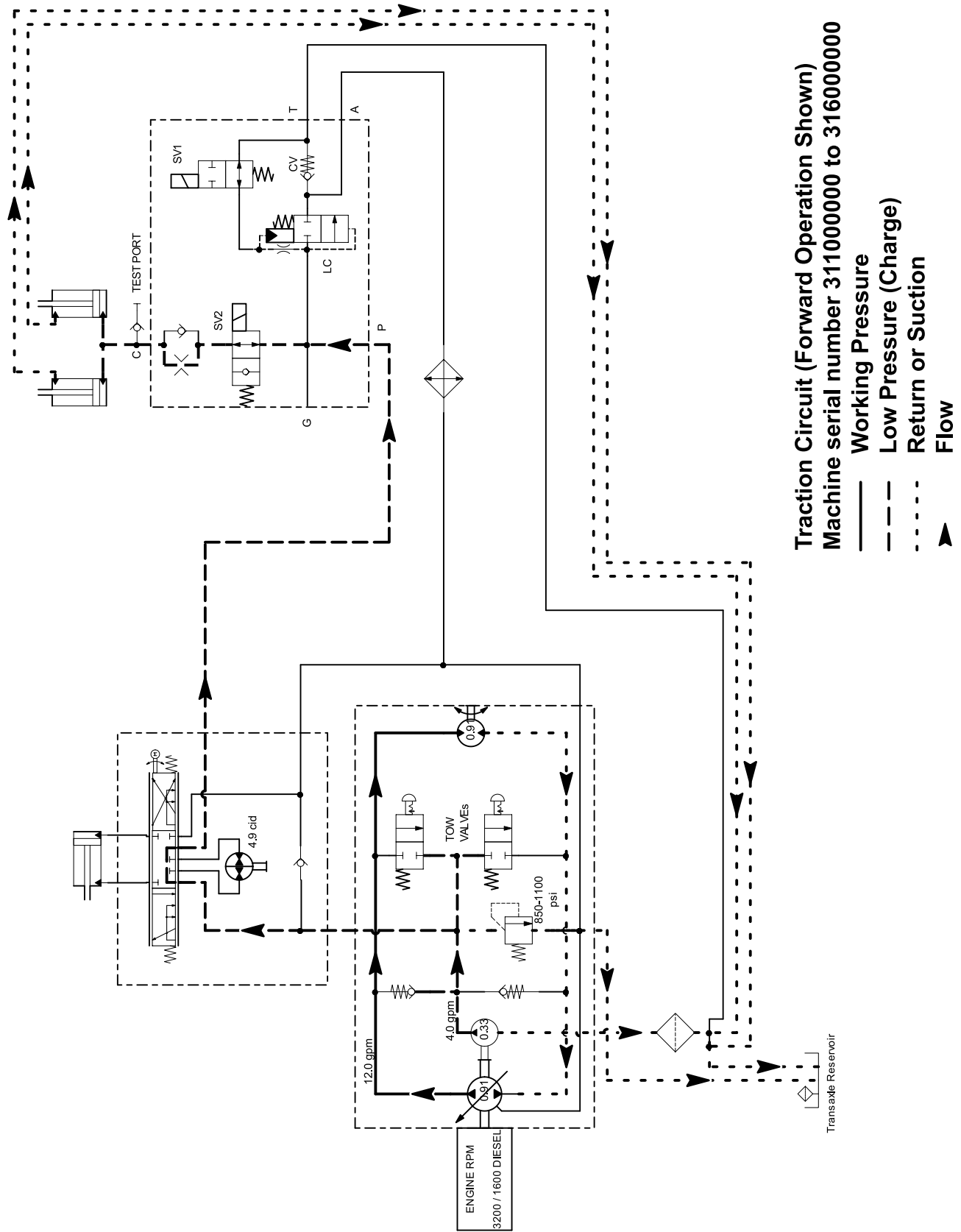
g246024

Figure 47

Traction Circuit (Forward Operation Shown)
 Machine serial number 270000401 to 311000000

- Working Pressure
- - - Low Pressure (Charge)
- · · · · Return or Suction
- ▶ Flow

Forward Direction (continued)



g246025

Figure 48

Reverse Direction

The traction circuit operates essentially the same in reverse as it does in the forward direction. However, the flow through the circuit is reversed. Pushing the bottom of the traction pedal rotates the variable displacement pump swash plate in the transmission to create a flow of fluid. This fluid is directed to the fixed displacement motor in the transmission which turns the differential input shaft to drive the front wheels in a reverse direction.

Fluid flowing from the motor returns to the variable displacement pump and is continuously pumped through the closed traction circuit as long as the traction pedal is pushed.

The charge circuit functions the same in reverse as it does in the forward direction.

Traction Circuit (Machine Serial Number above 316000000)

The hydraulic traction circuit is a closed loop system consisting of a variable displacement hydraulic pump and a hydraulic drive axle motor. The hydraulic pump is driven by a drive shaft connected to the engine crankshaft.

Forward Direction

Pressing the top of traction pedal, angles the hydraulic pump swash plate to create a flow of fluid. This fluid flow is directed to the hydraulic motor via hydraulic hoses and tubes which turns the front axle input shaft to drive the front wheels in the forward direction. The forward traction pressure is limited to 32,495 kPa (4,713 psi) by the forward traction relief valve located in the hydraulic pump.

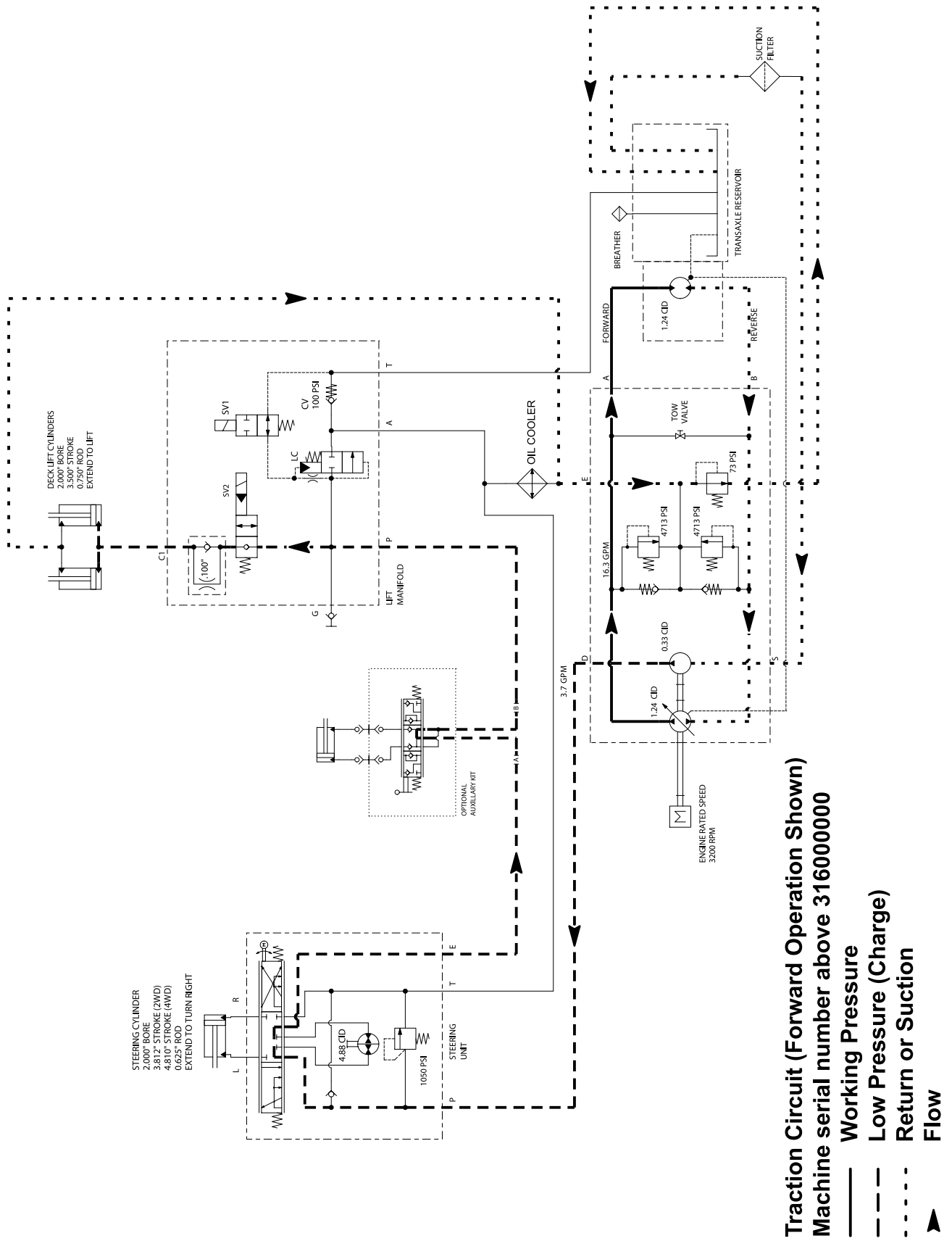
The fluid flowing from the motor returns to the variable displacement pump and is continuously pumped through the closed loop traction circuit as long as the traction pedal is pressed.

The angle of the swash plate determines the stroke of the pump pistons and therefore the pump flow and ultimately traction speed. When the traction pedal is pressed a small amount, the swash plate angle is slight resulting in low pump output and lower traction speed. When the traction pedal is pressed fully, the pump swash plate angle is dramatic providing maximum pump output and maximum traction speed.

The hydraulic pump is equipped with a case drain to allow normal internal leakage to be removed from the pump. The case drain is connected to the transaxle reservoir.

The hydraulic pump includes a gerotor charge pump. The charge pump provides a constant supply of charge fluid to the closed loop traction circuit for lubrication and to make up for fluid that is lost due to internal leakage in the hydraulic pump and motor. The charge pump takes its suction through a filter from the hydraulic reservoir (front axle). The charge pump flow is directed to the low pressure side of the closed loop traction circuit. The charge pressure is limited to 503 kPa (73 psi) by the charge pressure relief valve in the hydraulic pump. The charge pump flow in excess of traction circuit charge needs provides hydraulic flow for the steering and lift circuits.

Forward Direction (continued)



Traction Circuit (Forward Operation Shown)
Machine serial number above 316000000

- Working Pressure
- - - Low Pressure (Charge)
- · · Return or Suction
- ▶ Flow

g224777

Figure 49

Reverse Direction

The traction circuit operates essentially the same in reverse as it does in the forward direction. However, the flow through the circuit is reversed. Pushing the bottom of the traction pedal rotates the variable displacement pump swash plate in the hydraulic pump to create a flow of fluid. This fluid is directed to the fixed displacement motor which turns the differential input shaft to drive the front wheels in a reverse direction. The reverse traction pressure is limited to 32,495 kPa (4,713 psi) by the reverse traction relief valve located in the hydraulic pump.

The fluid flowing from the motor returns to the variable displacement pump and is continuously pumped through the closed loop traction circuit as long as the traction pedal is pushed.

The charge circuit functions the same in reverse as it does in the forward direction.

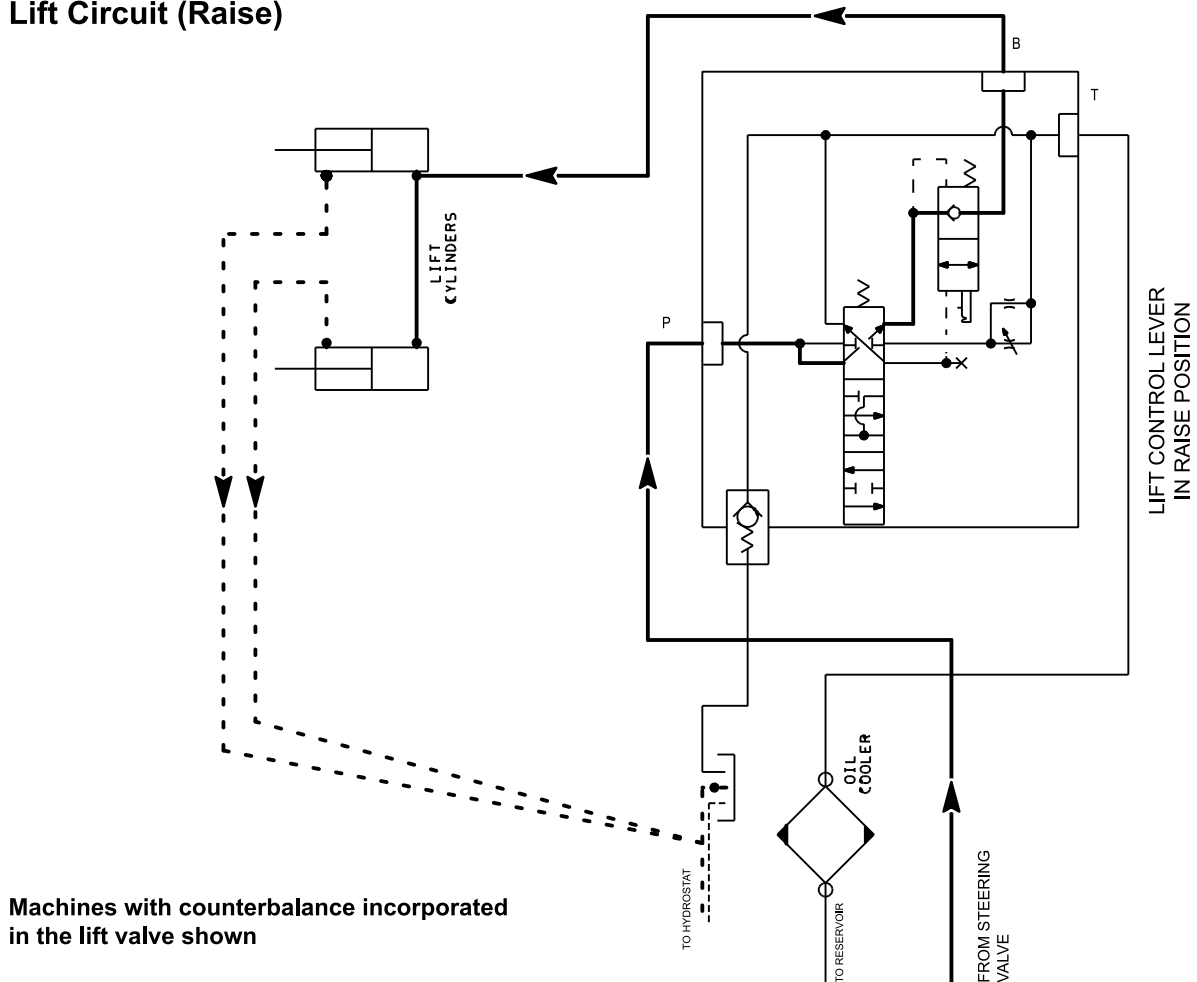
Lift Circuit (Machine Serial Number below 311000000)

The hydrostatic transmission charge pump supplies charge oil for the closed loop traction circuit in addition to supplying flow for the steering circuit and the lift circuit. The charge pump takes its suction through a filter from the reservoir (front axle). Pump output flows to the steering control valve before reaching the lift valve so the steering circuit has priority. Lift circuit pressure is limited to 5,515 kPa (800 psi) by the implement relief valve located in the hydrostat.

During conditions of not steering or operating the lift valve, flow from the charge pump passes through the lift and counterbalance valves, then on to the oil cooler and then to the reservoir (front axle).

Raise Cutting Deck (or Implement)

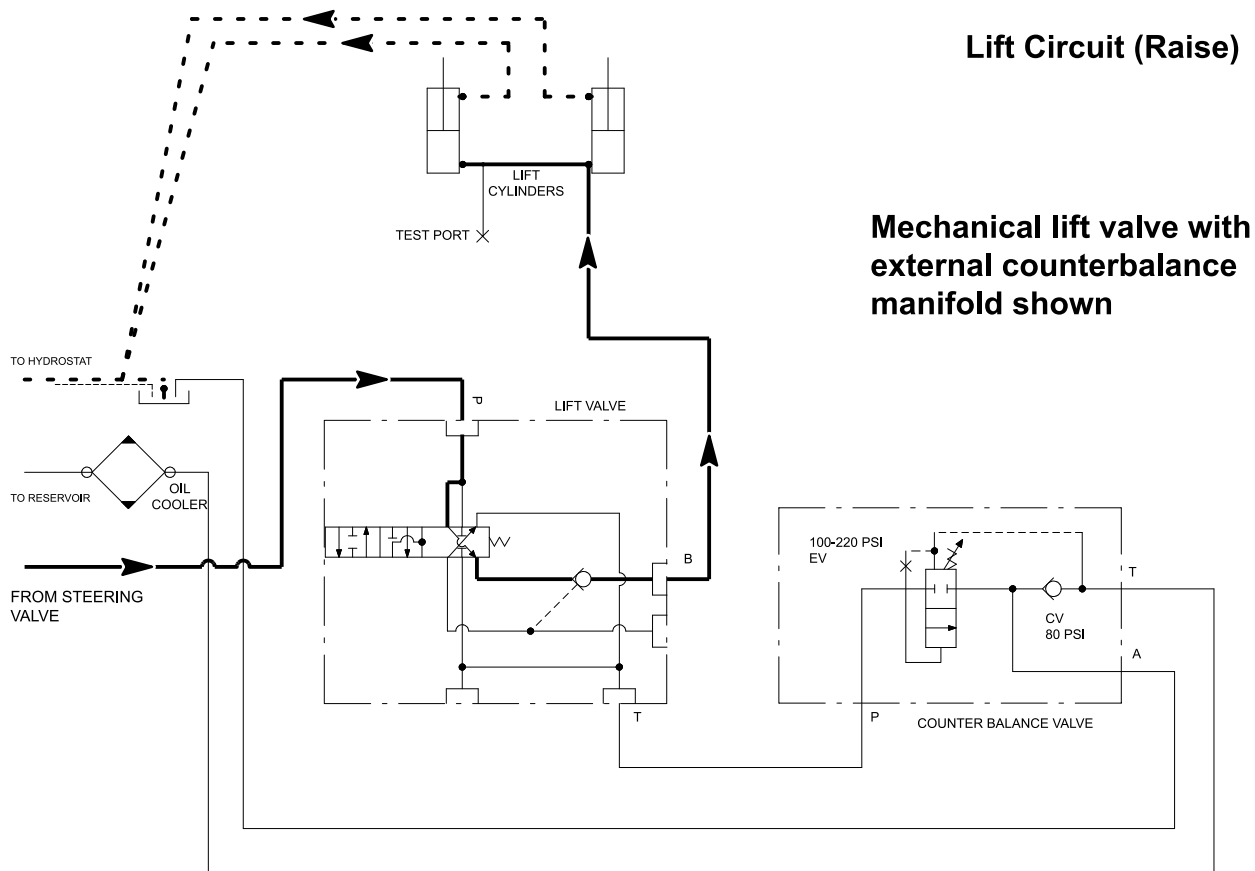
Lift Circuit (Raise)



g229583

Figure 50

Raise Cutting Deck (or Implement) (continued)



g246023

Figure 51

When the cutting deck (or implement) is to be raised, the control valve spool is positioned rearward and flow is directed out the B port of the control valve to the cap (upper) end of the lift cylinders. Hydraulic pressure against the cylinder pistons extends the lift cylinders. At the same time, the pistons push the hydraulic fluid in the lower portion of the lift cylinders out and to the reservoir (front axle). The extending lift cylinders cause the cutting deck (or implement) to raise.

When the control valve lever is released, spring action returns the lift control spool to the center position, and fluid flow passes through the lift valve to the reservoir (front axle). Lift cylinder movement is stopped.

Lower Cutting Deck (or Implement)

LIFT CIRCUIT (LOWER)

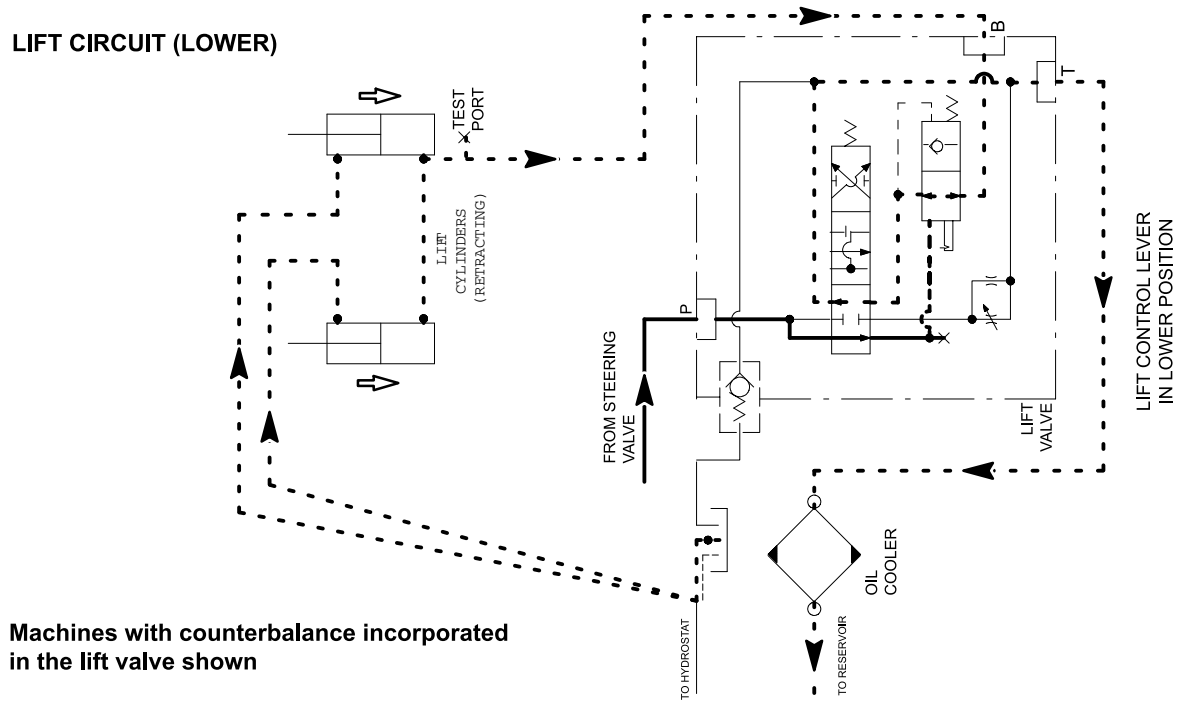


Figure 52

Lift Circuit (Lower)

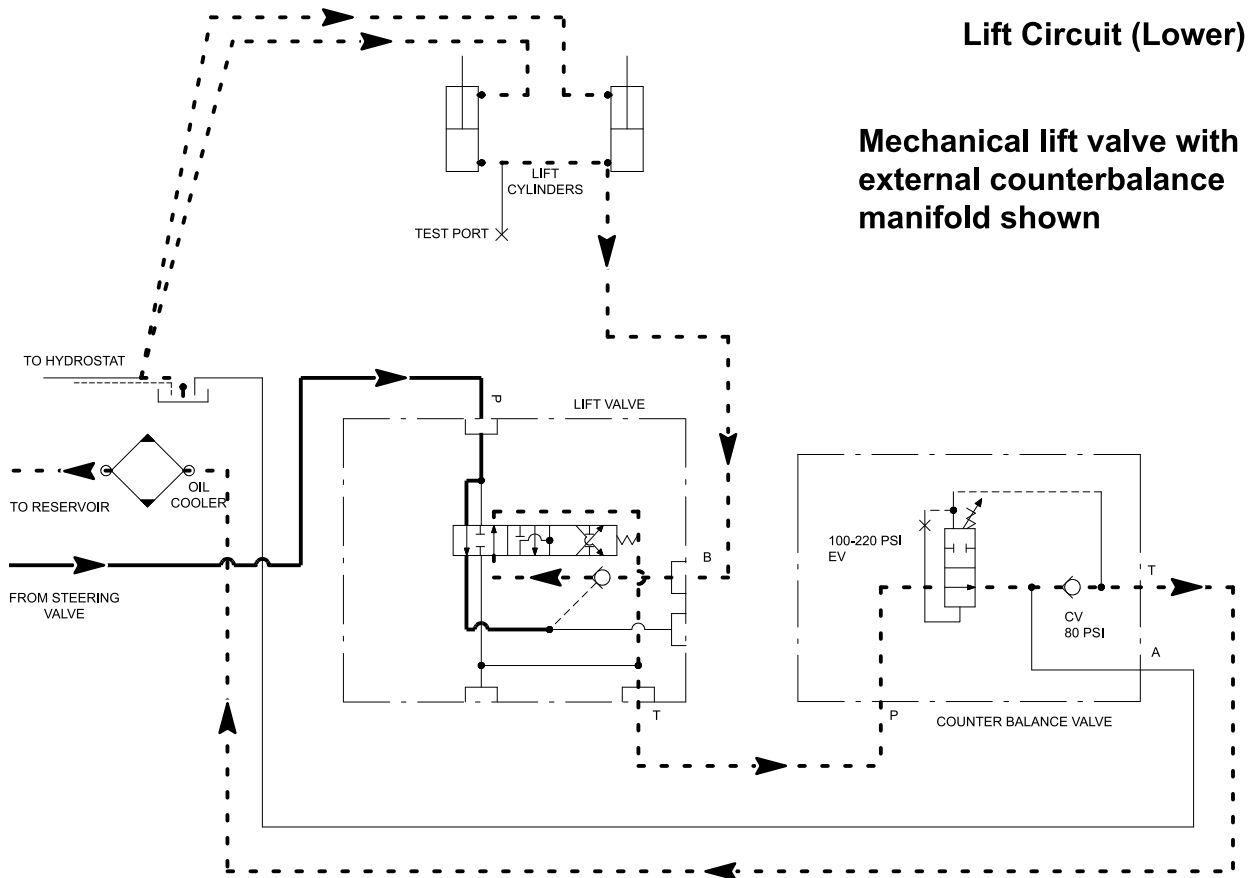


Figure 53

Lower Cutting Deck (or Implement) (continued)

When the cutting deck (or implement) is to be lowered, the control valve spool is moved forward causing the pilot valve to shift open. This shifted valve allows a return path from the lift cylinders to the reservoir (front axle) (Figure 52). The weight of the cutting deck (or implement) causes the cylinders to retract thus lowering the cutting deck (or implement). As the cylinders retract, the pistons draw hydraulic fluid from the reservoir (front axle) into the lower portion of the lift cylinders.

When the control valve lever is released, the lift control spool returns to the center position and causes the pilot valve to shift. Fluid flow by-passes passes through the lift valve and on to the reservoir (front axle) and lift cylinder movement is stopped.

Counterbalance

An adjustable counterbalance valve allows cutting unit weight transfer to the machine to improve traction. On early production machines, the counterbalance valve is incorporated in the lift control valve. Later production or updated machines use a different lift valve and a separate counterbalance manifold. Changes in traction conditions (e.g., moving up an incline) will cause a valve shift to slightly lift or lower the cutting deck to alter weight transfer. Counterbalance pressure settings are dependant on the cutting deck used on a machine. Check the type of counterbalance system used and refer to the *Traction Unit Operator's Manual* or the counterbalance kit *Installation Instructions* for counterbalance pressure recommendations.

Lift Circuit (Machine Serial Number above 311000000)

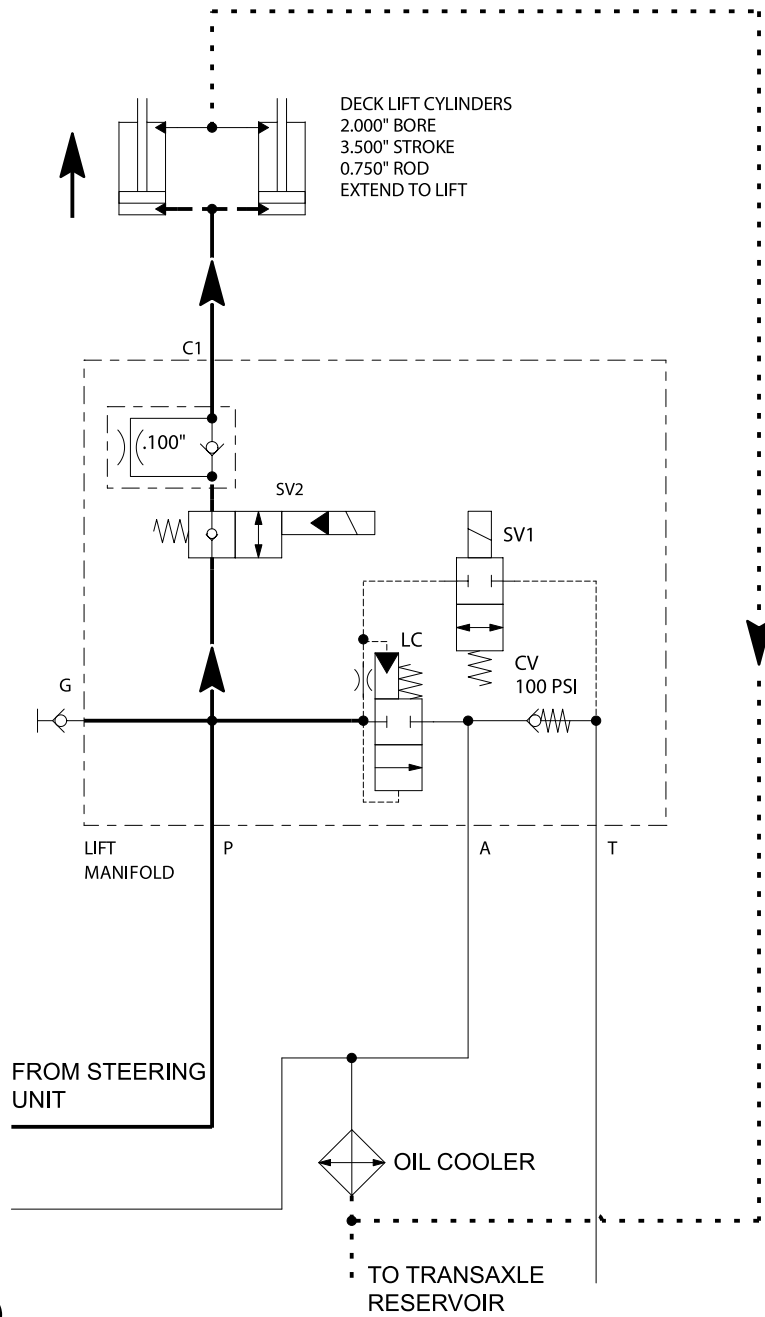
The charge pump supplies charge fluid for the closed loop traction circuit in addition to supplying flow for the steering circuit and the lift circuit. The charge pump takes its suction through a filter from the transaxle reservoir (front axle). The pump output flows to the steering control valve before reaching the lift manifold so that the steering circuit has priority. When the lift switch is not set to raise or lower, fluid flow enters the lift manifold at the P port. Hydraulic pressure will try and raise the lift arms until the logic cartridge LC shifts open and provides a fluid path to the tank (front axle). When the logic cartridge opens is controlled by adjusting the logic cartridge to the desired setting or counterbalance. Refer to the traction unit *Operator's Manual* for additional counterbalance adjustment information.

Raise the Cutting Deck (or Implement)

When the lift switch is set to the Raise position, solenoid valve SV1 is energized, holding logic cartridge LC closed. Hydraulic flow is directed through solenoid valve SV2 to the cap end (top) of the lift cylinders. When the cylinders reach the end of their stroke, or if the lift arms are prevented from raising, the charge pump relief valve in the hydraulic pump opens and directs the hydraulic flow to the tank (front axle) until the lift switch is released.

The hydraulic pressure against the cylinder pistons extends the lift cylinders. At the same time, the pistons push the hydraulic fluid in the lower portion of the lift cylinders out and to the hydraulic reservoir (front axle). The extending lift cylinders cause the cutting deck (or implement) to raise.

Raise the Cutting Deck (or Implement) (continued)



Lift Circuit (Raise)

Machine serial number above 311000000

- Working Pressure
- Low Pressure (Charge)
- Return or Suction
- Flow

g224770

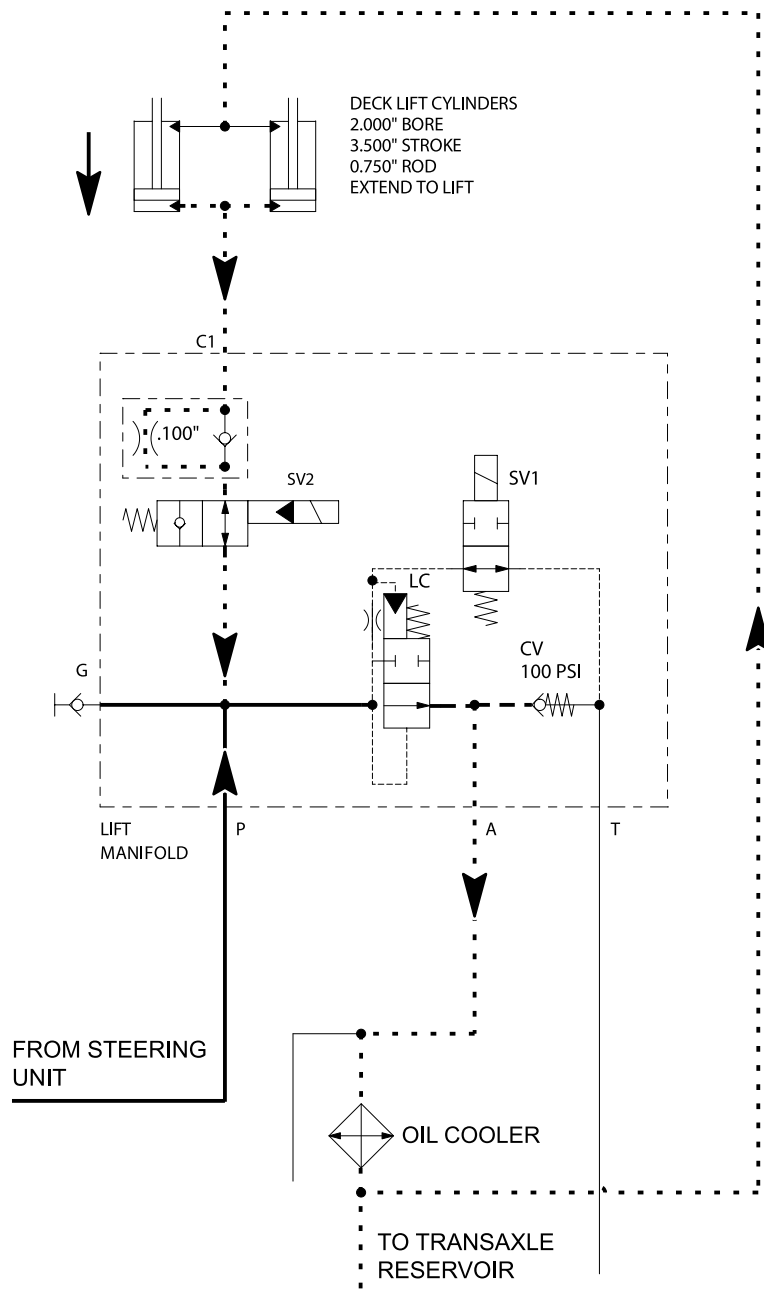
Figure 54

Lower the Cutting Deck (or Implement)

As previously described, when the lift switch is neither in the RAISE or LOWER position, fluid pressure shifts the logic cartridge LC open to provide a fluid path to the tank. When the lift switch is set to the LOWER position, solenoid valve SV2 is energized to open a path for fluid trapped behind the lift cylinder pistons to escape through the open logic cartridge LC as well.

The weight of the cutting deck or implement causes the cylinders to retract thus lowering the cutting deck or implement. As the cylinders retract, the pistons draw hydraulic fluid from the reservoir (front axle) into the lower (rod end) of the lift cylinders.

Lower the Cutting Deck (or Implement) (continued)



Lift Circuit (Lower)

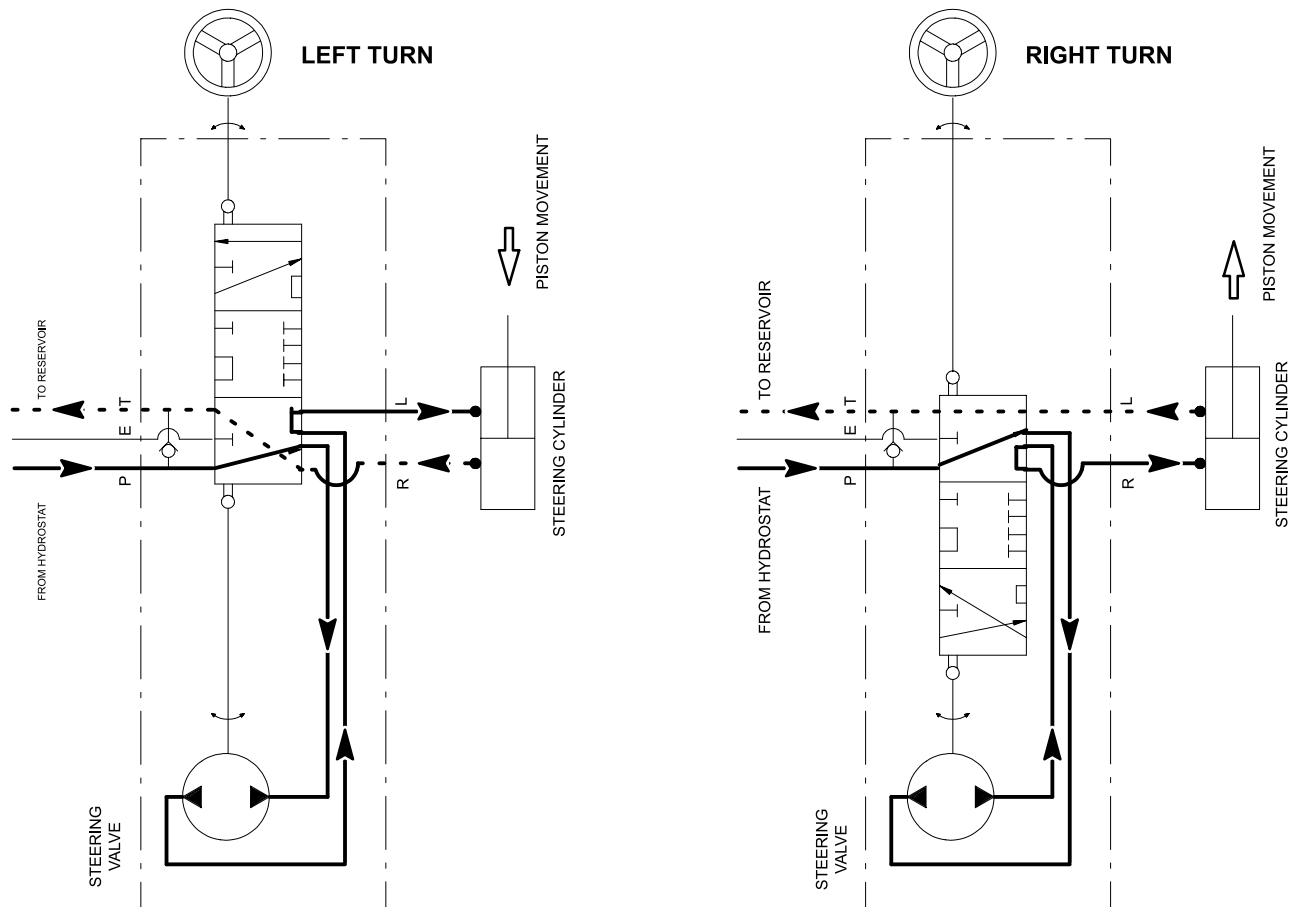
Machine serial number above 311000000

- Working Pressure
- - - Low Pressure (Charge)
- Return or Suction
- Flow

g224769

Figure 55

Steering Circuit (Machine Serial Number below 31600000)



g229584

Figure 56

The charge pump in the transmission supplies flow for the steering circuit and for the lift circuit. Charge pump output flows to the steering control valve before reaching the lift valve so that the steering circuit has priority. Steering circuit pressure is limited to 5,515 kPa (800 psi) by the implement relief valve located in the transmission.

When the steering wheel is not being turned and the engine is running (transmission input shaft being rotated), charge pump flow enters the steering control valve at the P port and by-passes the rotary meter and steering cylinder. Flow leaves the steering control valve through the E port and is directed to the lift control valve.

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 flow goes through the bottom of the spool. Flow entering the steering control valve at the P port passes through the rotary meter and is directed out the L port. Pressure retracts the steering cylinder for a left turn. The rotary meter ensures that the fluid flow to the cylinder is proportional to the amount of the turning on the steering wheel. Fluid leaving the steering cylinder flows back through the spool valve, then out the T port and returns to the hydraulic reservoir (front axle).

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 flow goes through the top of the spool. Flow entering the steering control valve at the P port passes through the rotary meter and is directed out port R. Pressure extends the steering cylinder for a right turn. The rotary meter ensures that the fluid flow to the cylinder is proportional to the amount of the turning on the steering wheel. Fluid leaving the cylinder flows back through the spool valve, then out the T port and to the hydraulic reservoir (front axle).

Steering Circuit (Machine Serial Number above 316000000)

The charge pump supplies flow for the steering circuit and for the lift circuit. The pump output flows to the steering control valve before reaching the lift manifold so that the steering circuit has priority. The steering circuit pressure is limited to 7,239 kPa (1,050 psi) by a relief valve located in the steering control valve.

When the steering wheel is not being turned and the engine is running (hydraulic pump input shaft being rotated), charge pump flow enters the steering control valve at the P port and by-passes the rotary meter and steering cylinder. Flow leaves the steering control valve through the E port and is directed to the lift manifold.

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 flow goes through the bottom of the spool. Flow entering the steering control valve at the P port passes through the rotary meter and is directed out the L port. Pressure retracts the steering cylinder for a left turn. The rotary meter ensures that the fluid flow to the cylinder is proportional to amount of steering wheel rotation. The fluid leaving the steering cylinder flows back through the spool valve, then out the T port and returns to the hydraulic reservoir (front axle).

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 flow goes through the top of the spool. Flow entering the steering control valve at the P port passes through the rotary meter and is directed out port R. Pressure extends the steering cylinder for a right turn. The rotary meter ensures that the fluid flow to the cylinder is proportional to the amount of steering wheel rotation. The fluid leaving the steering cylinder flows back through the spool valve, then out the T port and return to the oil cooler and the hydraulic reservoir (front axle).

Right Turn (continued)

Steering Circuit
Machine serial number above 316000000
 Working Pressure
 Low Pressure (Charge)
 Return or Suction
 Flow

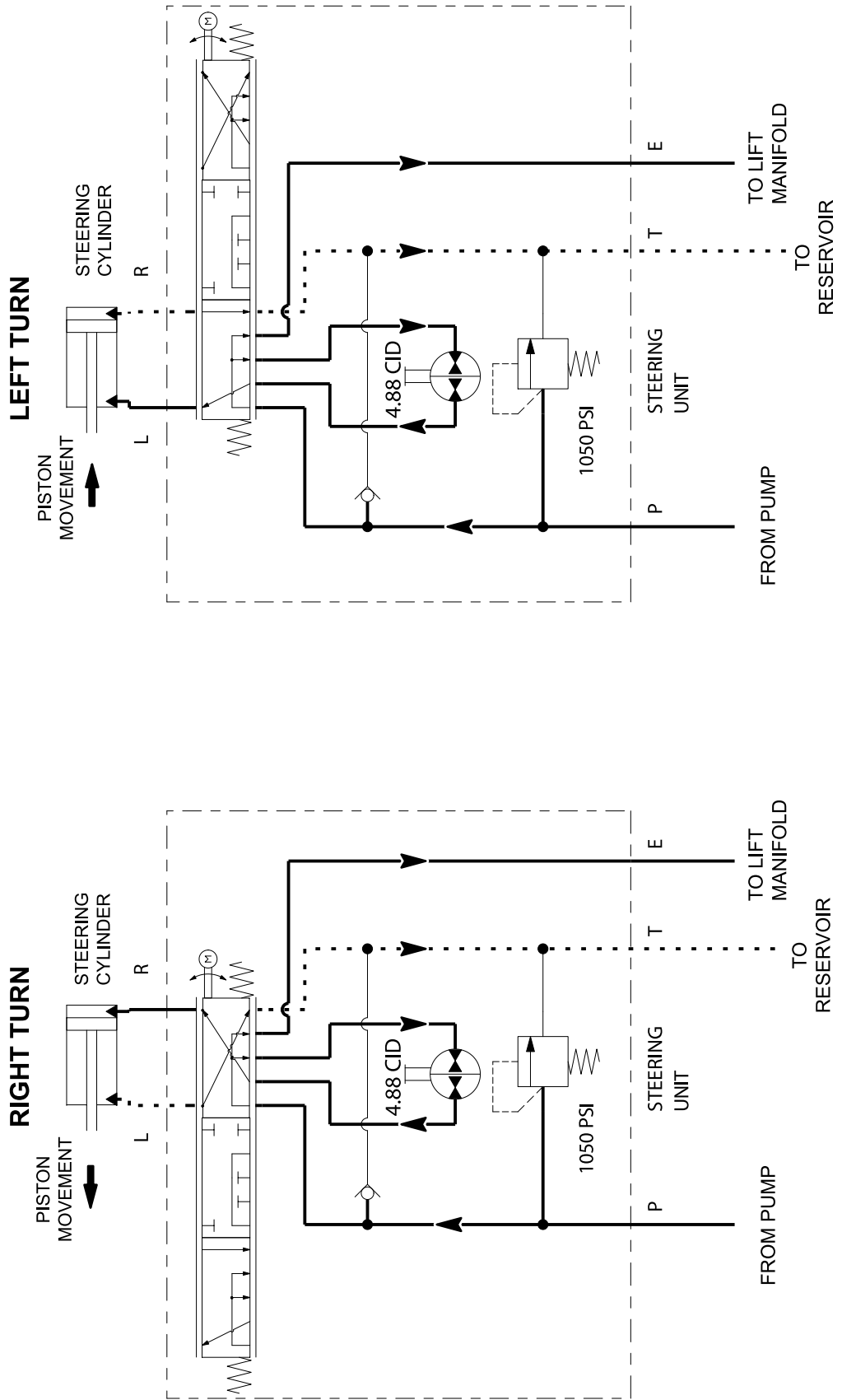


Figure 57

g224774

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

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 5–47).



15 GPM Hydraulic Tester Kit (Pressure and Flow)

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 5–47). 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 L/minute (1 to 15 gallons/minute).
- 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.



40 GPM Hydraulic Tester (Pressure and Flow)

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 \(page 5–47\)](#). This tester includes the following:

- Load Valve: Turn the valve to restrict the flow to create a simulated working load in the circuit.
- 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 35,000 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 L/minute (4 to 40 gallons/minute).

This tester does not include the hoses; refer to [Hydraulic Hose Kit \(page 5–40\)](#).



Hydraulic Hose Kit

Toro Part No. TOR6007

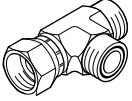
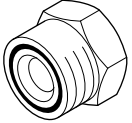
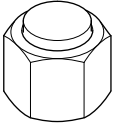
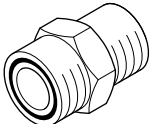
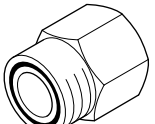
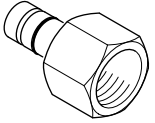
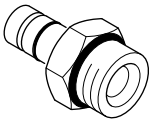
This kit includes the fittings and hoses that are used to connect the 40 GPM hydraulic tester (AT40002) or high flow hydraulic filter kit (TOR6011) to the machine hydraulic traction system components.



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
 <p>Swivel nut run tee (2 each)</p>	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
 <p>Plug (2 each)</p>	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
 <p>Cap (2 each)</p>	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
 <p>Union (1 each)</p>	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
 <p>Reducer (1 each)</p>	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
 <p>Test connector–Female thread (2 each)</p>	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
 <p>Test connector–Male thread (2 each)</p>	4 SAE-ORB (7/16–20) 1/8 NPTF	TOR4079–22 TOR4079–23

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.



High Flow Hydraulic Filter Kit

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., hydraulic pump or hydraulic 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 \(page 5–40\)](#).

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



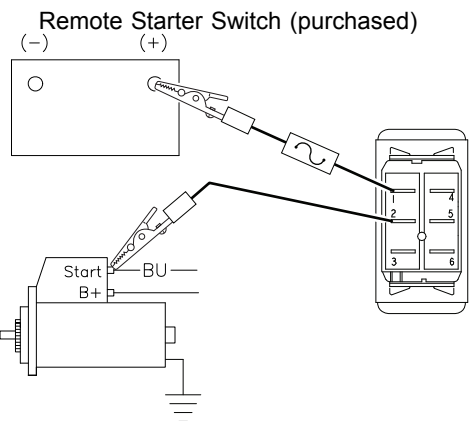
Remote Starter Switch

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.

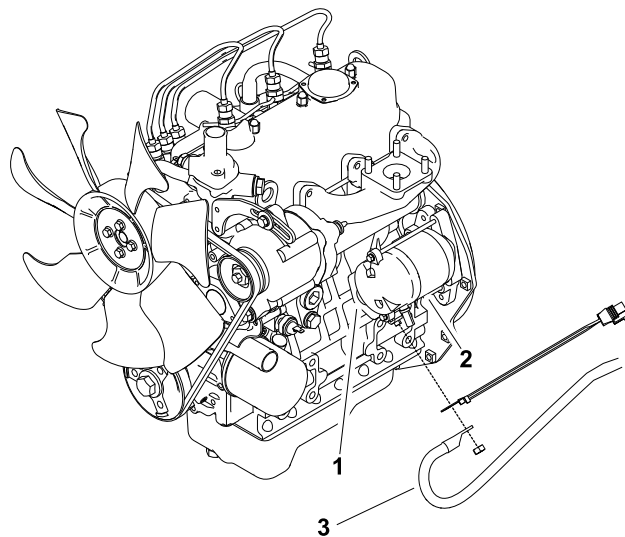
IMPORTANT: When using a remote starter switch, it is highly recommended to include a 20 amp in-line fuse between the battery and switch connector for circuit protection.

A remote starter 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 (fabricated)



g225779

Figure 58

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

A remote starter 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 ().

Note: For information on using the remote starter switch to prime the hydraulic pump; refer to [Priming the Hydraulic Pump \(page 5–79\)](#).

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 found in [Appendix A \(page A–1\)](#) and information on the hydraulic system operation in the [Hydraulic Flow Diagrams \(page 5–19\)](#). This information will be useful during the hydraulic troubleshooting process.

Refer to [Testing the Hydraulic System \(page 5–47\)](#) for precautions and specific hydraulic test procedures.

General Hydraulic System Problems

Problem	Possible Causes
The hydraulic fluid is leaking from the system.	<ul style="list-style-type: none"> • The fitting(s), hose(s), or tube(s) are loose or damaged. • The O-ring(s) or seal(s) are missing or damaged.
<p>The hydraulic fluid foams excessively.</p> <p>Note: Some aeration of the hydraulic fluid on this machine is normal. This aeration (foaming) may be more noticeable after initial filling of hydraulic reservoir (front axle).</p>	<ul style="list-style-type: none"> • The hydraulic-fluid level in the reservoir (front axle) 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.	<ul style="list-style-type: none"> • The traction system pressure is high due to load or dragging brakes. • The hydraulic-fluid level in the reservoir (front axle) is low. • 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 oil filter is plugged. • The hydraulic pump bypass valve is open or damaged (3280-D Models 30344 and 30345). • The hydrostat/hydraulic pump check valve is not seating or is damaged. • The charge pressure is low. • The hydrostat/hydraulic pump is worn or damaged. • Engine RPM is too low. <p>Note: If 1 traction circuit component has internal wear or damage, it is possible that the other traction components are also damaged.</p>

Traction Circuit Problems

Problem	Possible Causes
Traction jerky when starting.	<ul style="list-style-type: none"> • Friction wheel on traction pedal out of adjustment or worn (except 3280-D Models 30344 and 30345). • The traction control linkage is incorrectly adjusted, disconnected, binding, or damaged. • The hydrostat/hydraulic pump check valve is not seating or is damaged.
The traction response is sluggish.	<ul style="list-style-type: none"> • The hydraulic pump bypass valve is open or damaged (3280-D Models 30344 and 30345). • The brake is dragging or binding. • The brakes are not released. • The charge pressure is low. • The hydraulic fluid is very cold. • The hydrostat/hydraulic pump check valve is not seating or is damaged. • The hydrostat/hydraulic pump is worn or damaged. <p>Note: If 1 traction circuit component has internal wear or damage, it is possible that the other traction components are also damaged.</p>
Neutral is difficult to find or unit operates in 1 direction only.	<ul style="list-style-type: none"> • The traction control linkage is incorrectly adjusted, disconnected, binding, or damaged. • The hydrostat/hydraulic pump check valve is not seating or is damaged. • The hydrostat/hydraulic pump is worn or damaged.
No traction exists in either direction and the engine speed remains constant.	<ul style="list-style-type: none"> • The brakes are not released. • The hydraulic-fluid level in the reservoir (front axle) is low. • The hydraulic pump bypass valve is open (3280-D Models 30344 and 30345). • The hydrostat/hydraulic pump check valve is not seating or is damaged. • The charge pressure is low. • The transmission/hydraulic pump driveshaft or key damaged (the steering and lift circuits affected as well). • The hydrostat/hydraulic pump is worn or damaged. • The front axle is damaged. <p>Note: If 1 traction circuit component has internal wear or damage, it is possible that the other traction components are also damaged.</p>

Lift/Lower Circuit Problems

Problem	Possible Causes
The cutting deck (or implement) will not lift or lifts slowly.	<ul style="list-style-type: none"> • Engine RPM is too low. • The cutting deck has excessive unwanted elements in cutting chambers. • The lift arm or lift cylinder is binding. • The lift valve control linkage is binding or broken (except 3280-D Models 30344 and 30345). • The hydraulic-fluid level in the reservoir (front axle) is low. • The charge pump pressure or flow is insufficient. • The implement relief valve is stuck or damaged (except 3280-D Models 30344 and 30345). <p>Note: Steering circuit also affected.</p> <ul style="list-style-type: none"> • The flow control orifice in the lift control valve is plugged, stuck, or damaged. • The lift control valve is damaged. • The lift cylinder leaks internally.
The cutting deck (or implement) raises, but does not stay up.	<ul style="list-style-type: none"> • The lift cylinder leaks internally. • The lift circuit hydraulic lines or fittings are leaking. • The lift control valve leaks (except 3280-D Models 30344 and 30345). • Air exists in the lift circuit. • The solenoid valve (SV2) in the lift control valve is damaged or leaks.

Steering Circuit Problems

Problem	Possible Causes
The steering is inoperative or sluggish.	<ul style="list-style-type: none"> • Engine RPM is too low. • The hydraulic-fluid level in the reservoir (front axle) is low. • The steering components (e.g., tie rods, steering cylinder ends) are worn or binding. • The steering cylinder is binding. • The steering relief valve in the steering control valve is stuck or damaged. • The steering cylinder leaks internally. • The implement relief valve is stuck or damaged (except 3280-D Models 30344 and 30345). <p>Note: Lift circuit also affected.</p> <ul style="list-style-type: none"> • The steering control valve is worn or damaged. • The charge pump pressure or flow is low. <p>Note: Low charge pump flow or pressure will also affect the lift circuit.</p>

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 \(page 5–39\)](#).



WARNING



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

Before you disconnect the hydraulic components or work on the hydraulic system, release the pressure in the system; refer to [Releasing Pressure from the Hydraulic System \(page 5–6\)](#).



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 reservoir (front axle) and ensure that the reservoir 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.

Charge Pressure Test (Using Pressure Gauge) (Machine Serial Numbers below 31600000)

A charge pressure test should be performed to identify if a worn or damaged hydrostatic transmission is causing a hydraulic system problem.

Note: Before conducting charge pressure test, determine counterbalance pressure setting for the machine; refer to the *Traction Unit Operator's Manual*.

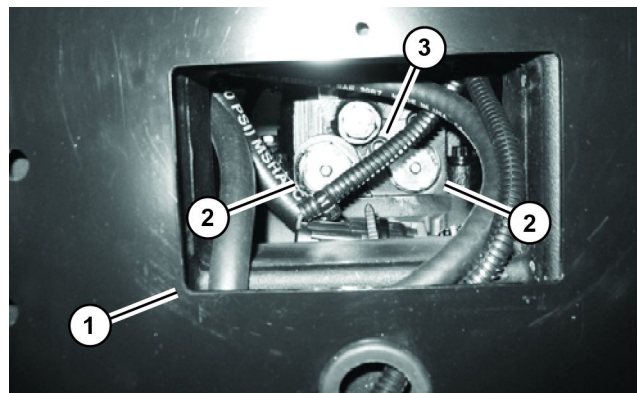
1. Ensure that the hydraulic fluid is at normal operating temperature.
2. Park machine on a level surface with the cutting deck (or implement) lowered and PTO switch off. Ensure that the engine is shut off. Set the parking brake and block the front wheels to prevent machine movement.
3. Read all Warning, Cautions, and precautions listed at the beginning of this section.



CAUTION



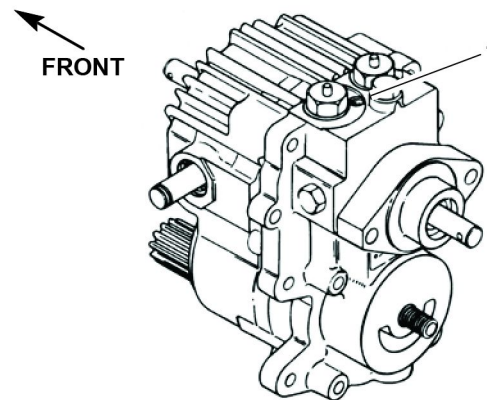
Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic fluid.



g230801

Figure 59

1. Seat base opening
2. Check valve
3. Pipe plug



g230802

Figure 60

1. Pipe plug

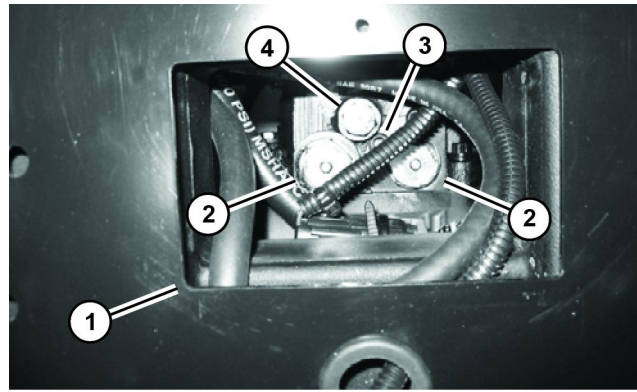
Charge Pressure Test (Using Pressure Gauge) (Machine Serial Numbers below 31600000) (continued)

4. Clean the area around the 1/8 inch pipe plug located on the top of the transmission between the 2 check valves (Figure 59 and Figure 60). Remove the plug from the transmission.
5. Connect a 6,900 kPa (1,000 psi) hydraulic pressure gauge to the transmission opening.
6. After installing pressure gauge, start engine, and run at idle speed. Check for any hydraulic leakage from test connections and correct before proceeding with test.
7. Run engine at full speed (**3,150 to 3,250 rpm**). Use a tachometer to verify that engine speed is correct.
8. Observe pressure gauge. The pressure reading should be approximately the same as counterbalance pressure.
9. Turn off machine. Record test results.
10. Perform a dynamic charge pressure test to identify possible hydrostat (pump or motor) problems as follows:
 - A. With pressure gauge still connected, sit in the operator seat, start engine, and press the traction pedal to forward.
 - B. While machine is moving straight ahead on level ground (no turning or deck lifting), monitor the pressure reading on the pressure gauge. Record test results.
11. The pressure should drop no more than 15% from initial test reading (step 8). A pressure drop of more than 15% may indicate a traction circuit leak (e.g., check valve not seating, worn or damaged hydrostat).

If charge pressure drop is more than 15%, inspect the condition of the charge pump gerotor and internal housing; refer to Charge Pump Service in the Sauer-Danfoss (Sundstrand) 15 Series Service Manual at the end of this chapter.

If the charge pump is in good condition (no scoring, scratches, or excessive wear), the general condition of the transmission's piston pump and piston motor might be suspected of wear and inefficiency.
12. Disconnect pressure gauge from the transmission. Install pipe plug back in the transmission. Check hydraulic-fluid level in reservoir (front axle).

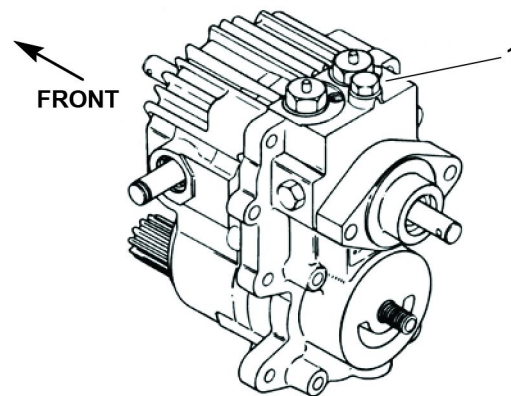
Implement Relief Pressure Test (Using Pressure Gauge) (Machine Serial Numbers below 316000000)



g230803

Figure 61

1. Seat base opening
2. Check valve
3. Pipe plug
4. Implement relief valve



g230804

Figure 62

1. Relief valve

The implement relief pressure test should be done if a problem is suspected with the implement relief valve.

Note: When conducting the Implement Relief Pressure Test, use a 34,500 kPa (5,000 psi) Pressure Gauge.

1. Perform steps 1 through 8 of the [Charge Pressure Test \(Using Pressure Gauge\) \(Machine Serial Numbers below 316000000\) \(page 5–49\)](#). Ensure to use a 34,500 kPa (5,000 psi) Pressure Gauge.
2. With the engine running at 3,200 rpm, move the lift control lever to the RAISE position and allow the cutting unit (or implement) to fully raise. Continue to hold the lever in the RAISE position and observe the pressure gauge. The pressure reading should be from 4,820 to 6,900 kPa (700 to 1,000 psi) as the implement relief valve lifts.
3. Move the lift control lever to the LOWER position to lower the cutting deck (or implement) to the ground. Shut off the engine. Record test results.

Implement Relief Pressure Test (Using Pressure Gauge) (Machine Serial Numbers below 316000000) (continued)

Note: If the implement relief pressure is 4,820 to 6,900 kPa (700 to 1,000 psi) and a steering or lift problem occurs, inspect for a problem unrelated to the hydraulic circuit (e.g., binding steering or lift system components, debris build-up on/under the cutting deck). Check and repair other items before continuing with hydraulic tests.

4. If the implement relief pressure is below 4,820 kPa (700 psi), adjust the implement relief valve in the transmission by adding the required amount of shims from the shim pack; refer to Implement Relief Valve in the Sauer-Danfoss (Sundstrand) 15 Series Service Manual at the end of this chapter.

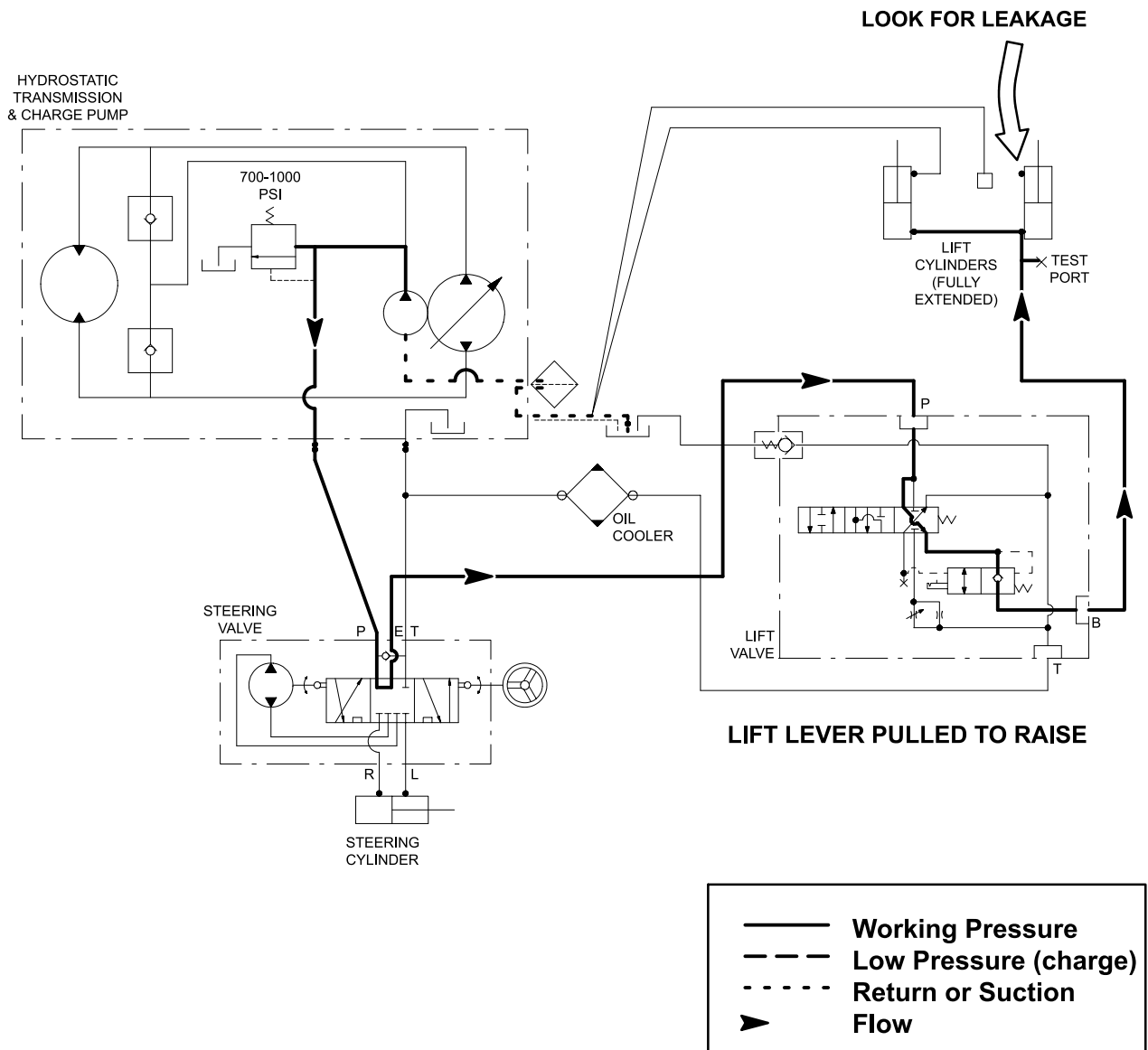
Note: For every 0.254 mm (0.010 inch) of shim thickness, there is an approximate 340 kPa (50 psi) change in implement relief pressure.

If adding shims to the relief valve does not increase pressure, inspect the condition of the charge pump gerotor and internal housing; refer to Charge Pump Service in the Sauer-Danfoss (Sundstrand) 15 Series Service Manual at the end of this chapter.

If the charge pump is in good condition (no scoring, scratches, or excessive wear), the general condition of the transmission's piston pump and piston motor might be suspected of wear and inefficiency. A lack of minimum implement relief pressure could be due to the charge pump having to direct all flow to the main traction circuit (piston pump and piston motor).

5. Disconnect pressure gauge from the transmission. Install pipe plug back in the transmission. Check hydraulic-fluid level in reservoir (front axle).

Lift Cylinder Internal Leakage Test (Machine Serial Numbers below 316000000)



g230805

Figure 63

Test Procedure

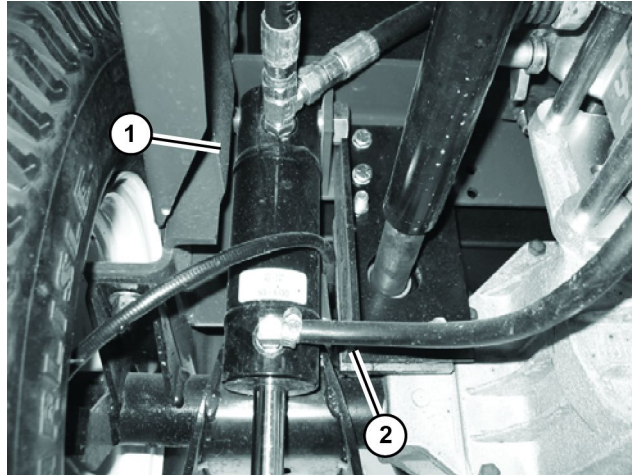
The lift cylinder internal leakage test should be performed if a cutting deck (or implement) raise and lower problem is identified. This test will determine if the lift cylinders are damaged.

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

1. Park machine on a level surface with the PTO switch OFF. Set the parking brake and block the front wheels to prevent machine movement.

Test Procedure (continued)

2. With the engine running, raise the cutting deck (or implement) completely. Using blocking or a hoist, support the cutting deck (or implement) to keep it in the fully raised position. Shut off the engine.
3. Place a drain pan under the lift cylinder that is to be tested for internal leakage. Clean the area around the cylinder return hose at the bottom of the lift cylinder.



g230806

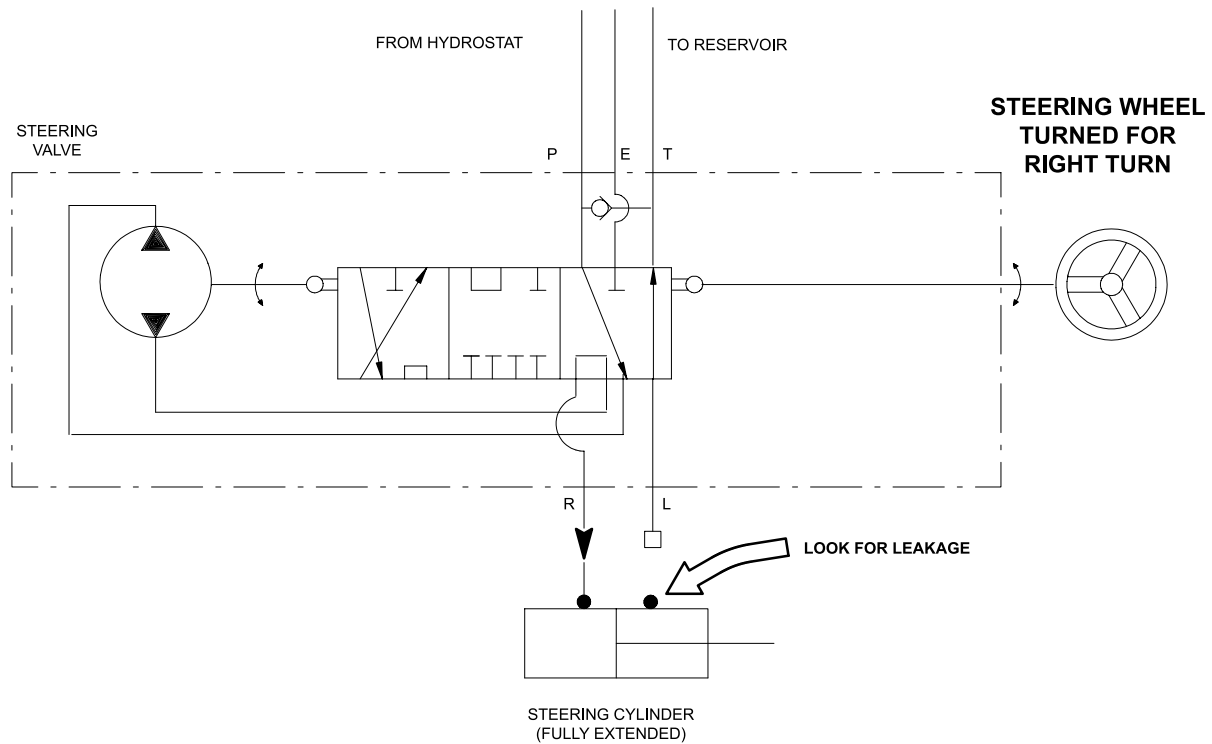
Figure 64

1. Lift cylinder

2. Return hose

-
4. Loosen the hose clamp and disconnect the cylinder return hose from the bottom of the lift cylinder (Figure 64). Leave the other end of the return hose connected to the filter adapter on the transmission.
 5. Securely plug the open end of the disconnected lift cylinder return hose to prevent hydraulic fluid leakage or suction of air by the transmission.
 6. Remove all hydraulic fluid from drain pan. Ensure that the empty drain pan remains under the open fitting of the lift cylinder.
 7. Start the engine and briefly hold the lift control lever in the RAISE position to pressurize the lift cylinders. Shut off the engine.
 8. Check to see if any fluid has leaked into the drain pan from the open fitting of the lift cylinder. If there is any fluid in the drain pan, the lift cylinder has internal leakage and must be replaced; refer to [Lift Cylinder \(page 5–110\)](#).
 9. If the lift cylinder shows no sign of leakage, remove the plug from the return hose, and install the hose on the lift cylinder fitting. Secure the hose by tightening the hose clamp.
 10. If necessary, repeat steps 3 through 9 for the other lift cylinder.
 11. After testing is completed, remove the support from the cutting deck (or implement). Start engine and operate lift cylinders through several up and down cycles. Shut off the engine and check for any leakage.
 12. Check hydraulic-fluid level in reservoir (front axle).

Steering Cylinder Internal Leakage Test (Machine Serial Numbers below 316000000)



g230807

Figure 65

Test Procedure

The steering cylinder internal leakage test should be performed if a steering problem is identified. This test will determine if the steering cylinder is damaged.

Note: Steering circuit operation will be affected by rear tire pressure, steering cylinder binding, extra weight on the vehicle, and/or binding of rear axle steering components. Ensure that these items are checked before proceeding with steering cylinder internal leakage test.

1. Ensure that the hydraulic fluid is at normal operating temperature.
2. Park machine on a level surface with the cutting deck (or implement) lowered and PTO switch off. Ensure that the engine is shut off. Set the parking brake.
3. Read all Warning, Cautions, and precautions listed at the beginning of this section.



CAUTION



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

4. Turn the steering wheel for a right turn (clockwise) so the steering cylinder rod is fully extended.
5. Remove hydraulic hose from the fitting on the rod end of the steering cylinder. Plug the end of the hose.

Test Procedure (continued)

6. With the engine shut off, continue turning the steering wheel for a right turn (clockwise) with the steering cylinder fully extended. Observe the open fitting on the steering cylinder as the wheel is turned. If fluid comes out of the fitting while turning the steering wheel to the right, the steering cylinder has internal leakage and must be repaired or replaced.
7. Remove plug from the hydraulic hose. Reconnect hose to the steering cylinder fitting.
8. If a steering problem exists and the steering cylinder tested acceptably, steering control valve requires service; refer to [Steering Control Valve \(page 5–113\)](#) and [Servicing the Steering Control Valve \(page 5–116\)](#).

Charge Pump Flow Test (Using Tester With Pressure Gauges and Flow Meter) (Machine Serial Numbers below 316000000)

The charge pump flow test should be performed if a hydraulic problem is identified that affects both the steering and lift circuits.

Note: The charge pump provides make-up fluid for internal hydrostat components before flow is available for the steering and lift circuits. Flow measured in this test will be less than total charge pump output.

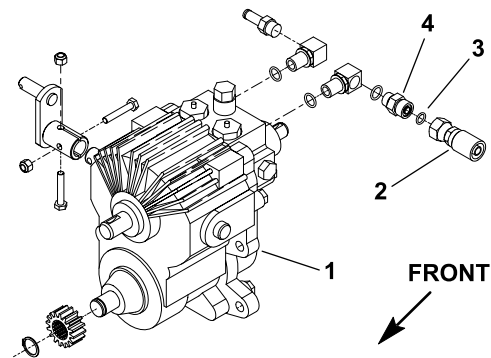
1. Ensure that the hydraulic fluid is at normal operating temperature by operating the machine for approximately 10 minutes.
2. Park machine on a level surface with the cutting deck (or implement) lowered and PTO switch off. Ensure that the engine is shut off. Set the parking brake and block the front wheels to prevent machine movement.
3. Read all Warning, Cautions, and precautions listed at the beginning of this section.



CAUTION



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



g230808

Figure 66

- | | |
|-----------------------------|-------------------|
| 1. Hydrostatic transmission | 3. O-ring |
| 2. Hydraulic hose | 4. Outlet fitting |

4. Place a drain pan under the transmission. Clean the area around the transmission charge pump outlet (pressure) fitting (Figure 66). Disconnect the hydraulic hose from the outlet fitting.

IMPORTANT

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

5. Connect inlet hose of tester with pressure gauges and flow meter to the transmission charge pump outlet (pressure) fitting. Connect the tester outlet hose to the hydraulic hose disconnected from the transmission fitting in step 5.

Charge Pump Flow Test (Using Tester With Pressure Gauges and Flow Meter) (Machine Serial Numbers below 316000000) (continued)

6. Ensure that the flow control valve on the tester is fully open. Also, ensure that the traction pedal and lift valve are in neutral and that the parking brake is engaged.
7. Start engine and run at idle speed. Check for any hydraulic leakage from test connections and correct before proceeding with test.
8. Run engine at full speed (**3,150 to 3,250 rpm**). Use a tachometer to verify that the engine speed is correct.

IMPORTANT

The charge pump is a positive displacement pump. If the flow control valve on the tester is fully closed, transmission damage can occur.

9. Watch tester pressure gauges carefully while slowly closing the flow control valve until pressure gauge reads 3,450 kPa (500 psi).
10. Flow gauge reading should be at least 3.8 L/minute (1 gallon/minute).
11. Open flow control valve on tester and shut off engine. Record results of hydraulic flow test.
12. If pressure of 3,450 kPa (500 psi) or flow of 3.8 L/minute (1 gallon/minute) could not be achieved, check the following:
 - A. Perform the charge pressure test; refer to [Charge Pressure Test \(Using Pressure Gauge\) \(Machine Serial Numbers below 316000000\) \(page 5–49\)](#). Also, a dynamic charge pressure test can be performed to identify if a worn or damaged hydrostatic transmission exists.
 - B. Perform the implement relief pressure test; refer to [Implement Relief Pressure Test \(Using Pressure Gauge\) \(Machine Serial Numbers below 316000000\) \(page 5–51\)](#).
 - C. Inspect the condition of the charge pump gerotor and internal housing; refer to Charge Pump Service in the Sauer-Danfoss (Sundstrand) 15 Series Service Manual at the end of this chapter.
 - D. The general condition of the transmission's piston pump and piston motor might be suspected of wear and inefficiency.
13. Disconnect tester from the transmission and hydraulic hose. Connect hydraulic hose to the transmission fitting. Check hydraulic-fluid level in reservoir (front axle).

Testing the Traction Circuit—Charge Pressure (Machine Serial Numbers above 316000000)

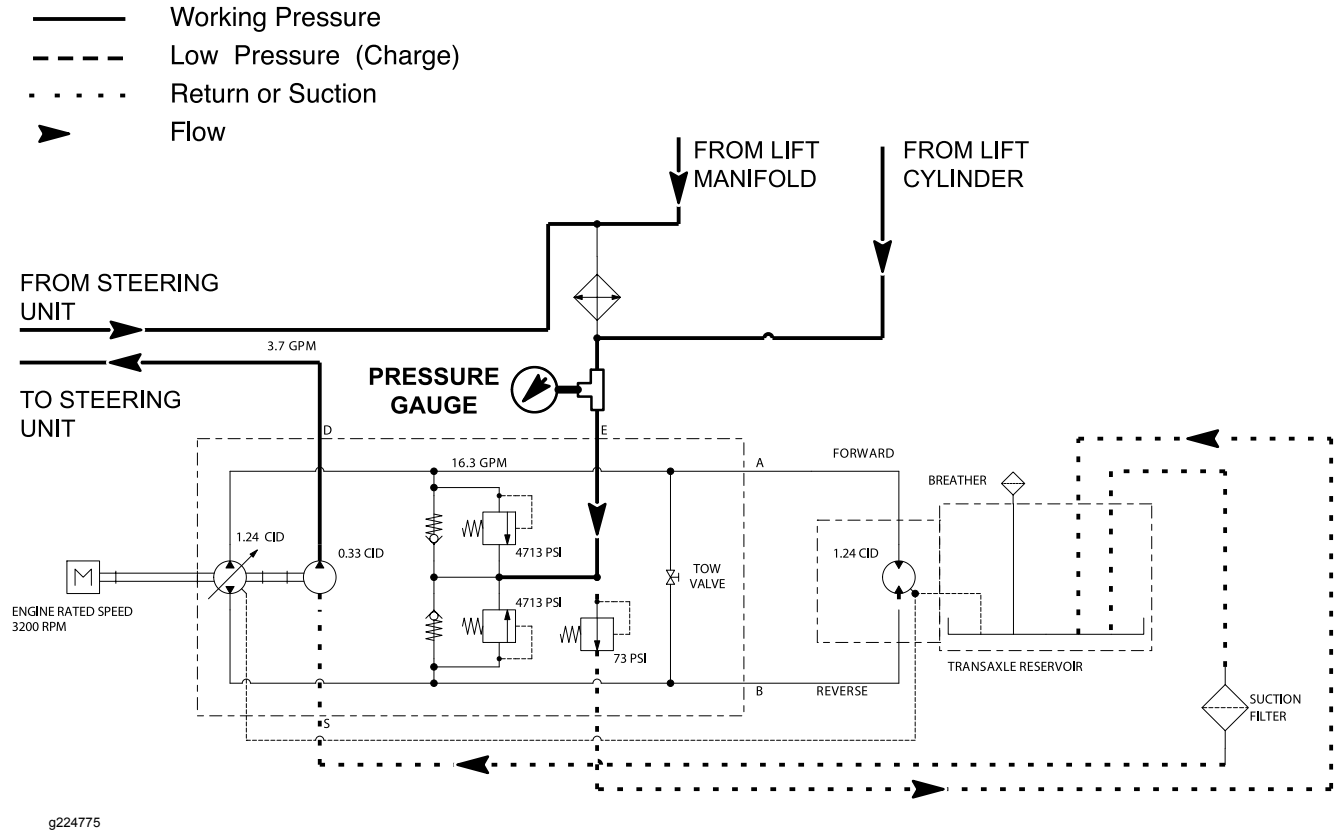


Figure 67

Test Procedure

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

Special Equipment Required: Pressure gauge

1. Warm oil after test equipment is connected to prevent technician from working on a hot machine—applicable to tests when possible (any test that requires an open un-plugged/capped line (case drain tests) would not apply and oil should be warmed before disconnecting the lines).



CAUTION

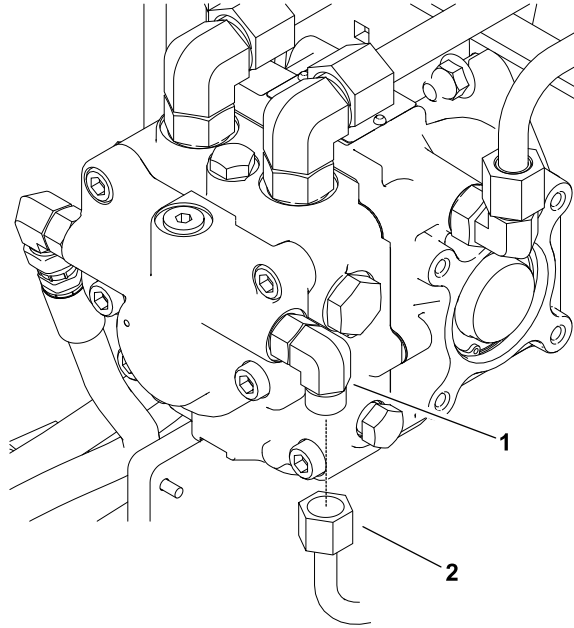


Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to [Releasing Pressure from the Hydraulic System \(page 5–6\)](#).

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

Test Procedure (continued)

3. Read all Warning, Cautions, and precautions listed at the beginning of this section.
4. Raise and support the operator seat, remove the seat plate to get access to the hydraulic pump assembly.
5. Ensure that the traction pedal is in the NEUTRAL position, the steering wheel is stationary and parking brake is set.



g226949

Figure 68

1. 90° hydraulic fitting

2. Hydraulic tube

6. Clean the fitting and hydraulic tube (Figure 68). Loosen and remove the tube from the fitting. Install a tee fitting with a 35,000 kPa (5,000 psi) pressure gauge between the fitting and disconnected tube.
7. Attach a heavy chain to the rear of the machine frame and an immovable object to prevent the machine from moving during testing.
8. Block the wheels with chocks to prevent the wheel rotation during testing.
9. Start the engine and move the throttle to full speed (**3,100 to 3,250 rpm**) position. Use a tachometer to check that the engine speed is correct.
10. Record the reading on the charge circuit pressure gauge. The charge pressure (without load) should read **345 to 483 kPa (50 to 70 psi)**. If the charge relief pressure specification is not met, consider the following:
 - A. The hydraulic pump charge relief valve is damaged. Repair or replace the hydraulic pump charge relief valve; refer to [Servicing the Hydraulic Pump \(Machine Serial Number above 316000000\)](#) (page 5–103).
11. Sit in the operator's seat, release the parking brake, and slowly press the traction pedal forward until **8,963 to 13,100 kPa (1,300 to 1,900 psi)** is reached on the traction circuit pressure gauge.

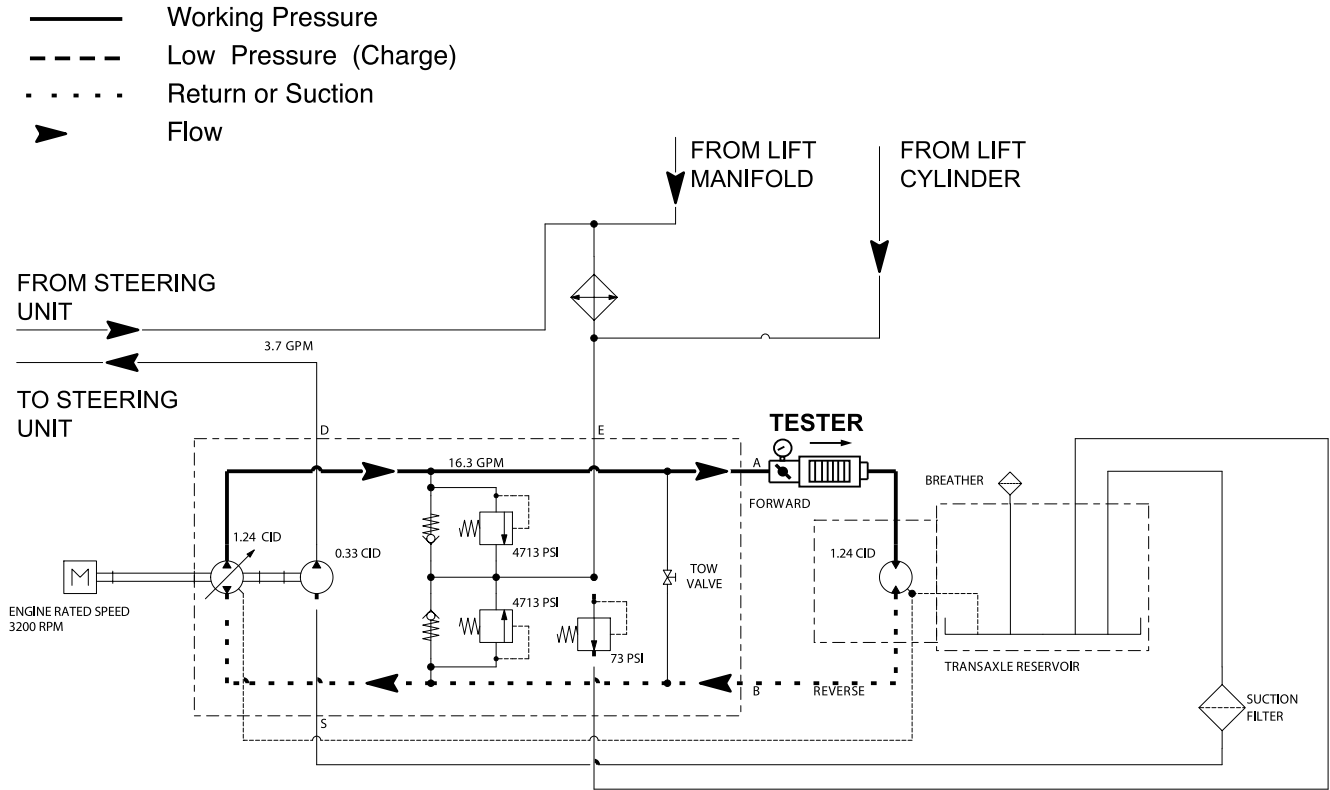
Test Procedure (continued)

12. Record the reading on the pressure gauge (under load). The charge pressure (under load) should not drop more than 20% when compared to charge pressure (without load) recorded in step 10.

If specifications are not met, perform the hydraulic pump flow and traction relief pressure test; refer to [Testing the Traction Circuit–Hydraulic Pump Flow and Relief Pressure \(Machine Serial Numbers above 316000000\) \(page 5–62\)](#).

13. Release the traction pedal, move the throttle to low speed position, and shut off the engine.
14. After you complete the charge pressure testing, ensure that the engine is not running and then release hydraulic system pressure; refer to [Releasing Pressure from the Hydraulic System \(page 5–6\)](#). Remove the tee fitting and pressure gauge, install the hydraulic tube to the fitting.
15. Install the seat plate, lower and secure the operator seat.
16. Start the engine, check for hydraulic-fluid leaks, repair any leaks as required, and fill the hydraulic reservoir (front axle) with the correct quantity of new hydraulic fluid before returning the machine to service.

Testing the Traction Circuit—Hydraulic Pump Flow and Relief Pressure (Machine Serial Numbers above 316000000)



g224776

Figure 69

The hydraulic pump flow test is the second in a series of tests recommended to determine the traction circuit performance. This test compares fluid flow at No Load with fluid flow Under Load. A drop in flow under load of more than 12% indicates an internal leak or malfunctioning relief valve in the hydraulic pump. The final traction circuit test is verifying the hydraulic pump relief valve operation. A worn hydraulic pump or malfunctioning relief valve is less efficient. Eventually, enough fluid bypass will cause the unit to stall under heavy load conditions. Continued operation can generate excessive heat, cause damage to seals and other components in the hydraulic system, and affect overall machine performance.

Special Equipment Required:

- Pressure gauge
- Flow meter with pressure gauge that has at least a 114 L/minute (30 gallons/minute) capacity.

Test Procedure

1. Warm oil after test equipment is connected to prevent technician from working on a hot machine—applicable to tests when possible (any test that requires an open un-plugged/capped line (case drain tests) would not apply and oil should be warmed before disconnecting the lines).

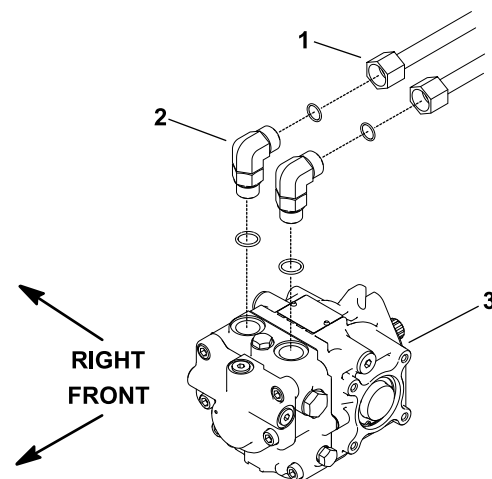


CAUTION



Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to [Releasing Pressure from the Hydraulic System \(page 5–6\)](#).

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. Raise and support the operator seat, remove the seat plate to get access to the hydraulic pump assembly.



g225780

Figure 70

1. Hydraulic hose (forward)
2. Right elbow fitting
3. Hydraulic pump

5. Ensure that the traction pedal is correctly adjusted for the NEUTRAL position. Also, ensure that the hydraulic pump is at full stroke when traction pedal is pressed fully in forward position.
6. Lift and support the machine so that all the wheels are off the ground; refer to [Jacking Instructions \(page 1–6\)](#).
7. Clean the junction of the hydraulic hose and right side fitting on the top of the hydraulic pump (Figure 70), and disconnect the hose from the fitting.

IMPORTANT

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

8. Install a tester with the pressure gauge and flow meter in series between the hydraulic pump fitting and the disconnected hose.

Test Procedure (continued)

9. Use the hydraulic hose kit to connect tester to the machine; refer to [Hydraulic Hose Kit \(page 5–40\)](#). Ensure that the fitting and hose connections are properly tightened. Also, ensure that the flow control valve on tester is fully open.



CAUTION



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

10. Start the engine and run it at low-idle speed. Check for hydraulic-fluid leaks from the test connections and correct before continuing the test.
11. With the engine running, move the throttle to full speed (**3,100 to 3,250 rpm**) position. Use a tachometer to check that the engine speed is correct.
12. Verify the pump flow at No Load as follows:
 - A. Slowly press the traction pedal to fully forward position.
 - B. Record the tester pressure and flow readings at no load. Unrestricted pump output should be approximately **62 L/minute (16.3 gallons/minute)** at **8,963 kPa (1,300 psi)**.
13. Verify the pump flow Under Load as follows:
 - A. Slowly press the traction pedal to fully forward position, and keep the pedal pressed in the forward position.
 - B. Apply an additional load of **8,963 to 13,100 kPa (1,300 to 1,900 psi)** by slowly closing the flow meter. The flow meter pressure gauge should read **16,545 to 20,000 kPa (2,400 to 2,900 psi)**.
 - C. Record the tester pressure and flow readings under load.
14. Verify the traction relief valve operation as follows:
 - A. Return the traction pedal to the NEUTRAL position.
 - B. Fully close the flow meter flow control valve.
 - C. Slowly set the traction pedal to full forward position.
 - D. Record the tester pressure reading.

The system pressure should reach **32,400 to 33,100 kPa (4,700 to 4,800 psi)** before the relief valve opens.

Note: The relief valve setting is **32,500 kPa (4,713 psi)**. An additional **690 to 1,030 kPa (100 to 200 psi)** is necessary to overcome system charge pressure before the relief valve opens.
 - E. Release the traction pedal, open the flow control valve fully, move the throttle to low speed, and shut off the engine.
15. If the relief pressure can not be met or is greater than specified, the traction relief valve is damaged and should be replaced.
16. The under load test flow reading (step 13C) should not drop more than 12% when compared to the no load test flow reading (step 12B). A difference of more than 12% may indicate the hydraulic pump is worn and should be repaired or replaced.
17. After you complete the testing, disconnect the tester and connect the hose to the pump fitting.

Test Procedure (continued)

18. Install the seat plate, lower and secure the operator seat.
19. Start the engine, check for hydraulic-fluid leaks, repair any leaks as required, and fill the hydraulic reservoir (front axle) with the correct quantity of new hydraulic fluid before returning the machine to service.

Testing the Steering Circuit—Steering Control Valve, Relief Valve Pressure, and Steering Cylinder (Machine Serial Numbers above 316000000)

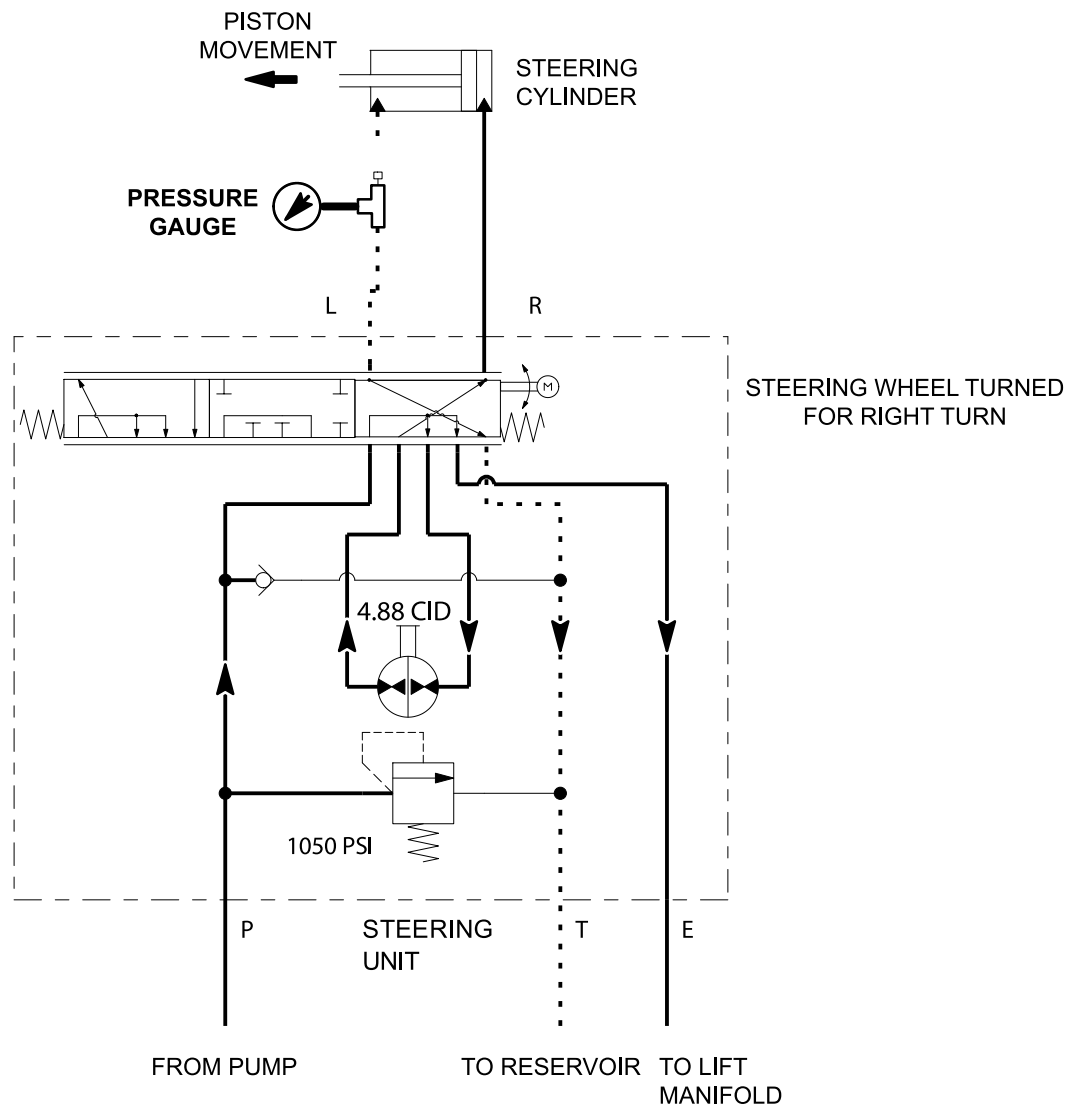


Figure 71

Unit steering performance will be affected by incorrect rear tire pressure, binding in the hydraulic steering cylinder, extra weight on the vehicle, and/or binding of the steering forks. Ensure that these conditions are checked and functioning properly before proceeding with any steering system hydraulic testing.

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

Test Procedure

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

Test Procedure (continued)

- A. There should be no shaking or vibration in the steering wheel or rear wheels.
- B. The steering wheel movements should be followed immediately by a corresponding rear wheel movement without the steering wheel continuing to turn.
3. Stop unit with the engine running. Turn the steering wheel with small quick movements in both directions. Let go of the steering wheel after each movement.
 - A. The steering control valve should respond to each steering wheel movement.
 - B. When steering wheel is released, steering control should return to the neutral position with no additional turning.
4. If either of these performance tests indicate a steering problem, determine if the steering cylinder is damaged using the following procedure:
 - A. Park the machine on a level surface with the PTO switch off, lower the cutting deck, and set the parking brake.
 - B. With the engine running, turn the steering wheel to the right (clockwise) until the steering cylinder rod is fully extended and shut off the engine.
 - C. Read all Warning, Cautions, and precautions listed at the beginning of this section.
 - D. Clean the fitting and hose end, disconnect the hydraulic hose from the fitting on the rod end of the steering cylinder.
 - E. Use an elbow or a tee fitting with a hole plugged and install a pressure gauge at the end of the disconnected hose.
 - F. With the engine shut off, continue turning the steering wheel to the right (clockwise) with the steering cylinder fully extended. Monitor the open fitting on the steering cylinder as the wheel is turned. If the hydraulic fluid comes out of the fitting while turning the steering wheel to the left, the steering cylinder has internal leakage and should be repaired or replaced.
5. The steering circuit relief valve located in the steering control valve can be tested with the pressure gauge installed in the same location as the steering cylinder test (step 4) as follows:
 - A. Start the engine and run it at low-idle speed. Check for hydraulic-fluid leaks from the test connections and correct before continuing the test.
 - B. Set the engine speed to approximately 2,000 rpm. Use a tachometer to check that the engine speed is correct.

IMPORTANT

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

- C. Monitor the pressure gauge carefully when turning the steering wheel for a right hand turn (clockwise) and holding.
- D. The system pressure should be approximately **7,240 kPa (1,050 psi)** as the relief valve lifts.
- E. Return the steering wheel to the NEUTRAL position, shut off the engine, and record the test results.

Test Procedure (continued)

6. If the specification is not met, repair or replace the steering control valve; refer to [Servicing the Steering Control Valve \(page 5–116\)](#).
7. After you complete the testing, shut off the engine, and then release hydraulic system pressure; refer to [Releasing Pressure from the Hydraulic System \(page 5–6\)](#). Disconnect the pressure gauge, and connect removed hydraulic hose to the steering cylinder.
8. Start the engine, check for hydraulic-fluid leaks, repair any leaks as required, and fill the hydraulic reservoir (front axle) with the correct quantity of new hydraulic fluid before returning the machine to service.

Testing the Steering Circuit–Charge Pump Flow (Machine Serial Numbers above 316000000)

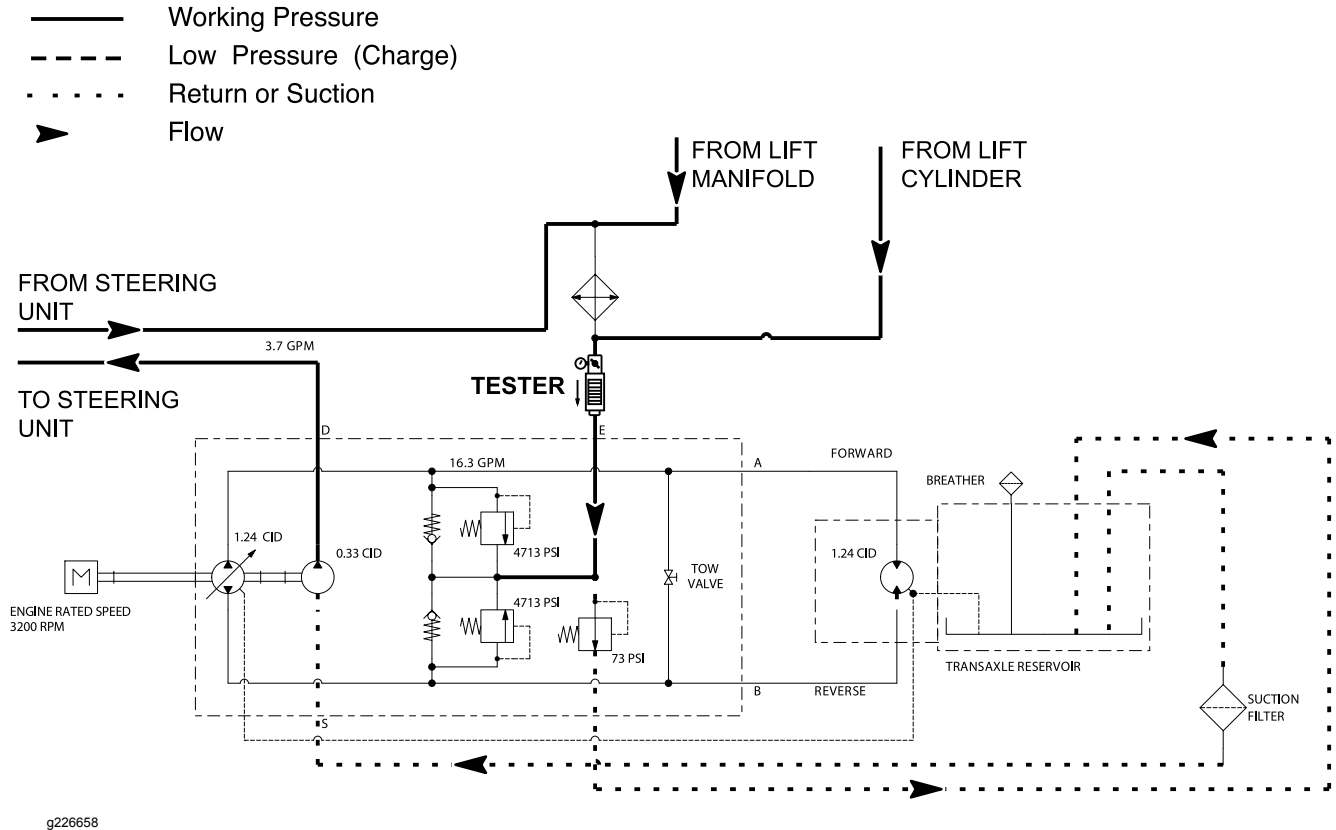


Figure 72

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

Special Equipment Required: Flow meter with pressure gauge that has at least a 16 L/minute (5 gallons/minute) capacity.

Test Procedure

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



CAUTION



Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to [Releasing Pressure from the Hydraulic System \(page 5–6\)](#).

Test Procedure (continued)

3. Raise and support the operator seat, remove the seat plate to get access to the hydraulic pump assembly.
4. Clean the junction of the hydraulic tube and left side elbow fitting on the charge pump. Disconnect the hydraulic tube from the left side of the pump fitting.

IMPORTANT

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

5. Install a tester with the pressure gauge and flow meter in series between the charge pump fitting and the disconnected tube. Ensure that the flow control valve on the tester is fully open.
6. Ensure that the hydraulic fluid is at normal operating temperature by operating the machine for at least 10 minutes.
7. Ensure that the traction pedal is in the NEUTRAL position, steering wheel is stationary, and parking brake is set.
8. Start the engine and run it at low-idle speed (**1,500 to 1,650 rpm**). Check for hydraulic-fluid leaks from the test connections and correct before continuing the test.
9. With the engine running, move the throttle to full speed (**3,100 to 3,250 rpm**) position. Use a tachometer to check that the engine speed is correct.
10. Verify the pump flow at No Load as follows:
 - A. Record the tester pressure and flow readings at no load. Unrestricted pump output should be approximately **14 L/minute (3.7 gallons/minute)**.
11. Verify the pump flow Under Load as follows:



CAUTION



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

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

- A. Monitor the tester pressure gauge carefully while you slowly close the flow control valve until you get **5,790 kPa (840 psi)**.
 - B. Record the tester pressure and flow readings under load.
12. Move the throttle to low speed (**1,500 to 1,650 rpm**) position and shut off the engine.
13. The under load test flow reading (step 11B) should not drop more than 15% when compared to the no load test flow reading (step 10A). A difference in flow of more than 15%, or the inability to achieve specified pressure may indicate:
 - A. A restriction in the pump inlet line.

Test Procedure (continued)

- B. The charge pump is worn and should be repaired or replaced; refer to [Servicing the Hydraulic Pump \(Machine Serial Number above 316000000\) \(page 5–103\)](#).
- 14. After you complete the testing, shut off the engine, and then release pressure from the hydraulic system; refer to [Releasing Pressure from the Hydraulic System \(page 5–6\)](#).
- 15. Disconnect the tester, and connect the removed hydraulic tube.
- 16. Install the seat plate, lower and secure the operator seat.
- 17. Start the engine, check for hydraulic-fluid leaks, repair any leaks as required, and fill the hydraulic reservoir (front axle) with the correct quantity of new hydraulic fluid before returning the machine to service.

Testing the Lift Circuit–Lift Cylinder Internal Leakage (Machine Serial Numbers above 316000000)

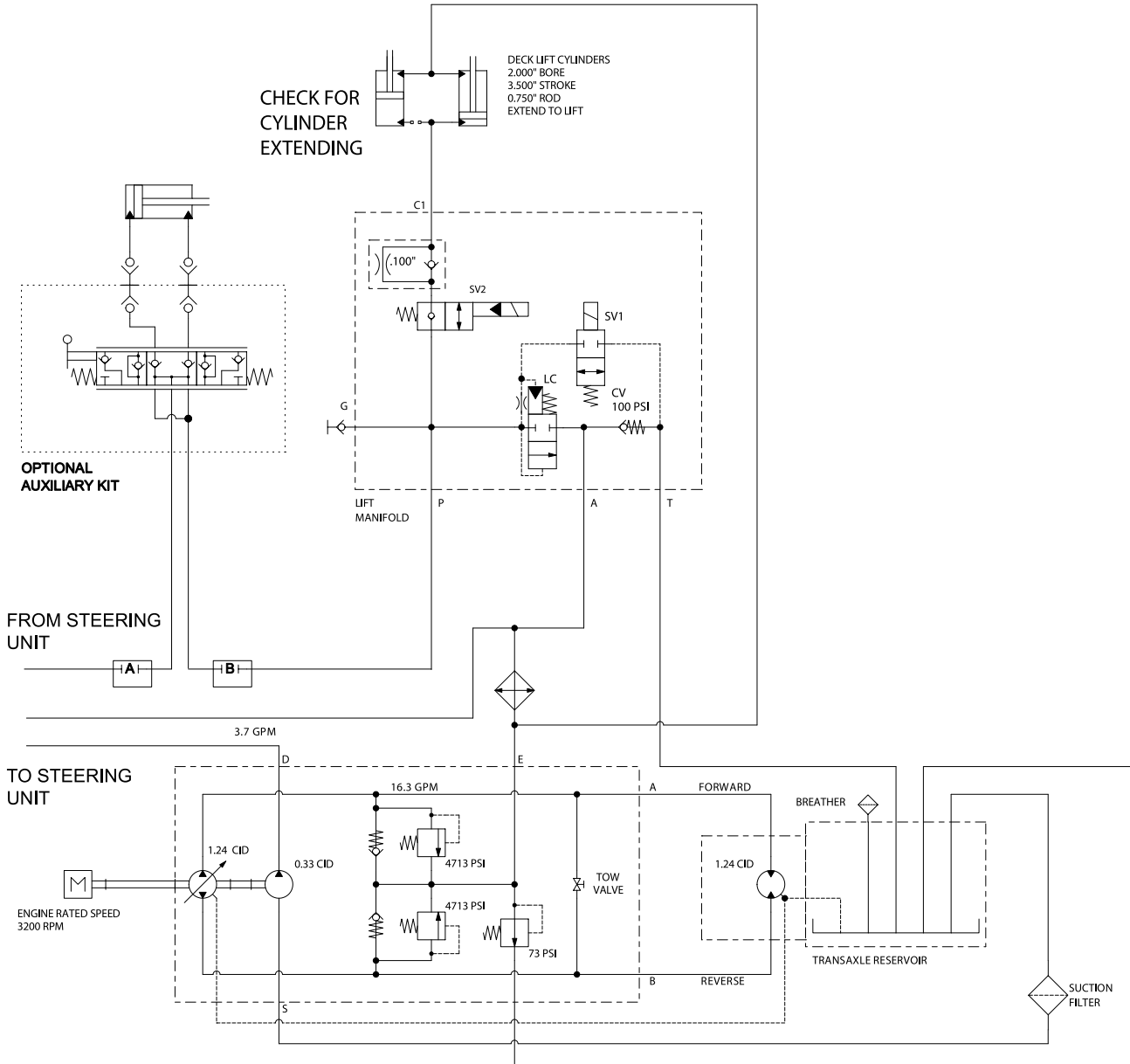


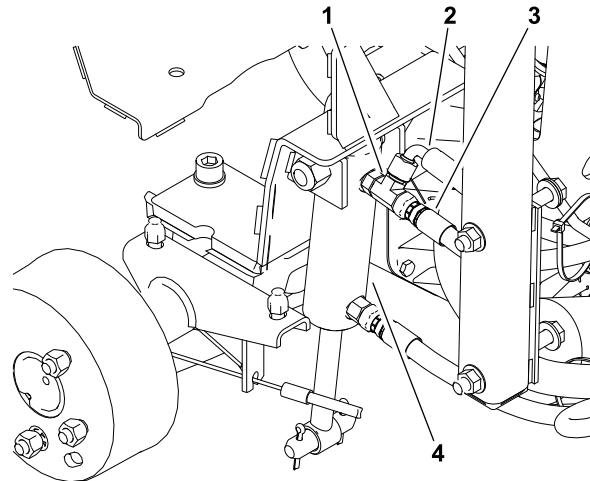
Figure 73

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

Note: The raise/lower circuit operation can be affected by 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

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



g225791

Figure 74

- | | |
|--------------------------------|-------------------|
| 1. Cylinder barrel end fitting | 3. Hydraulic hose |
| 2. Hydraulic hose | 4. Lift cylinder |

1. Park the machine on a level surface with the PTO switch off, shut off the engine, and set the parking brake.
2. For the lift cylinder that is to be tested, use a jack to raise the lift arm slightly. This removes the load from the lift cylinder and releases the lift cylinder hydraulic pressure.
3. Support the lift arm with jack stands to prevent it from lowering.
4. Clean the area around the hydraulic hoses end at the barrel end of the lift cylinder. Disconnect the hydraulic hoses from the lift cylinder barrel end fitting (Figure 74).

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.

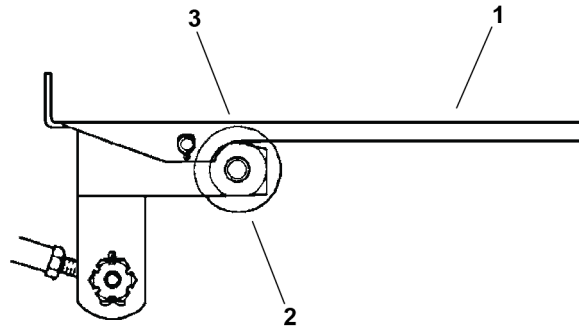
5. Install a steel cap on the open lift cylinder fitting to seal the lift cylinder. Also, install a steel plug in the open end of the disconnected hose to prevent leakage or contamination.
6. Raise the lift arm slightly with a jack and remove the jack stand, then lower and remove the jack.
7. The capped lift cylinder should be able to support the cutting deck long enough for the machine to move from one cutting area to another during operation.
8. If the lift cylinder allows the cutting deck to lower too quickly, replace or repair the lift cylinder; refer to the [Lift Cylinder \(page 5–110\)](#).
9. Once the lift cylinder condition is determined, use a jack to raise the lift arm slightly which removes the load from the lift cylinder.
10. Support the lift arm with jack stands to prevent it from lowering.

Test Procedure (continued)

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. Carefully remove the jack from under the lift arm. Start the engine and operate the lift cylinders through several up and down cycles. Shut off the engine and check for any leakage.
14. If necessary, repeat the steps 2 through 13 for other lift cylinders.
15. Check and fill the hydraulic reservoir (front axle) with the correct quantity of new hydraulic fluid before returning the machine to service.

Adjustments

Traction Pedal Friction Wheel (Machine Serial Number below 316000000)



g230809

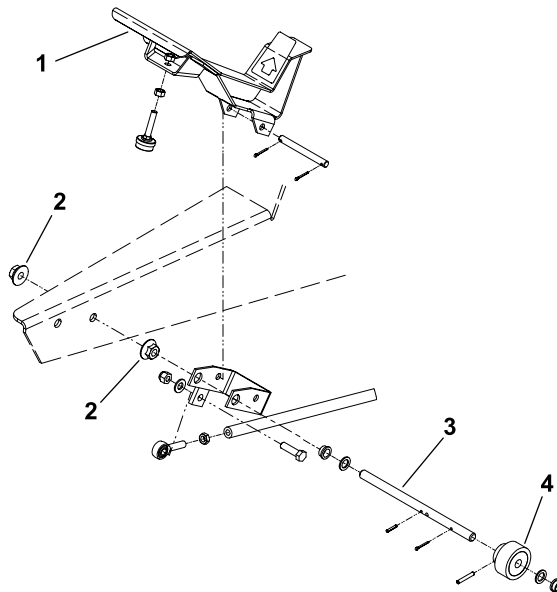
Figure 75

1. Traction pedal 2. Friction wheel 3. Inspection point

The traction pedal friction wheel is designed to reduce transmission oscillation caused by rapid back and forth foot movements against the traction pedal. This is most noticeable when operating over bumpy terrain.

Occasionally inspect the friction wheel surface that contacts the traction pedal ([Figure 75](#)). If the friction wheel is worn flat at this point, the wheel should be rotated to restore contact with the pedal.

Adjusting the Traction Pedal Friction Wheel



g230810

Figure 76

1. Traction pedal 3. Traction pedal shaft
2. Flange nut 4. Friction wheel

1. Loosen the flange nuts that secure the traction pedal shaft to the machine frame.

Adjusting the Traction Pedal Friction Wheel (continued)

2. Rotate the shaft to move the worn friction wheel section away from the traction pedal.
3. Tighten the flange nuts to secure traction pedal shaft and friction wheel in position.

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 \(page 5–6\)](#).

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

After Repairing or Replacing the Components

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

IMPORTANT

Drain and fill the hydraulic tank and change the oil filter if the component failure is severe or the system is contaminated; refer to [Flushing the Hydraulic System \(page 5–80\)](#).

2. If a component failure occurred in the closed-loop traction circuit (e.g., hydraulic pump or hydraulic motor), filtering the traction circuit is necessary; refer to [Filtering the Closed-Loop Traction Circuit \(Machine Serial Number above 316000000\) \(page 5–82\)](#).
3. Lubricate the O-rings and seals with clean hydraulic fluid before installing the hydraulic components.

After Repairing or Replacing the Components (continued)

4. Remove all the caps or plugs from the hydraulic tubes, hydraulic fittings, and components before connecting them again.
5. 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 5–9) and [Installing the Hydraulic Fittings \(SAE Straight Thread O-Ring Fitting into the Component Port\)](#) (page 5–11).
6. After you complete the repairs, check the control linkages or cables for proper adjustment, binding, or broken parts.
7. After you complete the repairs, clean the hydraulic components, hose connections, and fittings to prevent future accumulation of dirt and unwanted material on the hydraulic components.
8. 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 5–85).
9. Check for hydraulic-fluid leaks. Shut off the engine and repair leaks if necessary.
10. Check the hydraulic-fluid level in the hydraulic reservoir (front axle) and add correct quantity of fluid 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 pin-hole 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

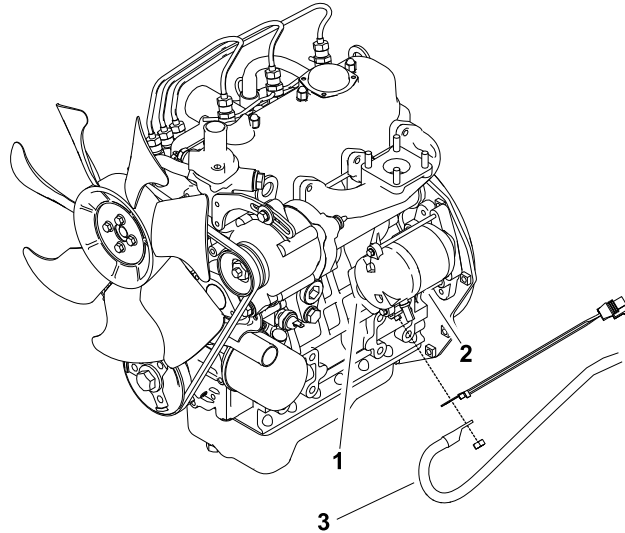
Check the hydraulic lines and hoses daily for leaks, kinked lines, loose mounting supports, wear, loose fittings, and hose deterioration. Repair the damaged hydraulic lines and hoses before operating the machine.

Priming the Hydraulic Pump

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 hydraulic pump have sufficient fluid during initial start-up and running. The pump can be primed by using a remote starter switch (refer to [Remote Starter Switch \(page 5–43\)](#)) to crank the engine which allows the pump to prime.

Use the following procedure to prime the hydraulic pump:

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 (front axle) and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.



g225779

Figure 77

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

Note: A blue wire connects to the starter motor solenoid B+ terminal ([Figure 77](#)). 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 pump. 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 \(page 5–7\)](#) 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.



CAUTION



Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to [Releasing Pressure from the Hydraulic System \(page 5–6\)](#).

2. 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.

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

3. Drain the hydraulic fluid from the hydraulic reservoir (front axle); refer to the *Operator's Manual*.
 4. Clean the area around the mounting area of the hydraulic-fluid filter. Remove and replace the hydraulic-fluid filter.
 5. Drain the complete hydraulic system. Drain all the hoses, tubes, and components while the system is warm. Flush the hoses and tubes to remove any contamination.
 6. Ensure that the mounting surface of the hydraulic-fluid filter is clean. Apply clean hydraulic fluid to the gasket on new filter. Tighten the filter until the gasket contacts the mounting plate, then tighten the filter 3 quarters of a turn.
-

IMPORTANT

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

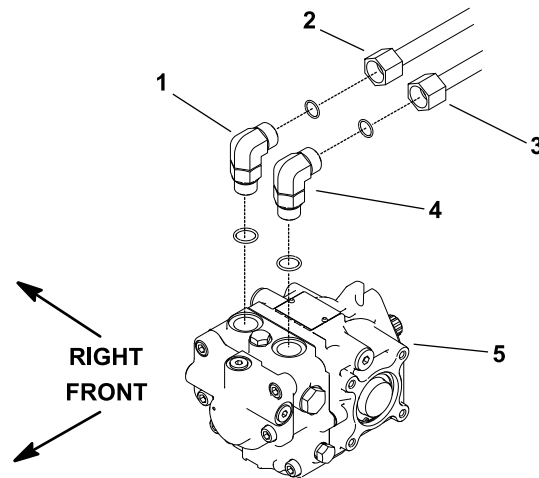
7. Fill the hydraulic reservoir (front axle) with the correct quantity of new hydraulic fluid; refer to the *Operator's Manual*.

Flushing the Hydraulic System (continued)

8. Perform the following to prevent engine from starting:
 - A. Disconnect the electrical connector to the fuel stop solenoid on Groundsmaster 3280-D machines.
 - B. Disconnect and ground all engine spark plug wires on Groundsmaster 3320 machines.
9. Prime the hydraulic pump; refer to [Priming the Hydraulic Pump \(page 5–79\)](#).
10. Connect the fuel stop solenoid (Groundsmaster 3280-D) or spark plug wires (Groundsmaster 3320) to allow the engine to start.
11. Start the engine and operate it at low-idle speed for a minimum of 2 minutes. Increase the engine speed to high idle for a minimum of 1 minute under no load.
12. Raise and lower the cutting deck several times. Turn the steering wheel fully left and right several times.
13. Shut off the engine and check for hydraulic-fluid leaks.

Note: Check the hydraulic-fluid level in the hydraulic reservoir (front axle) and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
14. Operate the machine for 2 hours under normal operating conditions.
15. Check the condition of hydraulic fluid. If new fluid shows any signs of contamination, repeat steps [1](#) through [14](#) again until the fluid is clean.
16. When the hydraulic fluid is free from contamination, assume normal operation and follow the recommended maintenance intervals.

Filtering the Closed-Loop Traction Circuit (Machine Serial Number above 316000000)



g225778

Figure 78

- | | |
|-----------------------------|-----------------------|
| 1. Right elbow fitting | 4. Left elbow fitting |
| 2. Hydraulic tube (forward) | 5. Hydraulic pump |
| 3. Hydraulic hose (reverse) | |

Filtering a closed-loop hydraulic system after a major component failure (e.g., hydraulic pump or hydraulic motor) is necessary to prevent unwanted material from transmitting throughout the system. If a closed-loop hydraulic system filtering tool is not used to ensure the system cleanliness, repeat failures, as well as subsequent damage to other hydraulic components in the affected system, will occur. To effectively remove the contamination from the closed-loop traction circuit, use the Toro high flow hydraulic filter and hydraulic hose kits (refer to [Special Tools \(page 5–39\)](#)).

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 \(page 1–6\)](#).

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

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

3. Clean the junction of the hydraulic hose and left elbow fitting at the top of the hydraulic pump ([Figure 78](#)). Disconnect the hose from the left pump fitting.
4. Connect the Toro high flow hydraulic filter in series between the hydraulic pump fitting and the disconnected hose. Use the hydraulic hose kit (refer to [Hydraulic Hose Kit \(page 5–40\)](#)) to connect the filter to the machine. Ensure that the fitting and hose connections are properly tightened.

Filtering the Closed-Loop Traction Circuit (Machine Serial Number above 316000000) (continued)

IMPORTANT

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

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



CAUTION



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

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

IMPORTANT

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

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

IMPORTANT

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

9. With the engine running at high-idle speed, alternately move the traction pedal from forward to reverse. While monitoring the filter indicator, continue this process for 5 more minutes.
10. Shut off the engine and remove the key from the key switch.

Filtering the Closed-Loop Traction Circuit (Machine Serial Number above 316000000) (continued)

11. Remove the high flow hydraulic filter and hydraulic hose kit from the machine. Connect the hydraulic hose to the left pump fitting. Ensure that you properly tighten the hoses; refer to [Installing the Hydraulic Hose and Tube \(O-Ring Face Seal Fitting\)](#) (page 5–9).
12. Lower the machine to the ground.
13. Check the hydraulic-fluid level in the hydraulic reservoir (front axle) 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 hydraulic pump, hydraulic motor, or lift cylinders, it is important that the hydraulic system is charged properly. Remove the air from the system and its components to reduce the chance of damage.

IMPORTANT

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

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

Note: Flush and fill the hydraulic system and reservoir whenever there is a severe component failure or the system is contaminated; refer to [Flushing the Hydraulic System \(page 5–80\)](#).

4. Ensure that the hydraulic reservoir (front axle) is full. Add correct quantity of hydraulic fluid if necessary; refer to the *Operator's Manual*.
5. Check the control linkage for proper adjustment, binding, or damaged parts.
6. Perform the following to prevent engine from starting:
 - A. Disconnect the electrical connector to the fuel stop solenoid on Groundsmaster 3280-D machines.
 - B. Disconnect and ground all engine spark plug wires on Groundsmaster 3320 machines.
7. Prime the hydraulic pump; refer to [Priming the Hydraulic Pump \(page 5–79\)](#).
8. Connect the fuel stop solenoid (Groundsmaster 3280-D) or spark plug wires (Groundsmaster 3320) to allow the engine to start.
9. Ensure that the traction pedal is in the NEUTRAL position and the PTO switch is in the OFF position. Start the engine and run it at low-idle speed.

Note: The hydrostat/hydraulic pump must pick up the hydraulic fluid and fill the hydraulic system. If there is no indication of fill in 30 seconds, shut off the engine and find the cause.

10. After the hydraulic system starts to show the signs of fill, press the deck lift switch until the lift cylinder rod moves in and out several times.
11. If the lift 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 charge relief valve in the hydraulic pump that is damaged.
12. After the lift cylinder moves normally, proceed to step [13](#).

Charging the Hydraulic System (continued)

13. Turn the steering wheel in both directions so that the steering cylinders move in and out several times.
14. Operate the traction pedal in the forward and reverse directions. The drive wheels should rotate in the proper direction. If the wheels rotate in the wrong direction, shut off the engine, inspect the hydraulic line placement at the hydraulic pump and hydraulic motor. Correct the hydraulic line installation before you proceed.
15. Ensure that the traction pedal returns to the NEUTRAL position when released from the forward or reverse direction and adjust if necessary.
16. Check the operation of the traction interlock switches; refer to [Checking the Operation of the Interlock Switches \(page 6–15\)](#).
17. If the hydrostat/hydraulic pump was replaced or rebuilt, operate the traction circuit so that all the wheels rotate slowly for 10 minutes.
18. Operate the machine by gradually increasing its work load to full over a 10 minute period.
19. Stop the machine. Check the hydraulic-fluid level in the hydraulic reservoir (front axle) and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
20. Check the hydraulic components for leaks and tighten any loose connections.

Transmission Driveshaft (Machine Serial Numbers below 316000000)

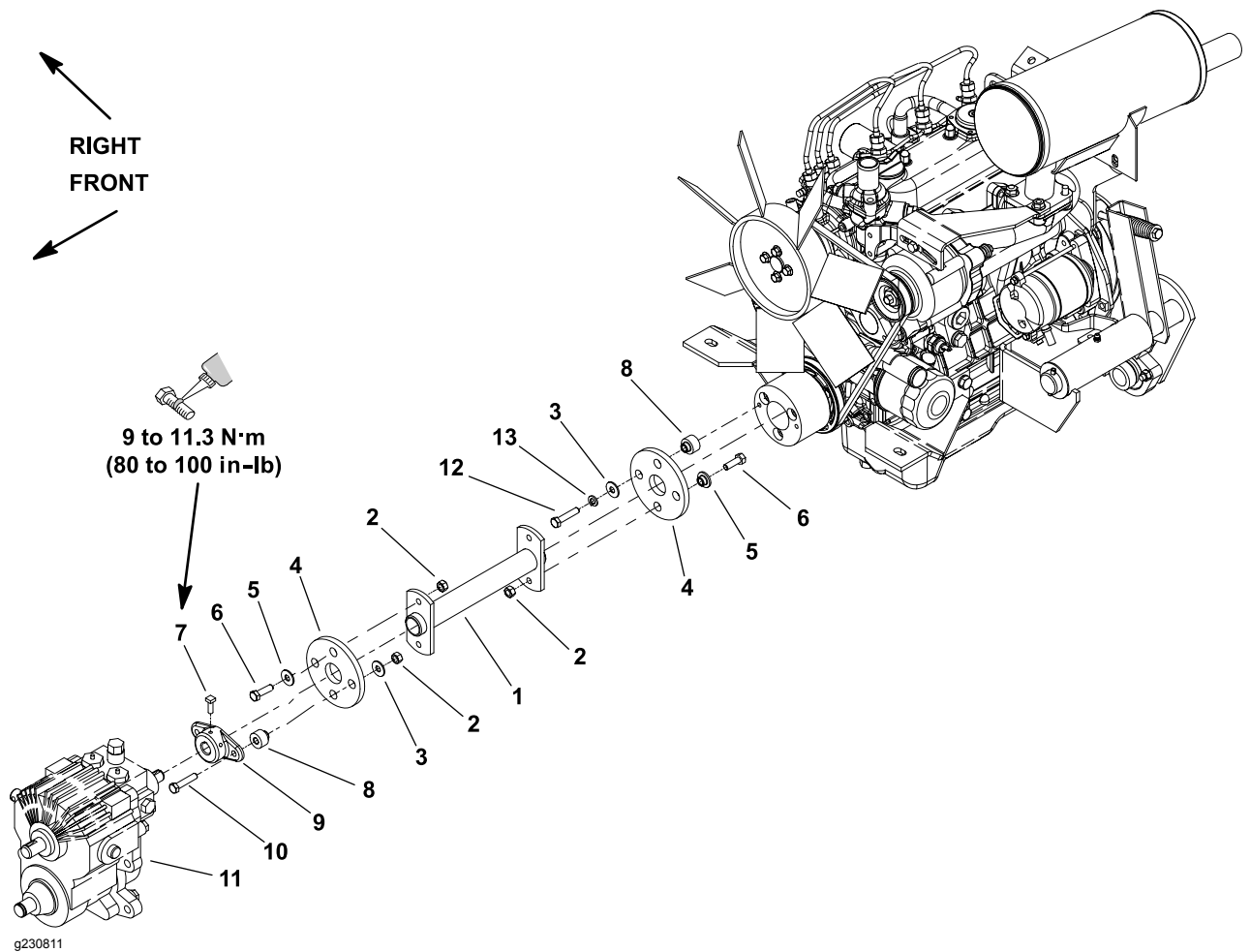


Figure 79

- | | | |
|--------------------|-------------------------------|------------------|
| 1. Driveshaft | 6. Bolt | 11. Transmission |
| 2. Conelock nut | 7. Square-head screw (2 each) | 12. Bolt |
| 3. Flat washer | 8. Coupling spacer | 13. Lock washer |
| 4. Rubber coupling | 9. Pump hub | |
| 5. Coupling spacer | 10. Bolt | |

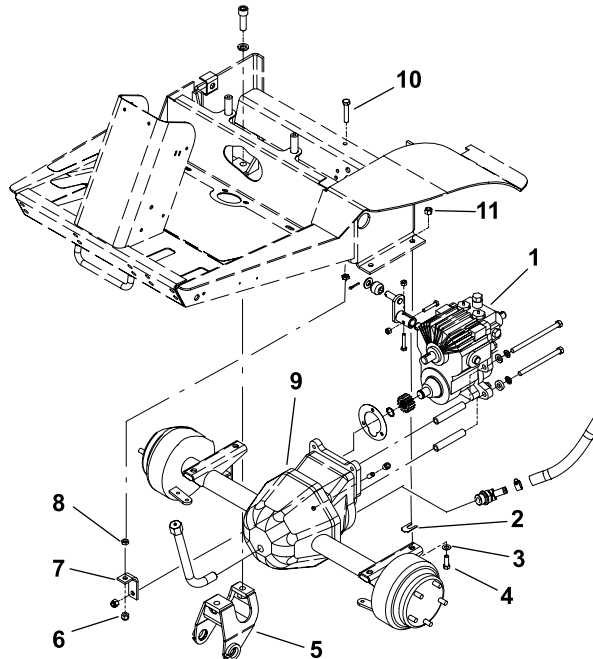
Removing the Transmission Driveshaft

1. Park the machine on a level surface, engage parking brake, lower cutting deck (or implement), and shut off the engine. Remove key from the key switch.
2. Remove conelock nuts, flat washers, and bolts that secure rubber coupling to pump hub (item 9 in [Figure 79](#)). Remove coupling spacers.
3. Remove bolts (item 12 in [Figure 79](#)), lock washers, and flat washers that secure rubber coupling to engine hub. Remove coupling spacers.
4. Remove driveshaft assembly from machine.
5. Remove conelock nuts (item 2 in [Figure 79](#)), coupling spacers, and bolts that secure driveshaft to rubber couplings.
6. Inspect rubber couplings and replace if cracked or damaged.

Aligning the Transmission Driveshaft

The engine crankshaft and the transmission input shaft must be aligned within 3 mm (0.125 inch) of each other.

1. Verify that the driveshaft is straight and that the flanges are perpendicular to the tube and are not bent.
2. Attach the driveshaft directly to the engine hub to allow verification of driveshaft alignment.
3. Loosen square-head screws (item 7 in [Figure 79](#)) that secure pump hub to transmission input shaft. Slide pump hub toward engine, align holes in pump hub with driveshaft flanges, and place bolts in holes.
4. Rotate driveshaft to check alignment of the driveshaft in all positions. Driveshaft and hub must be aligned within 3 mm (0.125 inch).



g230812

Figure 80

- | | | |
|-----------------|------------------------|---------------|
| 1. Transmission | 5. Carrier bracket | 9. Front axle |
| 2. Shim | 6. Locknut | 10. Bolt |
| 3. Flat washer | 7. Transmission anchor | 11. Locknut |
| 4. Bolt | 8. Jam nut | |

5. If alignment adjustment is necessary, loosen locknut and jam nut that secure transmission anchor ([Figure 80](#)).

Note: If necessary, loosen the lift arm carrier bracket before installing shims between frame and axle mounting pad.

6. Loosen fasteners that secure front axle to frame. Install shims between frame and axle mounting pads to adjust location of transmission input shaft.
 - A. If the transmission input shaft is high at the drive coupling, lower input shaft by installing shim(s) between the rearward axle mounting pads and the frame (or by removing shim(s) that may exist at forward mounting pads).
 - B. If the transmission input shaft is low at the drive coupling, raise input shaft by installing shim(s) between the forward axle mounting pads and the frame (or by removing shim(s) that exist at rearward axle mounting pad).

Aligning the Transmission Driveshaft (continued)

7. When driveshaft alignment is correct, tighten fasteners to secure front axle to frame.

IMPORTANT

Do not overtighten jam nut for transmission anchor as driveshaft alignment will be affected.

8. Tighten upper jam nut (item 8 in [Figure 80](#)) until it contacts top of transmission anchor and then tighten locknut below transmission anchor.

Installing the Transmission Driveshaft

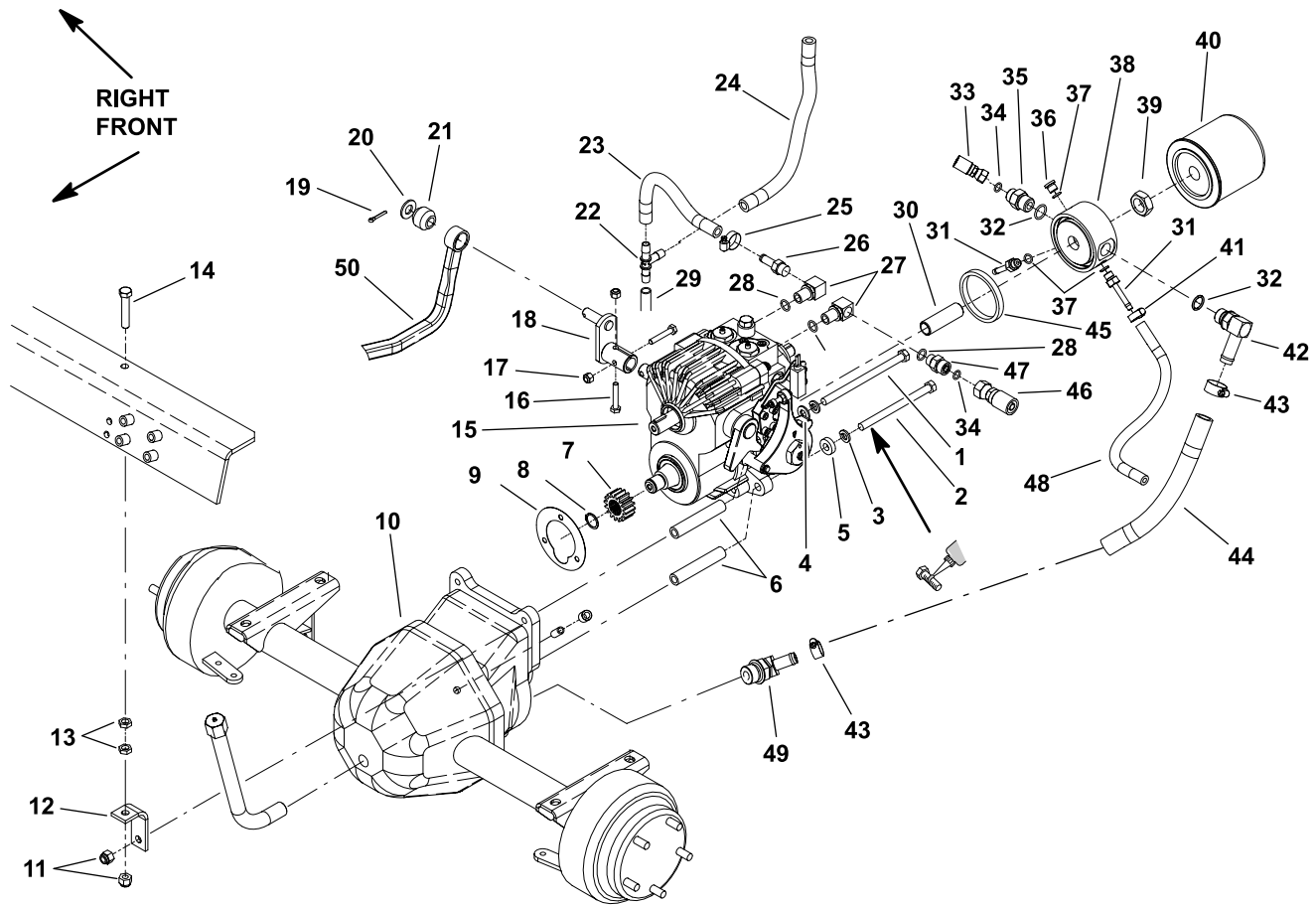
IMPORTANT

Ensure that the driveshaft alignment is correct before installing driveshaft.

1. Insert coupling spacers (item 5 in [Figure 79](#)) into rubber coupling holes. Secure rubber couplings to driveshaft with conelock nuts and bolts. Tighten so that the spacers are tight against driveshaft.
2. Insert coupling spacers (item 8 in [Figure 79](#)) into rubber couplings. Position driveshaft assembly to engine and pump hubs.
3. Secure rubber coupling to engine hub with bolts (item 12 in [Figure 79](#)), lock washers, and flat washers. Tighten bolts so that the spacers are tight against flat washers.
4. After attaching driveshaft to pump hub, ensure that neither rubber coupling is deformed more than 6.4 mm (0.250 inch) in either direction. If necessary, remove square-head screws from pump hub. Reposition hub on shaft until coupling deflection is less than 6.4 mm (0.250 inch). Apply Loctite #242 (or equivalent) to threads of square-head screws. Install screws into hub and torque to **9.0 to 11.3 N·m (80 to 100 in-lb)**.
5. Secure rubber coupling to pump hub with conelock nuts (item 2 in [Figure 79](#)), flat washers, and bolts. Tighten bolts so that the spacers are tight against flat washers.



Hydrostatic Transmission (Machine Serial Numbers below 316000000)



g230835

Figure 81

- | | | |
|-----------------------------|---------------------------|--------------------------------|
| 1. Bolt | 18. Pump lever | 35. Adapter |
| 2. Bolt (3 each) | 19. Cotter pin | 36. Plug |
| 3. Lock washer (4 each) | 20. Flat washer | 37. O-ring |
| 4. Flat washer | 21. Rubber bushing | 38. Filter adapter |
| 5. Spacer | 22. Hydraulic tee fitting | 39. Jam nut |
| 6. Mounting spacer (4 each) | 23. Hydraulic hose | 40. Hydraulic filter |
| 7. Pinion gear | 24. Hydraulic hose | 41. Hose clamp |
| 8. Snap ring | 25. Hose clamp | 42. Elbow fitting |
| 9. Transmission gasket | 26. Hydraulic fitting | 43. Hose clamp |
| 10. Front axle assembly | 27. Hydraulic fitting | 44. Hydraulic hose |
| 11. Locknut | 28. O-ring | 45. Filter adapter seal |
| 12. Transmission anchor | 29. Hydraulic hose | 46. Hydraulic hose |
| 13. Jam nut | 30. Filter union | 47. Straight hydraulic fitting |
| 14. Bolt | 31. Hydraulic fitting | 48. Hydraulic hose |
| 15. Transmission | 32. O-ring | 49. Elbow fitting |
| 16. Bolt (2 each) | 33. Hydraulic hose | 50. Traction rod |
| 17. Locknut (2 each) | 34. O-ring | |

Removing the Hydrostatic Transmission

1. Park the machine on a level surface, engage parking brake, lower cutting deck (or implement), and shut off the engine. Remove key from the key switch.
2. To prevent contamination of the hydraulic system, clean transmission and front axle.



CAUTION



Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic fluid.

3. Label hydraulic hoses to assist in assembly. Disconnect all hydraulic hoses from the transmission assembly. Allow hoses to drain into a suitable container. Plug or cap openings of transmission and hoses to prevent contamination.
4. On 4-wheel drive machines, disconnect 4-wheel drive driveshaft from transmission; refer to [Removing the Rear Axle Driveshaft \(4-Wheel Drive\) \(page 8–43\)](#). Position driveshaft away from transmission.
5. Remove transmission driveshaft; refer to [Removing the Transmission Driveshaft \(page 5–87\)](#).
6. Remove cotter pin (item 19 in [Figure 81](#)) and flat washer that retain traction rod end to pump lever. Remove traction rod from lever.
7. Label location of wires attached to neutral switch. Disconnect wires from switch and position away from transmission.
8. Remove locknut (item 11 in [Figure 81](#)) that secures transmission to transmission anchor.



CAUTION



Support transmission when removing it from the front axle to prevent it from falling and causing personal injury.

9. Loosen and remove 4 bolts (items 1 and 2 in [Figure 81](#)) that secure transmission to front axle. Locate and retrieve washers and spacers. Note location of washers and spacers for assembly purposes.
10. Carefully pull the transmission from the front axle differential.
11. Remove and discard gasket (item 9 in [Figure 81](#)). Clean gasket surfaces of transmission and front axle.
12. If necessary, remove hydraulic fittings from transmission. Note orientation of fittings for assembly purposes.
13. Remove and discard all O-rings from removed hydraulic hoses and fittings.

IMPORTANT

Pump lever is secured to transmission shaft with Loctite #680 Retaining Compound in addition to bolts and locknuts. Use puller to remove pump lever from transmission. To prevent transmission damage, strike lever with hammer during removal.

14. If pump lever (item 18 in [Figure 81](#)) removal is necessary, remove bolts and locknuts. Use puller to remove lever from transmission shaft.

Installing the Hydrostatic Transmission

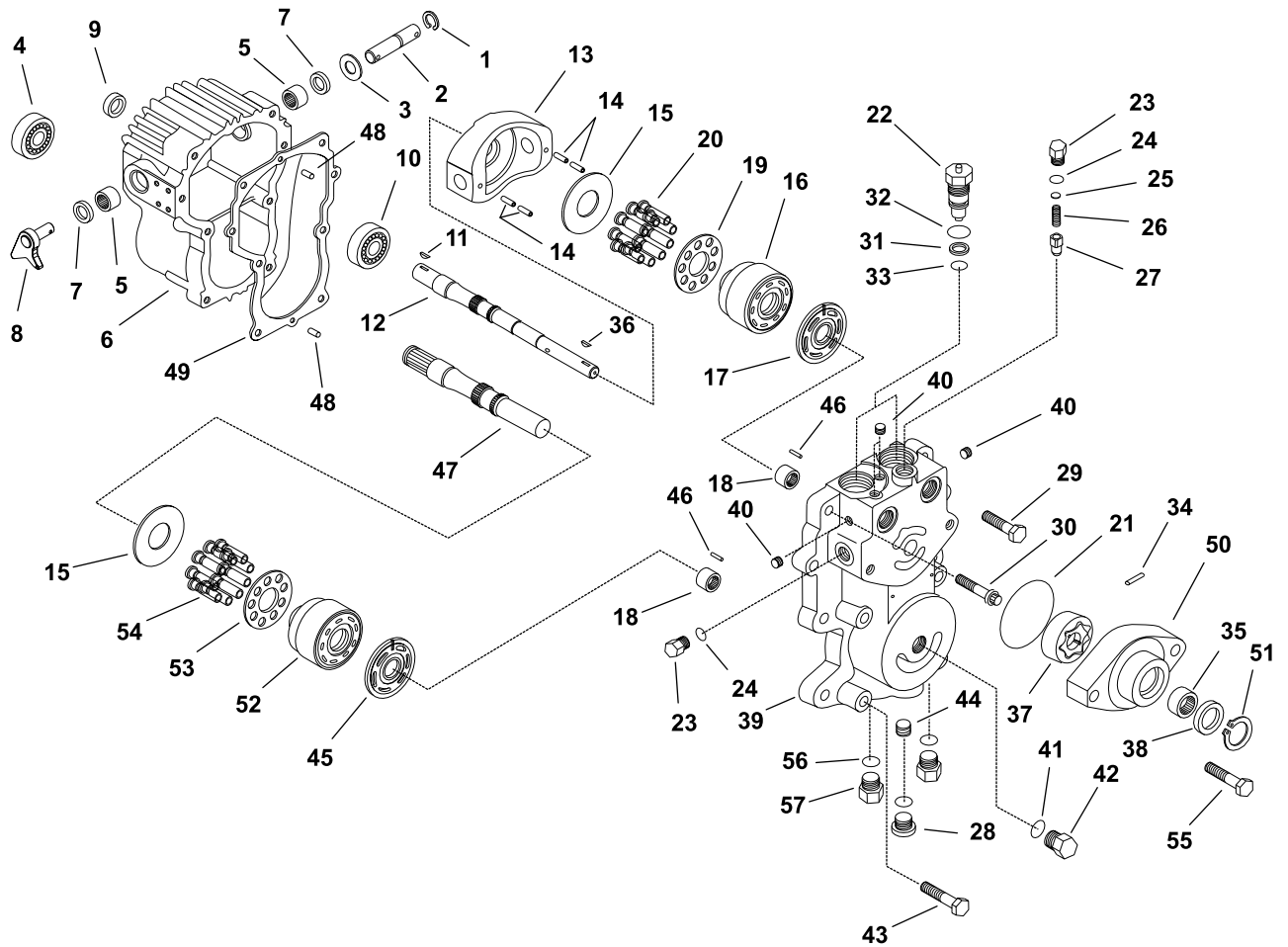
1. Coat new hydraulic fitting O-rings lightly with clean hydraulic fluid. Install fittings with new O-rings to the transmission. Orientate the fittings as noted during disassembly.
2. If pump lever (item 18 in [Figure 81](#)) was removed, clean pump shaft and apply Loctite #680 Retaining Compound (or equivalent) to pump shaft. Slide pump lever onto shaft and secure with bolts and locknuts.
3. Apply non-hardening gasket sealant to both sides of gasket (item 9 in [Figure 81](#)). Position gasket to front axle gasket surface.
4. Carefully position transmission to front axle taking care not to move or damage gasket. Ensure that the transmission and axle gears mesh properly.

IMPORTANT

During assembly, ensure that the upper left bolt (item 1 in [Figure 81](#)) extends through hole in transmission anchor.

5. Apply Loctite #242 (or equivalent) to threads of bolts (items 1 and 2 in [Figure 81](#)). Secure transmission to front axle with bolts, washers, and spacers using locations noted during disassembly. Tighten bolts in a crossing pattern. After tightening, ensure that mounting spacers do not rotate.
6. Secure transmission to anchor (item 12 in [Figure 81](#)) with locknut. Retain upper left bolt while tightening locknut.
7. Connect machine harness wires to neutral switch.
8. Slide traction rod (item 50 in [Figure 81](#)) to pump lever and secure with flat washer and cotter pin.
9. Check transmission driveshaft alignment and adjust if necessary; refer to [Transmission Driveshaft \(Machine Serial Numbers below 316000000\) \(page 5–87\)](#). Install transmission driveshaft.
10. On 4-wheel drive machines, connect 4-wheel drive driveshaft to transmission; refer to [Installing the Rear Axle Driveshaft \(4-Wheel Drive\) \(page 8–44\)](#).
11. Install hydraulic hoses to fittings on transmission in positions noted during disassembly.
12. Check hydraulic-fluid level in reservoir (front axle) and adjust as required; refer to the *Traction Unit Operator's Manual*.
13. Operate the machine functions slowly until air is out of system; refer to [Charging the Hydraulic System \(page 5–85\)](#).
14. Check traction drive for neutral and neutral switch adjustment; refer to the *Traction Unit Operator's Manual*.

Servicing the Hydrostatic Transmission (Machine Serial Numbers below 316000000)



g230836

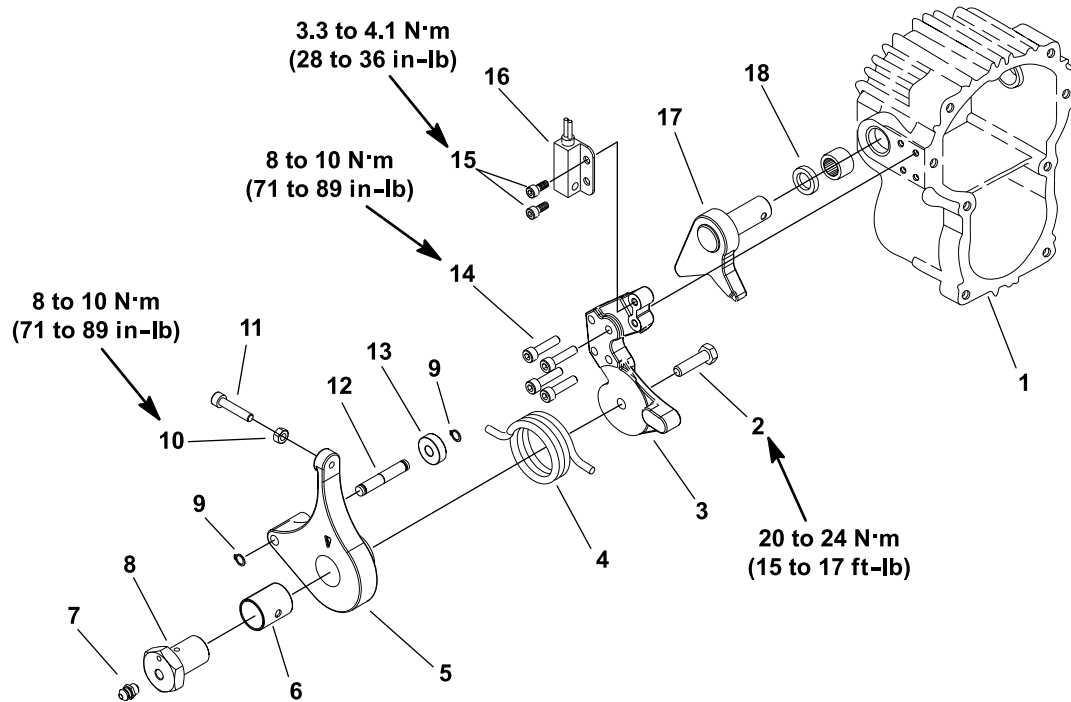
Figure 82

- | | | |
|-----------------------------|--------------------------------------|---------------------------------------|
| 1. Retaining ring | 20. Piston (pump) (9 each per block) | 39. Center section |
| 2. Trunnion shaft | 21. O-ring | 40. Pipe plug (4 each) |
| 3. Flat washer | 22. Check valve | 41. O-ring |
| 4. Roller bearing | 23. Plug | 42. Threaded plug |
| 5. Needle bearing | 24. O-ring | 43. Bolt (4 each) |
| 6. Transmission housing | 25. Shim pack | 44. Expansion plug |
| 7. Lip seal | 26. Relief valve spring | 45. Motor valve plate |
| 8. Trunnion cam | 27. Relief valve cone | 46. Dowel pin |
| 9. Lip seal | 28. Plug | 47. Motor shaft |
| 10. Ball bearing | 29. Bolt (2 each) | 48. Dowel pin (2 each) |
| 11. Woodruff key | 30. Bolt (2 each) | 49. Housing gasket |
| 12. Pump shaft | 31. Backup ring | 50. Charge pump housing |
| 13. Swash plate | 32. O-ring | 51. Retaining ring |
| 14. Spring pin | 33. O-ring | 52. Cylinder block (motor) |
| 15. Thrust plate | 34. Pin | 53. Slipper retainer (motor) |
| 16. Cylinder block (pump) | 35. Bearing | 54. Piston (motor) (9 each per block) |
| 17. Pump valve plate | 36. Woodruff key | 55. Flange-head screw (2 each) |
| 18. Needle bearing | 37. Gerotor (charge) pump | 56. O-ring (2 each) |
| 19. Slipper retainer (pump) | 38. Shaft seal | 57. Threaded plug (2 each) |

Servicing the Hydrostatic Transmission (Machine Serial Numbers below 316000000) (continued)

Note: For transmission repair information; refer to the Danfoss 15 Series Axial Piston Pumps, Motors and Transmission Repair Manual and Service Manual.

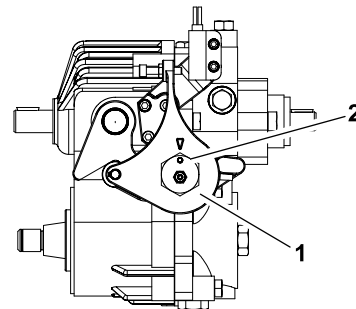
Hydrostatic Transmission Neutral Arm Assembly (Machine Serial Number below 316000000)



g230837

Figure 83

- | | | |
|--------------------------|-----------------------|--------------------------------|
| 1. Transmission housing | 7. Grease fitting | 13. Bearing |
| 2. Bolt | 8. Eccentric pin | 14. Socket-head screw (4 each) |
| 3. Mounting plate | 9. Retaining ring | 15. Socket-head screw |
| 4. Neutral return spring | 10. Jam nut | 16. Neutral proximity switch |
| 5. Neutral return arm | 11. Socket-head screw | 17. Trunnion cam |
| 6. Bushing | 12. Pin | 18. Seal |



g230838

Figure 84

- | | |
|------------------|-------------------|
| 1. Eccentric pin | 2. Alignment mark |
|------------------|-------------------|

Disassembling the Hydrostatic Transmission Neutral Arm Assembly

1. Disassemble neutral arm components on hydrostatic transmission as necessary ([Figure 83](#)).

Note: To remove trunnion cam (item 17 in [Figure 83](#)) from hydrostatic transmission, transmission has to be disassembled.

Assembling the Hydrostatic Transmission Neutral Arm Assembly

1. Assemble neutral arm components to hydrostatic transmission ([Figure 83](#)). If eccentric pin was removed, ensure that the mark on eccentric pin is orientated to top of transmission. Note fastener torque specifications.
2. Lubricate grease fitting on eccentric pin; refer to the *Traction Unit Operator's Manual*.
3. Check and adjust neutral position; refer to the *Traction Unit Operator's Manual*.
4. Check for correct operation of neutral switch and adjust if necessary; refer to [Adjusting the Traction Neutral Switch \(page 6–45\)](#).

Hydraulic Pump Driveshaft (Machine Serial Number above 316000000)

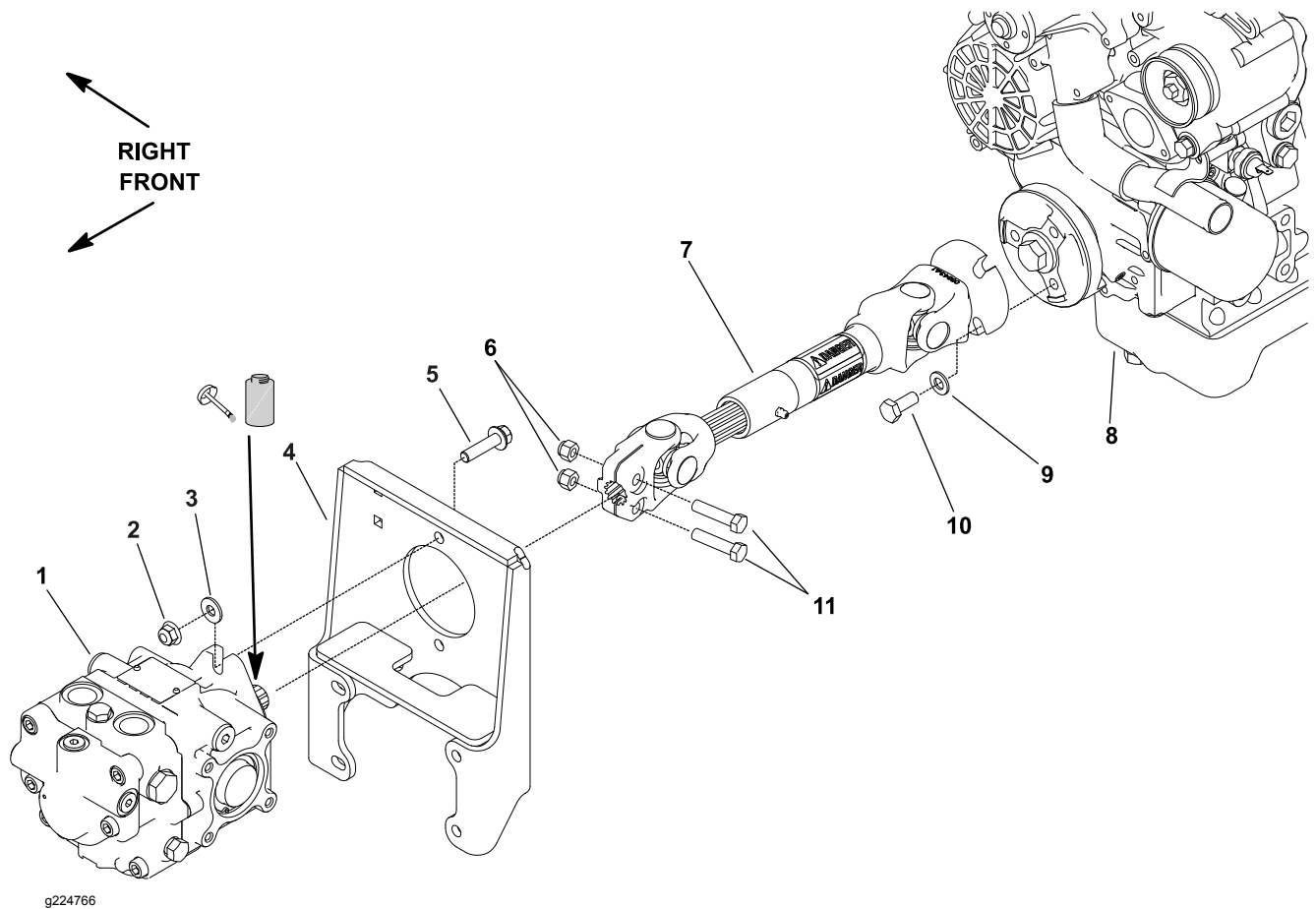


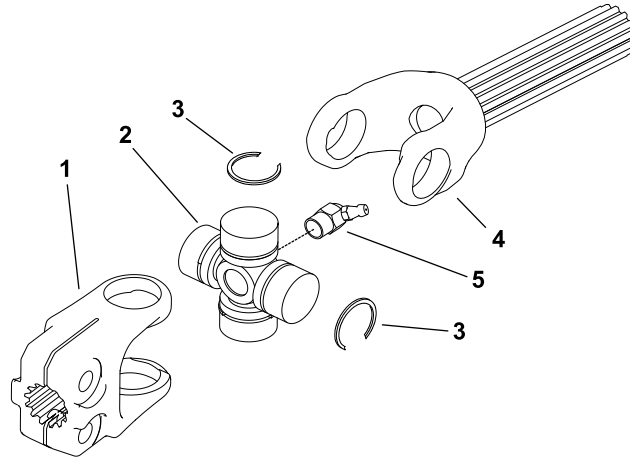
Figure 85

- | | | |
|-------------------------|-------------------------------|-------------------------|
| 1. Hydraulic pump | 5. Flange-head screw (2 each) | 9. Flat washer (3 each) |
| 2. Flange nut (2 each) | 6. Locknut (2 each) | 10. Bolt (3 each) |
| 3. Flat washer (2 each) | 7. Driveshaft assembly | 11. Bolt (2 each) |
| 4. Pump bracket | 8. Kubota diesel engine | |

Removing the Hydraulic Pump Driveshaft

1. Park the machine on a level surface, set the parking brake, lower the cutting deck, shut off the engine, and remove the key from the key switch.
2. Remove the 2 locknuts and 2 flat washers that secure the driveshaft loop to the radiator frame, and remove the driveshaft loop.
3. Remove the 2 bolts (item 11 in [Figure 85](#)) and 2 locknuts that secure the driveshaft end yoke to the hydraulic pump input shaft.
4. Remove the 3 bolts (item 10 in [Figure 85](#)) and 3 flat washers that secure the driveshaft flanged yoke to the engine.
5. Remove the driveshaft assembly from the machine.

Servicing the Driveshaft Cross and Bearing



g224767

Figure 86

- | | |
|--------------------------|-------------------|
| 1. End yoke | 4. Shaft yoke |
| 2. Cross and bearing kit | 5. Grease fitting |
| 3. Snap ring (4 each) | |

-
1. Remove the snap rings that secure the bearings in the yokes.
-

IMPORTANT

Support the yokes when removing and installing the bearings to prevent damage.

2. Use a press to remove the cross and bearings from the yokes. Clean the driveshaft yokes.
3. Install new cross and bearings as follows:
 - A. Apply a thick layer of grease to the bearing bores in the end yoke and shaft yoke.
 - B. Press 1 bearing partially into yoke.
 - C. Insert the cross into the yoke and bearing.
 - D. Hold the cross in alignment and press the bearing in until it hits the yoke.
 - E. Install the snap ring into the yoke groove to secure the installed bearing.
 - F. Place second bearing into the yoke bore and onto the cross shaft. Press the bearing into the yoke and secure with the snap ring.
 - G. Repeat the procedure for the other yoke.
 - H. Apply grease to the cross until it comes out of all the 4 bearing cups.
4. 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.

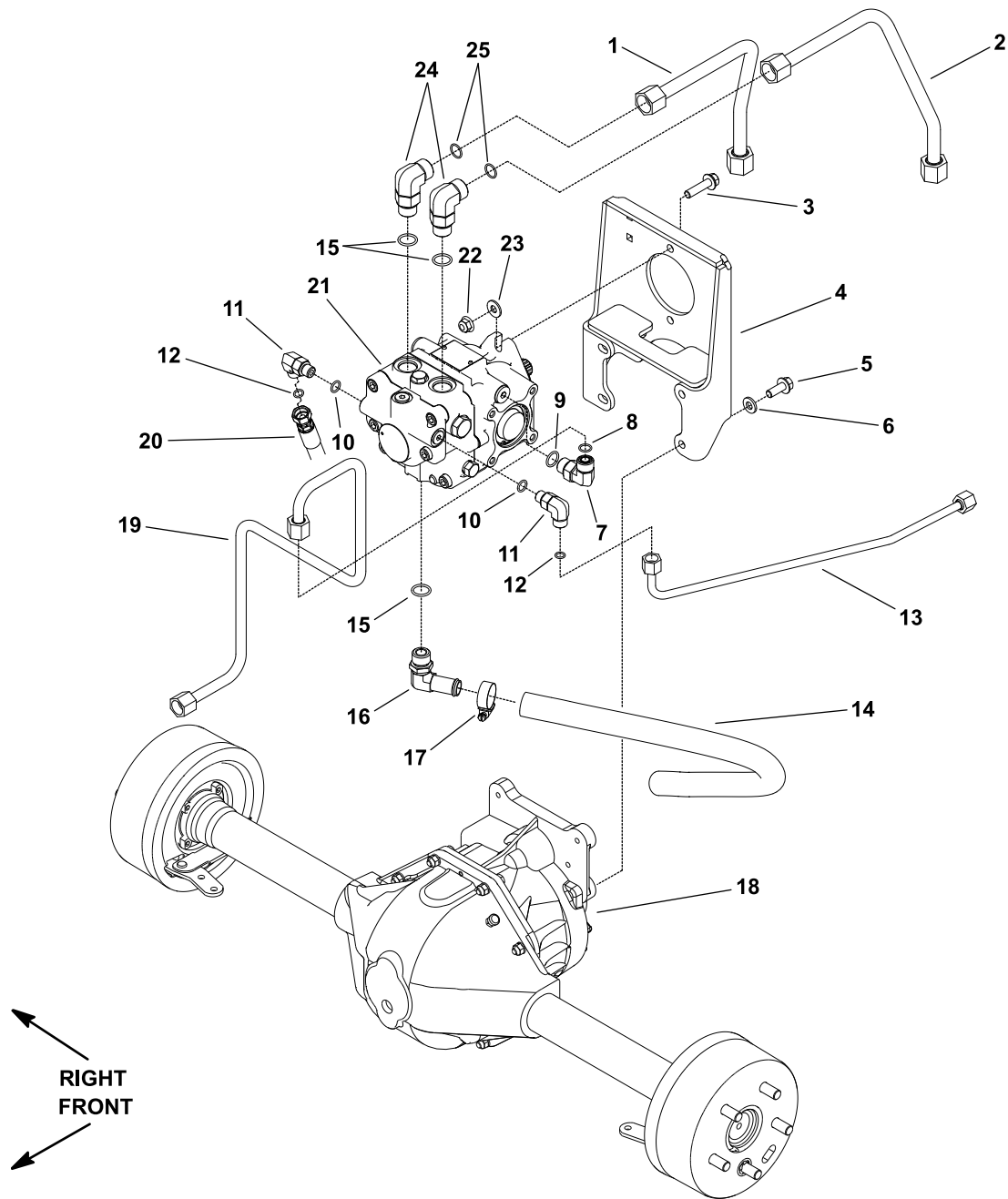
Installing the Hydraulic Pump Driveshaft

1. Apply anti-seize lubricant to the hydraulic pump input shaft.
2. Position the driveshaft assembly to the engine and pump input shaft.
3. Secure the driveshaft assembly to the engine with the 3 bolts (item 10 in [Figure 85](#)) and 3 flat washers.

Installing the Hydraulic Pump Driveshaft (continued)

4. Slide the driveshaft end yoke on the pump input shaft so that the yoke is flush with end of the input shaft. Secure the driveshaft end yoke to the pump input shaft with the 2 bolts (item 11 in [Figure 85](#)) and 2 locknuts.
5. Position the driveshaft loop to the radiator frame and secure with the 2 flat washers and 2 locknuts.
6. Lubricate the grease fittings on the driveshaft.

Hydraulic Pump (Machine Serial Number above 316000000)



g224765

Figure 87

- | | | |
|-------------------------------|------------------------------------|------------------------------------|
| 1. Hydraulic tube | 10. O-ring (2 each) | 19. Hydraulic tube |
| 2. Hydraulic tube | 11. 90° hydraulic fitting (2 each) | 20. Hydraulic hose |
| 3. Flange-head screw (2 each) | 12. O-ring (2 each) | 21. Hydraulic pump |
| 4. Pump Bracket | 13. Hydraulic tube | 22. Flange nut (2 each) |
| 5. Flange-head screw (4 each) | 14. Suction hose | 23. Flat washer (2 each) |
| 6. Hardened washer | 15. O-ring (3 each) | 24. 90° hydraulic fitting (2 each) |
| 7. 90° hydraulic fitting | 16. 90° hydraulic fitting | 25. O-ring (2 each) |
| 8. O-ring | 17. Hose clamp | |
| 9. O-ring | 18. Front axle | |

Removing the Hydraulic 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 \(page 5–6\)](#).

1. Park the machine on a level surface, set the parking brake, lower the cutting deck (or implement), shut off the engine, and remove the key from the key switch.
 2. Remove the operator seat; refer to [Removing the Operator Seat \(page 7–20\)](#).
 3. Remove the fuel tank; refer to [Removing the Fuel Tank \(page 4–16\)](#).
 4. Read the [General Precautions for Removing and Installing the Hydraulic System Components \(page 5–77\)](#).
 5. Clean the hydraulic pump, front axle, and all hydraulic connections to prevent hydraulic system contamination.
 6. For assembly purposes, label all the hydraulic connections.
 7. Disconnect the hoses and tubes from the fittings on the hydraulic pump. Allow the hydraulic lines to drain into a suitable container.
 8. Install clean caps or plugs on the openings of pump and disconnected lines to prevent contamination.
 9. Remove the hydraulic pump driveshaft; refer to [Hydraulic Pump Driveshaft \(Machine Serial Number above 316000000\) \(page 5–97\)](#).
 10. Remove the cotter pin and flat washer that retain the traction rod end to the pump lever, and remove the traction rod from the lever. Disconnect the wire harness electrical connector from the traction neutral sensor; refer to [Traction Neutral Arm Assembly \(Machine Serial Number above 316000000\) \(page 5–105\)](#).
 11. Remove the 2 flange-head screws (item 3 in [Figure 87](#)), 2 washers, and 2 flange nuts that secure the hydraulic pump to the pump bracket.
-

IMPORTANT

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

12. Carefully remove the hydraulic pump from the machine.
13. If necessary, remove the hydraulic fittings from the pump. Note the orientation of the fittings for assembly purposes.
14. Remove and discard all the O-rings from the hydraulic hoses, tubes, and fittings that were removed.

Installing the Hydraulic Pump

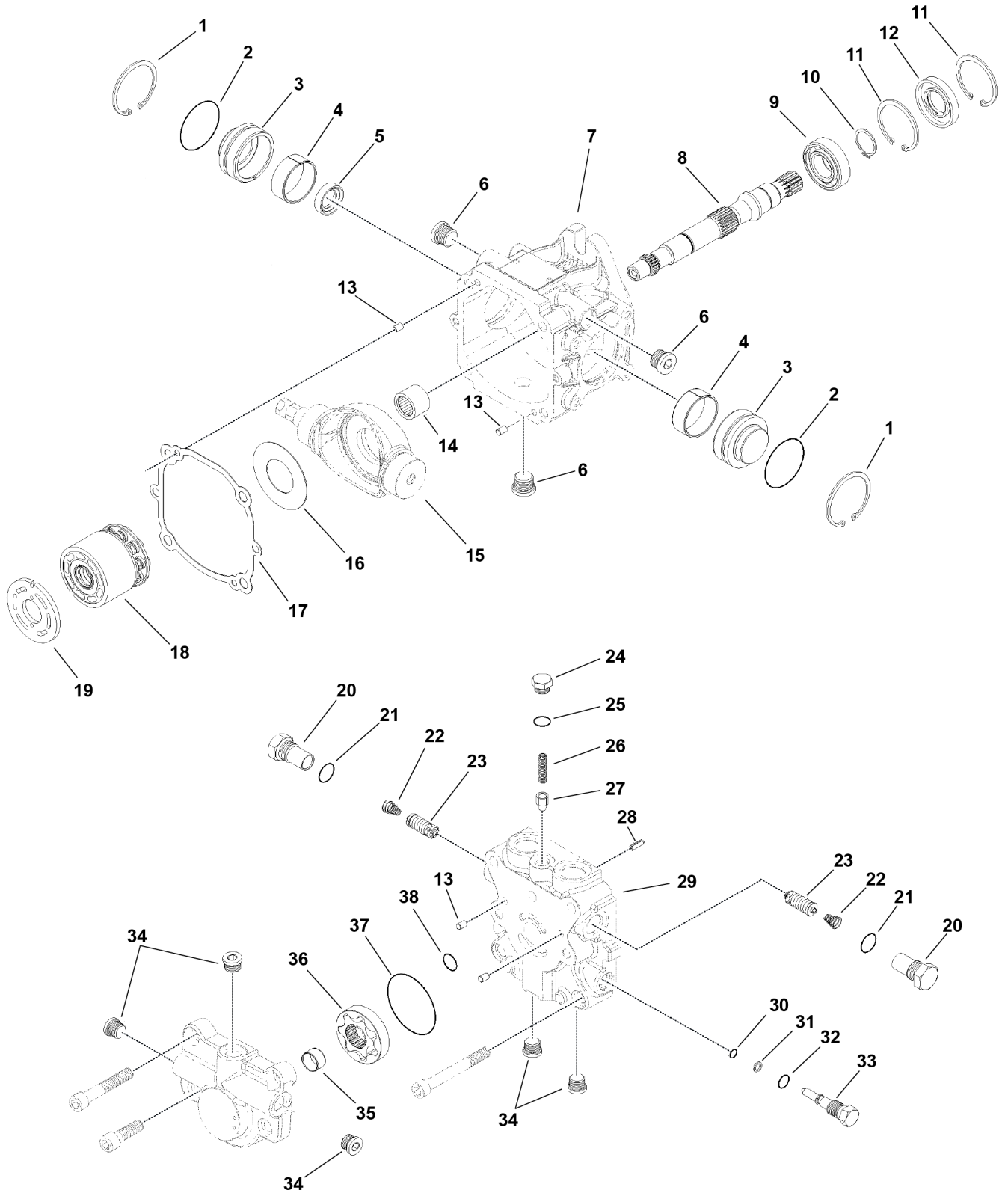
1. If the hydraulic fittings were removed from the pump, lubricate and install new O-rings to the fittings. Install the fittings into the pumps; refer to [Installing the Hydraulic Fittings \(SAE Straight Thread O-Ring Fitting into the Component Port\) \(page 5–11\)](#).

IMPORTANT

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

2. Carefully lower the hydraulic pump into the machine.
3. Secure the hydraulic pump to the pump bracket with the 2 flange-head screws (item 3 in [Figure 87](#)), 2 washers, and 2 flange nuts.
4. Use the labels that you attached during the removal process to correctly connect the hydraulic hoses and tubes to the fittings on the hydraulic pump; refer to [Installing the Hydraulic Hose and Tube \(O-Ring Face Seal Fitting\)](#) (page 5–9).
5. Secure the traction rod end to the pump lever with the cotter pin and flat washer. Connect the wire harness electrical connector to the traction neutral sensor; refer to [Traction Neutral Arm Assembly \(Machine Serial Number above 316000000\)](#) (page 5–105).
6. Install the hydraulic pump driveshaft; refer to [Hydraulic Pump Driveshaft \(Machine Serial Number above 316000000\)](#) (page 5–97).
7. Install the fuel tank; refer to [Installing the Fuel Tank](#) (page 4–17).
8. Install the operator seat; refer to [Installing the Operator Seat](#) (page 7–20).
9. Check the hydraulic-fluid level in the hydraulic reservoir (front axle) and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
10. Operate the machine functions slowly until air is out of system; refer to [Charging the Hydraulic System](#) (page 5–85).
11. Check the traction drive for neutral and traction neutral sensor operation. Adjust if necessary.

Servicing the Hydraulic Pump (Machine Serial Number above 316000000)



g224915

Figure 88

Servicing the Hydraulic Pump (Machine Serial Number above 316000000) (continued)

Figure 88 (continued)

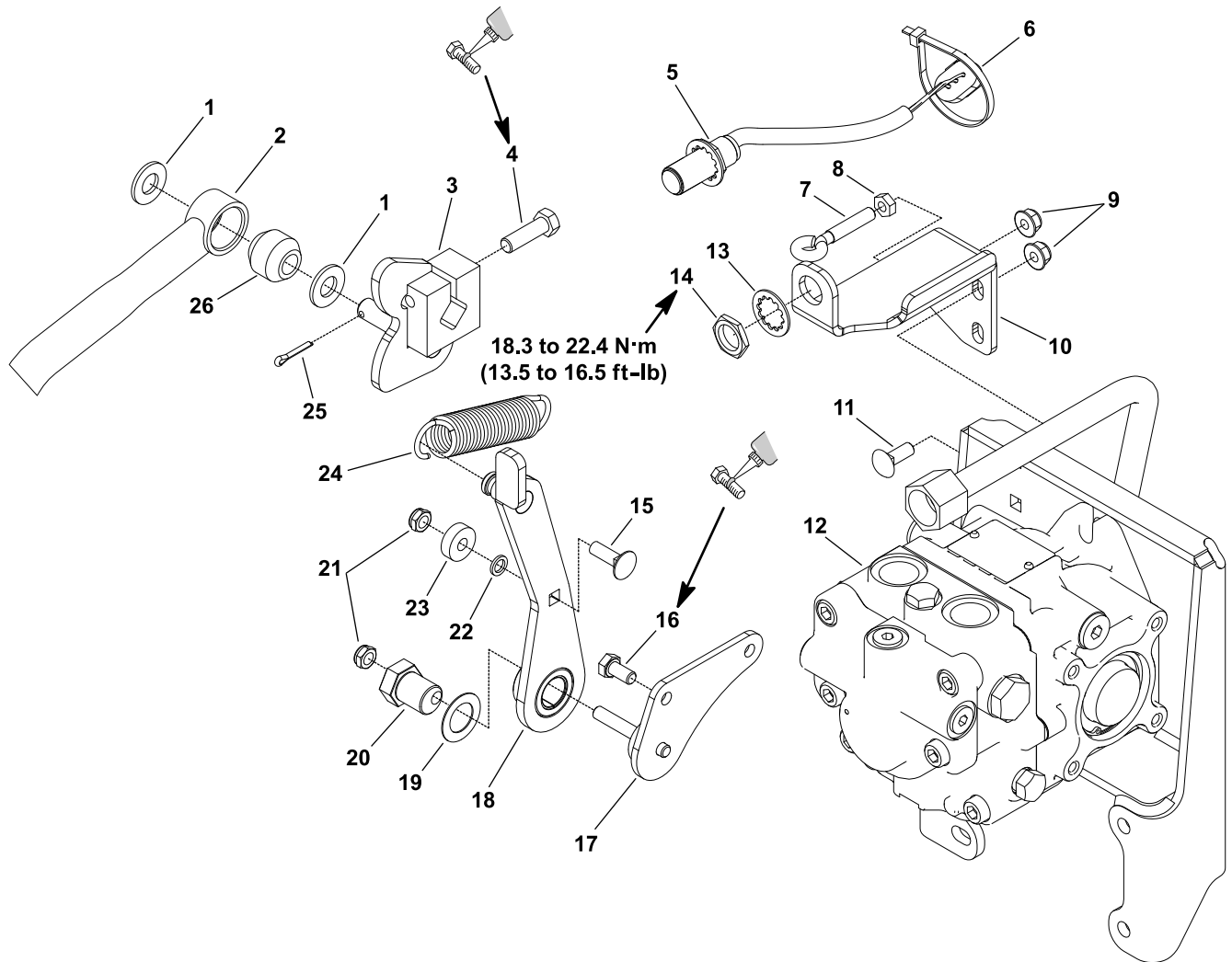
- | | | |
|-----------------------------|------------------------|-----------------------|
| 1. Retaining ring (2 each) | 14. Needle bearing | 27. Relief cone valve |
| 2. O-ring (2 each) | 15. Swash plate | 28. Slotted pin |
| 3. Body (2 each) | 16. Thrust plate | 29. End cap |
| 4. Inner race (2 each) | 17. End cap gasket | 30. O-ring |
| 5. Seal lip | 18. Cylinder block kit | 31. Back-up ring |
| 6. Plug (3 each) | 19. Valve plate | 32. O-ring |
| 7. Hydraulic pump housing | 20. Plug (2 each) | 33. Plug |
| 8. Driveshaft | 21. O-ring (2 each) | 34. Plug (5 each) |
| 9. Ball bearing | 22. Spring (2 each) | 35. Journal bearing |
| 10. Retaining ring | 23. SCR valve (2 each) | 36. Gerotor assembly |
| 11. Retaining ring (2 each) | 24. Plug | 37. O-ring |
| 12. Shaft seal lip | 25. O-ring | 38. O-ring |
| 13. Pin (4 each) | 26. Spring | |

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

IMPORTANT

If a hydraulic pump failure occurs; refer to the [Traction Circuit Component Failure \(page 5–7\)](#) for information regarding the importance of removing contamination from the traction circuit.

Traction Neutral Arm Assembly (Machine Serial Number above 316000000)



g225054

Figure 89

- | | | |
|----------------------------|-----------------------------|----------------------|
| 1. Flat washer (2 each) | 10. Sensor bracket | 19. Thrust washer |
| 2. Traction rod | 11. Carriage screw (2 each) | 20. Traction stud |
| 3. Neutral cam | 12. Hydraulic pump | 21. Locknut (2 each) |
| 4. Bolt | 13. Lock washer (2 each) | 22. Bearing spacer |
| 5. Traction neutral sensor | 14. Jam nut (2 each) | 23. Ball bearing |
| 6. Cable tie | 15. Carriage bolt | 24. Extension spring |
| 7. Thread eyebolt (right) | 16. Bolt (2 each) | 25. Cotter pin |
| 8. Jam nut | 17. Pivot | 26. Rubber bushing |
| 9. Flange nut (3 each) | 18. Neutral arm | |

Disassembling the Traction Neutral Arm Assembly

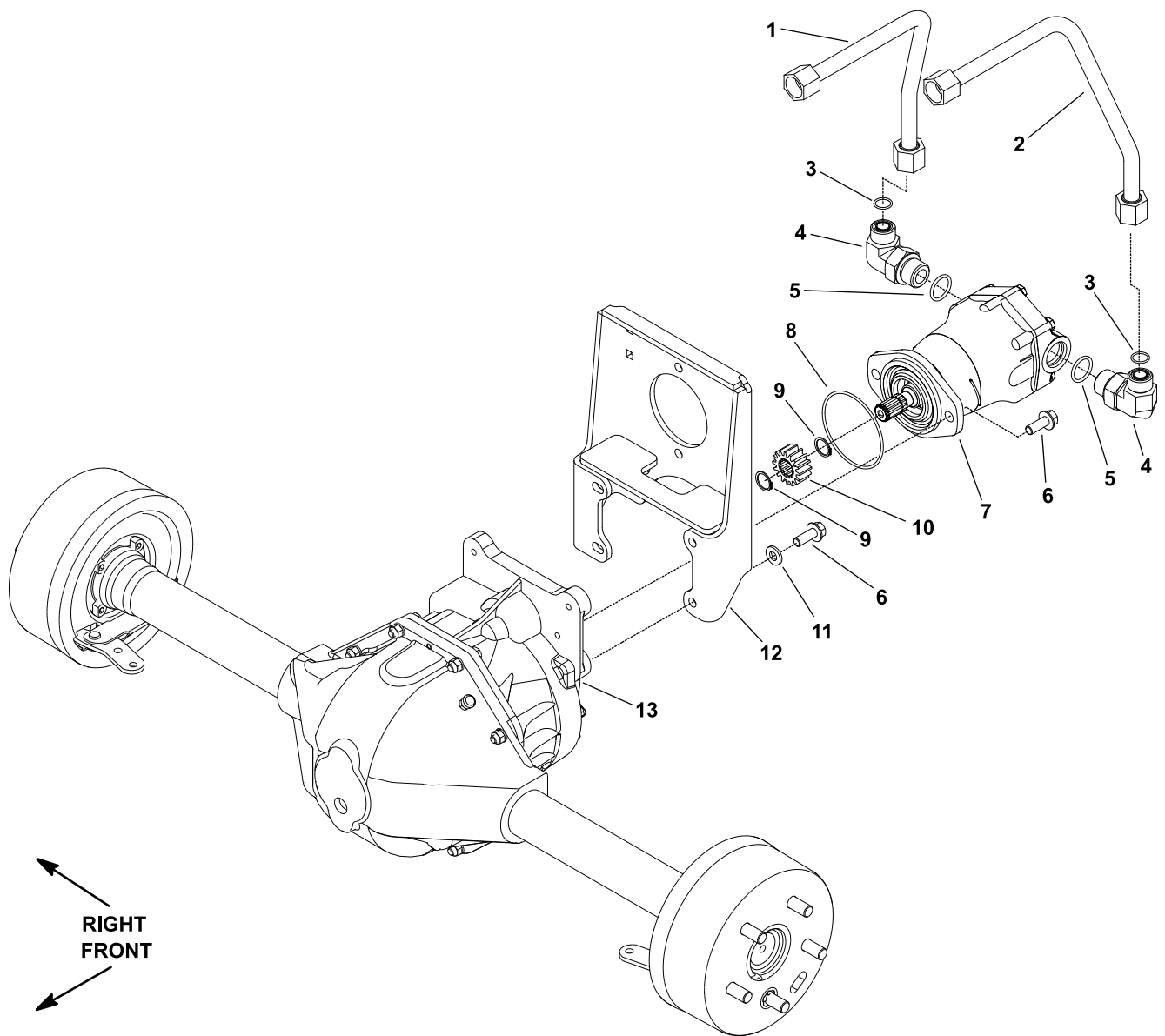
1. Disassemble the neutral arm components on the hydraulic pump as necessary ([Figure 89](#)).

Note: To remove the neutral cam (item 3 in [Figure 89](#)) from the hydraulic pump, the hydraulic pump has to be disassembled.

Assembling the Traction Neutral Arm Assembly

1. Assemble the neutral arm components to the hydraulic pump ([Figure 89](#)).
2. Check and adjust the neutral position; refer to the *Operator's Manual*.
3. Check for correct operation of the neutral sensor and adjust if necessary; refer to the [Traction Neutral Sensor \(Machine Serial Number above 316000000\)](#) (page 6–16).

Front Axle Drive Motor (Machine Serial Number above 316000000)



g224764

Figure 90

- | | | |
|-----------------------------------|-------------------------------|---------------------|
| 1. Hydraulic tube | 6. Flange-head screw (6 each) | 11. Hardened washer |
| 2. Hydraulic tube | 7. Hydraulic motor | 12. Pump bracket |
| 3. O-ring (2 each) | 8. O-ring | 13. Front axle |
| 4. 90° hydraulic fitting (2 each) | 9. Snap ring (2 each) | |
| 5. O-ring (2 each) | 10. Pinion gear | |

Removing the Front Axle Drive Motor



CAUTION



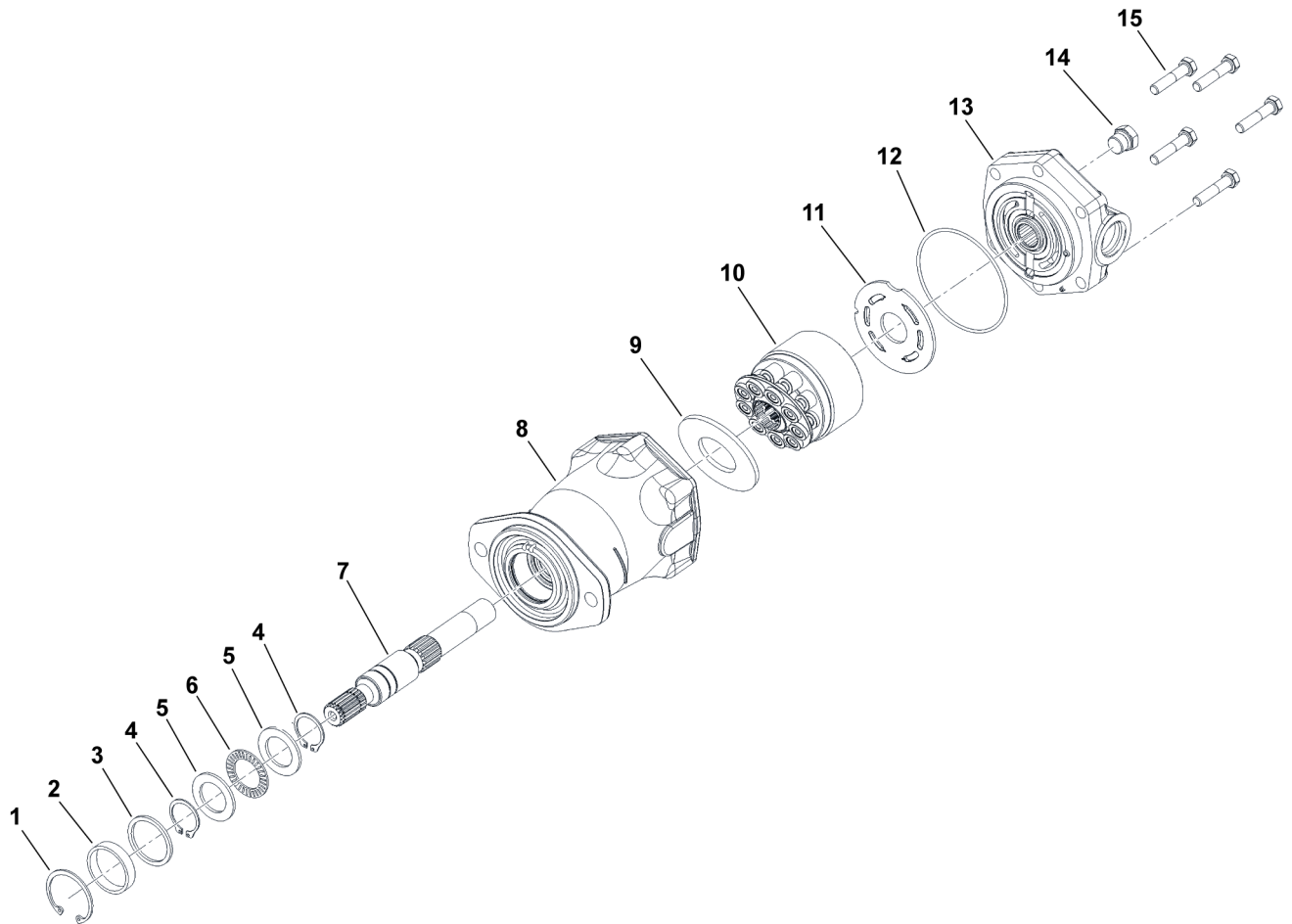
Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to [Releasing Pressure from the Hydraulic System \(page 5–6\)](#).

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. Read the [General Precautions for Removing and Installing the Hydraulic System Components \(page 5–77\)](#).
4. Clean the hydraulic tube ends and fittings on the hydraulic motor to prevent contaminants from entering into the hydraulic system.
5. For assembly purposes, label all the hydraulic connections at the hydraulic motor.
6. Loosen and remove the hydraulic tubes from the fittings on the hydraulic 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. On 4-wheel drive machines, remove the rear axle driveshaft; refer to [Removing the Rear Axle Driveshaft \(4-Wheel Drive\) \(page 8–43\)](#).
9. Remove the 2 flange-head screws (item 6 in [Figure 90](#)) that secure the hydraulic motor to the front axle; remove the motor from the machine.
10. Remove and discard the O-ring (item 8 in [Figure 90](#)) from the motor.
11. If the hydraulic fittings are to be removed from the hydraulic motor, mark the fitting orientation for assembly purposes. Remove the fittings from the hydraulic motor and discard the O-rings from the fittings.

Installing the Front Axle Drive Motor

1. If the hydraulic fittings were removed from the hydraulic motor, lubricate and install new O-rings to the fittings. To properly align and install the fittings into the hydraulic motor ports, use the marks that you made during the removal process; refer to [Installing the Hydraulic Fittings \(SAE Straight Thread O-Ring Fitting into the Component Port\) \(page 5–11\)](#).
2. Position the new O-ring (item 8 in [Figure 90](#)) to the hydraulic motor and install the motor into the front axle with the 2 flange-head screws.
3. On 4-wheel drive machines, install the rear axle driveshaft; refer to [Installing the Rear Axle Driveshaft \(4-Wheel Drive\) \(page 8–44\)](#).
4. Remove the caps and plugs from the hydraulic tubes and fittings.
5. Lubricate and install new O-rings to the fittings on the hydraulic motor. Use the labels that you attached during the removal process to correctly connect the hydraulic tubes to the motor fittings; refer to [Installing the Hydraulic Hose and Tube \(O-Ring Face Seal Fitting\) \(page 5–9\)](#).
6. Check the hydraulic-fluid level in the hydraulic reservoir (front axle) and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
7. Operate the machine functions slowly until air is out of system; refer to [Charging the Hydraulic System \(page 5–85\)](#).

Servicing the Front Axle Drive Motor (Machine Serial Number above 316000000)



g224914

Figure 91

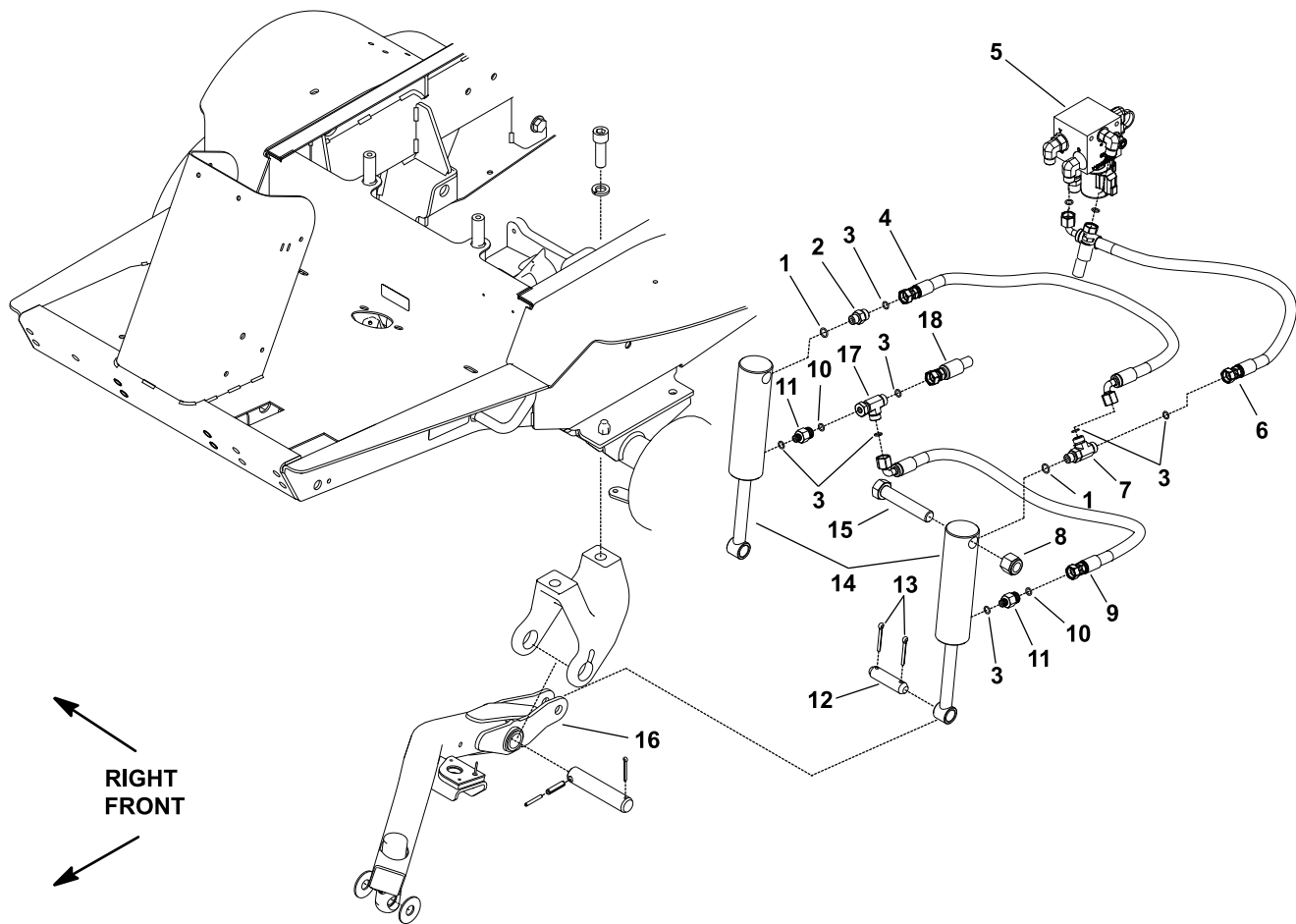
- | | | |
|----------------------------|---------------------------|------------------------|
| 1. Retaining ring | 6. Thrust bearing | 11. Valve plate |
| 2. Spacer | 7. Splined driveshaft | 12. O-ring |
| 3. Washer | 8. Housing assembly | 13. Backplate assembly |
| 4. Retaining ring (2 each) | 9. Camplate insert | 14. Plug assembly |
| 5. Bearing race (2 each) | 10. Rotating kit assembly | 15. Bolt (6 each) |

Note: For the hydraulic motor repair procedures; refer to the Eaton Motors 74111 and 74118 Fixed Axial Piston Motor Repair Manual.

IMPORTANT

If a hydraulic motor fails; refer to the [Traction Circuit Component Failure \(page 5–7\)](#) for information regarding the importance of removing contamination from the traction circuit.

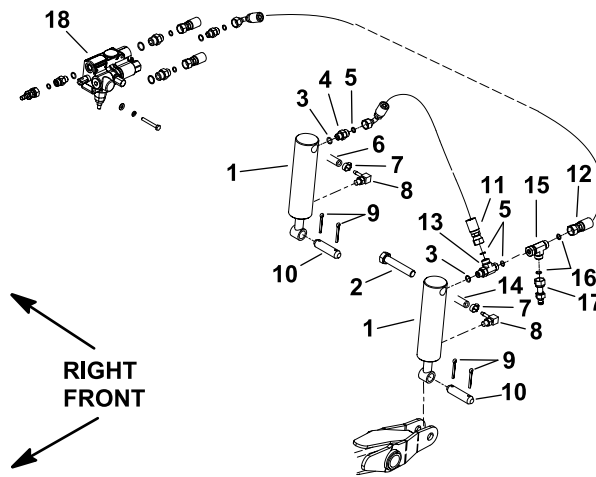
Lift Cylinder



g224916

Figure 92
3280-D Models 30344 and 30345

- | | | |
|-------------------------------|---------------------------|----------------------------|
| 1. O-ring (2 each) | 7. Tee fitting | 13. Cotter pin (4 each) |
| 2. Straight hydraulic fitting | 8. Locknut (2 each) | 14. Lift cylinder (2 each) |
| 3. O-ring (7 each) | 9. Hydraulic hose | 15. Bolt (2 each) |
| 4. Hydraulic hose | 10. O-ring (2 each) | 16. Lift arm (left) |
| 5. Lift control valve | 11. Adapter (2 each) | |
| 6. Hydraulic hose | 12. Cylinder pin (2 each) | |



g230839

Figure 93

- | | | |
|----------------------|--------------------|---------------------------|
| 1. Lift cylinder | 7. Hose clamp | 13. Hydraulic tee fitting |
| 2. Bolt | 8. Hose stem | 14. Hydraulic hose |
| 3. O-ring | 9. Cotter pin | 15. Hydraulic tee fitting |
| 4. Hydraulic fitting | 10. Cylinder pin | 16. O-ring |
| 5. O-ring | 11. Hydraulic hose | 17. Test port |
| 6. Hydraulic hose | 12. Hydraulic hose | 18. Lift control valve |

Note: If the lift cylinder wear or damage occurs, the lift cylinder replacement is necessary. The lift cylinders are not rebuildable.

Note: On machines with serial numbers above 260000001, the test port (item 17 in [Figure 93](#)) is located on the right lift cylinder.

Removing the Lift Cylinder

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Read the [General Precautions for Removing and Installing the Hydraulic System Components](#) (page 5–77).
3. For assembly purposes, label all the hydraulic connections. Clean the hydraulic connections before loosening the hydraulic lines from the lift cylinder.



CAUTION



Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to [Releasing Pressure from the Hydraulic System](#) (page 5–6).

4. Disconnect the hydraulic hoses from the fittings in the lift cylinder that is to be removed. Allow the hoses to drain into a suitable container. Remove and discard the O-rings from the fittings.
5. Install clean caps or plugs on the hydraulic hoses and fittings to prevent contamination.
6. Remove 1 cotter pin (item 13 in [Figure 92](#)) from the cylinder pin. Pull the cylinder pin from the lift cylinder and lift arm.

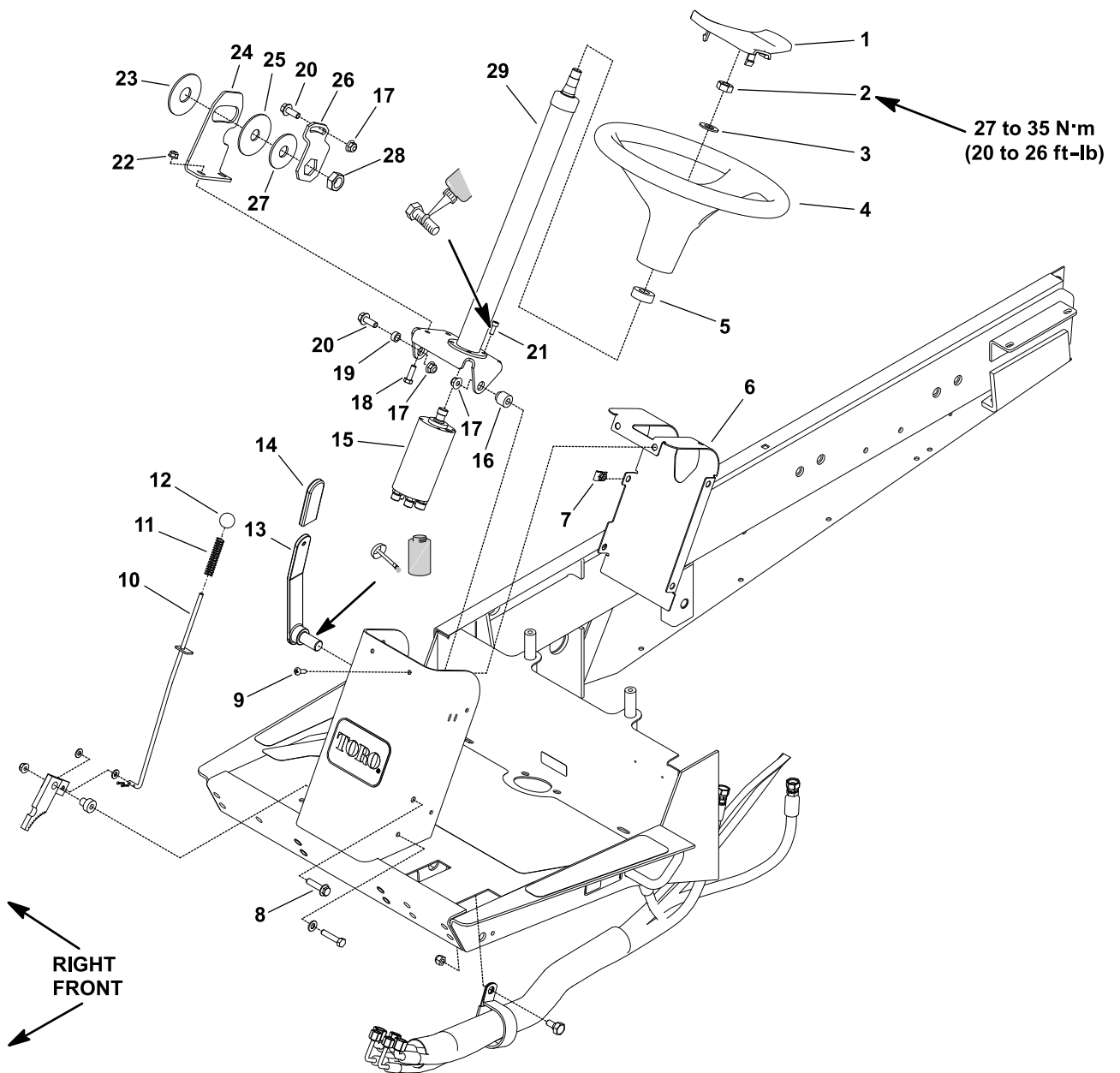
Removing the Lift Cylinder (continued)

7. Remove the locknut (item 8 in [Figure 92](#)) from the bolt that retains the lift cylinder to the frame.
8. Support the lift cylinder and slide the bolt (item 15 in [Figure 92](#)) from the lift cylinder and frame.
9. Lower the lift cylinder from the frame.
10. If the hydraulic fittings are to be removed from the lift cylinder, mark the fitting orientation for assembly purposes. Remove the fittings from the lift cylinder and discard the O-rings from the fittings.

Installing the Lift Cylinder

1. If the hydraulic fittings were removed from the lift cylinder, lubricate new O-rings with clean hydraulic fluid, position the O-rings to the fittings, and install the fittings into the lift cylinder ports; refer to [Installing the Hydraulic Fittings \(SAE Straight Thread O-Ring Fitting into the Component Port\)](#) (page 5–11). Ensure that the fittings are orientated correctly.
2. Position the lift cylinder to the frame with the barrel end up.
3. Slide the bolt (item 15 in [Figure 92](#)) through the lift cylinder and frame mounting holes.
4. Align the lift cylinder to the lift arm mounting holes. Slide the cylinder pin (item 12 in [Figure 92](#)) (with a cotter pin installed on the one end) through the lift cylinder and lift arm.
5. Secure the cylinder pin with the cotter pin (item 13 in [Figure 92](#)).
6. Remove the caps and plugs that were installed to the hydraulic hoses and fittings during the removal process.
7. Put a coating of clean hydraulic fluid on new fitting O-rings, install the O-rings, and connect the hydraulic hoses to the fittings on the lift cylinder. Tighten the hose connections; refer to [Installing the Hydraulic Hose and Tube \(O-Ring Face Seal Fitting\)](#) (page 5–9).
8. Check the hydraulic-fluid level in the hydraulic reservoir (front axle) and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
9. Operate the machine functions slowly until air is out of system; refer to [Charging the Hydraulic System](#) (page 5–85).

Steering Control Valve



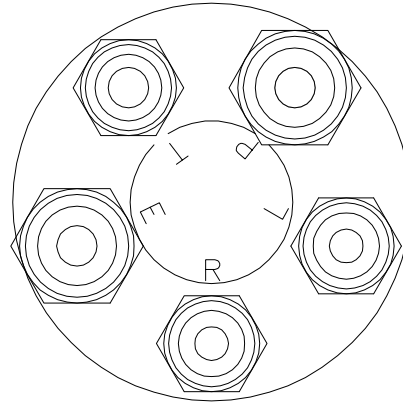
g223612

Figure 94

- | | | |
|--------------------------------|--------------------------------|--------------------------------|
| 1. Steering wheel cover | 11. Compression spring | 21. Socket-head screw (4 each) |
| 2. Locknut | 12. Knob | 22. Flange nut (2 each) |
| 3. Flat washer | 13. Tilt steering lever | 23. Friction disc |
| 4. Steering wheel | 14. Grip | 24. Pivot plate |
| 5. Foam collar | 15. Steering control valve | 25. Friction disc |
| 6. Tower panel | 16. Spacer | 26. Tilt bracket |
| 7. Retainer nut (6 each) | 17. Flange nut (3 each) | 27. Flat washer |
| 8. Flange-head screw | 18. Bolt (2 each) | 28. Jam nut |
| 9. Philips-head screw (6 each) | 19. Spacer | 29. Steering column |
| 10. Parking brake rod | 20. Flange-head screw (2 each) | |

Removing the Steering Control Valve

1. Park the machine on a level surface, set the parking brake, lower the cutting deck (or implement), shut off the engine, and remove the key from the key switch.
2. Remove the knob (item 12 in [Figure 94](#)) from the end of the parking brake rod.
3. Remove the 6 phillips-head screws (item 9 in [Figure 94](#)) that secure the tower panel to the machine, and remove the tower panel.
4. Read the [General Precautions for Removing and Installing the Hydraulic System Components](#) (page 5–77).



g224772

Figure 95

5. For assembly purposes, label all the hydraulic connections. Note the port designations on the steering control valve ([Figure 95](#)).
6. Clean the hydraulic connections before loosening the hydraulic lines.



CAUTION



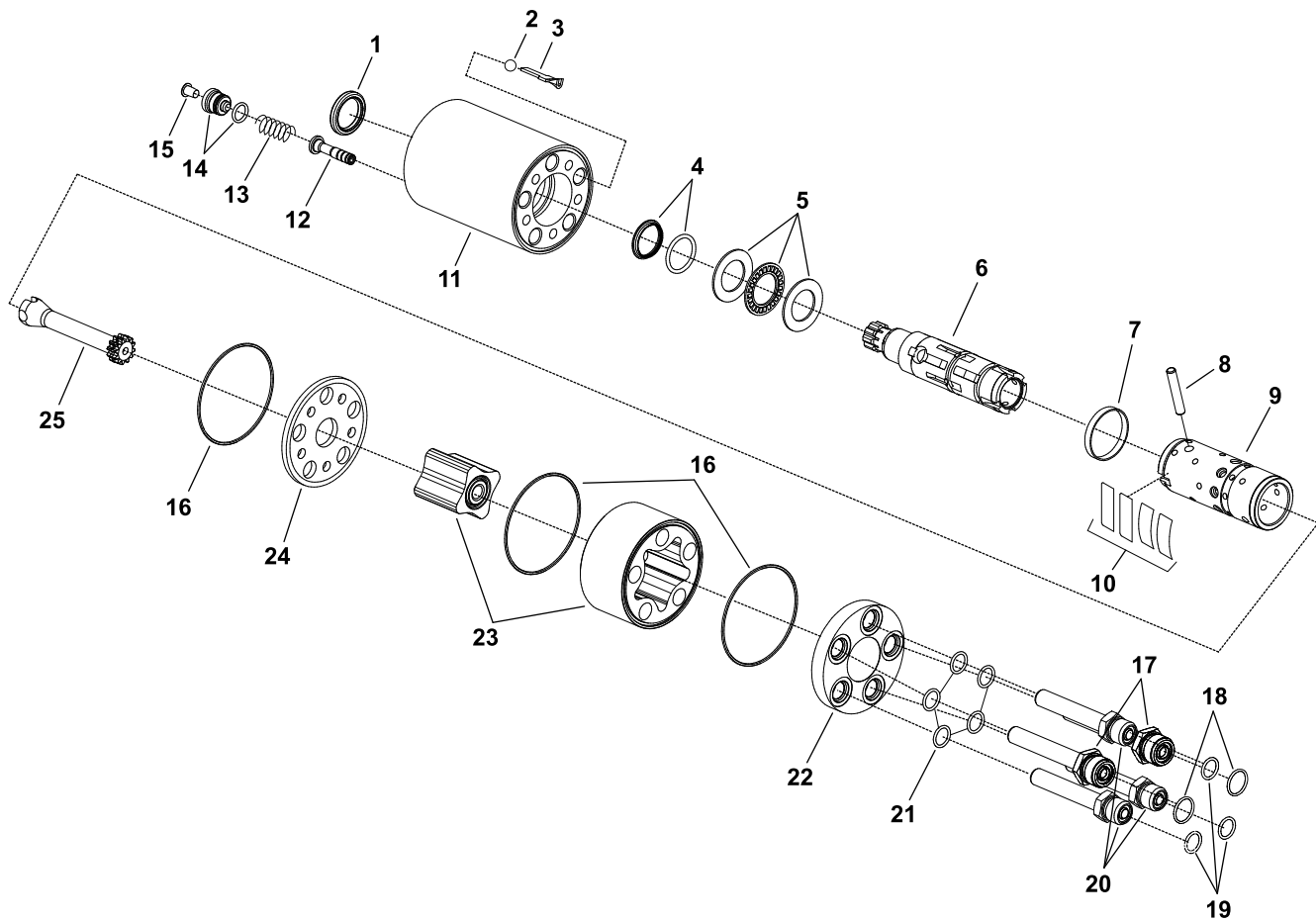
Before opening hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to [Releasing Pressure from the Hydraulic System](#) (page 5–6).

7. Disconnect the hydraulic lines from the steering control valve. Allow the lines to drain into a suitable container.
8. Install clean caps or plugs on the hydraulic lines and fittings to prevent contamination.
9. Support the steering control valve to prevent it from falling during removal.
10. Loosen and remove the 4 socket-head screws (item 21 in [Figure 94](#)) that secure the steering control valve to the steering column.
11. Slide the steering control valve from the steering column, and remove the steering control valve from the machine.
12. If necessary, remove the hydraulic fittings from the steering control valve.
13. Remove and discard the O-rings from the fittings.

Installing the Steering Control Valve

1. If the hydraulic fittings were removed from the steering control valve, lubricate new O-rings with clean hydraulic fluid, position the O-rings to the fittings, and install the fittings to the steering control valve; refer to [Installing the Hydraulic Fittings \(SAE Straight Thread O-Ring Fitting into the Component Port\)](#) (page 5–11).
2. Slide the steering control valve onto the steering column. Secure the steering control valve to the steering column with the 4 socket-head screws (item 21 in [Figure 94](#)).
3. Remove the caps and plugs that were installed to the hydraulic lines and fittings during the removal process.
4. Lubricate new O-rings and use the labels that you attached during valve removal to connect the hydraulic lines to the fittings on the steering control valve. Tighten the connections; refer to [Installing the Hydraulic Hose and Tube \(O-Ring Face Seal Fitting\)](#) (page 5–9).
5. Position the tower panel to the machine and secure the panel with the 6 phillips-head screws.
6. Install the knob on the end of the parking brake rod.
7. Check the hydraulic-fluid level in the hydraulic reservoir (front axle) and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
8. After you complete the assembly, rotate the steering wheel to check that the hydraulic hoses and fittings do not contact anything and that there are no leaks.
9. Operate the machine functions slowly until air is out of system; refer to [Charging the Hydraulic System](#) (page 5–85).

Servicing the Steering Control Valve



g224771

Figure 96

- | | | |
|---------------------|----------------------------------|----------------------------|
| 1. Dust seal ring | 10. Spring set | 19. O-ring (3 each) |
| 2. Ball | 11. Housing | 20. Special screw (3 each) |
| 3. Ball stop | 12. Piston | 21. O-ring (5 each) |
| 4. Shaft seal | 13. Compression spring | 22. End cover |
| 5. Bearing assembly | 14. Adjusting spring with O-ring | 23. Gearwheel set |
| 6. Spool | 15. Plug | 24. Distributor plate |
| 7. Ring | 16. O-ring (3 each) | 25. Cardan shaft |
| 8. Cross pin | 17. Special screw (2 each) | |
| 9. Sleeve | 18. O-ring (2 each) | |

Note: For the steering control valve repair procedures; refer to the Danfoss Steering Unit Type OSPM Service Manual at the end of this chapter.

Steering Cylinder (2-Wheel Drive)

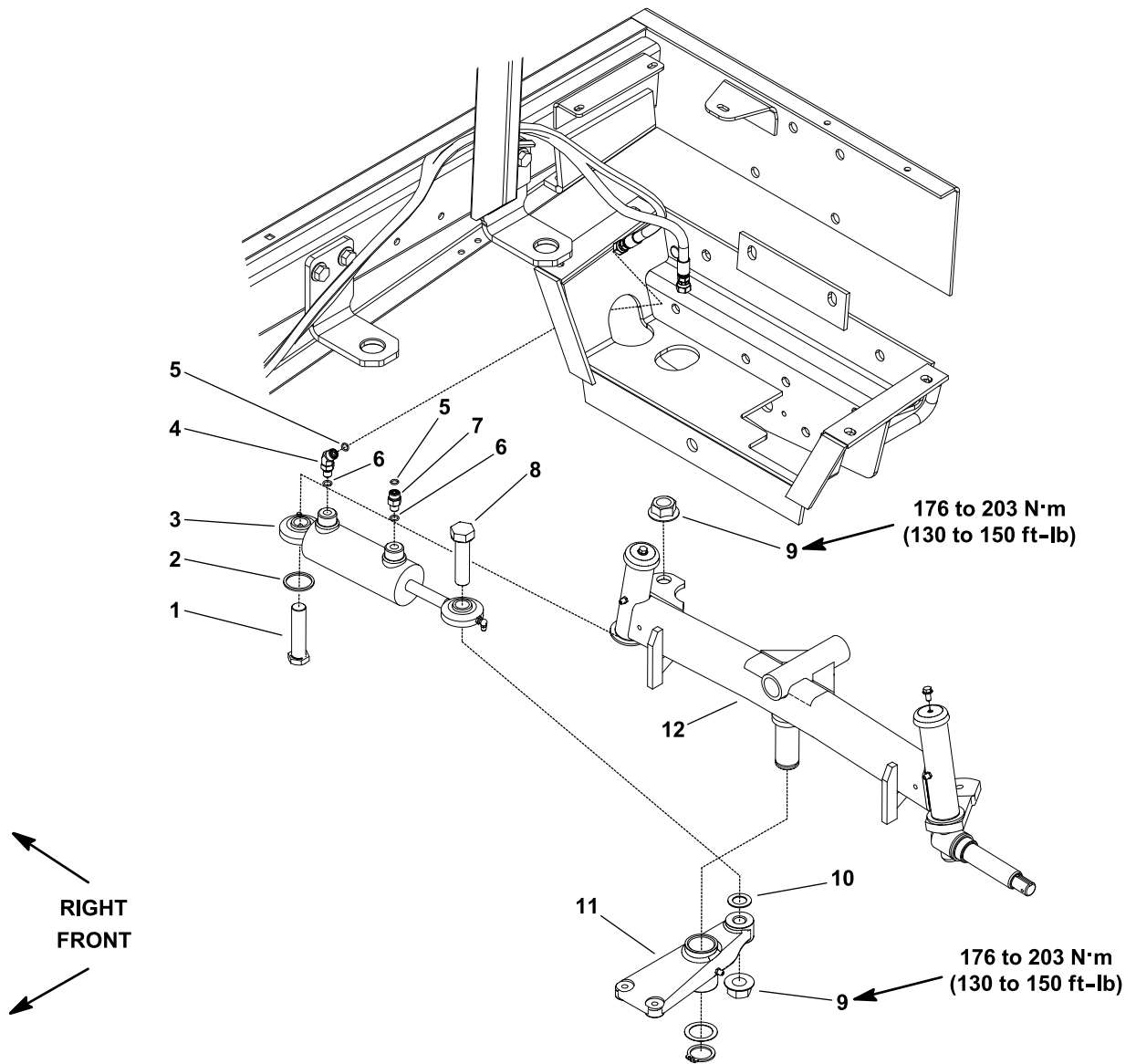


Figure 97

- | | | |
|--------------------------|-------------------------------|--------------------------|
| 1. Bolt | 5. O-ring (2 each) | 9. Flange nut (2 each) |
| 2. Spacer ring | 6. O-ring (2 each) | 10. Thrust washer |
| 3. Steering cylinder | 7. Straight hydraulic fitting | 11. Steering pivot plate |
| 4. 45° hydraulic fitting | 8. Bolt | 12. Rear axle |

Removing the Steering Cylinder (2-Wheel Drive)

1. Park the machine on a level surface, lower cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.
2. Read the [General Precautions for Removing and Installing the Hydraulic System Components](#) (page 5–77).

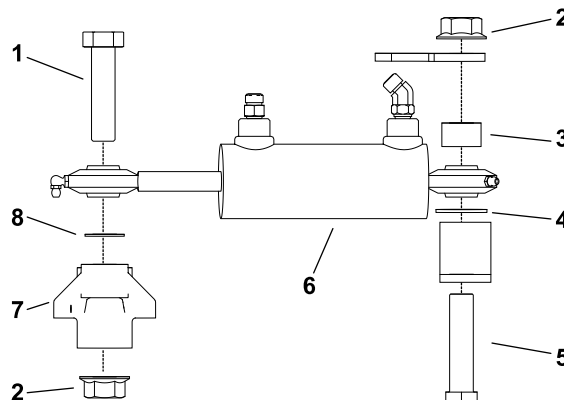


CAUTION



Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to [Releasing Pressure from the Hydraulic System](#) (page 5–6).

3. For assembly purposes, label all the hydraulic hoses that are connected to the fittings on the steering cylinder.
4. Clean the hydraulic hose ends before you disconnect the hoses from the steering cylinder.
5. Disconnect the hydraulic hoses from the steering cylinder.
6. Install caps or plugs on the disconnected hoses and fittings to prevent contamination.
7. Remove the bolts (items 1 and 8 in [Figure 97](#)) and 2 locknuts that secure the steering cylinder to the machine.



g225168

Figure 98

- | | |
|------------------------|-------------------------|
| 1. Bolt | 5. Bolt |
| 2. Flange nut (2 each) | 6. Steering cylinder |
| 3. Cylinder spacer | 7. Steering pivot plate |
| 4. Spacer ring | 8. Thrust washer |

8. Pull the steering cylinder from the machine. Locate and retrieve the spacer ring and thrust washer, and note the location for installation purposes ([Figure 98](#)).
9. If the hydraulic fittings are to be removed from the steering cylinder, mark the fitting orientation for assembly purposes. Remove the fittings from the steering cylinder and discard the O-rings from the fittings.

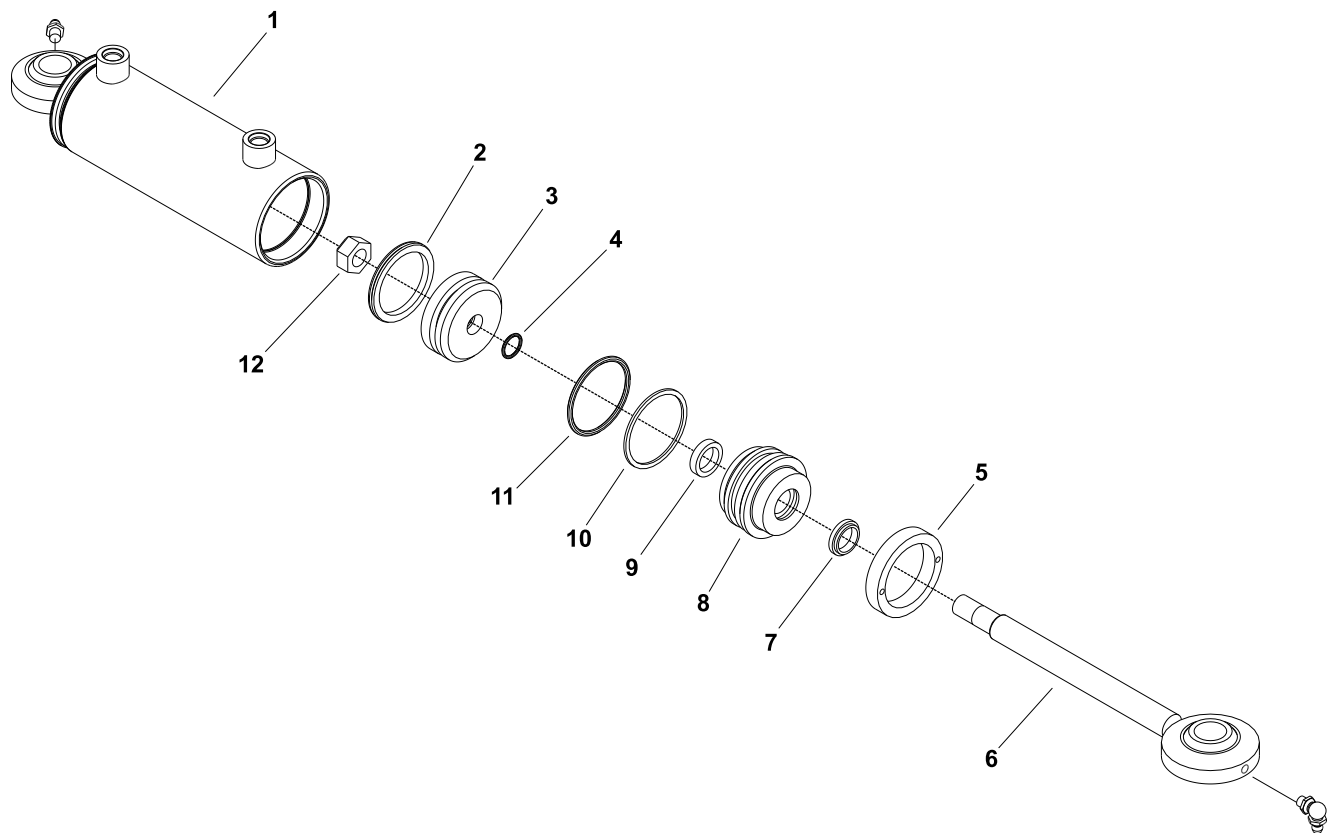
Installing the Steering Cylinder (2-Wheel Drive)

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 to the steering cylinder ports; refer to [Installing the Hydraulic Fittings \(SAE Straight Thread O-Ring Fitting into the Component Port\)](#) (page 5–11).
2. Position the steering cylinder to the machine. Ensure to place the spacer ring and thrust washer in locations that you noted during removal ([Figure 98](#)).



3. Secure the steering cylinder to the machine with the bolts (items 1 and 8 in [Figure 97](#)) and 2 locknuts. Torque the locknuts to **176 to 203 N·m (130 to 150 ft-lb)**.
4. Remove the caps and plugs from the hydraulic hoses and fittings.
5. 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 5–9).
6. Check the hydraulic-fluid level in the hydraulic reservoir (front axle) and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
7. Lubricate the steering cylinder grease fittings.
8. Operate the machine functions slowly until air is out of system; refer to [Charging the Hydraulic System](#) (page 5–85).
9. Check that the steering cylinder does not contact the axle or frame as cylinder moves from fully retracted to fully extended.

Servicing the Steering Cylinder (2-Wheel Drive)



g225169

Figure 99

- | | | |
|------------|--------------------|--------------------|
| 1. Barrel | 5. Internal collar | 9. BS seal |
| 2. BP seal | 6. Shaft | 10. Back-up washer |
| 3. Piston | 7. Dust seal | 11. O-ring |
| 4. O-ring | 8. Head | 12. Locknut |

Disassembling the Steering Cylinder (2-Wheel Drive)

1. Slowly pump the cylinder shaft 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 pivot end only to prevent damage. Do not close the vise on the barrel.

2. Mount the steering cylinder securely in a vise by clamping on the pivot end so that the shaft end tilts up slightly. Use a vise equipped with soft jaws.
3. Use a spanner wrench to loosen and remove the internal collar (item 5 in [Figure 99](#)) from the barrel.
4. Hold the end of the shaft and use a twisting and pulling motion to carefully extract the shaft, internal collar, head, and piston from the barrel.

Disassembling the Steering Cylinder (2-Wheel Drive) (continued)

IMPORTANT

Clamping the vise jaws against the shaft surface could damage the shaft. When securing the shaft in a vise, protect the shaft surface.

5. Mount the shaft in a vise. Remove the locknut and piston from the shaft. Carefully slide the head and internal collar off the shaft.
6. Remove and discard the BP seal (item 2 in [Figure 99](#)) and O-rings from the piston. Remove and discard the O-ring, dust seal, and BS seal from the head.

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, shaft, and piston for excessive pitting, scoring, and wear.
4. Replace the steering cylinder if the internal components are worn or damaged.

Assembling the Steering Cylinder (2-Wheel Drive)

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

IMPORTANT

Clamping the vise jaws against the shaft surface could damage the shaft. When securing the shaft in a vise, protect the shaft surface.

2. Mount the shaft securely in a vise.
3. Coat the shaft lightly with clean hydraulic fluid. Slide the internal collar onto the shaft.

Note: Do not damage the seals and O-rings during installation.

4. Install the head and piston onto the shaft. Install the locknut onto the shaft and tighten the locknut.
5. Remove the shaft from the vise.

IMPORTANT

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

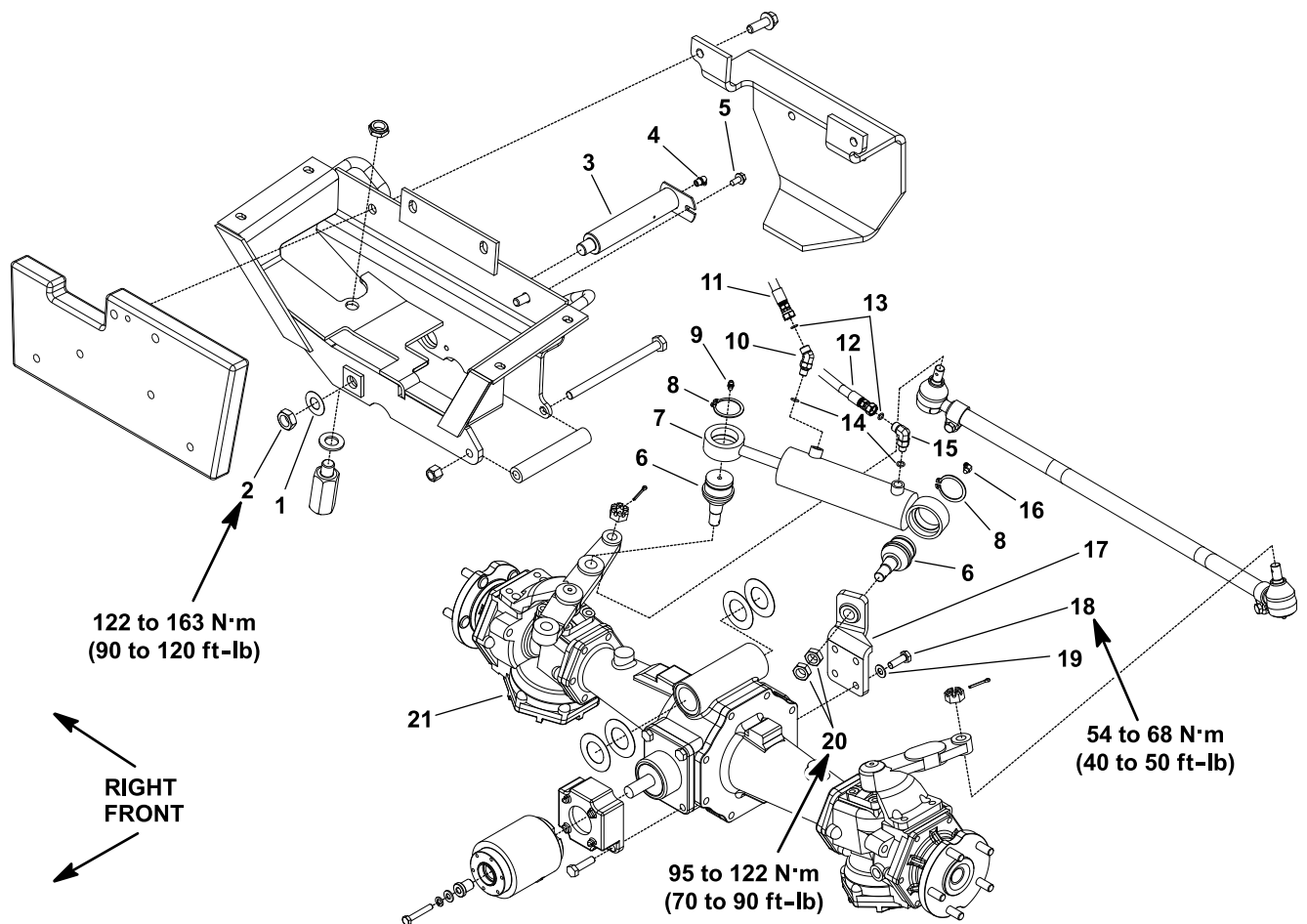
6. Mount the steering cylinder barrel in a vise equipped with soft jaws by clamping on the barrel so that the shaft end tilts up slightly.

Assembling the Steering Cylinder (2-Wheel Drive) (continued)

Note: Do not damage the seals during installation.

7. Coat all the internal cylinder components with clean hydraulic fluid. Slide the shaft assembly into the barrel.
8. Use a spanner wrench, secure the internal collar in the barrel.

Steering Cylinder (4-Wheel Drive)



g225055

Figure 100

- | | | |
|------------------------|----------------------------|---------------------------------------|
| 1. Thrust washer | 8. Retaining ring (2 each) | 15. 90° hydraulic fitting |
| 2. Jam nut | 9. Grease fitting | 16. 45° lube fitting |
| 3. Rear axle pin | 10. 45° hydraulic fitting | 17. Steering cylinder support bracket |
| 4. 90° grease fitting | 11. Hydraulic hose | 18. Bolt (4 each) |
| 5. Washer-head screw | 12. Hydraulic hose | 19. Washer (4 each) |
| 6. Ball joint (2 each) | 13. O-ring (2 each) | 20. Jam nut (4 each) |
| 7. Steering cylinder | 14. O-ring (2 each) | 21. Rear axle (4-wheel drive) |

Removing the Steering Cylinder (4-Wheel Drive)

1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.
2. Read the [General Precautions for Removing and Installing the Hydraulic System Components](#) (page 5–77).

Removing the Steering Cylinder (4-Wheel Drive) (continued)



CAUTION



Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to [Releasing Pressure from the Hydraulic System \(page 5–6\)](#).

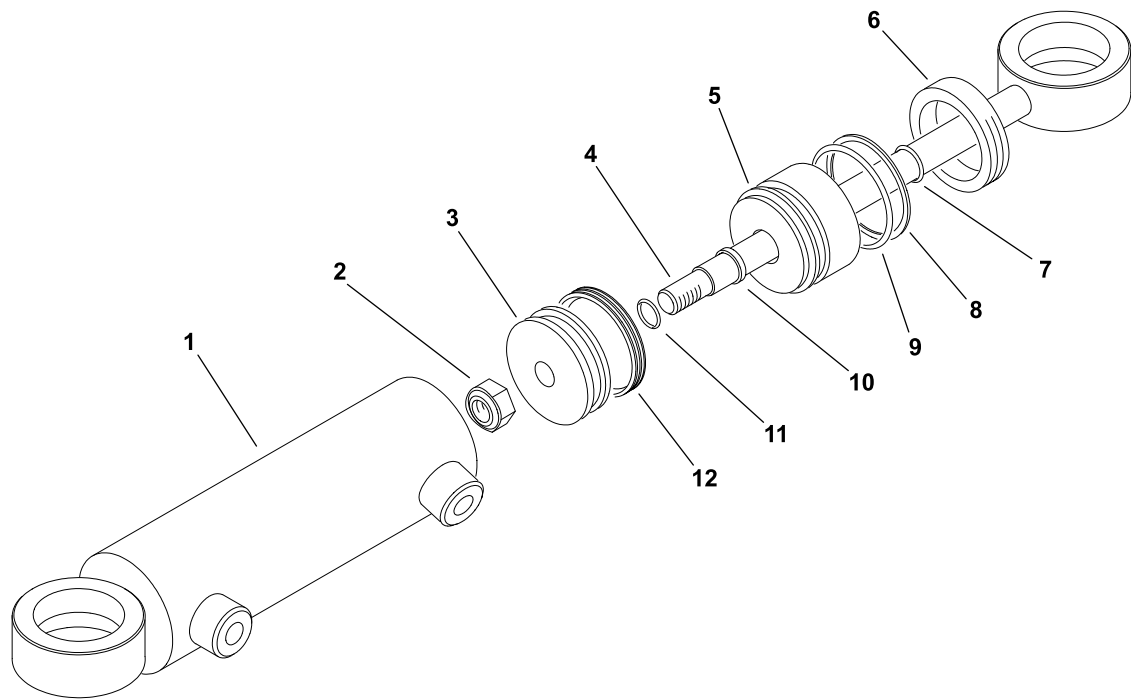
3. For assembly purposes, label all the hydraulic hoses that are connected to the fittings on the steering cylinder.
4. Clean the hydraulic hose ends before you disconnect the hoses from the steering cylinder.
5. Disconnect the hydraulic hoses from the steering cylinder.
6. Install caps or plugs on the disconnected hoses and fittings to prevent contamination.
7. Remove the 4 jam nuts (item 20 in [Figure 100](#)) that secure the steering cylinder to the machine.
8. Separate the steering cylinder ball joints from the axle assembly. Remove the steering cylinder from the machine.
9. If necessary, remove the ball joints from the steering cylinder.
10. If the hydraulic fittings are to be removed from the steering cylinder, mark the fitting orientation for assembly purposes. Remove the fittings from the steering cylinder and discard the O-rings from the fittings.

Installing the Steering Cylinder (4-Wheel Drive)

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 to the steering cylinder; refer to [Installing the Hydraulic Fittings \(SAE Straight Thread O-Ring Fitting into the Component Port\) \(page 5–11\)](#).
2. If removed, install the ball joints (item 6 in [Figure 100](#)) into the steering cylinder and secure the ball joints with the retaining rings.
3. Position the steering cylinder to the rear axle. Secure the steering cylinder to the axle with the 4 jam nuts (item 20 in [Figure 100](#)). Install the first jam nut onto the cylinder ball joint threads and torque the jam nut to **95 to 122 N·m (70 to 90 ft-lb)**. Then, hold the first jam nut with wrench, install and torque the second jam nut to **95 to 122 N·m (70 to 90 ft-lb)**.
4. Remove the caps and plugs from the hydraulic hoses and fittings.
5. 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 \(O-Ring Face Seal Fitting\) \(page 5–9\)](#).
6. Check the hydraulic-fluid level in the hydraulic reservoir (front axle) and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
7. Lubricate the steering cylinder ball joint grease fittings; refer to the *Operator's Manual*.
8. Operate the machine functions slowly until air is out of system; refer to [Charging the Hydraulic System \(page 5–85\)](#).
9. Check that the steering cylinder does not contact the axle or frame as cylinder moves from fully retracted to fully extended.



Servicing the Steering Cylinder (4-Wheel Drive)



g225059

Figure 101

- | | | |
|------------|--------------------|--------------|
| 1. Barrel | 5. Head | 9. O-ring |
| 2. Locknut | 6. Internal collar | 10. Rod seal |
| 3. Piston | 7. Dust seal | 11. O-ring |
| 4. Shaft | 8. Back-up washer | 12. U-ring |

Disassembling the Steering Cylinder (4-Wheel Drive)

1. Slowly pump the cylinder shaft 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 pivot end only to prevent damage. Do not close the vise on the barrel.

2. Mount the steering cylinder securely in a vise by clamping on the pivot end so that the shaft end tilts up slightly. Use a vise equipped with soft jaws.
3. Use a spanner wrench to loosen and remove the internal collar (item 6 in [Figure 101](#)) from the barrel.
4. Hold the end of the shaft and use a twisting and pulling motion to carefully extract the shaft, internal collar, head, and piston from the barrel.

IMPORTANT

Clamping the vise jaws against the shaft surface could damage the shaft. When securing the shaft in a vise, protect the shaft surface.

Disassembling the Steering Cylinder (4-Wheel Drive) (continued)

5. Mount the shaft in a vise. Remove the locknut and piston from the shaft. Carefully slide the head and internal collar off the shaft.
6. Remove and discard the U-ring (item 12 in [Figure 101](#)) and O-ring from the piston. Remove and discard the dust seal, back-up washer, O-ring, and rod seal from the head.

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, shaft, and piston for excessive pitting, scoring, and wear.
4. Replace the steering cylinder if the internal components are worn or damaged.

Assembling the Steering Cylinder (4-Wheel Drive)

1. Use a new seal kit and replace the dust seal, U-ring, back-up washer, rod seal, and all O-rings to the piston and head. Apply clean hydraulic fluid to all the seal kit components before you install them.

IMPORTANT

Clamping the vise jaws against the shaft surface could damage the shaft. When securing the shaft in a vise, protect the shaft surface.

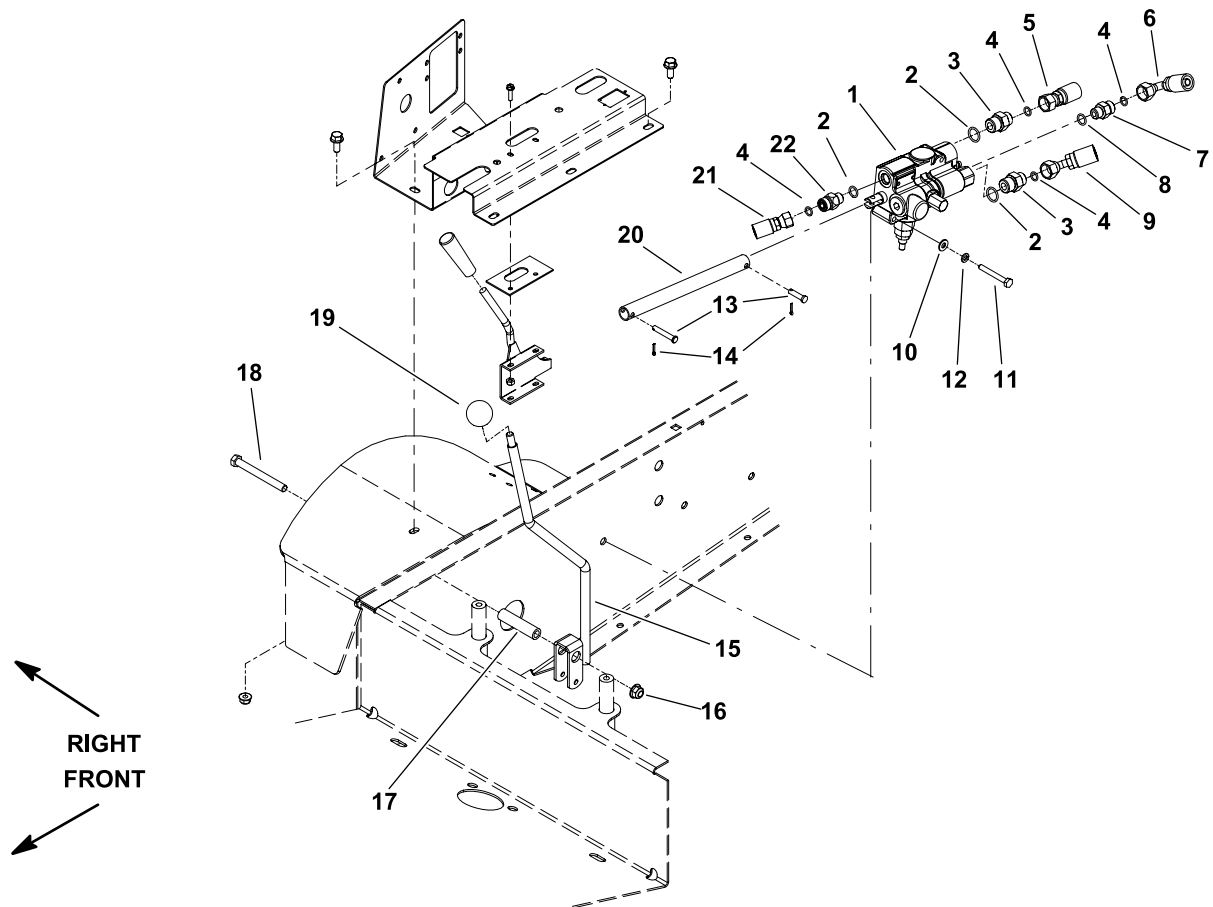
2. Mount the shaft securely in a vise.
Note: Do not damage the rod seal and dust seal during installation.
3. Coat the shaft lightly with clean hydraulic fluid. Slide the internal collar and head onto the shaft.
Note: Do not damage the O-ring during installation.
4. Install the piston onto the shaft. Install the locknut onto the shaft and tighten the locknut.
5. Remove the shaft from the vise.

IMPORTANT

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

6. Mount the steering cylinder barrel in a vise equipped with soft jaws by clamping on the barrel so that the shaft end tilts up slightly.
7. Coat all the internal cylinder components with clean hydraulic fluid. Slide the piston, shaft, and head assembly into the barrel.
8. Use a spanner wrench, secure the head in barrel with the internal collar.

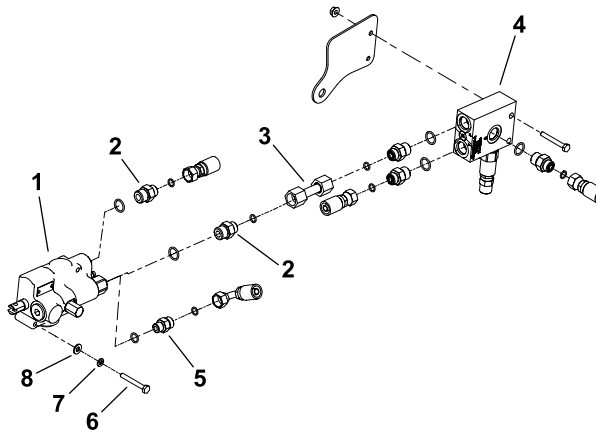
Lift Control Valve (Machine Serial Numbers below 316000000)



g230840

Figure 102

- | | | |
|-----------------------|--------------------------|--------------------|
| 1. Lift control valve | 9. Hydraulic hose | 17. Spacer |
| 2. O-ring | 10. Flat washer (2 each) | 18. Bolt |
| 3. Hydraulic adapter | 11. Bolt (2 each) | 19. Knob |
| 4. O-ring | 12. Lock washer (2 each) | 20. Link tube |
| 5. Hydraulic hose | 13. Pin | 21. Hydraulic hose |
| 6. Hydraulic hose | 14. Cotter pin | 22. Check valve |
| 7. Hydraulic fitting | 15. Lift lever | |
| 8. O-ring | 16. Flange nut | |



g230841

Figure 103

- | | | |
|-----------------------|----------------------------|-------------------------|
| 1. Lift control valve | 4. Counterbalance manifold | 7. Lock washer (2 each) |
| 2. Hydraulic adapter | 5. Hydraulic fitting | 8. Flat washer (2 each) |
| 3. Hydraulic tube | 6. Bolt (2 each) | |

Note: Early machines came fitted with a lift control valve that incorporated the counterbalance valve ([Figure 102](#)). On later machines (machine serial numbers below 311000000) or early machines that have been updated, the counterbalance valve is located in a separate manifold ([Figure 103](#)). Check the lift valve configuration used before servicing the lift valve.

Removing the Lift Control Valve

1. Park the machine on a level surface, engage the parking brake, lower the cutting deck (or implement), and shut off the engine. Remove the key from the key switch.
2. Read the [General Precautions for Removing and Installing the Hydraulic System Components](#) (page 5–77).
3. Remove fuel tank from machine; refer to [Removing the Fuel Tank](#) (page 3–10) or [Removing the Fuel Tank](#) (page 4–16).
4. Label all hydraulic connections for assembly purposes. Clean hydraulic hose ends prior to disconnecting the hoses.



CAUTION



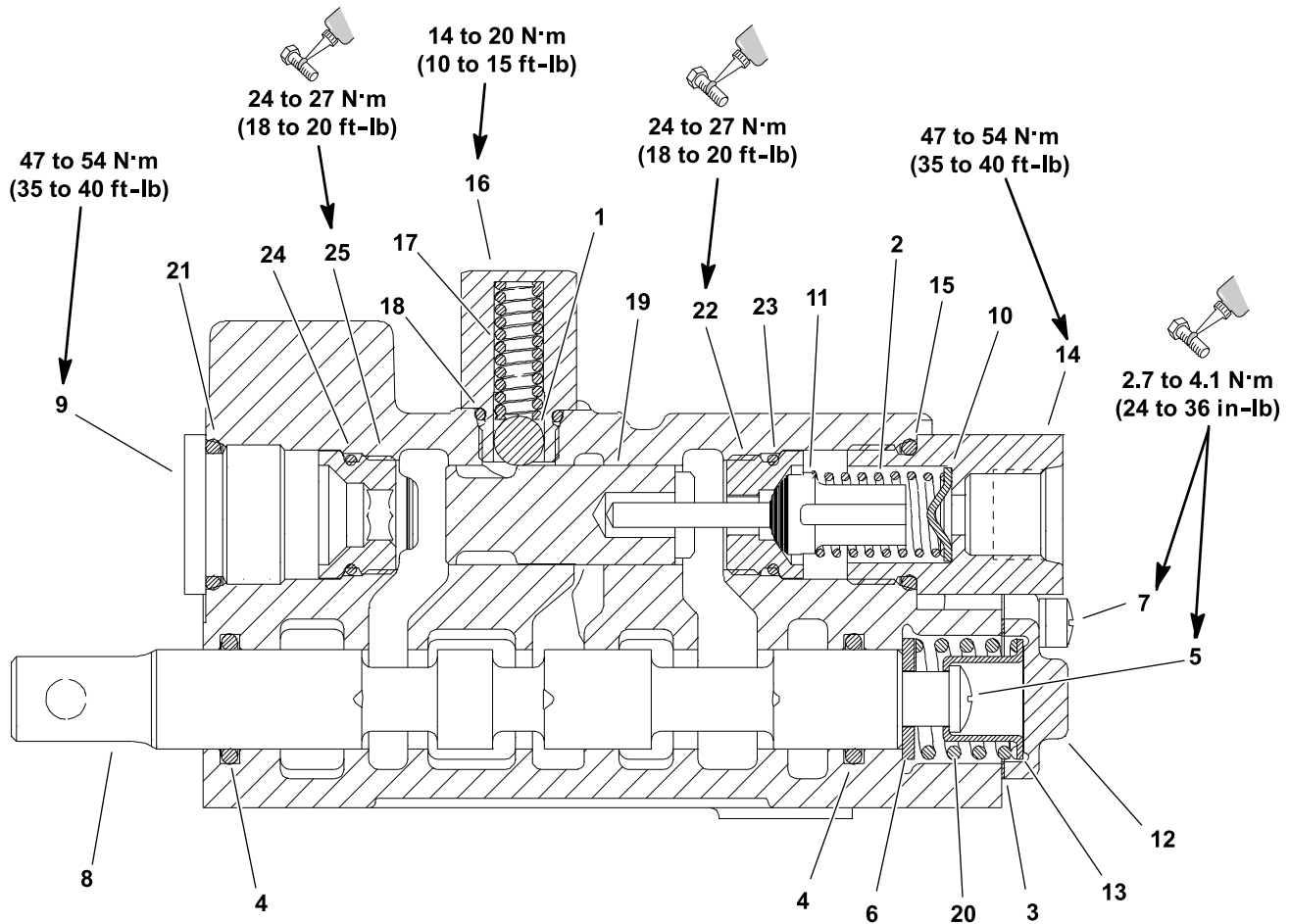
Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic fluid.

5. Disconnect hose connections from hydraulic fittings on lift control valve. Allow hoses to drain into a suitable container.
6. Put caps or plugs on disconnected hoses and fittings to prevent contamination.
7. Remove cotter pin (item 14 in [Figure 102](#)) and pin that secure link tube to control valve.
8. Remove 2 bolts (item 11 in [Figure 102](#)), 2 lock washers, and 2 flat washers that secure lift control valve to machine
9. Remove control valve from the machine.
10. Remove hydraulic fittings as necessary from the control valve. Discard all removed O-rings

Installing the Lift Control Valve

1. Coat new O-rings lightly with clean hydraulic fluid. Install all removed hydraulic fittings with new O-rings to the lift control valve.
2. Position lift control valve to machine frame. Secure control valve to machine with 2 bolts (item 11 in [Figure 102](#)), 2 lock washers, and 2 flat washers.
3. Secure link tube (item 20 in [Figure 102](#)) to control valve with pin and cotter pin.
4. Remove all caps or plugs from hydraulic hoses and fittings.
5. Connect hydraulic hoses to hydraulic fittings on lift control valve.
6. Install fuel tank to machine; refer to [Installing the Fuel Tank \(page 3–11\)](#) or [Installing the Fuel Tank \(page 4–17\)](#).
7. Check hydraulic-fluid level in reservoir (front axle) and adjust as required; refer to the *Traction Unit Operator's Manual*.
8. Operate the machine functions slowly until air is out of system; refer to [Charging the Hydraulic System \(page 5–85\)](#).
9. Check counterbalance valve adjustment; refer to the *Traction Unit Operator's Manual*.

Servicing the Lift Control Valve (Machine Serial Numbers below 311000000)



g230842

Figure 104

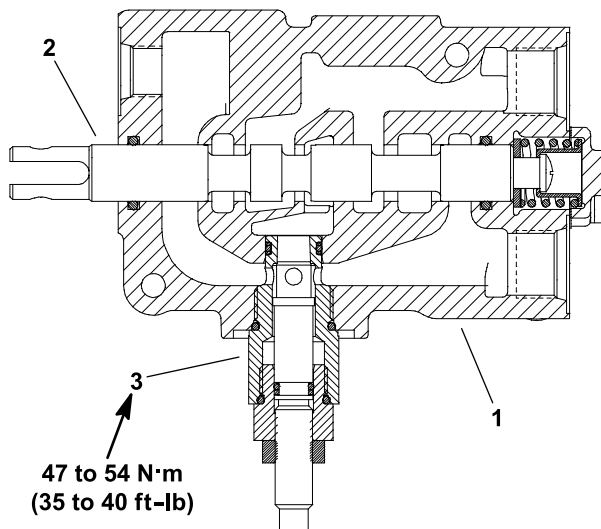
- | | | |
|-----------------------------------|------------------|---------------------------|
| 1. Detent ball | 10. Poppet stop | 19. Detent plunger |
| 2. Spring | 11. Poppet | 20. Spring |
| 3. Gasket | 12. End cap | 21. O-ring |
| 4. O-ring | 13. Spacer | 22. Lockout seat (black) |
| 5. Screw | 14. Adapter plug | 23. O-ring |
| 6. Washer | 15. O-ring | 24. O-ring |
| 7. Screw and lock washer (2 each) | 16. Detent plug | 25. Lockout seat (silver) |
| 8. Spool | 17. Spring | |
| 9. Plug | 18. O-ring | |

Disassembly the Lift Control Valve

1. Plug all ports and clean the outside of control valve.
2. Remove 2 screws and lock washers (item 7 in [Figure 104](#)) that secure end cap to control valve. Remove end cap.
3. Remove screw (item 5 in [Figure 104](#)), spacer, spring, and washer from control valve.
4. Carefully slide spool (item 8 in [Figure 104](#)) from housing bore.

Disassembly the Lift Control Valve (continued)

5. Carefully remove O-rings (item 4 in [Figure 104](#)) from spool bore. Take care not to damage spool bore or O-ring cavities during O-ring removal.
6. Remove detent plug (item 16 in [Figure 104](#)), O-ring, spring, and detent ball.
7. Remove plug (item 9 in [Figure 104](#)) with O-ring, and lockout seat with O-ring from valve body.
8. Remove adapter plug (item 14 in [Figure 104](#)) with O-ring, poppet stop, spring, and poppet from control valve body.
9. Remove lockout seat (item 22 in [Figure 104](#)) with O-ring from control valve body. Remove detent plunger.



g230844

Figure 105

- | | | |
|-----------------------|----------|-------------------------|
| 1. Lift control valve | 2. Spool | 3. Counterbalance valve |
|-----------------------|----------|-------------------------|

10. If control valve is equipped with counterbalance valve ([Figure 105](#)), remove valve from control valve if necessary. Counterbalance valve disassembly is not recommended.

Inspecting the Lift Control Valve

1. Inspect spool and spool bore for wear. If wear is excessive, replace lift control valve assembly.
2. Inspect all springs and replace if damaged or broken.
3. Inspect detent plunger, detent ball, and poppet for wear. Replace as necessary.
4. Inspect lockout seats for wear or damage. Replace as necessary.
5. Inspect control valve housing threads and O-ring sealing surfaces. Replace as necessary.
6. Inspect threads and O-ring sealing surfaces on plugs. Replace as necessary.

Assembling the Lift Control Valve

IMPORTANT

Do not wipe parts with dry paper towels or rags. Lint may cause damage to the hydraulic system.

Assembling the Lift Control Valve (continued)



CAUTION



Use eye protection such as goggles when using compressed air.

1. Clean all control valve components with clean solvent and blow dry with compressed air.
2. Replace all removed O-rings. Lightly lubricate new O-rings with clean hydraulic fluid before assembly.
3. Install new O-rings into control valve spool bore.
4. Lubricate spool liberally with clean hydraulic fluid and carefully install into control valve bore.



5. Coat spacer (item 13 in [Figure 104](#)), spring, and washer liberally with MPG-2 (or equivalent) grease. Apply Loctite #242 (or equivalent) to threads of screw. Install washer, spring, and spacer into valve and secure with screw. Torque screw to **2.7 to 4.1 N·m (24 to 36 in-lb)**.

6. Apply Loctite #242 (or equivalent) to threads of screws (item 7 in [Figure 104](#)).



7. Position gasket (item 3 in [Figure 104](#)) and end cap to control valve. Secure end cap to valve with 2 screws with lock washers. Torque screws to **2.7 to 4.1 N·m (24 to 36 in-lb)**.

8. Lubricate detent plunger (item 19 in [Figure 104](#)) with clean hydraulic fluid and slide into control valve bore.



9. Install new O-rings (items 23 and 24 in [Figure 104](#)) to lockout seats. Apply Loctite #242 (or equivalent) to threads of lockout seats. Install seats into control valve. Torque seats to **24 to 27 N·m (18 to 20 ft-lb)**.

10. Lubricate poppet (item 11 in [Figure 104](#)), poppet stop, and spring liberally with clean hydraulic fluid and install into control valve bore.



11. Install adapter plug (item 14 in [Figure 104](#)) with new O-ring, and plug with new O-ring into control valve. Torque plugs to **47 to 54 N·m (35 to 40 ft-lb)**.

12. Install new O-ring to detent plug (item 16 in [Figure 104](#)). Lubricate detent ball and spring with clean hydraulic fluid and install into detent plug.



13. Install detent plug assembly to control valve. Torque plug to **14 to 20 N·m (10 to 15 ft-lb)**.



14. If counterbalance valve was removed, carefully thread valve into control valve housing ([Figure 105](#)). Torque counterbalance valve to **47 to 54 N·m (35 to 40 ft-lb)**.

Counterbalance Valve Manifold (Machine Serial Numbers below 311000000) (If Equipped)

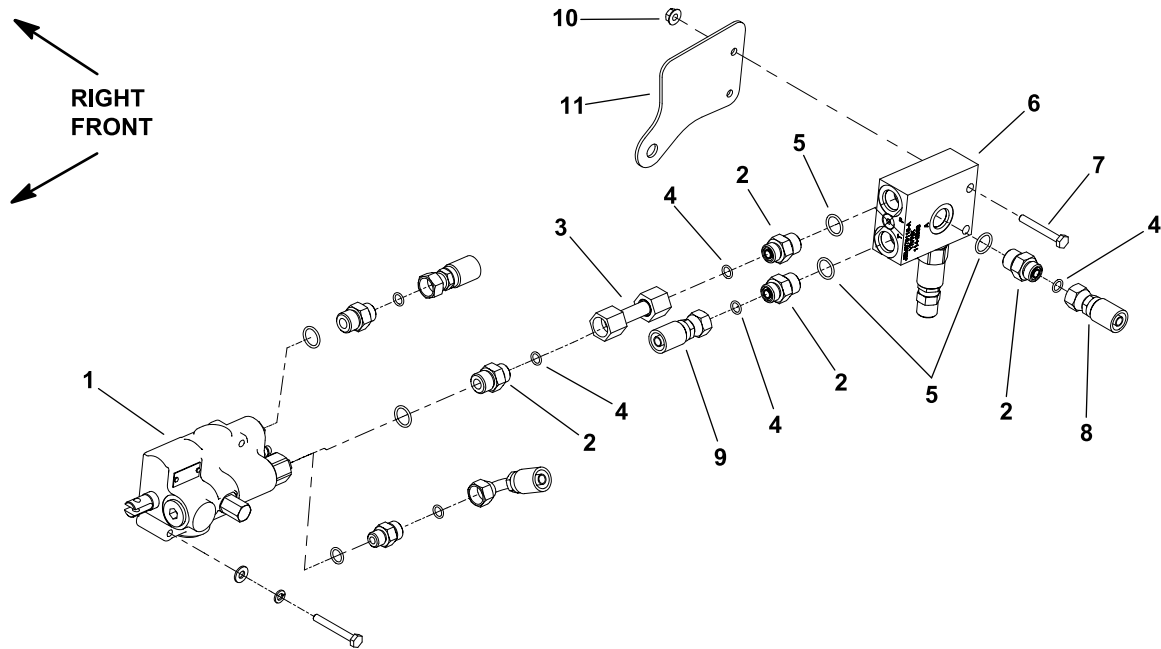


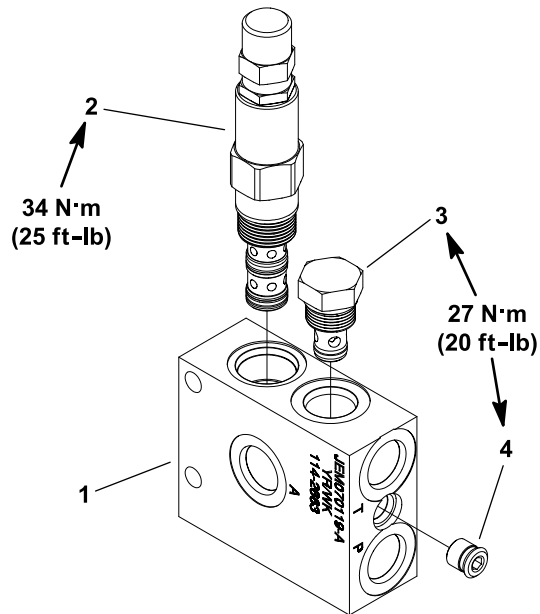
Figure 106

- | | | |
|-----------------------|----------------------------|-------------------------|
| 1. Lift control valve | 5. O-Ring | 9. Hydraulic hose |
| 2. Hydraulic adapter | 6. Counterbalance manifold | 10. Flange nut (2 each) |
| 3. Hydraulic tube | 7. Bolt (2 each) | 11. Mounting bracket |
| 4. O-Ring | 8. Hydraulic hose | |

Removing the Counterbalance Valve Manifold

1. Park the machine on a level surface, engage the parking brake, lower the cutting deck (or implement), and shut off the engine. Remove the key from the key switch.
2. Read the [General Precautions for Removing and Installing the Hydraulic System Components \(page 5–77\)](#).
3. Remove fuel tank from machine; refer to [Removing the Fuel Tank \(page 3–10\)](#) or [Removing the Fuel Tank \(page 4–16\)](#).
4. Label all hydraulic connections for assembly purposes. Clean hydraulic hose ends prior to disconnecting the hoses from control manifold.
5. Disconnect hose connections from hydraulic fittings on counterbalance valve manifold. Allow hoses to drain into a suitable container.
6. Put caps or plugs on disconnected hoses and fittings to prevent contamination.
7. Remove 2 bolts and 2 flange nuts that secure manifold to machine.
8. Remove manifold from the machine.
9. Remove hydraulic fittings as necessary from the manifold. Discard all removed O-rings.

Servicing the Manifold



g230846

Figure 107

- | | |
|-------------------------|----------------|
| 1. Manifold | 3. Check valve |
| 2. Counterbalance valve | 4. Plug |

-
1. Ensure that the manifold is cleaned before removing either of the valves.
-

IMPORTANT

Use care when handling the hydraulic valve. Slight bending or distortion of the stem tube can cause binding and malfunction.

2. Using a deep socket, remove valves from manifold. Note correct location of O-rings, sealing rings, and back-up rings. Remove and discard seal kit from valves.
3. Visually inspect the manifold port and removed valves for damage to the sealing surfaces, damaged threads, and contamination.
 - A. Contamination may cause valve to stick or hang up. Contamination can become lodged in small valve orifices or seal areas causing valve malfunction.
 - B. If valve sealing surfaces appear pitted or damaged, the hydraulic system may be overheating or there may be water in the system.



CAUTION



Use eye protection such as goggles when using compressed air for cartridge valve cleaning.

4. Clean valves by submerging valve in clean mineral spirits to flush out contamination. Particles as fine as talcum powder can affect the operation of the valve. Be extremely careful not to damage cartridge. Use compressed air for cleaning.

Servicing the Manifold (continued)

5. Lubricate new valve seal kit components with clean hydraulic fluid and install on valves. The O-rings, sealing rings, and backup rings must be arranged properly on the valves for proper operation and sealing.
6. Thread valves carefully into correct manifold port. The valves should go in easily without binding. Using a deep socket, torque valves to values identified in [Figure 107](#).

Installing the Counterbalance Valve Manifold

1. Coat new O-rings lightly with clean hydraulic fluid. Install all removed hydraulic fittings with new O-rings to the manifold.
2. Position counterbalance valve manifold to machine frame. Secure manifold to machine with 2 bolts and 2 flange nuts.
3. Remove all caps or plugs from hydraulic hoses and fittings.
4. Connect hydraulic hoses to hydraulic fittings on manifold.
5. Install fuel tank to machine; refer to [Installing the Fuel Tank \(page 3–11\)](#) or [Installing the Fuel Tank \(page 4–17\)](#).
6. Check hydraulic fluid level in reservoir (front axle) and adjust as necessary; refer to the *Traction Unit Operator's Manual*.
7. Operate the machine functions slowly until air is out of system; refer to [Charging the Hydraulic System \(page 5–85\)](#).
8. Check counterbalance valve adjustment; refer to the *Traction Unit Operator's Manual*.

Lift Control Valve (Machine Serial Number above 311000000)

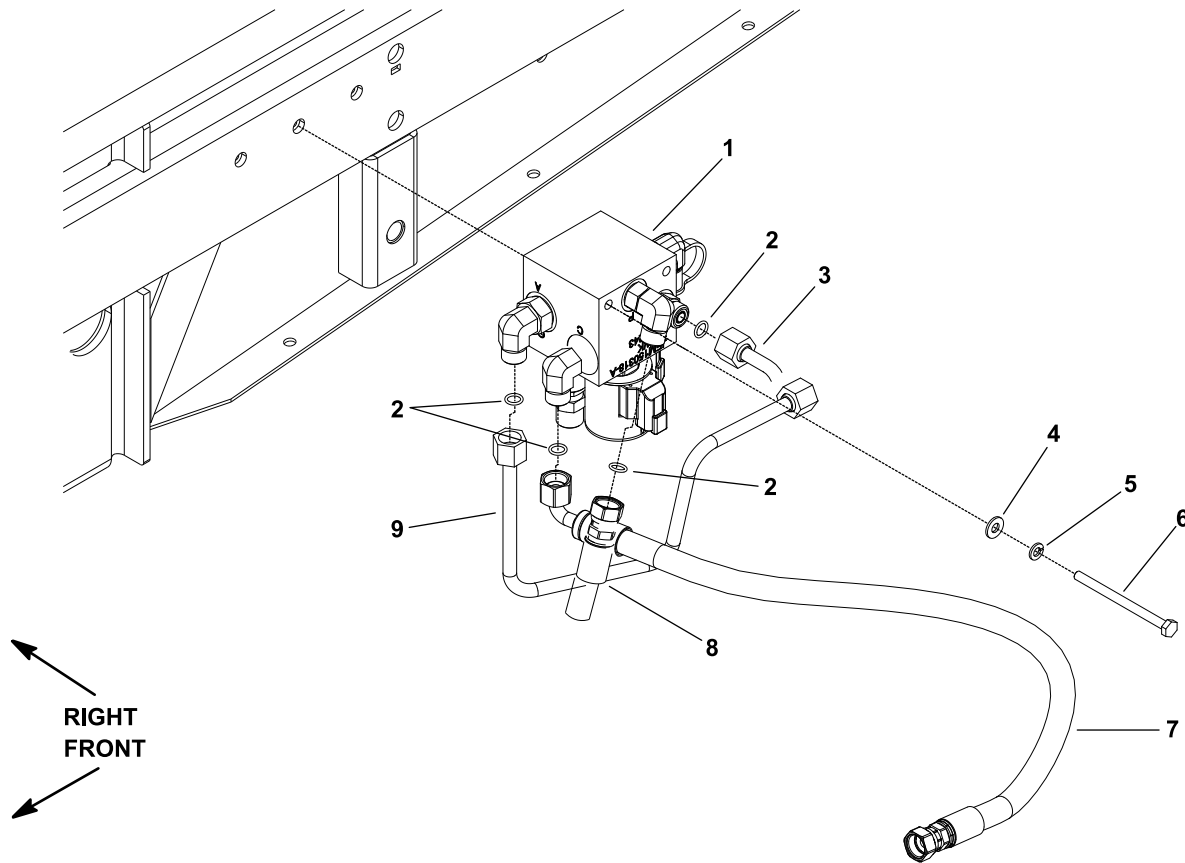


Figure 108

- | | | |
|-----------------------|-------------------------|-------------------|
| 1. Lift control valve | 4. Flat washer (2 each) | 7. Hydraulic hose |
| 2. O-ring (4 each) | 5. Lock washer (2 each) | 8. Hydraulic hose |
| 3. Hydraulic tube | 6. Bolt (2 each) | 9. Hydraulic tube |

Note: For testing the solenoid valve coils; refer to [Lift Control Valve Solenoid Valve Coil \(Machine Serial Number above 311000000\)](#) (page 6–62).

Removing the Lift Control Valve

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Read the [General Precautions for Removing and Installing the Hydraulic System Components](#) (page 5–77).
3. Remove the operator seat; refer to [Removing the Operator Seat](#) (page 7–20).
4. Remove the fuel tank; refer to [Removing the Fuel Tank](#) (page 4–16).
5. Locate the hydraulic lift control valve that is attached to the machine frame.
6. For assembly purposes, label all the hydraulic and electrical connections. Clean the hydraulic connections before loosening the hydraulic lines.

Removing the Lift Control Valve (continued)



CAUTION



Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to [Releasing Pressure from the Hydraulic System \(page 5–6\)](#).



WARNING



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

If the deck is not fully lowered when the lift control valve components are loosened, the deck may drop unexpectedly.

7. Disconnect the hydraulic hoses and tubes from the fittings in the lift control valve. Allow the lines to drain into a suitable container. Remove and discard the O-rings from the fittings.
8. Install clean caps or plugs on the hydraulic lines and fittings to prevent contamination.
9. Disconnect the wire harness leads from the solenoid coils on the lift control valve.
10. Remove the 2 bolts (item 6 in [Figure 108](#)), 2 lock washers, and 2 flat washers that secure the lift control valve to the machine frame.
11. Remove the lift control valve from the machine.

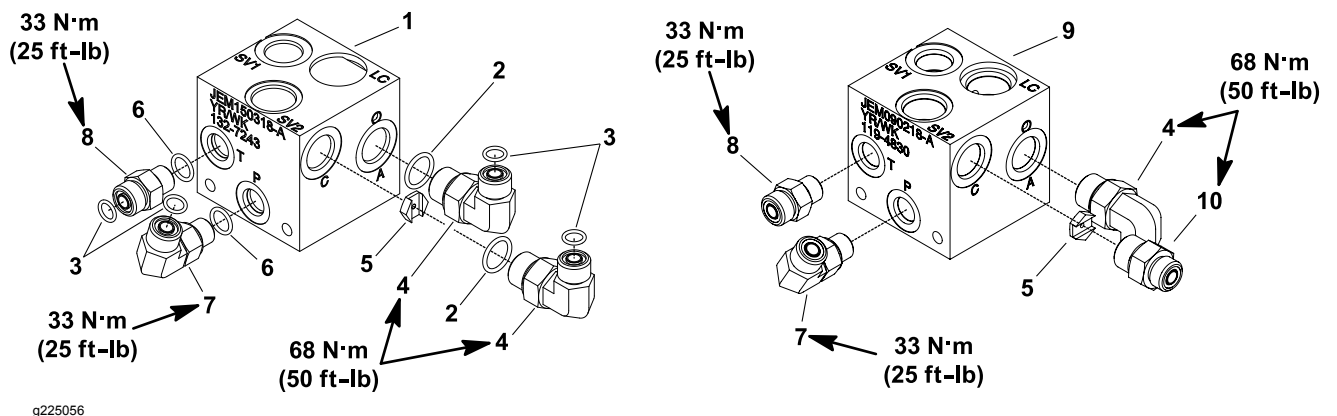


Figure 109

- | | | |
|-----------------------------------|-------------------------------|-------------------|
| 1. Manifold block | 5. Flow control orifice | 9. Manifold block |
| 2. O-ring (2 each) | 6. O-ring (2 each) | 10. Adapter |
| 3. O-ring (4 each) | 7. 90° hydraulic fitting | |
| 4. 90° hydraulic fitting (2 each) | 8. Straight hydraulic fitting | |

Removing the Lift Control Valve (continued)

IMPORTANT

A flow control orifice (item 5 in [Figure 109](#)) is placed below the hydraulic fitting on the lift control valve. If the fitting is removed from the manifold and a flow control orifice is in the manifold block, ensure that you remove the orifice and label its position for assembly purposes.

12. If necessary, remove the hydraulic fittings from the manifold block (item 1 in [Figure 109](#)), and discard the O-rings.
13. Locate, retrieve, and label the orifice from the manifold block (if equipped).

Installing the Lift Control Valve

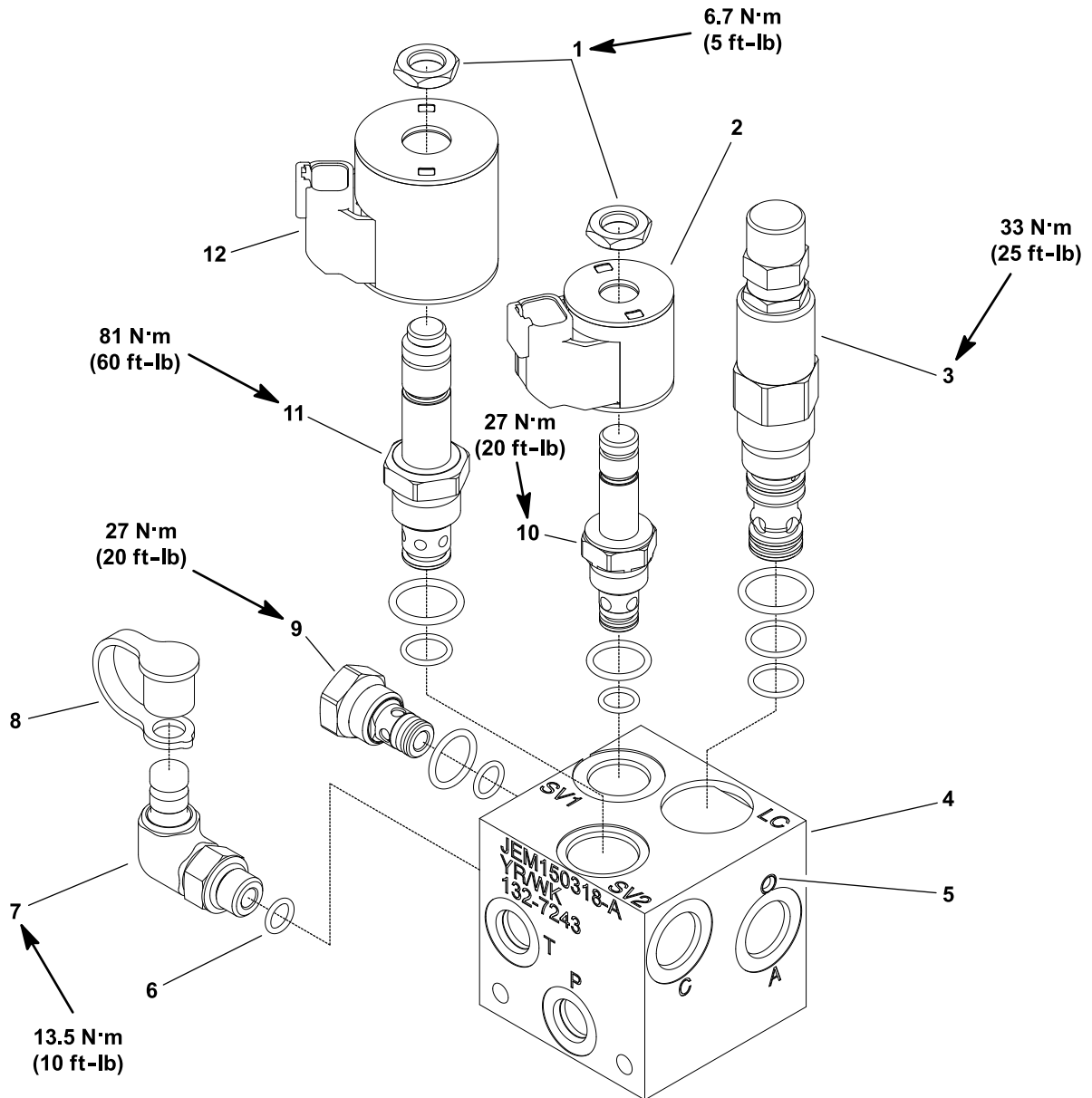
1. If the hydraulic fittings were removed from the manifold block (item 1 in [Figure 109](#)), do the following:
 - A. Lubricate new O-rings with clean hydraulic fluid, install the lubricated O-rings onto the fittings.

IMPORTANT

When installing the flow control orifice in the manifold block, ensure that the flow control orifice is flat in the base of the fitting cavity. Letting the flow control orifice stay cocked in the cavity can damage the manifold block.

- B. For the manifold port with orifice, install the flow control orifice in the block with the orifice slot facing out.
 - C. Install the fittings into the manifold block. Torque the fittings to the torque values identified in [Figure 109](#).
2. Position the lift control valve to the machine frame and install the 2 bolts (item 6 in [Figure 108](#)), 2 lock washers, and 2 flat washers but do not fully tighten.
3. Remove the caps and plugs from the hydraulic lines and fittings.
4. Lubricate and install new O-rings on the manifold fittings. Use the labels that you attached during removal, correctly connect the hydraulic lines to the fittings and tighten all the connections; refer to [Installing the Hydraulic Hose and Tube \(O-Ring Face Seal Fitting\)](#) (page 5–9).
5. Tighten the 2 bolts to secure the lift control valve to the frame.
6. Use the labels that you attached during removal to connect the wire harness leads to the solenoid coils on the manifold block.
7. Install the fuel tank; refer to [Installing the Fuel Tank](#) (page 4–17).
8. Install the operator seat; refer to [Installing the Operator Seat](#) (page 7–20).
9. Check the hydraulic-fluid level in the hydraulic reservoir (front axle) and add correct quantity of fluid if necessary; refer to the *Operator's Manual*.
10. Operate the machine functions slowly until air is out of system; refer to [Charging the Hydraulic System](#) (page 5–85).

Servicing the Lift Control Valve (Machine Serial Number above 311000000)



g225058

Figure 110

- | | | |
|-------------------|----------------------|--------------------------|
| 1. Nut (2 each) | 5. Expander plug | 9. Check valve |
| 2. Coil | 6. O-ring | 10. Solenoid valve (SV1) |
| 3. Logic valve | 7. 90° elbow fitting | 11. Solenoid valve (SV2) |
| 4. Manifold block | 8. Dust cap | 12. Solenoid coil |

Note: The ports on the lift control valve are marked for easy identification of the components. Example: P is the steering control valve (E) connection port and SV2 is the location for solenoid valve SV2; refer to the Hydraulic Schematic in [Appendix A \(page A-1\)](#) to identify the function of the hydraulic lines and cartridge valves at each manifold port.



WARNING



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

If the deck is not fully lowered as the lift control valve components are loosened, the deck may drop unexpectedly.

Servicing the Control Manifold 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 \(page 5–6\)](#).

1. Ensure that the entire outer surface of the manifold block is clean before you remove the cartridge valve.
 2. If the solenoid cartridge valve is being serviced, remove the nut (item 1 in [Figure 110](#)) that secures the solenoid coil to the cartridge valve. Carefully slide the solenoid coil off the valve.
-

IMPORTANT

Carefully handle the valve cartridge. 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. Remove the cartridge valve with a deep well socket wrench. Note the correct location of the O-rings, sealing rings, and back-up rings.
 4. Remove and discard the seal kit.
 5. Visually examine the port in the manifold for damaged sealing surfaces, damaged threads, and contamination. Also, 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 can be too hot or there can be water in the system.
-



CAUTION



Use the eye protection such as goggles when using the compressed air.



CAUTION



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

6. Use clean-mineral spirits and clean the cartridge valve. Put the valve in the 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 the compressed air for cleaning.

7. Install the cartridge valve as follows:
 - A. Lubricate the new seal kit components with clean hydraulic fluid and install them onto the valve.
 - B. Install the O-rings, sealing rings, and back-up rings correctly on the cartridge valve for proper operation and sealing.

IMPORTANT

Carefully handle the valve cartridge. 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.

- C. Turn the cartridge valve carefully into the manifold port. The valve should go in easily without binding.
 - D. Use a deep well socket and torque the cartridge valve to the values identified in [Figure 110](#).
8. If the solenoid coil was removed from the cartridge valve, do the following steps:
 - A. Carefully install the coil onto the valve.

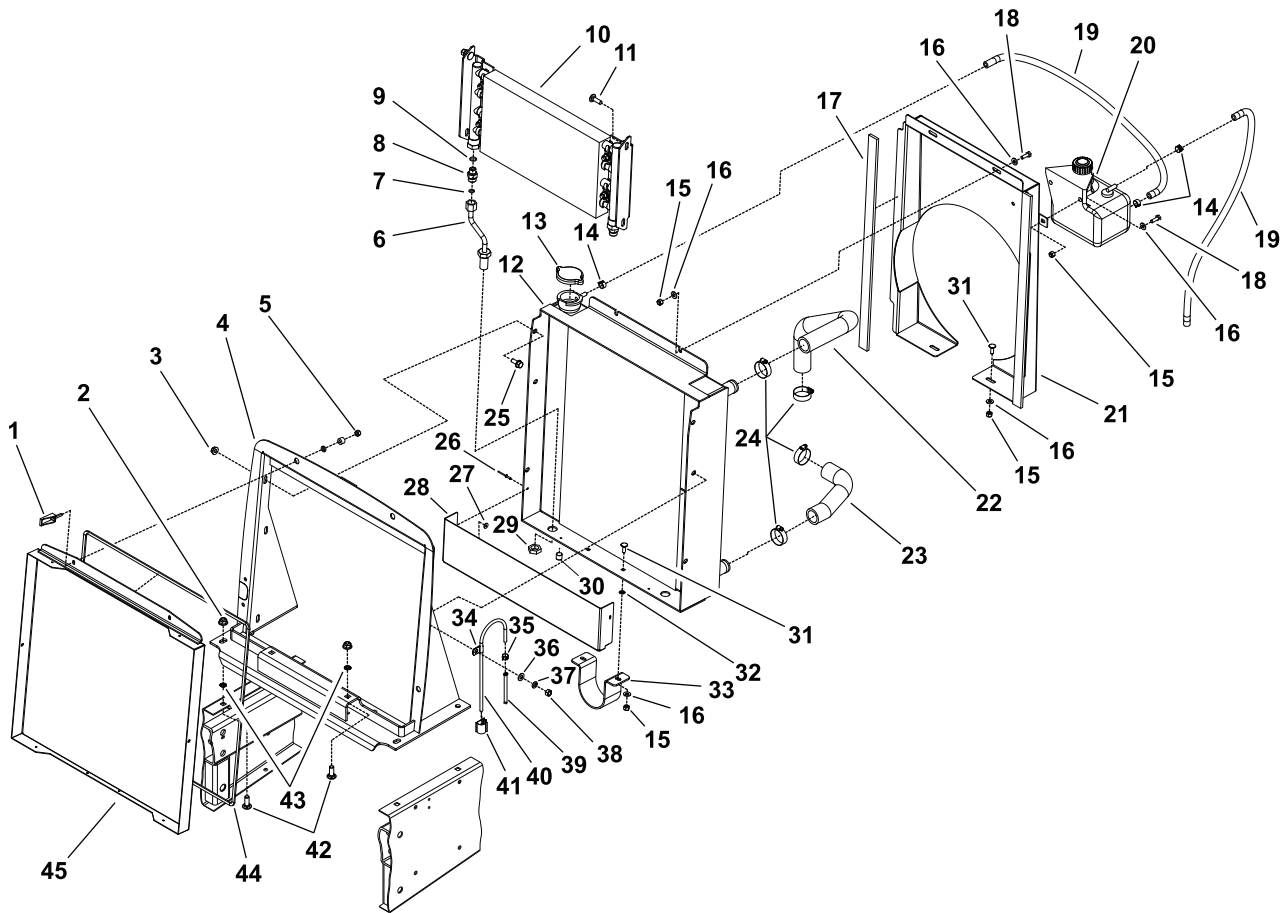
IMPORTANT

Overtightening the nut can damage the solenoid or cause valve malfunction. Do not overtighten the nut.



- B. Install the nut and torque the nut to **6.7 N·m (5 ft-lb)**.
9. If the problems still exist, remove the valve and clean it again or replace the valve.

Oil Cooler (Groundsmaster 3280-D)



g221637

Figure 111

1. Swell latch (2 each)	13. Radiator cap	25. Flange-head screw (4 each)	37. Lock washer (6 each)
2. Flange nut (6 each)	14. Hose clamp (3 each)	26. Pop rivet (4 each)	38. Hex nut (6 each)
3. Flange nut (4 each)	15. Locknut (8 each)	27. Back washer (2 each)	39. Vent hose
4. Radiator frame	16. Flat washer (10 each)	28. Bottom radiator shield	40. Vent tube
5. Locknut (2 each)	17. Foam strip (2 each)	29. Bulkhead locknut (2 each)	41. Adhesive clamp
6. Hydraulic tube (2 each)	18. Bolt (4 each)	30. Pipe plug	42. Carriage screw (6 each)
7. O-ring (2 each)	19. Reservoir hose (2 each)	31. Carriage bolt (4 each)	43. Retaining ring (6 each)
8. Straight hydraulic fitting (2 each)	20. Coolant reservoir assembly	32. Retainer nut (2 each)	44. Foam seal
9. O-ring (2 each)	21. Fan shroud	33. Driveshaft loop	45. Radiator screen
10. Oil cooler assembly	22. Upper radiator hose	34. Clamp	
11. Carriage bolt (2 each)	23. Lower radiator hose	35. Hose clamp	
12. Radiator	24. Hose clamp (4 each)	36. Flat washer (6 each)	

Removing the Oil Cooler

The radiator and oil cooler must be removed from the machine as an assembly; refer to [Removing the Radiator \(page 4–12\)](#).

Inspecting the Oil Cooler

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



WARNING



Use 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.

Installing the Oil Cooler

The radiator and oil cooler must be installed into the machine as an assembly; refer to [Installing the Radiator \(page 4–13\)](#).



Table of Contents

General Information	6-3
Electrical Schematics and Wire Harness Drawings/Diagrams.....	6-3
Standard Control Module (SCM).....	6-3
Standard Control Module Logic Chart.....	6-5
Special Tools	6-7
Multimeter	6-7
Terminal Protector.....	6-7
Battery Hydrometer.....	6-7
Dielectric Gel.....	6-8
Troubleshooting.....	6-9
Electrical System Quick Checks	6-15
Testing the Battery (Open Circuit Test).....	6-15
Testing the Charging System	6-15
Testing the Glow Plug System (Groundsmaster 3280-D)	6-16
Checking the Operation of the Interlock Switches	6-16
Adjustments.....	6-17
Traction Neutral Sensor (Machine Serial Number above 316000000).....	6-17
Parking Brake Switch	6-19
Testing the Electrical Components.....	6-20
Fusible Link Harness.....	6-20
Fuses (Machine Serial Number below 400000000).....	6-22
Fuses (Machine Serial Number above 400000000)	6-23
Operator Cab Fuses (Machines with Operator Cab)	6-25
Key Switch	6-27
Indicator Lights.....	6-29
Hour Meter	6-31
PTO Switch	6-32
Deck Lift Switch (Machine Serial Numbers above 311000000).....	6-34
Seat Switch	6-36
Windshield Washer/Wiper Switch (Machines with Operator Cab)	6-38
Accessory Power Switch (Machines with Operator Cab).....	6-40
Fan Speed Switch (Machines with Operator Cab).....	6-42
Work Light Switch (Machines with Operator Cab-Optional)	6-44
Traction Neutral Switch (Machine Serial Numbers below 316000000)	6-46
Traction Neutral Sensor (Machine Serial Number above 316000000).....	6-48
Parking Brake Switch	6-50
High Temperature Warning Switch.....	6-52
High Temperature Shutdown Switch	6-55
Engine Oil Pressure Switch.....	6-58
Relays (Groundsmaster 3280-D)	6-60
Lift Control Valve Solenoid Valve Coil (Machine Serial Number above 311000000)	6-63
PTO Electric Clutch.....	6-65
Fuel Stop Solenoid (Groundsmaster 3280-D)	6-66
Glow Controller (Groundsmaster 3280-D).....	6-68
Fuel Pump (Groundsmaster 3280-D).....	6-70
Fuel Pump (Groundsmaster 3320).....	6-73
Fuel Pump Relay (Groundsmaster 3320).....	6-75
Service and Repairs	6-76

Lift Control Valve Solenoid Valve Coils (Machine Serial Number above 311000000)	6-76
PTO Electric Clutch.....	6-78
Battery Storage	6-80
Battery Care.....	6-80
Servicing the Battery.....	6-81

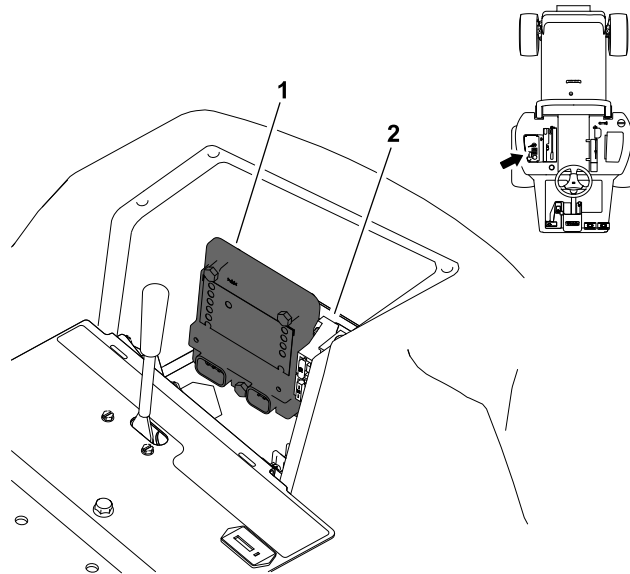
General Information

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

Electrical Schematics and Wire Harness Drawings/Diagrams

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

Standard Control Module (SCM)



g226810

Figure 112

1. Standard Control Module (SCM)
2. Fuse block

The Groundsmaster 3280-D and Groundsmaster 3320 machines is equipped with a Standard Control Module (SCM) to monitor and control the electrical components required for safe operation. The SCM is located under the control panel cover ([Figure 112](#)).

The SCM monitors the inputs from the key, neutral, parking brake, PTO, seat, high temperature warning switch, and high temperature shutdown switch. Current output to the PTO (electric clutch), engine starter motor, and engine run components (fuel pump, diesel engine run solenoid, and gasoline engine ignition) are controlled based on the inputs monitored by the SCM.

Use the SCM to check the operation of the machine switches by monitoring the SCM LEDs. If a SCM LED does not illuminate (e.g., the in seat input LED does not illuminate when the seat is occupied and the key switch is in the ON position), you must test the switch, fuses, and circuit wiring.

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

Refer to the *Traction Unit Operator's Manual* for additional Standard Control Module information.

SCM Inputs

The power input LED should be illuminated when the key switch is in the ON position. The power input LED should also be illuminated when the key switch is in the START position.

The start input LED should be illuminated when the key switch is in the START position.

The neutral input LED should be illuminated when the traction pedal is in the neutral position.

The parking brake off input LED should be illuminated when you do not set the parking brake.

The PTO switch input LED should be illuminated when the PTO switch is ON (pulled out).

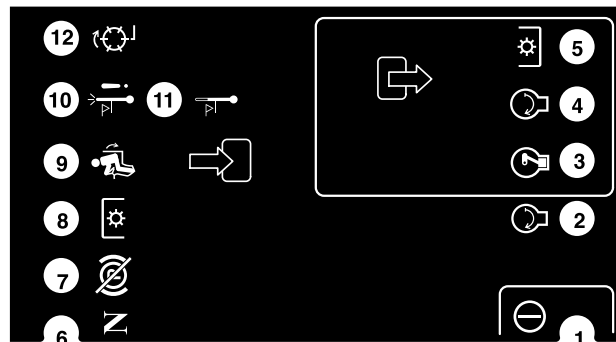
The in seat input LED should be illuminated when the operator is sitting in the seat.

The high-temperature shutdown input LED should be illuminated when the high-temperature shutdown switch closes due to engine coolant temperature of approximately 115°C (240°F).

The high-temperature warning input LED should be illuminated when the high-temperature warning switch closes due to engine coolant temperature of approximately 105°C (220°F).

The backlap input LED is not used on the Groundsmaster 3280-D or 3320 machine.

SCM Outputs



g227291

Figure 113

- | | | |
|--------------------------|-----------------------------|---|
| 1. Power input LED | 5. PTO output LED | 9. In seat input LED |
| 2. Start input LED | 6. Neutral input LED | 10. High-temperature shutdown input LED |
| 3. Engine run output LED | 7. Park brake off input LED | 11. High-temperature warning input LED |
| 4. Start output LED | 8. PTO switch input LED | 12. Backlap input LED |

The start output LED should be illuminated when the key switch is in the START position with the traction pedal in the neutral position, the PTO switch OFF, and either the seat is occupied or parking brake is set.

The run output LED should be illuminated when the key switch is in the ON position and inputs from the neutral, parking brake, PTO, seat, and engine coolant temperature switches indicate safe engine operation (e.g., the seat is occupied and the parking brake is disengaged when the traction pedal is pressed).

SCM Outputs (continued)

The PTO output LED should be illuminated when the key switch is in the ON position and the PTO switch is ON (pulled out).

Note: If the SCM high-temperature warning input LED is illuminated, the PTO output LED does not illuminate, and the PTO disengages regardless of the PTO switch position.

Standard Control Module Logic Chart

Each line of the following chart ([Figure 114](#)) identifies the necessary component position (inputs) in order for the SCM to energize the appropriate outputs for operating the machine.

Example: To start the engine with an operator in the seat, when the key is in the START position, the traction pedal in the neutral position, and the parking brake is not set, the engine components and engine starter is energized.

IMPORTANT

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

Standard Control Module Logic Chart (continued)

MACHINE FUNCTION	INPUTS										OUTPUTS		
	Power	Start	Neutral	Parking brake Off	PTO Switch	In Seat	High Temperature Warning	High Temperature Shutdown	Backup		Engine Run	Engine Start	PTO
Engine Start (operator in seat)	⊖	⊕	⊖	⊖	○	⊖	○	○	NA		⊖	⊖	○
Engine Start (no operator in seat)	⊖	⊕	⊖	○	○	○	○	○	NA		⊖	⊖	○
Engine Run (operator in seat)	⊖	○	○	⊖	○	⊖	○	○	NA		⊖	○	○
Engine Run (no operator in seat)	⊖	○	⊖	○	○	○	○	○	NA		⊖	○	○
Mow	⊖	○	○	⊖	⊖	⊖	○	○	NA		⊖	○	⊕
High Temperature Warning	⊖	○					⊕	○	NA		⊖	⊖	○
High Temperature Shutdown	⊖	○						⊕	NA		○	○	○

KEY TO CHART

⊖	LED ON- Circuit closed to ground
⊕	LED ON- Circuit is energized
○	LED OFF- Circuit is open to ground or circuit is de-energized
	Circuit is not involved with this machine function (LED OFF)
NA	Backup Input is not used on this machine

g226938

Figure 114

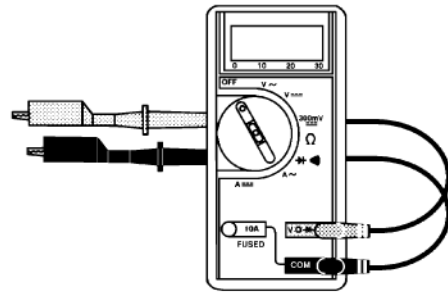
Special Tools

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

Multimeter

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

Toro Part No. 107-0392

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



Battery Hydrometer

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



Dielectric Gel

Toro Part No. 107-0342

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

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



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 \(page A-1\)](#).

If the machine has any interlock switches that are bypassed, connect the switches for the correct troubleshooting and safety.

Note: Use the Standard Control Module input and output LED's when troubleshooting an electrical problem of the Groundsmaster 3280-D or 3320 machine.

Starting Problems

Problem	Possible Causes
All the electrical power is dead.	<ul style="list-style-type: none"> • The battery is discharged. • The battery cables are loose or corroded. • The fuse F1-1 (15 A) to the key switch is damaged; refer to Fuses (Machine Serial Number below 400000000) (page 6–22) or Fuses (Machine Serial Number above 400000000) (page 6–23). • The ground connection is loose or corroded. • The key switch or circuit wiring is damaged.
<p>The starter solenoid clicks, but the starter does not crank.</p> <p>Note: If the starter solenoid clicks, the problem is not in the interlock circuit.</p>	<ul style="list-style-type: none"> • 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. • The starter mounting bolts are loose or not supplying a sufficient ground for solenoid.
The engine cranks, but does not start.	<ul style="list-style-type: none"> • The fuel tank is empty. • The engine run solenoid is damaged (Groundsmaster 3280-D). • The wiring in the engine crank circuit is loose, corroded, or damaged; refer to the Electrical Schematics in Appendix A (page A–1). • The fuel filter is plugged. • The engine and/or fuel can be too cold. • The engine fuel pump or circuit wiring is damaged. • The glow plugs are damaged (Groundsmaster 3280-D). • The engine glow plug circuit does not operate properly. • The engine or fuel system is malfunctioning; refer to Chapter 3: Gasoline Engine (page 3–1) or Chapter 4: Diesel Engine (page 4–1). • The Standard Control Module is damaged.
The engine cranks (but should not) with the traction pedal out of the neutral position.	<ul style="list-style-type: none"> • The traction neutral sensor is out of adjustment. • The traction neutral sensor or circuit wiring is damaged.
The glow plug circuit does not operate properly.	<ul style="list-style-type: none"> • The wiring in the engine glow circuit is loose, corroded, or damaged; refer to the Electrical Schematics in Appendix A (page A–1). • 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 fuses F1-1, F1-2, F1-3, and/or F1-4 are/is damaged; refer to Fuses (Machine Serial Number above 400000000) (page 6–23).

Starting Problems (continued)

<p>The engine cranks, but should not, when the PTO switch is in the ON (up) position.</p>	<ul style="list-style-type: none"> • The PTO switch or circuit wiring is damaged. • The Standard Control Module is damaged.
<p>The engine starts, but stops when the key switch is released from the START position.</p>	<ul style="list-style-type: none"> • The circuit wiring is damaged. • The key switch is damaged.
<p>Nothing happens when you attempt to start the engine.</p>	<ul style="list-style-type: none"> • The traction pedal is not in the neutral position. • Interlock system has problem. • The operator seat is unoccupied or the parking brake is not applied. • The traction neutral sensor is damaged 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 shutdown switch is damaged. • The battery is discharged. • The battery cables are loose or corroded. • The ground connection is loose or corroded. • The fuse F1-1 (15 A) is damaged; refer to Fuses (Machine Serial Number below 400000000) (page 6–22) or Fuses (Machine Serial Number above 400000000) (page 6–23). • The fuse block is 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). • The key switch is damaged. • The starter solenoid wiring is loose, corroded, or damaged. • The starter solenoid is damaged. • The Standard Control Module is damaged.

General Run and Transport Problems

Problem	Possible Causes
<p>The engine continues to run, but should not, when the key switch is turned to the OFF position.</p>	<ul style="list-style-type: none"> • The battery is discharged. • The battery cables are loose or corroded. • The fuse F1-1 (15 A) to the key switch is damaged; refer to Fuses (Machine Serial Number below 400000000) (page 6–22) or Fuses (Machine Serial Number above 400000000) (page 6–23). • The key switch or circuit wiring is damaged.
<p>The engine shuts off during the operation, but it is able to start again.</p> <p>Note: If the excessive coolant temperature causes the engine to shutdown, the operator can start the engine by moving the machine to a short distance. After starting the engine in this condition, the engine runs for approximately 10 seconds before it shuts off again.</p>	<ul style="list-style-type: none"> • The parking brake is engaged. • The operator is raising from the seat (the seat switch not fully pressed). • The seat switch or circuit wiring is damaged. • The key switch or circuit wiring is damaged. • The machine is operated on a slope with a low fuel level. • The parking brake switch or circuit wiring is damaged.
<p>The engine continues to run, but should not, when the traction pedal is pressed with no operator on the seat.</p>	<ul style="list-style-type: none"> • The seat switch is damaged. • The seat switch wiring is loose, corroded, or damaged. • The traction neutral sensor is out of adjustment or damaged.
<p>The engine shuts off when the traction pedal is pressed or the PTO switch is ON with the operator in the seat.</p>	<ul style="list-style-type: none"> • The operator is raising from the seat (the seat switch not fully pressed). • The parking brake is engaged. • The seat switch is damaged. • The seat switch wiring is loose, corroded, or damaged.
<p>The engine continues to run, but should not, when the PTO switch is ON with no operator in the seat.</p>	<ul style="list-style-type: none"> • The seat switch is damaged. • The seat switch wiring is loose, corroded, or damaged. • The traction neutral sensor is out of adjustment or damaged.

General Run and Transport Problems (continued)

Problem	Possible Causes
<p>The engine shuts off during the operation (the operator sitting on the seat).</p>	<ul style="list-style-type: none"> • The operator is not in the center of the seat (the seat switch is not pressed). • The engine temperature is excessive (above 115°C /240°F). • The engine high temperature shutdown switch is damaged. • The machine is operated on a slope with a low fuel level. • The parking brake is engaged or the parking brake switch is damaged. • The key switch is damaged. • The seat switch is damaged. • The seat switch wiring is loose, corroded, or damaged. • The fuses F1-1, F1-2, F1-3, and/or F1-4 are/is damaged; refer to Fuses (Machine Serial Number below 400000000) (page 6–22) or Fuses (Machine Serial Number above 400000000) (page 6–23). • Wiring to the run circuit components is damaged or disconnected; refer to Wiring Schematics in Appendix A (page A–1). • The fuel pump is damaged. • The Standard Control Module is damaged.
<p>The battery does not charge.</p>	<ul style="list-style-type: none"> • A loose, corroded, or broken wire(s) exist in the charging circuit; refer to the Electrical Schematics in Appendix A (page A–1). • The engine alternator belt is loose or damaged. • The alternator is damaged. • The battery is damaged. • The fusible link harness at the engine starter motor is damaged.
<p>The PTO clutch does not engage.</p>	<ul style="list-style-type: none"> • The system fuse F1-1 (15 A) or F1-3 (10 A) is open; refer to Fuses (Machine Serial Number below 400000000) (page 6–22) or Fuses (Machine Serial Number above 400000000) (page 6–23). • The logic power fuse F1-4 (2 A) is open. • The fuse block is damaged. • The PTO switch is damaged. • The PTO latch relay is damaged. • The electric clutch wiring is loose, corroded, or damaged. • The electric clutch is out of adjustment or damaged.

Cutting Deck Operating Problems

Problem	Possible Causes
The cutting deck remains engaged, but should not, with no operator in the seat.	<ul style="list-style-type: none"> • The seat switch or circuit wiring is damaged. • A loose, corroded, or broken wire(s) exist in the PTO clutch circuit; refer to the Electrical Schematics in Appendix A (page A-1).
The cutting deck run, but should not, with the PTO switch in the OFF (disengage) position.	<ul style="list-style-type: none"> • The PTO switch or circuit wiring is damaged. • A loose, corroded, or broken wire(s) exist in the PTO clutch circuit; refer to the Electrical Schematics in Appendix A (page A-1).
The cutting deck does not operate with the PTO switch in the ON (up) position.	<ul style="list-style-type: none"> • The operator seat is unoccupied. • The hydraulic-fluid level in the hydraulic reservoir (front axle) is low. • The seat switch or circuit wiring is damaged. • The PTO switch or circuit wiring is damaged. • The engine temperature is excessive (above 105°C/220°F). • The high temperature shutdown switch or circuit wiring is damaged. • The Standard Control Module is damaged. • A loose, corroded, or broken wire(s) exist in the PTO clutch circuit; refer to the Electrical Schematics in Appendix A (page A-1).

Cutting Deck Lift/Lower Problems

Problem	Possible Causes
The cutting deck does not lower.	<ul style="list-style-type: none"> • The operator is not fully pressing the seat switch. • The seat switch or circuit wiring is damaged. • The lift control manifold solenoid coil SV1 or circuit wiring is damaged. • A hydraulic problem in the lift/lower circuit exists; refer to the Troubleshooting (page 5-44).
The cutting deck does not raise.	<ul style="list-style-type: none"> • The lift control manifold solenoid coil SV1 or circuit wiring is damaged. • A hydraulic problem in the lift/lower circuit exists; refer to the Troubleshooting (page 5-44).

Electrical System Quick Checks

Testing the Battery (Open Circuit Test)

Use a multimeter to measure the voltage between the battery terminals; refer to [Battery Test Table \(page 6–15\)](#).

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

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

Measure and record the battery voltage. Use the [Battery Test Table \(page 6–15\)](#) to determine charge level of the battery.

Note: This test provides a relative condition of the battery. The load testing of the battery provides additional and more accurate information; refer to [Servicing the Battery \(page 6–81\)](#).

Battery Test Table

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

Testing the Charging System

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

Tool required: Digital multimeter to set DC volts.

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

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

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

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

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

Refer to the [Battery Voltage Table \(page 6–16\)](#) 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 (Groundsmaster 3280-D)

This is a fast, simple test that helps to determine the integrity and operation of the Groundsmaster 3280-D glow plug system. Perform this test when you find hard starting (cold engine) on a diesel engine equipped with a glow plug system.

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

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

The glow plug system of the Groundsmaster 3280-D machine should have a reading of approximately 21 A.

Checking the Operation of the Interlock Switches



CAUTION

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

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

Replace any malfunctioning switches before operating the machine.

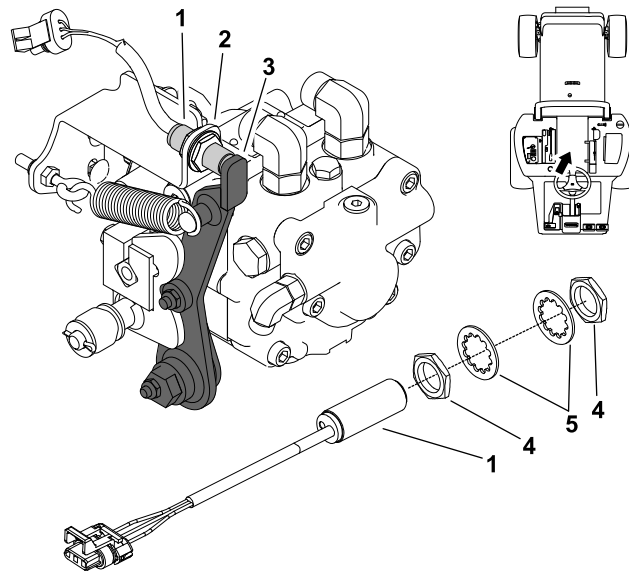
The Groundsmaster 3280-D and 3320 machines is equipped with a Standard Control Module (SCM) which monitors the interlock switch operation. The information on the SCM is described in [Standard Control Module \(SCM\) \(page 6–3\)](#) and the *Traction Unit Operator's Manual*.

The interlock system used on your Groundsmaster includes the key switch, PTO switch, seat switch, traction neutral sensor, parking brake switch, and deck lift switch.

Testing of the individual interlock switches is included in the [Testing the Electrical Components \(page 6–20\)](#).

Adjustments

Traction Neutral Sensor (Machine Serial Number above 316000000)



g226812

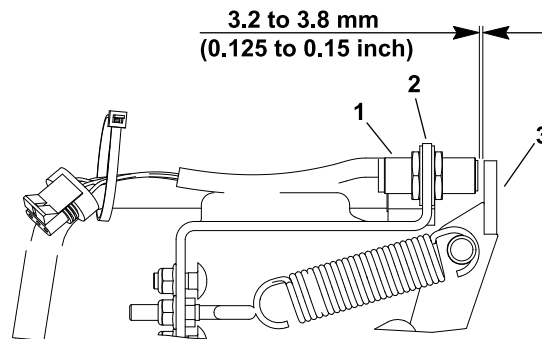
Figure 115

- | | | |
|----------------------------|---------------------|-------------------------|
| 1. Traction neutral sensor | 3. Neutral arm | 5. Lock washer (2 each) |
| 2. Sensor bracket | 4. Jam nut (2 each) | |

The traction neutral sensor is a normally open proximity sensor that closes when the traction pedal is in the neutral position. The sensor is located under the seat and mounted to a sensor bracket over the hydraulic pump (Figure 115). 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 drive for neutral; refer to Adjusting the Traction Drive for Neutral in the *Traction Unit Operator's Manual*.



g226813

Figure 116

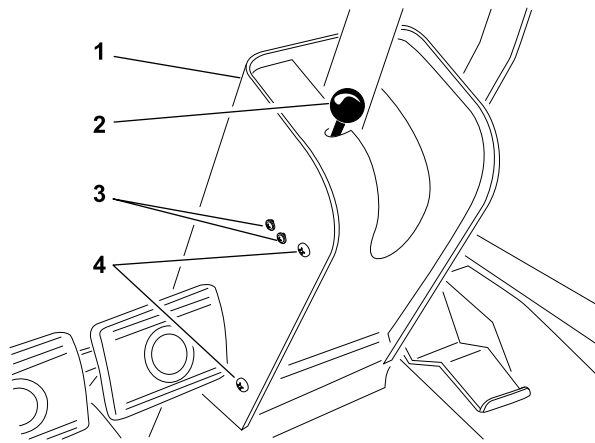
- | | | |
|----------------------------|-------------------|----------------|
| 1. Traction neutral sensor | 2. Sensor bracket | 3. Neutral arm |
|----------------------------|-------------------|----------------|

2. When the traction pedal is in the neutral position, the gap between the traction neutral sensor and the neutral arm should be 3.2 to 3.8 mm (0.125 to 0.15 inch) (Figure 116).

Adjusting the Traction Neutral Sensor (continued)

3. If the gap is incorrect, adjust the traction neutral sensor; refer to Adjusting the Proximity Sensor in the *Traction Unit Operator's Manual*.
4. Check that the LED on the cable end of the traction neutral sensor is illuminated when the traction pedal is in the neutral position.

Parking Brake Switch



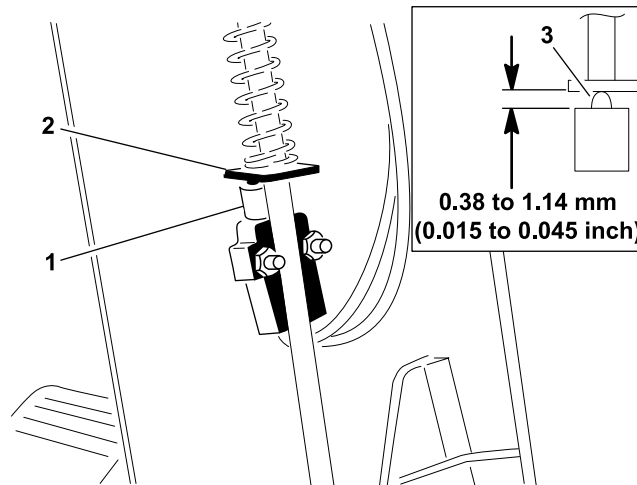
g227534

Figure 117

- | | |
|-------------------------|---------------------------------|
| 1. Steering tower cover | 3. Phillips-head screw (2 each) |
| 2. Parking brake knob | 4. Phillips-head screw (6 each) |

The switch used for the parking brake is a normally open switch. The switch closes when the parking brake is disengaged. The parking brake switch is located under the steering tower cover (Figure 117). The sensing plate for the parking brake switch is the parking brake rod tab (Figure 118).

Adjusting the Parking Brake Switch



g226937

Figure 118

- | | |
|----------------------------|-------------------|
| 1. Parking brake switch | 3. Switch plunger |
| 2. Tab (parking brake rod) | |

When the parking brake is set, the compressed length of the switch plunger should be 0.38 to 1.14 mm (0.015 to 0.045 inch) (Figure 118).

Note: This is the distance between the parking brake rod tab and the switch plunger housing.

If the gap is incorrect, adjust the parking brake switch; refer to Adjusting the Parking-Brake-Interlock Switch in the *Traction Unit Operator's Manual*.

Testing the Electrical Components

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

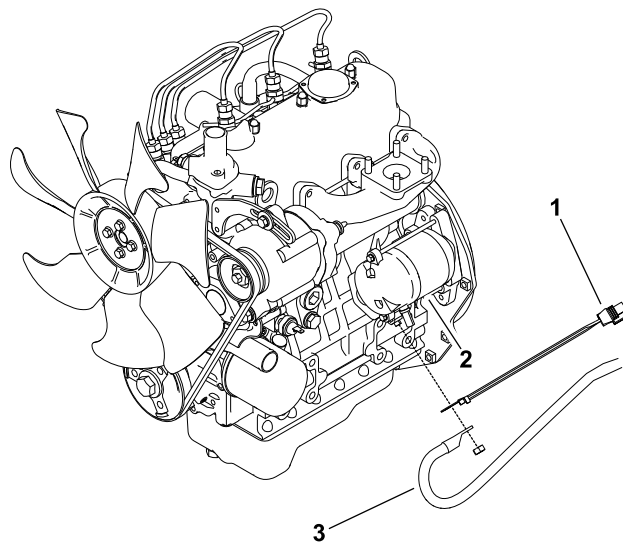
Note: Electrical troubleshooting of any 12 Volt power connection can be performed through voltage drop tests without disconnecting the component.

Note: Refer to the Kubota Workshop Manual: 05 Series Engine (Groundsmaster 3280-D) or Briggs and Stratton/Daihatsu Engine Repair Manual (Groundsmaster 3320) for additional electrical component repair information.

IMPORTANT

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

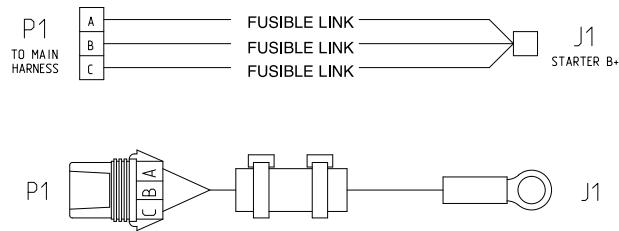
Fusible Link Harness



g225177

Figure 119

1. Fusible link harness 2. Starter motor 3. Positive battery cable
-



g223020

Figure 120

The Groundsmaster 3280-D and 3320 machines use 3 fusible links for the circuit protection. These fusible links are located in a harness that connects the starter B+ terminal to the wire harness (Figure 119 and Figure 120). If any of these links fail, current to the protected circuit stops; refer to the Electrical Schematics in Appendix A (page A-1) for additional circuit information.

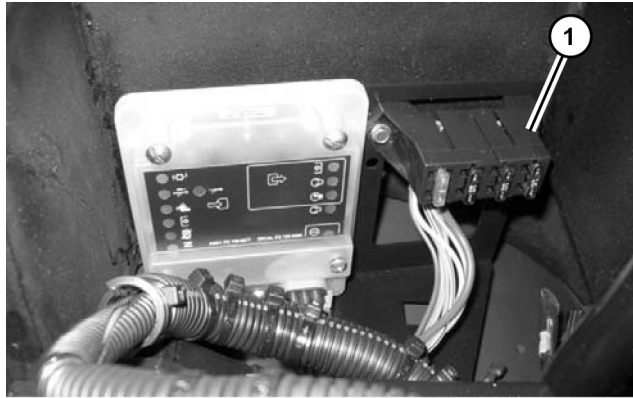
Testing the Fusible Link Harness

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 \(page 6-81\)](#).
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 120).
4. If any of the fusible links are open, replace the fusible link harness.

Note: Do not replace individual fusible link conductors of the fusible link harness. If any of the harness links are open (failed), replace the entire fusible link harness.

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 (Machine Serial Number below 400000000)

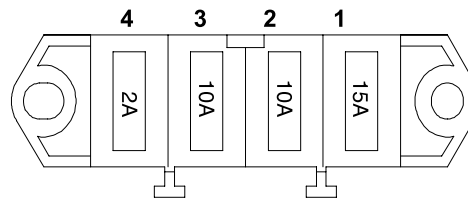


g230995

Figure 121

1. Fuse block

The fuse block is located under the control panel ([Figure 121](#)).



g230996

Figure 122

Identification and Function

The fuses are held in the fuse block. Use [Figure 122](#) to identify each individual fuse and its correct amperage. Each fuse holder has the following function.

Fuse 1 (15 A): Protects main power circuit to key switch terminal B.

Fuse 2 (10 A): Protects power circuit from key switch terminal S.

Fuse 3 (10 A): Protects power circuit from key switch terminal I.

Fuse 4 (2 A): Protects power supply to Standard Control Module.

Testing the Fuses

Remove fuses from the fuse block for testing. Fuse should have continuity between fuse terminals.

Identification and Function (continued)

F2-2 (20 A) (if equipped): Protects power supply to the optional accessory.

F2-3 (20 A) (if equipped): Protects power supply to the optional accessory.

F2-4 (20 A) (if equipped): Protects power supply to the optional accessory.

Testing the Fuses

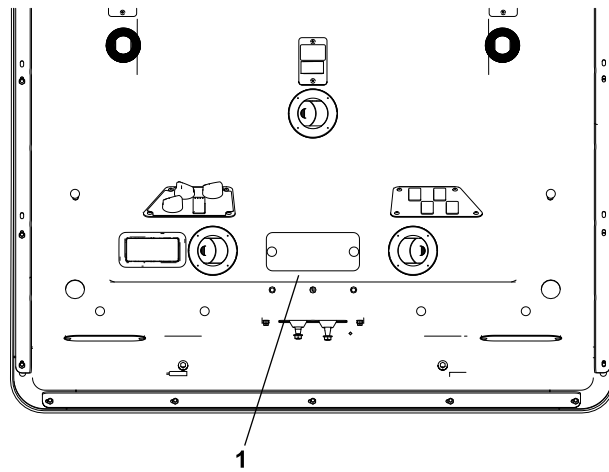
1. Turn the key switch to the ON position (do not start the engine) and remove the control panel. With the fuse installed in the fuse block, use a multimeter to check that 12 VDC exists at both of the terminal test points on the fuse. If 12 VDC exists at 1 of the fuse test points but not at the other,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

IMPORTANT

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

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

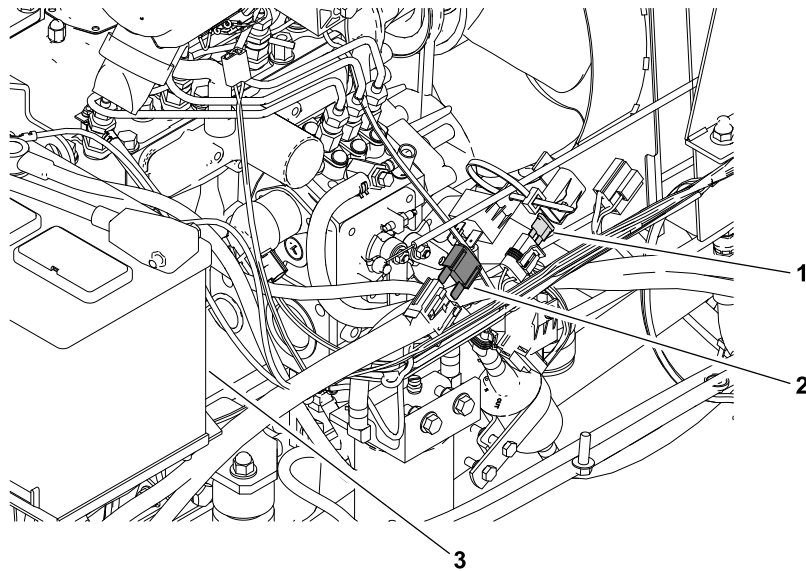
Operator Cab Fuses (Machines with Operator Cab)



g243422

Figure 125

1. Fuse blocks location



g243782

Figure 126

1. 10 A fuse
2. 60 A maxi-fuse
3. Battery

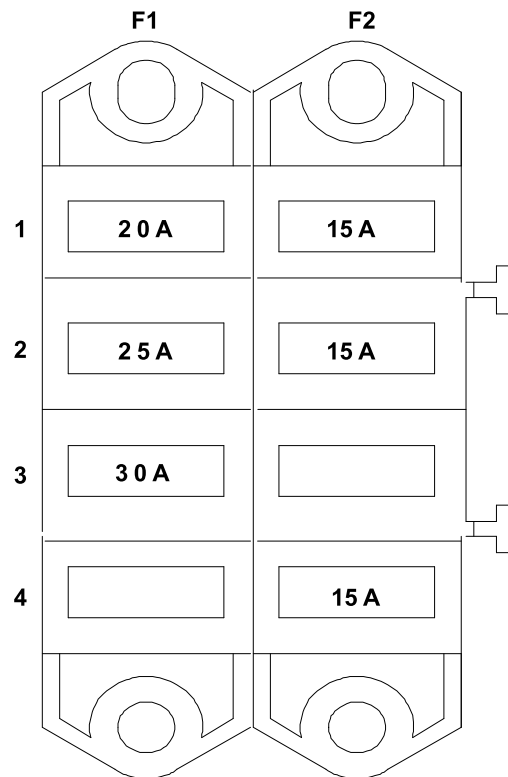
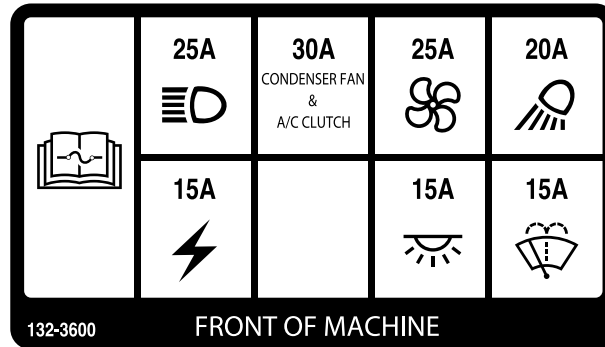
The operator cab fuse blocks are located in the cab headliner ([Figure 125](#)).

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 battery ([Figure 126](#)). 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



g244181

Figure 127

Refer to [Figure 127](#) 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.

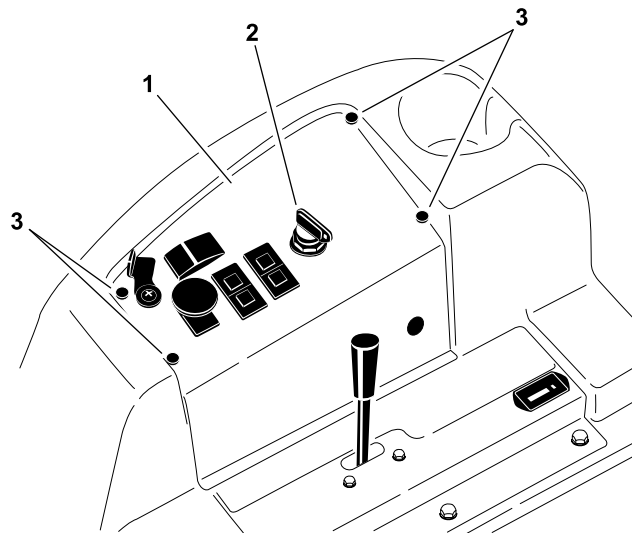
Fuse F2-4 (15 A): Protects the auxiliary power circuit.

Fuses F1-4 and F2-3 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.

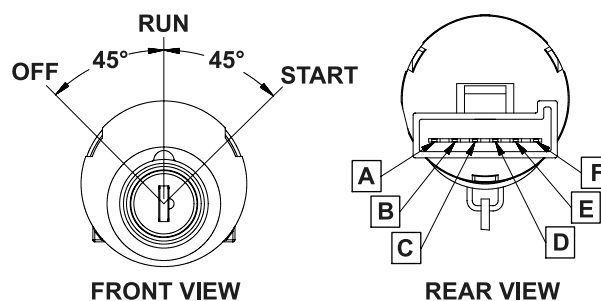
Key Switch



g226806

Figure 128

1. Control panel
2. Key switch
3. Thumb screw (4 each)



g190999

Figure 129

The key switch (item 2 in [Figure 128](#)) is located on the control panel and has 3 positions: OFF, RUN, and START ([Figure 129](#)).

The Standard Control Module (SCM) monitors the operation of the key switch. When the key switch is in the ON position, the SCM power input LED must be illuminated. If the key switch is in the START position, both the power input and start input LEDs should be illuminated.

Testing the Key Switch

1. Park the machine on a level surface, lower the cutting deck, set the parking brake, and shut off the engine.
2. Before you disconnect the key switch for testing, ensure that you test the switch and its circuit wiring as a SCM input; refer to [Standard Control Module \(SCM\)](#) (page 6–3).
3. If the SCM verifies that the key switch and circuit wiring are functioning correctly, no further switch testing is necessary.

Testing the Key Switch (continued)

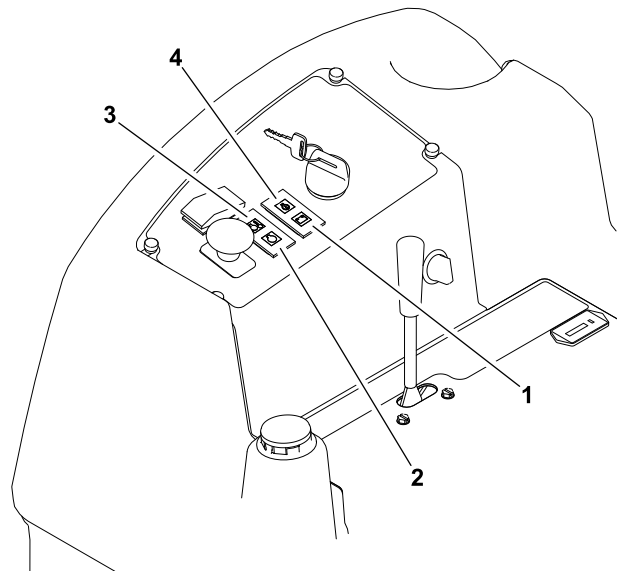
4. If the SCM determines that the key switch and circuit wiring are not functioning correctly, then test the key switch as follows:
 - A. Remove the 4 thumb screws (item 3 in [Figure 128](#)) that secure the control panel to the fuel tank.
 - B. Ensure that the key switch is in the OFF position. Disconnect the wire harness connector from the key switch.
 - C. The key switch terminals are identified in [Figure 129](#) and the circuitry of the key switch is shown in the [Circuit Logic Table](#) (page 6–28). With the use of a multimeter (ohms setting), test the switch functions to determine if the continuity exists between the various terminals for each switch position. Check the continuity between the switch terminals.

Circuit Logic Table

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

- D. Replace the key switch if testing determines that the switch is damaged.
- E. 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).
- F. After you complete the testing, connect the machine wire harness connector to the key switch.
- G. Secure the control panel to the machine with the 4 thumb screws.

Indicator Lights



g226805

Figure 130

- | | |
|------------------------|-----------------------------|
| 1. Charge indicator | 3. High temperature warning |
| 2. Glow plug indicator | 4. Engine oil pressure |

Charge Indicator Light

The charge indicator light should come on when the key switch is in the ON position with the engine not running. Also, it should illuminate with an improperly operating charging circuit while the engine is running.

Engine Oil Pressure Light

The engine oil pressure light should come on when the key switch is in the ON position with the engine not running. Also, it should illuminate with the engine running if the engine oil pressure drops to an unsafe level.

IMPORTANT

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

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

High Temperature Warning Light

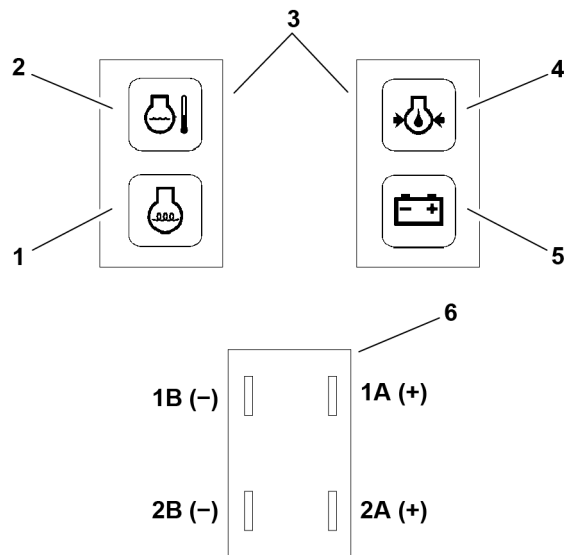
If the engine coolant temperature reaches 105°C (221°F) (approximate), the high temperature warning light should come on.

To test the high temperature warning light and circuit wiring, turn the key switch to the ON position and ground the yellow wire attached to high temperature warning switch located on the engine water pump housing; refer to [High Temperature Warning Switch \(page 6–52\)](#). The indicator light should illuminate.

Glow Plug Indicator Light

The glow plug light on Groundsmaster 3280-D machines should come on when the key switch is placed in the ON position before placing the key switch in the START position. The light should stay lit for approximately 6 seconds while the key switch is left in the ON position.

Testing the Indicator Lights



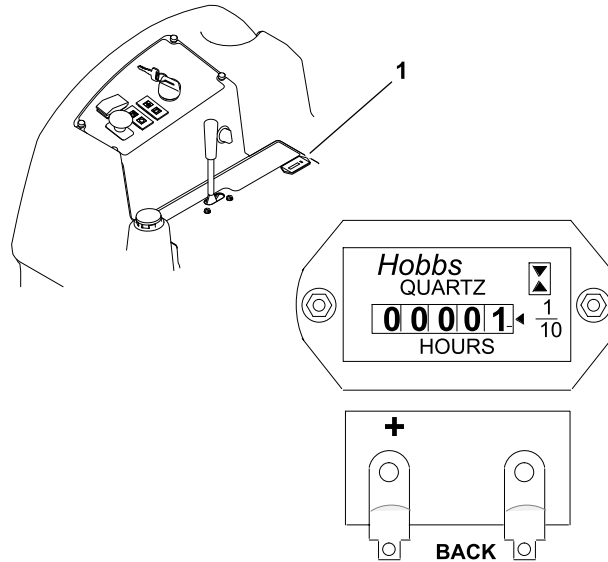
g226816

Figure 131

- | | | |
|-----------------------------|------------------------|-----------------------|
| 1. Glow plug indicator | 3. Warning light front | 5. Charge indicator |
| 2. High temperature warning | 4. Engine oil pressure | 6. Warning light back |

1. Park the machine on a level surface, lower the cutting deck, set the parking brake, and shut off the engine.
2. Apply 12 VDC to the terminals 1A and 2A (Figure 131).
3. Ground the terminals 1B and 2B (Figure 131).
4. Both indicator lights should illuminate.

Hour Meter



g225181

Figure 132

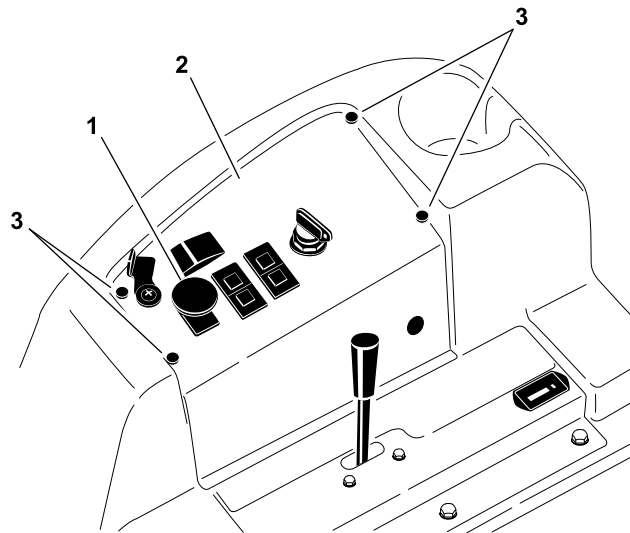
1. Hour meter

The hour meter records and displays accumulated hours of engine operation (Figure 132).

Testing the Hour Meter

1. Park the machine on a level surface, lower the cutting deck, set the parking brake, and shut off the engine.
2. Ensure that the key switch is in the OFF position. Locate the hour meter and disconnect the wire harness electrical connector from the hour meter.
3. Connect the positive (+) terminal of a 12 VDC source to the positive terminal of the hour meter.
4. Connect the negative (-) terminal of the voltage source to the other terminal of the hour meter.
5. The hour meter should move 1/10 of an hour in 6 minutes.
6. Disconnect the voltage source from the hour meter.
7. Replace the hour meter if necessary.
8. Connect the wire harness electrical connector to the hour meter.

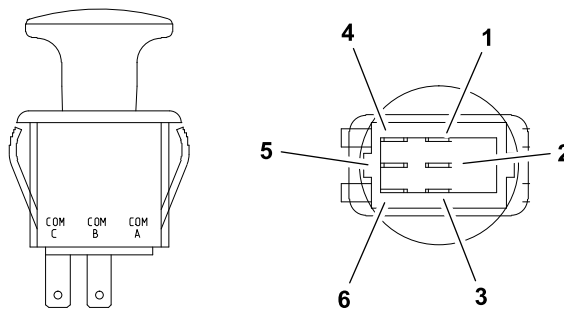
PTO Switch



g226809

Figure 133

1. PTO switch 2. Control panel 3. Thumb screw (4 each)
-



g227536

Figure 134

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

The PTO switch is located on the control panel ([Figure 133](#)). Pull up the PTO switch to engage the PTO electric clutch.

The Standard Control Module (SCM) 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 SCM controls the energizing of the electric PTO clutch and thus, the PTO. If the key switch is in the ON position and the PTO switch is engaged, the SCM PTO switch input LED should be illuminated.

IMPORTANT

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

Testing the PTO Switch

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 SCM input; refer to [Standard Control Module \(SCM\) \(page 6–3\)](#).
3. If the SCM verifies that the PTO switch and circuit wiring are functioning correctly, no further switch testing is necessary.
4. If the SCM determines that the PTO switch and circuit wiring are not functioning correctly, then test the PTO switch as follows:
 - A. Remove the 4 thumb screws (item 3 in [Figure 133](#)) that secure the control panel to the fuel tank.
 - B. Ensure that the key switch is in the OFF position. Disconnect the wire harness connector from the PTO switch.
 - C. The PTO switch terminals are identified in [Figure 134](#) and the circuitry of the PTO switch is shown in the [Circuit Logic Table \(page 6–33\)](#). With the use of a multimeter (ohms setting), test the switch functions to determine if the continuity exists between the various terminals for each switch position. Check the continuity between the switch terminals.

Circuit Logic Table

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

- D. Replace the PTO switch if testing determines that the switch is damaged.
- E. 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 \(page A–1\)](#).
- F. After you complete the testing, connect the machine wire harness connector to the PTO switch.
- G. Secure the control panel to the machine with the 4 thumb screws.

Deck Lift Switch (Machine Serial Numbers above 311000000)

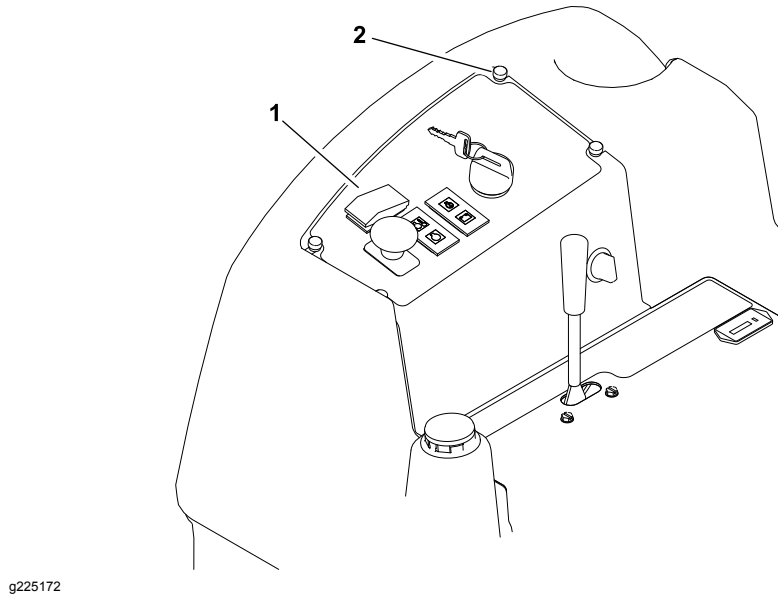


Figure 135

1. Deck lift switch
2. Thumb screw (4 each)

The deck lift/lower switch is used to raise and lower the cutting deck on later machines. The switch is located on the control panel (Figure 135).

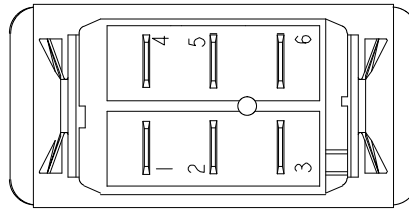
The engine must be running to allow the cutting deck to be raised or lowered. When the front of the lift switch is pressed, the deck will lower fully. When the rear of the lift switch is pressed and held, the deck will raise. When raising the deck, the deck will remain in position if the switch is released.

When the rear of the lift/lower switch is pressed, both of the solenoid valve coils (SV1 and SV2) on the hydraulic lift control valve are energized causing the valves to shift and the lift cylinder to extend to raise the cutting deck. When the front of the lift/lower switch is pressed, solenoid valve coil (SV2) on the hydraulic lift control valve is energized causing the valve to shift and the lift cylinder to retract to lower the cutting deck.

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. Ensure that the key switch is in the OFF position and the key is removed from the key switch.
3. Remove the 4 thumb screws (item 2 in Figure 135) that secure the control panel to the fuel tank.
4. Locate the deck lift switch and disconnect the wire harness connector from the switch.

Testing the Deck Lift Switch (continued)



BACK OF SWITCH

g223017

Figure 136

5. The deck lift switch terminals are identified in [Figure 136](#) and the circuitry of the switch is shown in the [Circuit Logic Table \(page 6–35\)](#). 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.

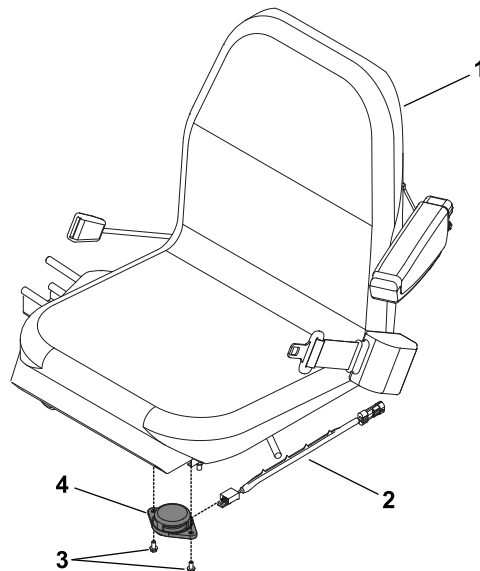
Circuit Logic Table

Switch Position	Normal Circuits	Other Circuits
RAISE	2+1	5+4
OFF	None	None
LOWER	2+3	5+6

Note: The deck lift switch terminals 4, 5, and 6 are not used.

6. Replace the deck lift switch if testing determines that the switch is damaged.
7. 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 \(page A–1\)](#).
8. After you complete the testing, connect the wire harness connector to the deck lift switch.
9. Secure the control panel to the machine with the 4 thumb screws.

Seat Switch



g190803

Figure 137

- | | |
|-------------------------|-------------------------------|
| 1. Seat | 3. Washer-head screw (2 each) |
| 2. Machine wire harness | 4. Seat switch |

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, the engine shuts off. The seat switch and its electrical connector are located directly under the seat (Figure 137). Testing of the switch can be done without seat removal by disconnecting the seat wire from the machine wire harness.

The Standard Control Module (SCM) monitors the operation of the seat switch. If the key switch is in the ON position and the seat is occupied, the SCM in seat input LED should be illuminated.

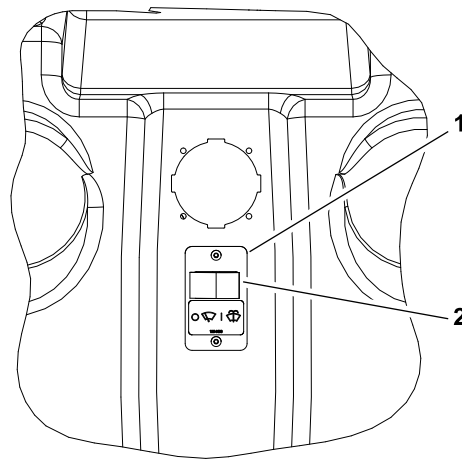
Testing the Seat Switch

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 SCM input; refer to [Standard Control Module \(SCM\)](#) (page 6–3).
3. If the SCM verifies that the seat switch and circuit wiring are functioning correctly, proceed with the test.
4. If the SCM determines that the seat switch and circuit wiring are not functioning correctly, then test the seat switch as follows:
5. Ensure that the key switch is in the OFF position. Locate the switch for testing.
6. Disconnect the machine wire harness electrical connector from the seat switch (Figure 137).
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.

Testing the Seat Switch (continued)

8. Replace the seat switch if testing determines that the switch is damaged.
9. If the seat switch testing is correct and the circuit problem still exists, check the machine wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in [Appendix A \(page A-1\)](#).
10. After you complete the seat switch testing, connect the machine wire harness connector to the seat switch. Check the operation of the seat switch.

Windshield Washer/Wiper Switch (Machines with Operator Cab)



g243779

Figure 138

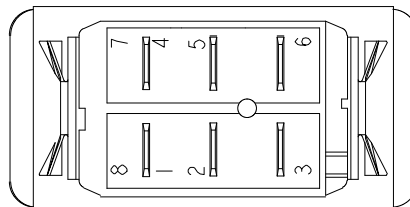
Center roof switch installation view

1. Switch panel
2. Washer/wiper switch

The windshield washer/wiper switch controls the operation of the windshield wiper and washer pump. The switch is located in the cab headliner ([Figure 138](#)).

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 from the top of the cab; refer to [Roof Assembly \(page 11–3\)](#).
3. Remove the left or right defrost vent hose from the mixing box to access the flange nuts that secure 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.



g243424

Figure 139

Back of Switch

5. The windshield wiper/washer switch terminals are identified in [Figure 139](#) and the circuitry of the switch is shown in the [Circuit Logic Table \(page 6–39\)](#). 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.

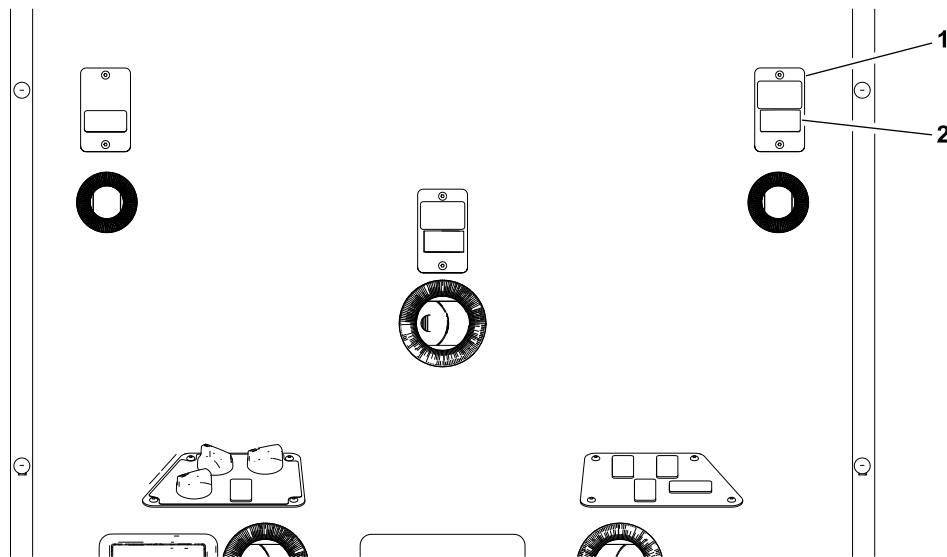
Testing the Windshield Washer/Wiper Switch (continued)

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 \(page A-1\)](#).
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 \(page 11-3\)](#).

Accessory Power Switch (Machines with Operator Cab)



g243784

Figure 140

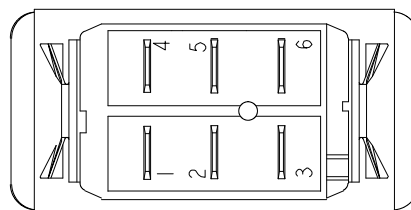
1. Switch panel

2. Accessory power switch

The accessory power switch controls the power supply to the accessory power outlet. The switch is located in the cab headliner ([Figure 140](#)).

Testing the Accessory Power 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 accessory power switch, remove the roof from the top of the cab; refer to [Roof Assembly \(page 11–3\)](#).
3. Remove the switch panel from the cab headliner.
4. Disconnect the wire harness electrical connector from the accessory power switch.



g243573

Figure 141
Back of Switch

5. The accessory power switch terminals are identified in [Figure 141](#) and the circuitry of the switch is shown in the [Circuit Logic Table \(page 6–41\)](#). 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 Accessory Power Switch (continued)

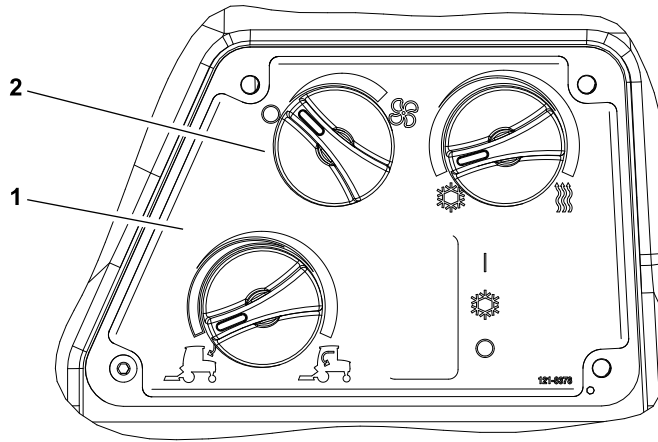
Circuit Logic Table

Switch Position	Normal Circuits	Other Circuits
DECREASE	2+1	5+4
OFF	None	None
INCREASE	2+3	5+6

Note: The accessory power switch terminals 4, 5, and 6 are not used on the Groundsmaster 3280-D machines.

6. Replace the accessory power switch if testing determines that the switch is damaged.
7. If the accessory power switch testing is correct and a circuit problem still exists, check the wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in [Appendix A \(page A-1\)](#).
8. After you complete the testing, connect the wire harness connector to the accessory power switch.
9. Secure the switch panel to the cab headliner with the removed fasteners.
10. Install the cab roof; refer to [Roof Assembly \(page 11-3\)](#).

Fan Speed Switch (Machines with Operator Cab)



g243778

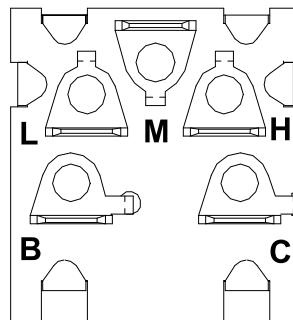
Figure 142

1. Cab headliner (air/heat panel)
2. Fan speed switch

The fan speed switch is located in the cab headliner ([Figure 142](#)). The switch is used to select the 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 from the top of the cab; refer to [Roof Assembly \(page 11–3\)](#).
3. Remove the air/heat panel from the cab headliner.
4. Disconnect the machine wire harness connector from the fan speed switch.



g242792

Figure 143
Back of Switch

5. The switch terminals are identified in [Figure 143](#) and the circuitry of the switch is shown in the [Circuit Logic Table \(page 6–43\)](#). 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.

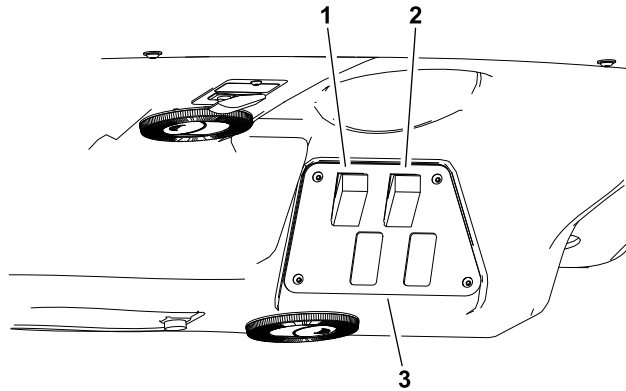
Testing the Fan Speed Switch (continued)

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 harness; refer to the Electrical Schematics and Wire Harness Drawings and Diagrams in [Appendix A \(page A-1\)](#).
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 \(page 11-3\)](#).

Work Light Switch (Machines with Operator Cab–Optional)



g243426

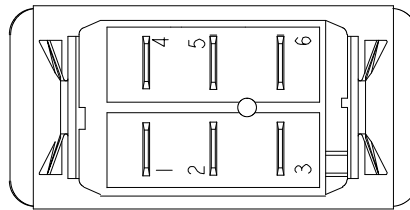
Figure 144

1. Work light switch (optional)
2. Beacon switch (optional)
3. Cab headliner (lights switch panel)

The switches are located in the cab headliner (Figure 144). 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 from the top of the cab; refer to [Roof Assembly \(page 11–3\)](#).
3. Remove the lights switch panel from the cab headliner.
4. Disconnect the machine wire harness connector from the switch that you are testing.



g243573

Figure 145
Back of Switch

5. The switch terminals are identified in Figure 145 and the circuitry of the switch is shown in the [Circuit Logic Table \(page 6–44\)](#). 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

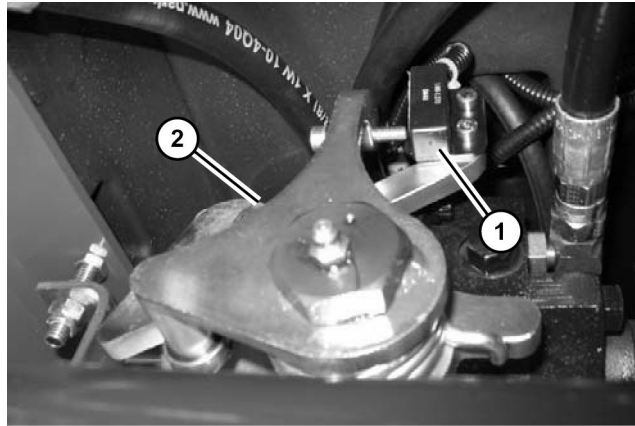
Switch Position	Closed Circuits	Open Circuits
OFF	2+1 and 5+4	2+3 and 5+6
ON	2+3 and 5+6	2+1 and 5+4

6. Replace the switch if testing determines that the switch is damaged.

Testing the Work Light Switch (continued)

7. If the switch testing is correct and a circuit problem still exists, check the wire harnesses; refer to the Electrical Schematics and Wire Harness Drawings and Diagrams in [Appendix A \(page A-1\)](#).
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 \(page 11-3\)](#).

Traction Neutral Switch (Machine Serial Numbers below 316000000)



g231017

Figure 146

1. Traction neutral switch
2. Neutral return arm

The traction neutral switch is a normally open proximity switch that closes when the traction pedal is in the neutral position. A socket-head screw threaded into the hydrostat neutral return arm acts as the sensing plate for the switch (Figure 146).

The Standard Control Module monitors the operation of the traction neutral switch. If the key switch is in the ON position and the traction pedal is in the neutral position, the SCM neutral input LED should be illuminated.

Testing the Traction Neutral Switch

1. Park machine on a level surface, lower cutting deck (or implement), shut off the engine, engage parking brake, and remove key from the key switch.
2. Disconnect the electrical connector from the traction neutral switch.
3. Check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.
4. With the key switch in the OFF position, slowly push the traction pedal in the forward and reverse direction while watching the multimeter. Continuity should be broken in both the forward and reverse directions.
5. Allow the traction pedal to return to the neutral position. There should be continuity across the terminals.
6. Connect electrical connector to the traction neutral switch.

Adjusting the Traction Neutral Switch

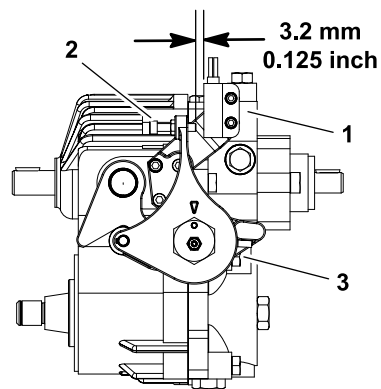
1. Before adjusting the traction neutral switch, check and adjust traction system neutral position; refer to the *Traction Unit Operator's Manual*.

IMPORTANT

To prevent traction neutral switch damage, ensure that end of socket-head screw does not contact switch.

2. Loosen jam nut on socket-head screw.

Adjusting the Traction Neutral Switch (continued)



g230994

Figure 147

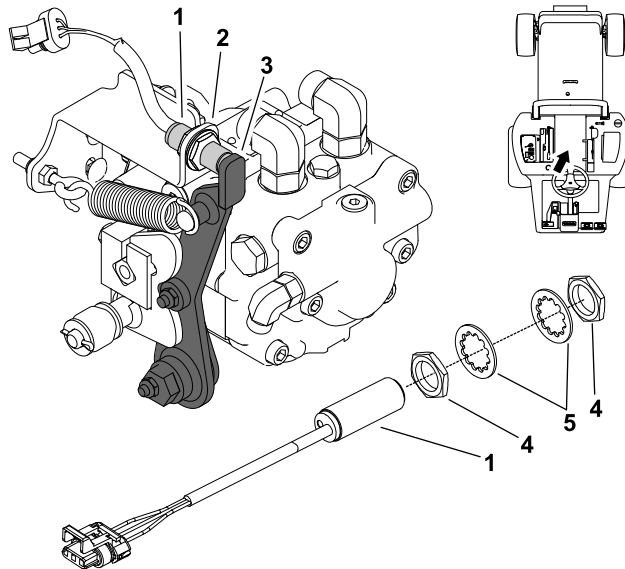
1. Traction neutral switch 2. Socket-head screw 3. Neutral return arm
-

3. Rotate socket-head screw so that the clearance between end of the socket-head screw and neutral switch is 3.2 mm (0.125 inch) ([Figure 147](#)).



4. Torque jam nut to **8 to 10 N·m (71 to 89 in-lb)** to secure adjustment. After jam nut is tightened, ensure that the clearance between the socket-head screw and the traction neutral switch has not changed.
5. Check for proper switch operation; refer to [Testing the Traction Neutral Switch](#) (page 6–46).

Traction Neutral Sensor (Machine Serial Number above 316000000)



g226812

Figure 148

- | | | |
|----------------------------|---------------------|-------------------------|
| 1. Traction neutral sensor | 3. Neutral arm | 5. Lock washer (2 each) |
| 2. Sensor bracket | 4. Jam nut (2 each) | |

The traction neutral sensor is a normally open proximity switch that closes when the traction pedal is in the neutral position. The sensor is located under the seat and mounts to a sensor bracket over the hydraulic pump (Figure 148). The sensing plate for the traction neutral sensor is the neutral arm.

The Standard Control Module monitors the operation of the traction neutral sensor. If the key switch is in the ON position and the traction pedal is in the neutral position, the SCM neutral input LED should be illuminated.

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 traction neutral sensor for testing, ensure that you test the sensor and its circuit wiring as a SCM input; refer to [Standard Control Module \(SCM\) \(page 6–3\)](#).
3. If the SCM verifies that the sensor and circuit wiring are functioning correctly, then no more switch testing is necessary.
4. If the SCM determines that the traction neutral sensor and circuit wiring are not functioning correctly, proceed with the test.
5. Raise the operator seat and remove the seat plate.
6. Locate the traction neutral sensor.
7. Turn the key switch to the RUN position (do not start the engine) and check the LED on the cable end of the traction neutral sensor. The LED should be illuminated when the traction pedal is in the neutral position.
8. With the key switch is still in the RUN position (do not start the engine), press the traction pedal either forward or reverse and check the LED on the cable end of the traction neutral sensor. The LED should not be illuminated when the traction pedal is pressed.

Testing the Traction Neutral Sensor (continued)

9. If the traction neutral sensor LED did not function correctly, do the following:
 - A. Ensure that the traction neutral sensor is correctly adjusted; refer to adjusting the traction neutral sensor.
 - B. Ensure that the key switch is in the OFF position and disconnect the traction neutral 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 traction neutral sensor. Adjust the sensor after installation; refer to [Adjusting the Traction Neutral Sensor \(page 6–17\)](#).
10. After you complete the brake sensor testing, ensure that the sensor connector is plugged into the machine wire harness.
11. Install the seat plate and lower the operator seat.

Parking Brake Switch

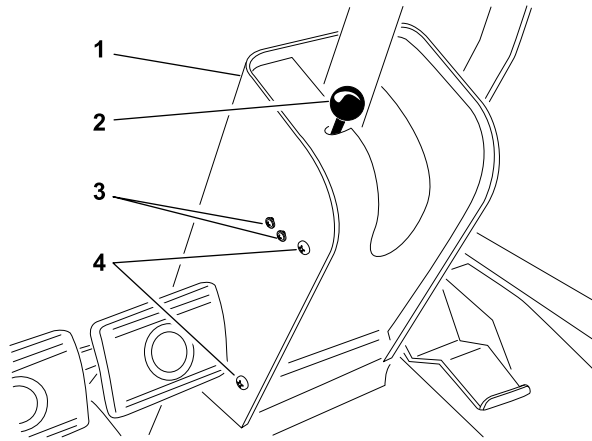


Figure 149

- | | |
|-------------------------|---------------------------------|
| 1. Steering tower cover | 3. Phillips-head screw (2 each) |
| 2. Parking brake knob | 4. Phillips-head screw (6 each) |

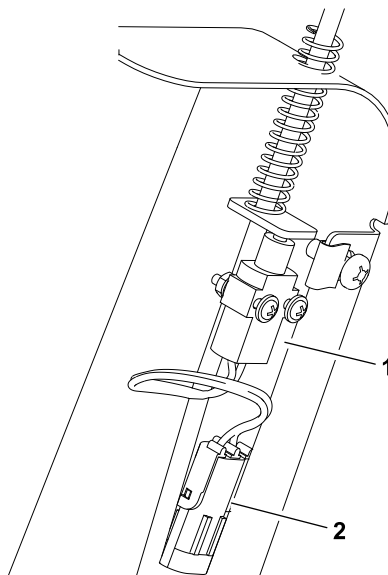


Figure 150

- | | |
|-------------------------|--------------|
| 1. Parking brake switch | 2. Connector |
|-------------------------|--------------|

The switch used for the parking brake is a normally open switch. The switch closes when the parking brake is not set. The parking brake switch is located under the steering tower cover ([Figure 149](#)).

The Standard Control Module (SCM) monitors the operation of the parking brake switch. If the key switch is in the ON position and the parking brake is released, the SCM parking brake off input LED should be illuminated.

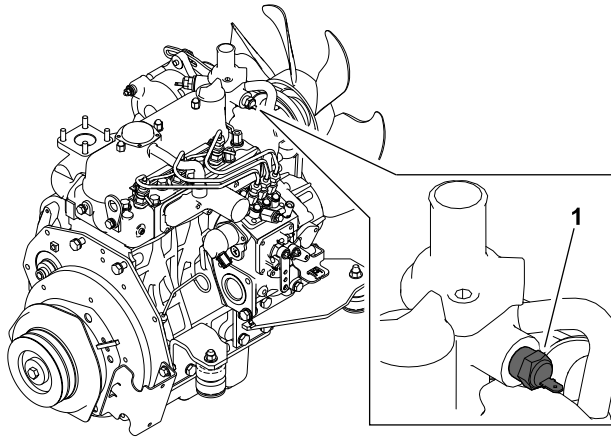
Testing the Parking Brake Switch

1. Park the machine on a level surface, lower the cutting deck, and shut off the engine.
2. Before you disconnect the traction neutral sensor for testing, ensure that you test the sensor and its circuit wiring as a SCM input; refer to the [Standard Control Module \(SCM\)](#) (page 6–3).

Testing the Parking Brake Switch (continued)

3. If the SCM verifies that the sensor and circuit wiring are functioning correctly, then no more switch testing is necessary.
4. If the SCM determines that the parking brake switch and circuit wiring are not functioning correctly, proceed with the test.
5. Remove the knob from the parking brake rod and the screws from the steering tower cover ([Figure 149](#)).
6. Slide the steering tower cover up the steering column.
7. Locate the parking brake switch ([Figure 150](#)).
Note: Ensure that the parking brake is not set.
8. Disconnect the switch connector from the machine wire harness.
9. Connect a multimeter (ohms setting) across the switch connector terminals to check the continuity of the switch as follows:
 - A. When the switch plunger is extended, there should not be continuity between the switch terminals.
 - B. When the switch plunger is pressed, there should be continuity between the switch terminals.
10. Replace the switch if testing determines that the switch is damaged.
11. If the parking brake switch testing is correct and a circuit problem still exists, check the main wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in [Appendix A \(page A-1\)](#).
12. After you complete the parking brake switch testing, connect the switch connector to the machine wire harness.
13. Install the steering tower cover and parking brake knob.

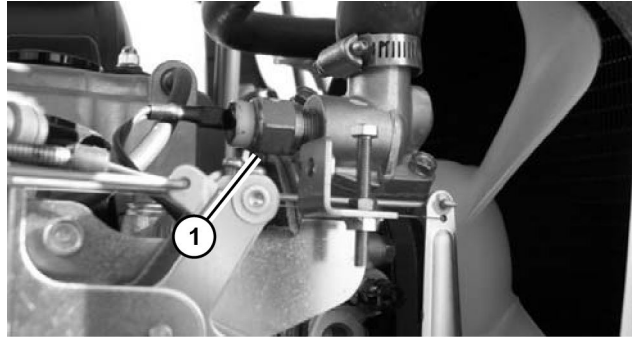
High Temperature Warning Switch



g227147

Figure 151

1. High temperature warning switch (diesel engine)



g230991

Figure 152

1. High temperature warning switch (gasoline engine)

The high temperature warning switch ([Figure 151](#) and [Figure 152](#)) is attached to the water pump housing on the engine and has a yellow wire attached to it. This switch is normally open and closes when the engine coolant temperature reaches approximately 105°C (220°F). The closed switch causes the high temperature warning light on the console to illuminate and also provides an input to the Standard Control Module (SCM).

This input causes the SCM high temperature warning LED to illuminate and the cutting deck to shut down. The high temperature warning switch and circuit wiring should be tested as a SCM input before performing the following testing procedure.

Testing the High Temperature Warning Switch

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.

Testing the High Temperature Warning Switch (continued)

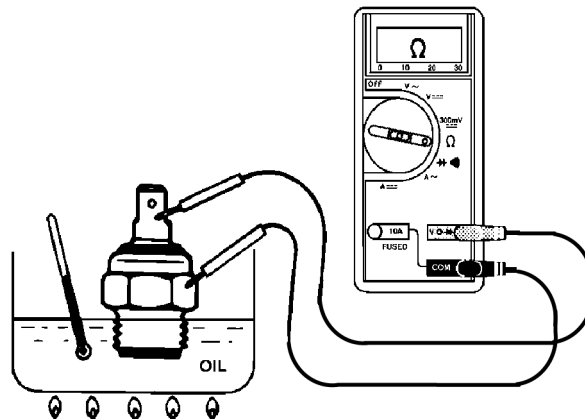


DANGER

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

Do not open the radiator cap or drain the radiator when the coolant is hot. Ensure that the engine is cool before removing the high temperature warning switch from the engine.

3. Lower the coolant level in the engine.
4. Remove the wire harness connector from the high temperature warning switch, and remove the switch from the engine.



g226814

Figure 153

5. Put the end of the switch in a container of oil with a thermometer and then slowly heat the oil (Figure 153).



CAUTION


The oil is hot and could cause personal injury or fire.

Handle the hot oil with extreme care.

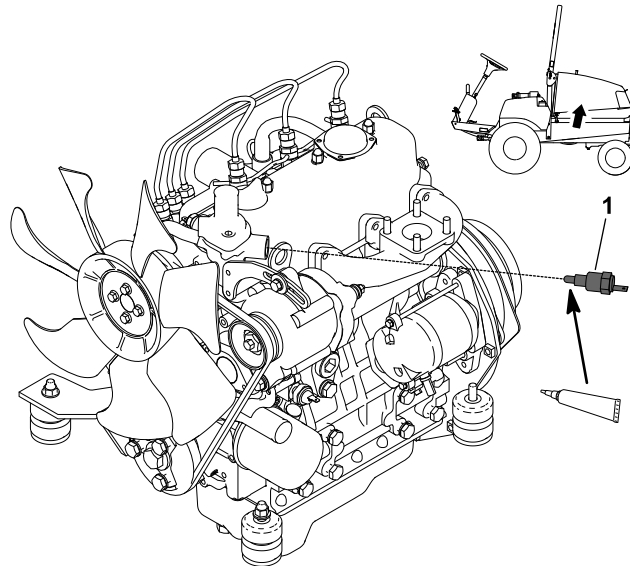
Note: Before taking the small resistance readings with a digital multimeter, short the multimeter test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is because of the internal resistance of the multimeter and test leads. Subtract this value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

6. Check the resistance of the switch with a multimeter (ohms setting) as the oil temperature increases.
 - A. The meter should indicate more than 600 ohms at 21°C (70°F).
 - B. The meter should indicate approximately 460 ohms at 38°C (100°F).
 - C. The meter should indicate from 54 to 78 ohms at 93°C (200°F).
7. If the switch does not meet the specifications, replace the switch.

Testing the High Temperature Warning Switch (continued)

8. After you complete the testing, install the temperature switch to the engine housing, do the following steps:
 - A. Clean the threads of the housing and switch. Apply thread sealant to the threads of the switch.
 -  B. Thread the switch into the housing; torque the switch to **29.4 to 39.2 N·m (22 to 28 ft-lb)**.
 - C. Connect the harness wires to the temperature switch.
9. Fill the engine cooling system; refer to the *Traction Unit Operator's Manual*.
10. Lower the hood and secure it with the latches.

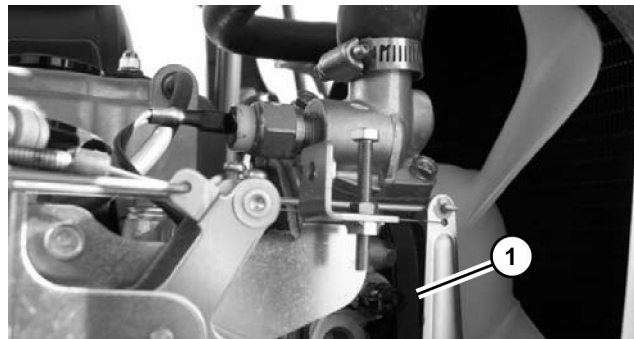
High Temperature Shutdown Switch



g226811

Figure 154

1. High temperature shutdown switch (diesel engine)



g230992

Figure 155

1. High temperature shutdown switch (gasoline engine)

The high temperature shutdown switch ([Figure 154](#) or [Figure 155](#)) is attached to the water pump housing on the engine and has a blue/white wire attached to it. This switch is normally open and closes when engine coolant temperature reaches approximately 115°C (240°F). The closed switch provides an input to the Standard Control Module (SCM).

This input causes the SCM high temperature shutdown LED to illuminate and the cutting deck to shut down. The high temperature shutdown switch and circuit wiring should be tested as a SCM input before performing the following testing procedure.

Testing the High Temperature Shutdown Switch

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.

Testing the High Temperature Shutdown Switch (continued)



DANGER

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

Do not open the radiator cap or drain the radiator when the coolant is hot. Ensure that the engine is cool before removing the high temperature shutdown switch from the engine.

3. Lower the coolant level in the engine.
4. Remove the wire harness connector from the high temperature shutdown switch, and remove the switch from the engine.

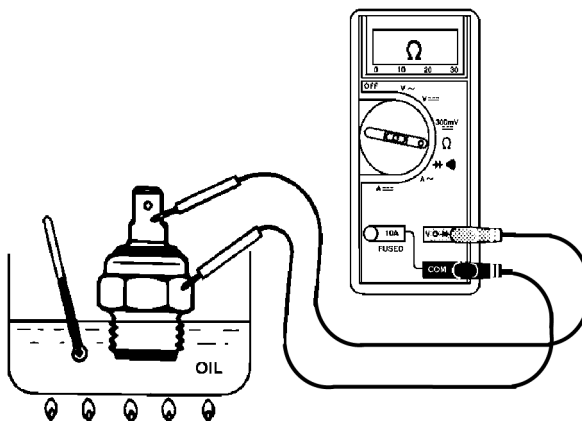


Figure 156

5. Put the end of the switch in a container of oil with a thermometer and then slowly heat the oil (Figure 156).



CAUTION



The oil is hot and could cause personal injury or fire.
Handle the hot oil with extreme care.

6. Check the resistance of the switch with a multimeter (ohms setting) as the oil temperature increases. The high-temperature shutdown switch is normally open.
 - A. On the Groundsmaster 3280-D (diesel engine), the high temperature shutdown switch should close between 107° and 113°C (225° and 235°F).
 - B. On the Groundsmaster 3320 (gasoline engine), the high temperature shutdown switch should close at approximately 114°C (238°F).
7. Allow oil to cool while observing temperature.
 - A. On the Groundsmaster 3280-D (diesel engine), the high temperature shutdown switch should open at approximately 104°C (219°F).
 - B. On the Groundsmaster 3320 (gasoline engine), the high temperature shutdown switch should open at approximately 111°C (232°F).
8. If the switch does not meet the specifications, replace the switch.

Testing the High Temperature Shutdown Switch (continued)

9. After you complete the testing, install the temperature switch to the engine housing, do the following steps:

A. Clean the threads of the housing and switch. Apply thread sealant to the threads of the switch.



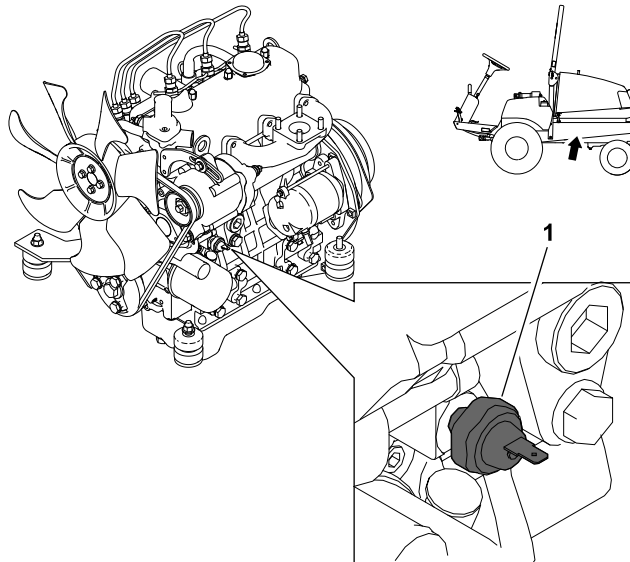
B. Thread the switch into the housing; torque the switch to **29.4 to 39.2 N·m (22 to 28 ft-lb)**.

C. Connect the harness wires to the temperature switch.

10. Fill the engine cooling system; refer to the *Traction Unit Operator's Manual*.

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

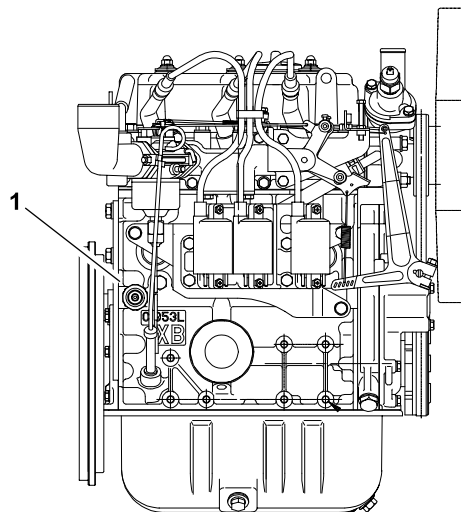
Engine Oil Pressure Switch



g226807

Figure 157

1. Oil pressure switch (diesel engine)
-



g230993

Figure 158

1. Oil pressure switch (gasoline engine)
-

The engine oil pressure switch is located on the engine near the oil filter ([Figure 157](#) or [Figure 158](#)). The oil pressure switch is a normally closed switch that opens with oil pressure.

On the Groundsmaster 3280-D (diesel engine), the oil pressure switch should open at approximately 55 kPa (8 psi).

On the Groundsmaster 3320 (gasoline engine), the oil pressure switch should open between 20 to 39 kPa (2.9 to 5.7 psi).

The oil pressure switch is connected to the oil pressure indicator light on the control panel. If the switch opens while the engine is running (indicating low oil pressure) the indicator light on the control panel illuminates.

IMPORTANT

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

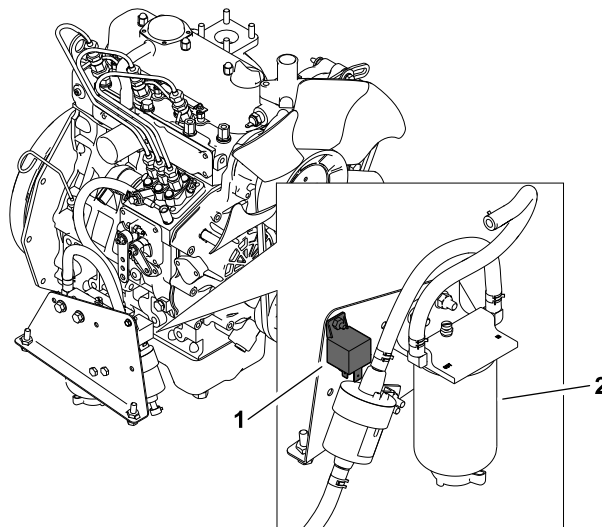
Testing the Engine Oil Pressure Switch

Note: Refer to engine service manual for information regarding engine lubrication system and testing.

1. Park the machine on a level surface, lower the cutting deck, set the parking brake, and shut off the engine.
2. Turn the key switch to the ON position. The oil pressure indicator light on the control panel should be illuminated.
3. If the indicator light is not illuminated:
 - A. Unlatch the hood and raise it.
 - B. Locate the engine oil pressure switch on the engine and disconnect the wire harness connector from the switch.
 - C. Connect a multimeter (ohms setting) across the switch harness connector terminals to check the continuity of the switch:
 - D. With the engine shut off, there should be no continuity between the switch harness terminals.
 - E. With the engine running, there should be continuity between the switch harness terminals.
4. If the testing determines that the oil pressure switch is not operating correctly, check the pressure switch and/or pressure switch harness for continuity. Repair or replace the components as necessary.
5. If the switch testing is correct and the circuit problem still exists, check the machine wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in [Appendix A \(page A-1\)](#).
6. After you complete the oil pressure switch testing, connect the wire harness connector to the oil pressure switch.
7. Lower the hood and secure it with the latches.

Relays (Groundsmaster 3280-D)

The Groundsmaster 3280-D machine uses 3 identical electrical relays that have 4 terminals. A tag near the wire harness relay connector can be used to identify each relay.

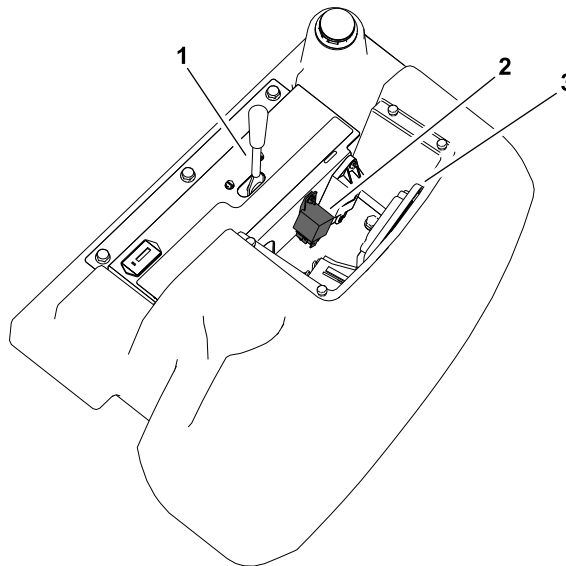


g225179

Figure 159

1. Glow relay
2. Fuel/water separator

The glow relay used is attached to the support bracket inside the right side frame near the fuel/water separator (Figure 159). When energized, the glow relay allows electrical current to the engine glow plugs.

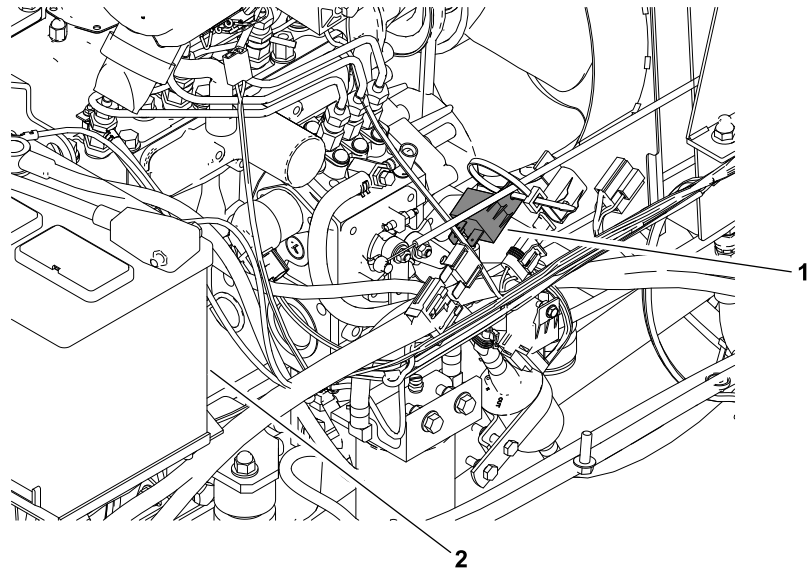


g225178

Figure 160

1. Throttle control lever
2. Accessory relay (if equipped)
3. SCM

The accessory relay (if equipped) is located under the control console near the SCM (Figure 160). When energized, the accessory relay allows electrical current to optional accessories.



g244180

Figure 161

1. Cab power relay
2. Battery

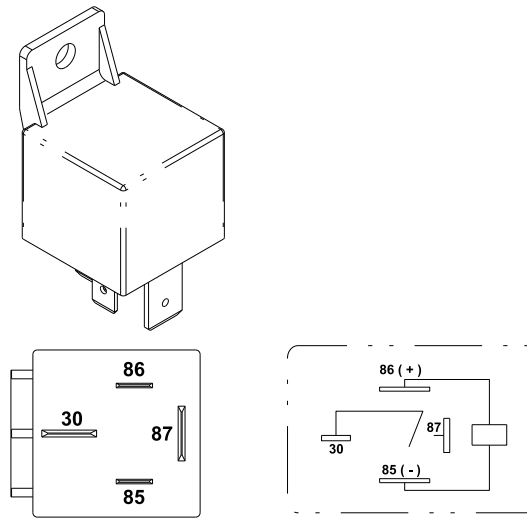
The cab power relay (on the machines with operator cab) is attached near the battery ([Figure 161](#)). The cab power relay is used to provide current to the operator cab electrical circuits.

Testing the Relays

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. To get access to the glow relay, remove the control panel. To get access to the accessory relay or cab power relay, open the hood.
3. To ensure that the machine operation does not occur unexpectedly, disconnect the negative (-) cable from the battery and then disconnect the positive (+) cable from the battery; refer to [Servicing the Battery \(page 6–81\)](#).
4. Locate the relay that is to be tested and disconnect the wire harness connectors from the relay.

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

Testing the Relays (continued)

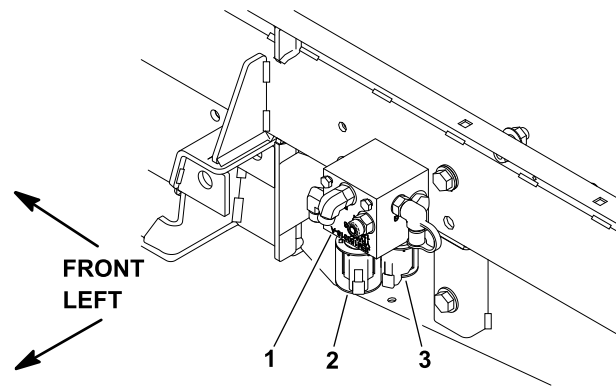


g214499

Figure 162

5. Check the coil resistance between terminals the 85 and 86 with a multimeter (ohms setting). The resistance should be approximately 72 ohms ([Figure 162](#)).
6. Connect the multimeter (ohms setting) leads to relay terminals 30 and 87. The ground terminal 85 and apply +12 VDC to terminal 86. The relay should make and break continuity between the terminals 30 and 87 as +12 VDC is applied and removed from terminal 86.
7. Disconnect the voltage and leads from the relay terminals.
8. Replace the relay if testing determines that the relay is damaged.
9. If the relay testing is correct and a circuit problem still exists, check the main wire harness; refer to the Electrical Schematics and Wire Harness Drawings/Diagrams in [Appendix A \(page A-1\)](#).
10. Connect the wire harness electrical connectors to the relay after you complete the testing.
11. Connect the positive (+) cable to the battery and then connect the negative (-) cable to the battery; refer to [Servicing the Battery \(page 6-81\)](#).
12. Install the control panel if the glow relay was accessed. Lower and secure the hood if the accessory relay or cab power relay was accessed.

Lift Control Valve Solenoid Valve Coil (Machine Serial Number above 311000000)



g227680

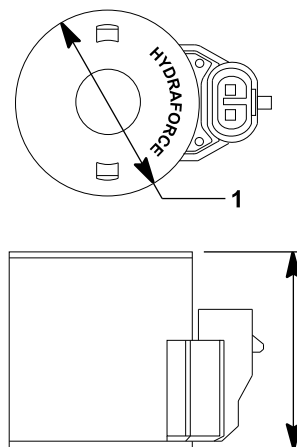
Figure 163

1. Lift control valve
2. SV2 solenoid
3. SV1 solenoid

The hydraulic lift control valve is located on the right side of the machine, near the front right wheel (Figure 163). When the solenoid coils are energized, the valve shift occurs to control the hydraulic fluid flow. The electrical testing of the coils can be done with the coil installed on the hydraulic valve.

Testing the Lift Control Valve 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.



g227289

Figure 164

1. Coil diameter
2. Coil height

2. Identify the coil resistance specification by measuring the coil diameter and coil height (Figure 164).
3. Disconnect the wire harness electrical connector from the solenoid valve coil that is to be tested.

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.

Testing the Lift Control Valve Solenoid Valve Coil (continued)

4. Use a multimeter (ohms setting), measure the resistance between the 2 connector terminals on the solenoid valve coil. The correct resistance for the solenoid coil is identified in the [Solenoid Valve Coil Specifications Table \(page 6–64\)](#).

Solenoid Valve Coil Specifications Table

Solenoid Valve Coil	Diameter	Height	Resistance
SV1	35.8 mm (1.41 inches)	36.3 mm (1.43 inches)	8.8 ohms
SV2	46.7 mm (1.84 inches)	49.9 mm (1.96 inches)	7.1 ohms

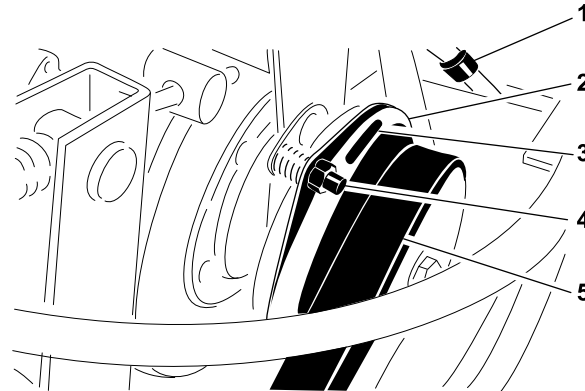
5. If the solenoid coil resistance is incorrect, replace the solenoid coil; refer to the [Lift Control Valve Solenoid Valve Coils \(Machine Serial Number above 311000000\) \(page 6–76\)](#).
6. After testing the coils, connect the wire harness electrical connector to the solenoid valve coil.

PTO Electric Clutch

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

Testing the PTO Electric Clutch

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



g227535

Figure 165

- | | | |
|-------------------------|-------------------------|-------------|
| 1. Electrical connector | 3. Access slot (3 each) | 5. PTO belt |
| 2. PTO clutch | 4. Locknut (3 each) | |

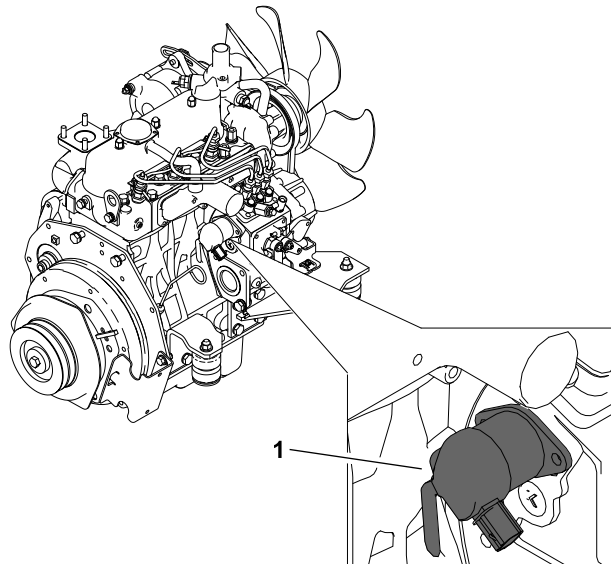
3. Locate the PTO electric clutch on the engine crankshaft ([Figure 165](#)).
4. Unplug the clutch electrical connector from the machine wire harness.

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

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

5. Use a multimeter (ohms setting), check the clutch coil resistance between the 2 terminals of the clutch electrical connector. The coil resistance should be approximately 3.0 ohms. Additionally, check that there is no continuity between either of the clutch wire connector terminals and the clutch frame.
6. Use the access slots in the clutch cover, measure the gap between the clutch rotor and the armature ([Figure 165](#)). The gap should be 0.4 mm (0.015 inch) at all the 3 access slots. If gap is incorrect, loosen or tighten the 3 locknuts evenly to achieve correct, uniform gap.
7. As an additional test, apply 12 volts to the terminals of the PTO electric clutch. The clutch should engage. If the clutch does not engage when voltage is applied, replace the PTO electric clutch.
8. If the clutch removal is necessary; refer to [PTO Electric Clutch \(page 6–78\)](#).
9. After you complete the PTO electric clutch testing, connect the clutch electrical connector to the machine wire harness.
10. Lower the hood and secure it with the latches.

Fuel Stop Solenoid (Groundsmaster 3280-D)



g225174

Figure 166

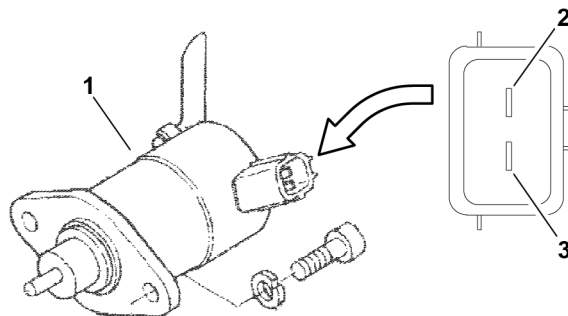
1. Fuel stop solenoid

The fuel stop solenoid used on the Groundsmaster 3280-D machine must be energized for the diesel engine to run. The solenoid is mounted to the injection pump on the engine ([Figure 166](#)).

Testing the Fuel Stop Solenoid (In Place)

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

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



g227148

Figure 167

1. Fuel stop solenoid
2. Pull coil terminal
3. Hold coil terminal

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

4. Use a digital multimeter, touch 1 test lead to the pull coil terminal and the other test lead to the fuel stop solenoid frame (ground) (Figure 167). The resistance of the pull coil should be less than 1 ohm (but not zero).
5. Use a digital multimeter, touch 1 test lead to the hold coil terminal and the other test lead to the fuel stop solenoid frame (ground) (Figure 167). The resistance of the hold coil should be approximately 15 ohms.
6. Replace the fuel stop solenoid if the testing determines that it is damaged.
7. Connect the wire harness connector to the fuel stop solenoid.
8. Lower the hood and latch it.

Testing the Fuel Stop Solenoid (Live)

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

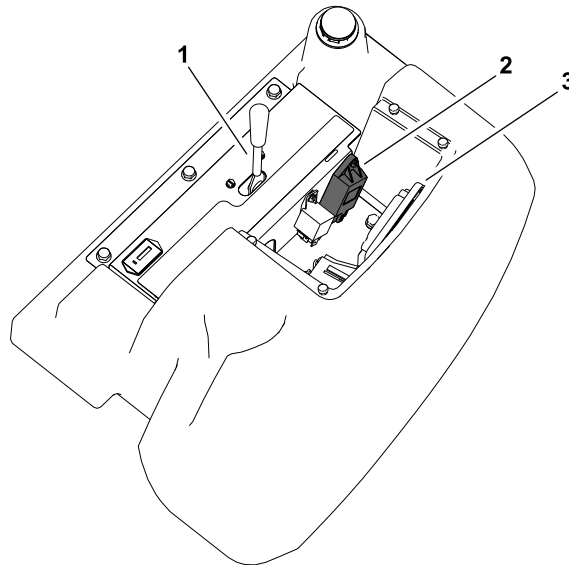
Note: The solenoid can be removed from the engine or tested in place.

4. If the solenoid is removed from the engine, ensure that the solenoid plunger moves freely and is free of dirt, unwanted material, and corrosion.

Note: When testing the run solenoid, use test leads with at least 14 gauge wire.

5. Connect a positive (+) test lead from a 12 VDC source to the pull coil and hold coil terminals.
6. Touch a negative (-) test lead from the 12 VDC source to the fuel stop solenoid frame (ground) (Figure 167). The solenoid should engage, making an audible click, and the plunger should retract.
7. Remove positive (+) voltage from the pull coil terminal. The solenoid should stay engaged.
8. Remove positive (+) voltage from the hold coil terminal. The solenoid should release.
9. Replace the fuel stop solenoid if the testing determines that it is damaged.
10. Connect the wire harness connector to the fuel stop solenoid.
11. Lower the hood and latch it.

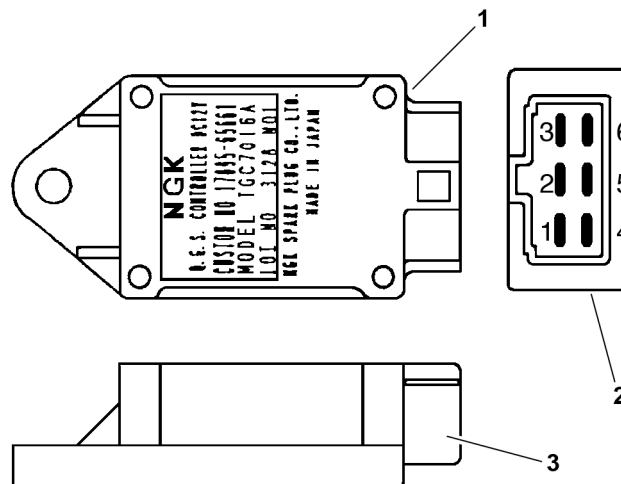
Glow Controller (Groundsmaster 3280-D)



g227149

Figure 168

1. Throttle control lever 2. Glow controller 3. SCM



g227537

Figure 169

1. Top view 2. Glow controller end view 3. Slide view

The glow controller used on the Groundsmaster 3280-D machine is located under the control panel (Figure 168).

Note: Refer to the Electrical Schematics in [Appendix A \(page A-1\)](#) when troubleshooting the glow controller circuit.

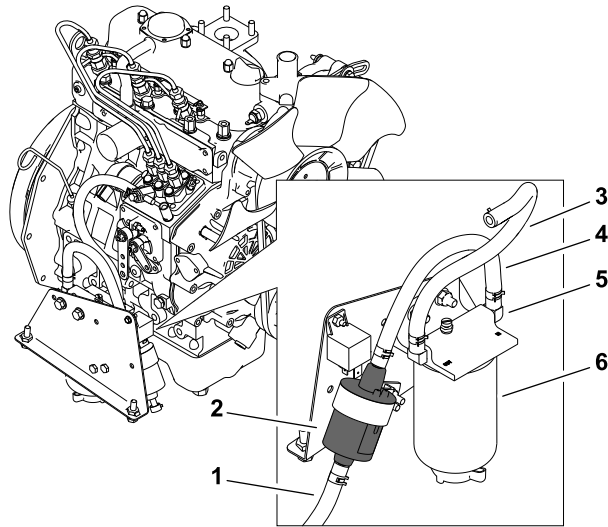
Controller Operation

1. When the key switch is turned to the RUN position, the controller energizes the glow plugs and lights up the glow lamp for approximately 6 seconds.
2. When the key switch is held in the START position, the glow plugs will energize while the switch is held in START and the glow lamp will not light.
3. When the key switch is released from START to RUN, the glow plugs will de-energize and the glow lamp will remain off.

Controller Checks

1. Ensure that there is power from the battery.
2. Disconnect the electrical connector to the fuel stop solenoid to prevent the engine from starting.
3. Turn the key switch to the RUN position. Check the following while in the RUN position:
 - A. Glow indicator lamp is on.
 - B. Glow relay is energized.
 - C. Glow plugs are energized.
 - D. Glow indicator lamp goes out and glow plugs de-energize after approximately 6 seconds.
4. Turn the key switch to the START position. Check the following while in the START position:
 - A. Glow indicator lamp is out.
 - B. Glow relay is energized.
 - C. Glow plugs are energized.
 - D. Power exists at terminal 1 of the glow controller.
Note: If there is no power to terminal 1 of the glow controller, check the continuity of the circuitry from the key switch to the glow controller and perform step 4 again; refer to the Electrical Schematics in [Appendix A \(page A-1\)](#).
5. If any of the conditions in step 3 are not met or power to terminal 1 exists and any of the other conditions in step 4 are not met:
 - A. Check the continuity of the circuitry from the battery to the glow relay and glow plugs; refer to the Electrical Schematics in [Appendix A \(page A-1\)](#).
 - B. Check the continuity of the circuitry from the battery to key switch, glow controller, glow lamp, glow relay, and ground; refer to the Electrical Schematics in [Appendix A \(page A-1\)](#).
 - C. Replace the parts as necessary.
6. Connect the electrical connector to the fuel stop solenoid.

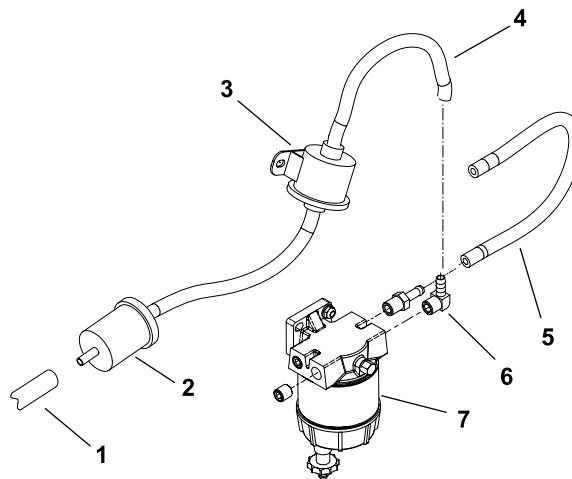
Fuel Pump (Groundsmaster 3280-D)



g225173

Figure 170

- | | | |
|--------------------------|----------------------------|-------------------------|
| 1. Fuel hose (from tank) | 3. Fuel hose (from engine) | 5. Inlet fitting |
| 2. Fuel pump | 4. Pump discharge hose | 6. Fuel/water separator |



g230997

Figure 171

- | | | |
|--------------------------|--------------------------|----------------------|
| 1. Fuel hose (from tank) | 4. Pump discharge hose | 7. Fuel/water filter |
| 2. Fuel filter | 5. Fuel hose (to engine) | |
| 3. Fuel pump | 6. Inlet fitting | |

The fuel pump used on the Groundsmaster 3280-D (for Models 30344 and 30345) is attached to the support bracket inside the right side frame near the fuel/water separator (Figure 170). The fuel pump used on the Groundsmaster 3280-D (except Models 30344 and 30345) is attached to the support bracket inside the right side frame near the fuel/water filter (Figure 171).

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

1. Park the machine on a level surface, lower the cutting deck, set the parking brake, and shut off the engine. Ensure that the key switch is in the OFF position.
2. Unlatch the hood and raise it.
3. Ensure that the fuel hoses attached to the fuel pump are free of obstructions.
4. Disconnect the fuel pump discharge hose from the inlet fitting of the fuel/water separator or filter.
5. Place the disconnected end of the pump discharge hose into a large, graduated cylinder sufficient enough to collect 0.9 L (32 fl oz).

IMPORTANT

When testing the fuel pump output, do not turn the key switch to the START position.

6. Turn the key switch to the ON position and collect the fuel in the graduated cylinder. Allow the pump to run for 15 seconds and then turn the switch to the OFF position.

Note: The amount of fuel pumped in 15 seconds must be approximately 475 ml (16 fl oz).

7. Replace the fuel pump if output specification is not met.

IMPORTANT

If the fuel pump is replaced, ensure that replacement pump is the correct pump for your Groundsmaster by using your *Parts Catalog*. If incorrect pump is used, the fuel system damage can occur.

8. Connect the fuel pump discharge hose to the fuel/water separator or filter. Ensure to secure the hose with the hose clamp.
9. Prime the fuel system; refer to [Priming the Fuel System \(page 4–16\)](#).

Fuel Pump Specifications (for Models 30344 and 30345)

Pump Capacity	1.9 L/minute (64 fl oz/minute)
Pressure	48.3 kPa (7 psi)
Maximum Current Draw	2.0 A

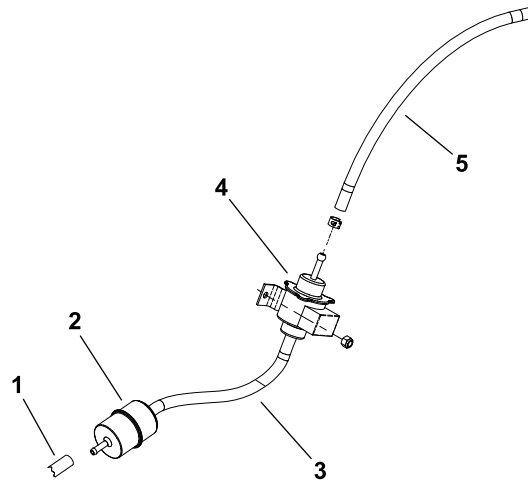
Testing the Fuel Pump Capacity (continued)

Fuel Pump Specifications (except Models 30344 and 30345)

Pump Capacity	0.7 L/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.

Fuel Pump (Groundsmaster 3320)



g230998

Figure 172

- | | | |
|--------------------------|--------------|--------------------------|
| 1. Fuel hose (from tank) | 3. Fuel hose | 5. Fuel hose (to engine) |
| 2. Fuel filter | 4. Fuel pump | |

The fuel pump used on the Groundsmaster 3320 (gasoline engine) is attached to the support bracket inside the right side frame near the fuel filter (Figure 172).

IMPORTANT

When testing fuel pump, ensure that the pump is not operated without fuel.

⚠ DANGER

Because gasoline is highly flammable, use caution when handling it. Do not smoke while testing the fuel pump. Do not test fuel pump while engine is hot. Ensure that there is adequate ventilation when testing. Always wipe up any spilled fuel before starting the engine.

Testing the Fuel Pump Capacity

1. Park machine on a level surface, lower cutting deck (or implement), shut off the engine, and engage parking brake.
 2. Disconnect fuel pump discharge hose from the carburetor inlet (Figure 172).
 3. Ensure that the fuel hoses attached to the fuel pump are free of obstructions.
 4. Place disconnected pump discharge hose into a large, graduated cylinder sufficient enough to collect 0.95 L (1 US qt).
-

IMPORTANT

When testing the fuel pump, Do not turn key switch to START.

5. Collect fuel in the graduated cylinder by turning key switch ON. Allow pump to run for 30 seconds, then release key switch to OFF.

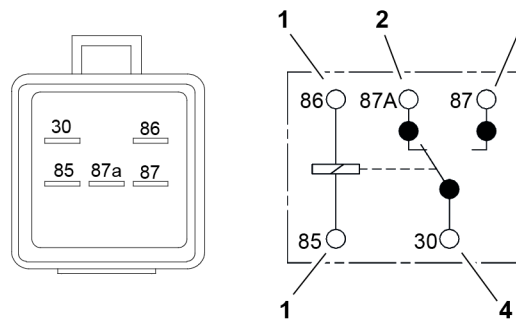
Testing the Fuel Pump Capacity (continued)

6. The amount of fuel collected in the graduated cylinder should be approximately 400 ml (13.5 fl oz) after 30 seconds.
7. Replace fuel pump if necessary. Install fuel hose to carburetor inlet.

Fuel Pump Specifications

Pump Capacity	800 ml/minute (27 fl oz/minute)
Pressure	19.6 to 29.4 kPa (2.8 to 4.3 psi)

Fuel Pump Relay (Groundsmaster 3320)



g223021

Figure 173

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

The Groundsmaster 3320 uses a relay to energize the fuel pump. The fuel pump relay is attached to the support bracket inside the right side frame near the fuel filter.

Testing the Fuel Pump Relay

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

1. Locate relay and disconnect the machine wire harness connector from the relay.
2. Using a multimeter (ohms setting), measure coil resistance between terminals 85 and 86 (Figure 173). Resistance should be between 70 and 90 ohms.
3. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87 as +12 VDC is applied and removed from terminal 85.
4. Disconnect voltage from terminal 85 and multimeter lead from terminal 87.
5. Connect multimeter (ohms setting) leads to relay terminals 30 and 87A. Apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87A as +12 VDC is applied and removed from terminal 85.
6. Disconnect voltage and multimeter leads from the relay terminals. Connect relay to machine wire harness.

Service and Repairs

Note: Refer to the Kubota Workshop Manual: 05 Series Engine (Groundsmaster 3280-D) or the Briggs and Stratton/Daihatsu Engine Repair Manual (Groundsmaster 3320) for additional component repair information.

Lift Control Valve Solenoid Valve Coils (Machine Serial Number above 311000000)

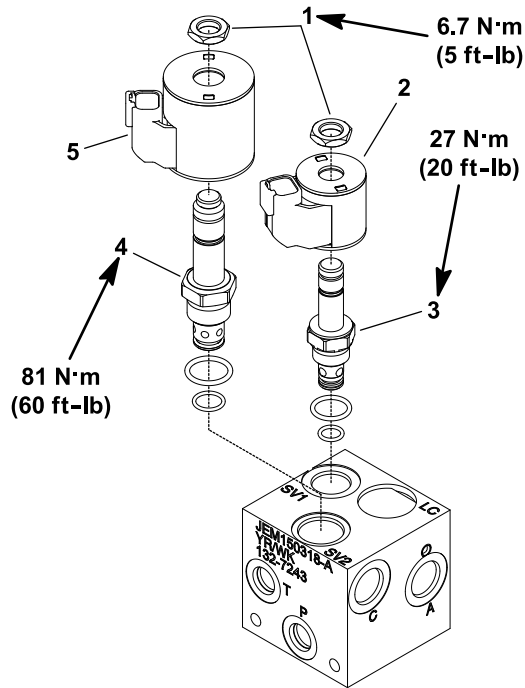


Figure 174

- | | | |
|-----------------|-------------------------|------------------|
| 1. Nut (2 each) | 3. Solenoid valve (SV1) | 5. Solenoid coil |
| 2. Coil | 4. Solenoid valve (SV2) | |

You can replace a hydraulic solenoid valve coil on the lift control valve ([Figure 174](#)) without opening the hydraulic system.

Removing the Lift Control Valve 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. Refer to [Figure 174](#) for the location of solenoid coils on the lift control valve.
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 Valve Solenoid Valve Coils

1. Slide the coil assembly onto the hydraulic valve.

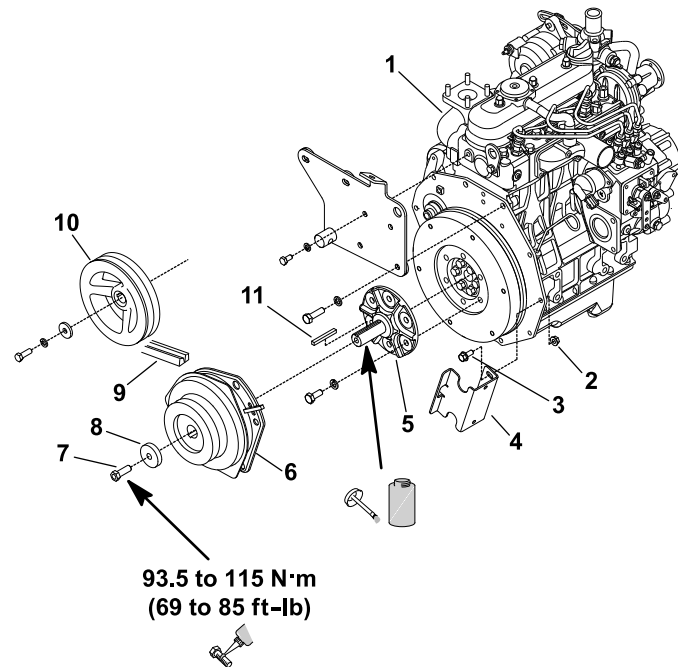


2. Install the nut onto the valve and torque the nut to **6.7 N·m (5 in-lb)**.

Note: Do not overtighten the nut.

3. Connect the machine wire harness connector to the solenoid coil.

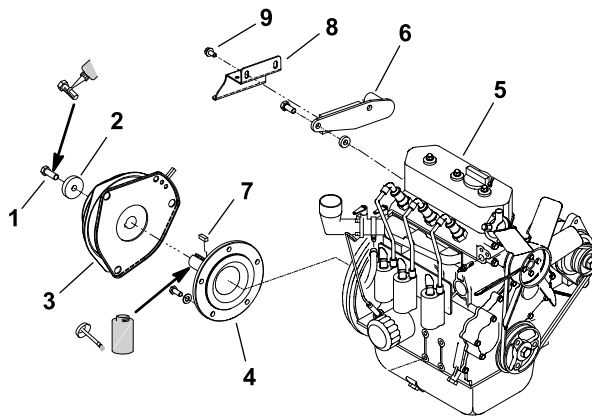
PTO Electric Clutch



g227287

Figure 175

- | | | |
|-------------------------------|--------------------|----------------------|
| 1. Kubota diesel engine | 5. Stub shaft | 9. PTO drive belt |
| 2. Flange nut (2 each) | 6. Electric clutch | 10. PTO shaft pulley |
| 3. Flange-head screw (2 each) | 7. Bolt | 11. Square key |
| 4. Clutch stop | 8. Spacer | |



g230999

Figure 176

- | | | |
|--------------------|---------------------|----------------------|
| 1. Bolt | 4. Stub shaft | 7. Square key |
| 2. Spacer | 5. Gasoline engine | 8. Clutch stop |
| 3. Electric clutch | 6. Mounting bracket | 9. Flange-head screw |

Removing the PTO Electric Clutch

1. Park machine on a level surface, lower cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.
2. Unplug the clutch connector from the machine wire harness.

Removing the PTO Electric Clutch (continued)

3. Remove the PTO belt from the clutch and PTO shaft pulley; refer to the *Traction Unit Operator's Manual*.

4. Remove the clutch stop components ([Figure 175](#) or [Figure 176](#)).

Note: Hold the coupler on the front of the engine to prevent crankshaft from turning when removing the bolt that secures the clutch to the stub shaft.

5. Remove the bolt and spacer that secure the clutch to the stub shaft.

Note: It may be necessary to lower the rear frame and axle assembly to allow clutch removal; refer to [Removing the Rear Frame and Axle Assembly \(page 7–9\)](#).

6. Slide the clutch from the stub shaft. Locate and retrieve the square key.

Installing the PTO Electric Clutch

1. Apply anti-seize lubricant to the stub shaft.

2. Position the square key in the stub shaft. Slide the clutch onto the stub shaft and ensure to engage the clutch stop.

Note: Hold the coupler on the front of the engine to prevent crankshaft from turning when installing the bolt that secures the clutch to the stub shaft.

3. Apply Loctite #242 (or equivalent) to the threads of the bolt. Secure the clutch to the stub shaft with the spacer and bolt.

4. Install the clutch stop components ([Figure 175](#)). Ensure that the clutch stop is tight against the clutch flange.

5. Check alignment between the clutch pulley and the PTO shaft pulley; refer to [Aligning the PTO Pulley to the Electric Clutch Pulley \(page 9–11\)](#).

6. Install the PTO belt to the clutch and PTO shaft pulley, and adjust PTO belt tension; refer to the *Traction Unit Operator's Manual*.

7. Connect the clutch to the machine wire harness.

Battery Storage

If you store the machine for more than 30 days:

1. Ensure that the key switch is in the OFF position. Remove the battery and charge it fully; refer to [Servicing the Battery \(page 6–81\)](#).
2. Either store the battery on a shelf or on the machine.
3. Disconnect the cables if the battery is kept on the machine.
4. Store the battery in a cool atmosphere to avoid quick deterioration of the battery charge.
5. To prevent the battery from freezing during storage, ensure that you charge it fully; refer to [Servicing the Battery \(page 6–81\)](#).

Battery Care

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



WARNING

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

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

IMPORTANT

Do not remove battery fill caps while cleaning.

2. Check the battery condition weekly or after every 50 hours of operation. Keep the terminals and entire battery case clean because a dirty battery will discharge slowly.
 - A. Clean the battery by washing entire case with a solution of baking soda and water. Flush the battery case with clear water.
 - B. Coat the battery posts and cable connectors with the battery terminal protector (refer to [Terminal Protector \(page 6–7\)](#)) or petroleum jelly to prevent corrosion.
3. Tighten the battery cables on the battery terminals to provide a good electrical contact.

Battery Care (continued)

WARNING

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

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

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

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

Servicing the Battery

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

CAUTION

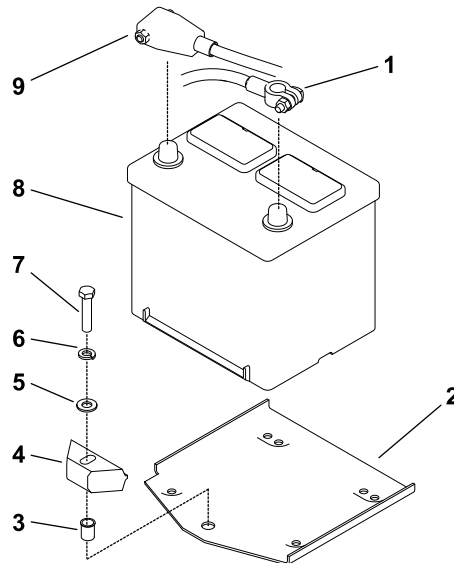
Battery-electrolyte is corrosive and can burn skin and eyes and damage clothing.

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

Battery Specifications

Battery-electrolyte specific gravity	Fully Charged: 1.250 to 1.280 Discharged: less than 1.240
Battery specifications	BCI Group Size: 26 525 CCA at -18°C (0°F) Reserve Capacity of 80 minutes at 27°C (80°F)
Battery dimensions (including terminal posts and caps)	Length 20.8 cm (8.2 inches) Width 17.3 cm (6.8 inches) Height 20.3 cm (8.0 inches)

Removing and Installing the Battery



g227290

Figure 177

- | | | |
|--------------------|---------------------|-------------------|
| 1. Negative cable | 4. Battery retainer | 7. Bolt |
| 2. Battery base | 5. Flat washer | 8. Battery |
| 3. Threaded insert | 6. Lock washer | 9. Positive cable |

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 bolt 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; refer to [Charging the Battery \(page 6–85\)](#).
2. Perform the hydrometer test of the battery-electrolyte.

IMPORTANT

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

- A. Use a hydrometer to measure the specific gravity of each cell. Pull the electrolyte in and out of the hydrometer barrel before taking a reading to warm-up the hydrometer. At the same time, take the temperature of the cell.
- B. Temperature correct each cell reading. For each 5.5°C (10°F) above 27°C (80°F) add 0.004 to the specific gravity reading. For each 5.5°C (10°F) below 27°C (80°F) subtract 0.004 from the specific gravity reading; refer to the [Cell Specific Gravity Example \(page 6–83\)](#).

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

Inspecting, Maintaining, and Testing the Battery (continued)

- C. If the difference between the highest and lowest cell specific gravity is 0.050 or more or the lowest cell specific gravity is less than 1.225, charge the battery.
 - D. Charge at the rate and time given in [Charging the Battery \(page 6–85\)](#) or until all cells specific gravity is 1.225 or greater with the difference in specific gravity between the highest and lowest cell is less than 0.050. If you can not meet these charging conditions, replace the battery.
3. Do a high-discharge test with an adjustable load tester. This is 1 of the most reliable means of testing a battery as it simulates the cold-cranking test. A commercial battery load tester is required to do this test.



CAUTION

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

- A. Check the voltage across the battery terminals before testing the battery. If the voltage is less than 12.4 VDC, charge the battery before continuing the test; refer to [Charging the Battery \(page 6–85\)](#).
- B. Ensure that the battery terminals are free of corrosion.
- C. Measure the electrolyte temperature of the center battery cell.
- D. Connect a battery load tester to the battery terminals following the manufacturer's instructions. Connect a digital multimeter to the battery terminals.
- E. If you charge the battery, apply a 150 A load for 15 seconds to remove the surface charge. Wait for 10 minutes before proceeding with load test.
- F. Apply a test load of 270 A (1/2 the cranking performance rating of the battery) for 15 seconds.
- G. After test load has been applied for 15 seconds, take a test voltage reading and then remove the load. Record the test voltage reading.
- H. Use the [Minimum Voltage Table \(page 6–84\)](#), determine the minimum voltage for the center cell electrolyte temperature reading.

Minimum Voltage Table

Minimum Voltage	Battery-Electrolyte Temperature	
9.6	70°F (and up)	21.1°C (and up)
9.5	60°F	16°C
9.4	50°F	10°C
9.3	40°F	4°C
9.1	30°F	-1°C
8.9	20°F	-7°C
8.7	10°F	-12°C
8.5	0°F	-18°C

- I. If the test voltage is below the minimum, replace the battery. If the test voltage is at or above the minimum, return the battery to service.
4. After you make the connections, apply terminal protector (Toro Part No. 107-0392) or a light layer of grease on all the battery posts and cable connectors to reduce corrosion.

Charging the Battery

To minimize damage to the battery and allow the battery to charge fully, do the following slow charging procedure. You can do this charging procedure with a constant current battery charger that is locally available.

IMPORTANT

Follow the manufacturer's instructions when using a battery charger.

Note: Use specific gravity of the battery cells is the most accurate procedure of determining the battery condition.

1. Determine the battery charge level from either its specific gravity or open circuit voltage.

Battery Charge Level	Specific Gravity	Open Circuit Voltage
100%	1.265	12.68
75%	1.225	12.45
50%	1.190	12.24
25%	1.155	12.06
0%	1.120	11.89

2. Determine the charging time and rate using the manufacturer's battery charger instructions or the following [Battery Charge Level Table \(page 6–85\)](#).

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.

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.



Table of Contents

Specifications	7-2
General Information	7-3
Service and Repairs	7-4
Wheels	7-4
Steering Column	7-6
Rear Frame and Axle Assembly	7-9
Rear Axle (2-Wheel Drive)	7-11
Servicing the Rear Axle (2-Wheel Drive)	7-13
Rear Wheel Bearings (2-Wheel Drive)	7-17
Operator Seat	7-19
Mechanical Seat Suspension	7-21
Pneumatic Seat Suspension	7-24
Lift Arms	7-26

Specifications

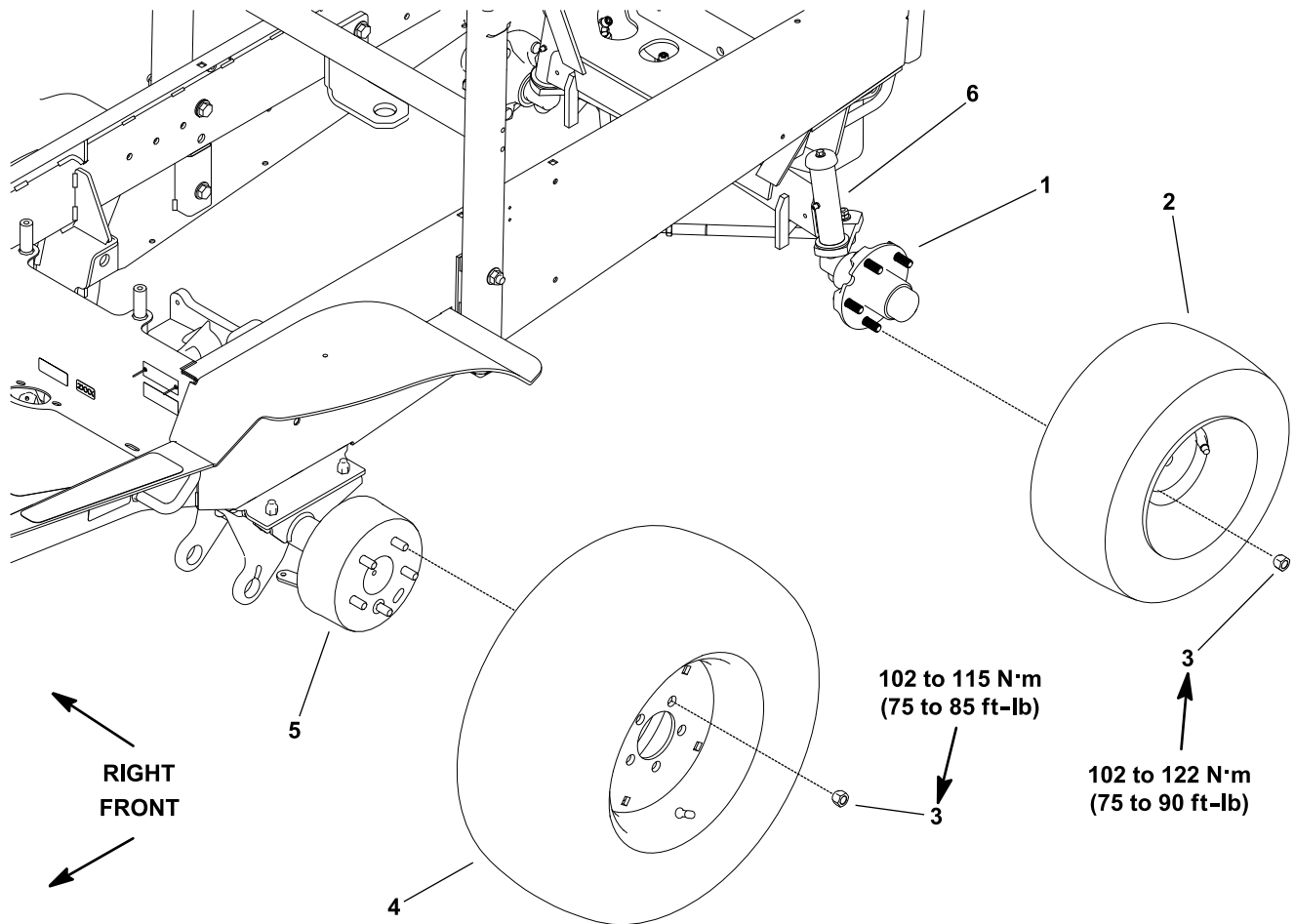
Item	Description
Front tire pressure (23 x 9.50 – 12, 4 ply, tubeless)	138 kPa (20 psi)
Rear tire pressure (2-wheel drive machines) (16 x 6.50 – 8, 4 ply, tubeless)	138 kPa (20 psi)
Rear tire pressure (4-wheel drive machines) (18 x 6.50–8, 4 ply, tubeless)	138 kPa (20 psi)
Front wheel lug nut torque	102 to 115 N·m (75 to 85 ft-lb)
Rear wheel lug nut torque (2-wheel drive and 4-wheel drive machines)	102 to 122 N·m (75 to 90 ft-lb)
Steering wheel mounting nut	27 to 35 N·m (20 to 26 ft-lb)

General Information

The *Operator's Manual* provides information regarding the operation, general maintenance, and maintenance intervals for your Groundsmaster 3280-D and 3320 machines. Refer to the *Operator's Manual* for additional information when servicing the machine.

Service and Repairs

Wheels



g223611

Figure 178

- | | | |
|------------------------|-------------------------------------|------------------------------|
| 1. Rear wheel hub | 3. Wheel-lug nut (5 each per wheel) | 5. Front axle |
| 2. Rear wheel assembly | 4. Front wheel assembly | 6. Rear axle (2-wheel drive) |

Removing the Wheel

1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.
2. Block the wheels that are not removed with chocks to prevent the machine from moving.
3. Loosen, but do not remove the 5 wheel-lug nuts that attach the wheel to the machine.

IMPORTANT

Before lifting the machine with a jack, review and follow [Jacking Instructions \(page 1–6\)](#).

Removing the Wheel (continued)

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.

Installing the Wheel

1. Install the wheel to the machine with the 5 wheel-lug nuts.
2. 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.

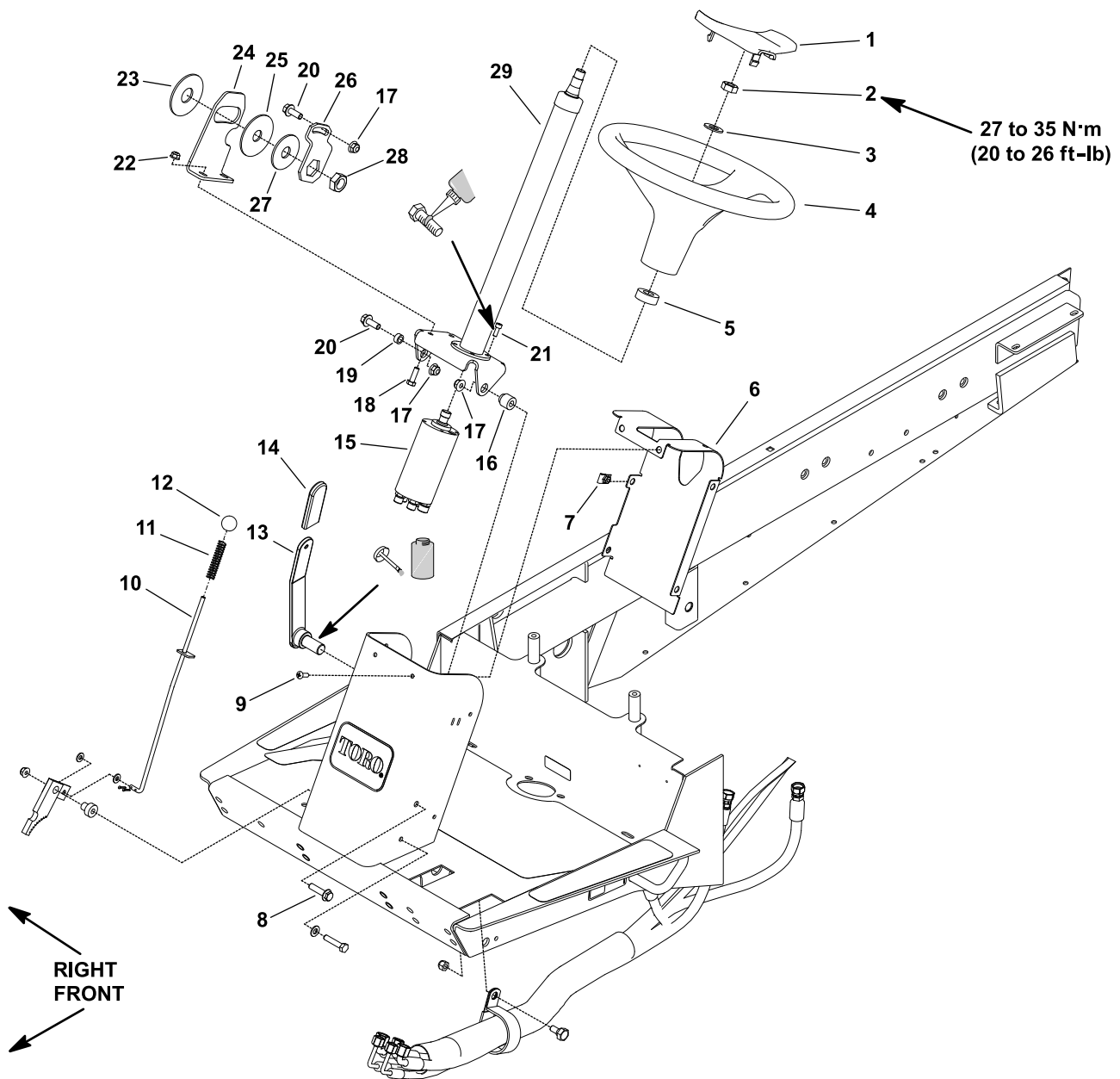


3. Torque the front wheel-lug nuts evenly to **102 to 115 N·m (75 to 85 ft-lb)** in a crossing pattern.



4. Torque the rear wheel-lug nuts evenly to **102 to 122 N·m (75 to 90 ft-lb)** in a crossing pattern.
5. Check and adjust the tire pressures; refer to [Specifications \(page 7–2\)](#).

Steering Column



g223612

Figure 179

- | | | |
|--------------------------------|--------------------------------|--------------------------------|
| 1. Steering wheel cover | 11. Compression spring | 21. Socket-head screw (4 each) |
| 2. Locknut | 12. Knob | 22. Flange nut (2 each) |
| 3. Flat washer | 13. Tilt steering lever | 23. Friction disc |
| 4. Steering wheel | 14. Grip | 24. Pivot plate |
| 5. Foam collar | 15. Steering control valve | 25. Friction disc |
| 6. Tower panel | 16. Spacer | 26. Tilt bracket |
| 7. Retainer nut (6 each) | 17. Flange nut (3 each) | 27. Flat washer |
| 8. Flange-head screw | 18. Bolt (2 each) | 28. Jam nut |
| 9. Philips-head screw (6 each) | 19. Spacer | 29. Steering column |
| 10. Parking brake rod | 20. Flange-head screw (2 each) | |

Removing the Steering Column

1. Park the machine on a level surface, set the parking brake, lower the cutting deck (or implement), shut off the engine, and remove the key from the key switch.
2. Carefully remove the steering wheel cover (item 1 in [Figure 179](#)) from the steering wheel.
3. Remove the locknut (item 2 in [Figure 179](#)) and flat washer that secure the steering wheel to the steering column.
4. Remove the steering wheel and foam collar from the steering column (item 29 in [Figure 179](#)).
5. Remove the knob (item 12 in [Figure 179](#)) from the end of the parking brake rod.
6. Remove the 6 phillips-head screws (item 9 in [Figure 179](#)) that secure the tower panel to the machine, and remove the tower panel.
7. Remove the flange-head screw (item 20 in [Figure 179](#)) and flange nut that secure the tilt bracket to the steering tower. Slide the tilt bracket off the jam nut.
8. Loosen and remove the jam nut (item 28 in [Figure 179](#)). Remove the tilt steering lever from the steering tower.
9. Locate and retrieve the friction discs (items 23 and 25 in [Figure 179](#)) and flat washer.
10. Loosen and remove the 4 socket-head screws (item 21 in [Figure 179](#)) that secure the steering control valve to the steering column.
11. Loosen and remove the flange-head screws (items 8 and 20 in [Figure 179](#)) and flange nuts that attach the steering column to the frame.
12. Slide the steering column from the steering control valve, and remove the steering column from the machine.
13. Locate and retrieve the 2 spacers (items 16 and 19 in [Figure 179](#)).
14. If necessary, remove the 2 bolts (item 18 in [Figure 179](#)) and 2 flange nuts (item 22 in [Figure 179](#)) that secure the pivot plate to the steering column.

Installing the Steering Column

1. If removed, secure the pivot plate (item 24 in [Figure 179](#)) to the steering column with the 2 bolts and 2 flange nuts.
2. Slide the steering column onto the steering control valve. Position the spacers (items 16 and 19 in [Figure 179](#)) to the steering column.
3. Attach the steering column to the frame with the flange-head screws (items 8 and 20 in [Figure 179](#)) and flange nuts.
4. Secure the steering column to the steering control valve with the 4 socket-head screws (item 21 in [Figure 179](#)).
5. Apply anti-seize lubricant onto the threads and rod of the tilt steering lever (item 13 in [Figure 179](#)). Position the friction disc (item 23 in [Figure 179](#)) between the steering tower and the pivot plate. Install the tilt lever through the steering tower boss, friction disc, and pivot plate. Place the friction disc (item 25 in [Figure 179](#)) and flat washer onto the lever, and thread the jam nut onto the lever.
6. Torque the jam nut to **27 to 31 N·m (20 to 23 ft-lb)** so that the lever handle is secured in the up position ($90^\circ \pm 10^\circ$ from horizontal).
7. Position the tilt bracket (item 26 in [Figure 179](#)) onto the jam nut and secure the bracket to the steering tower with the flange-head screw and flange nut.



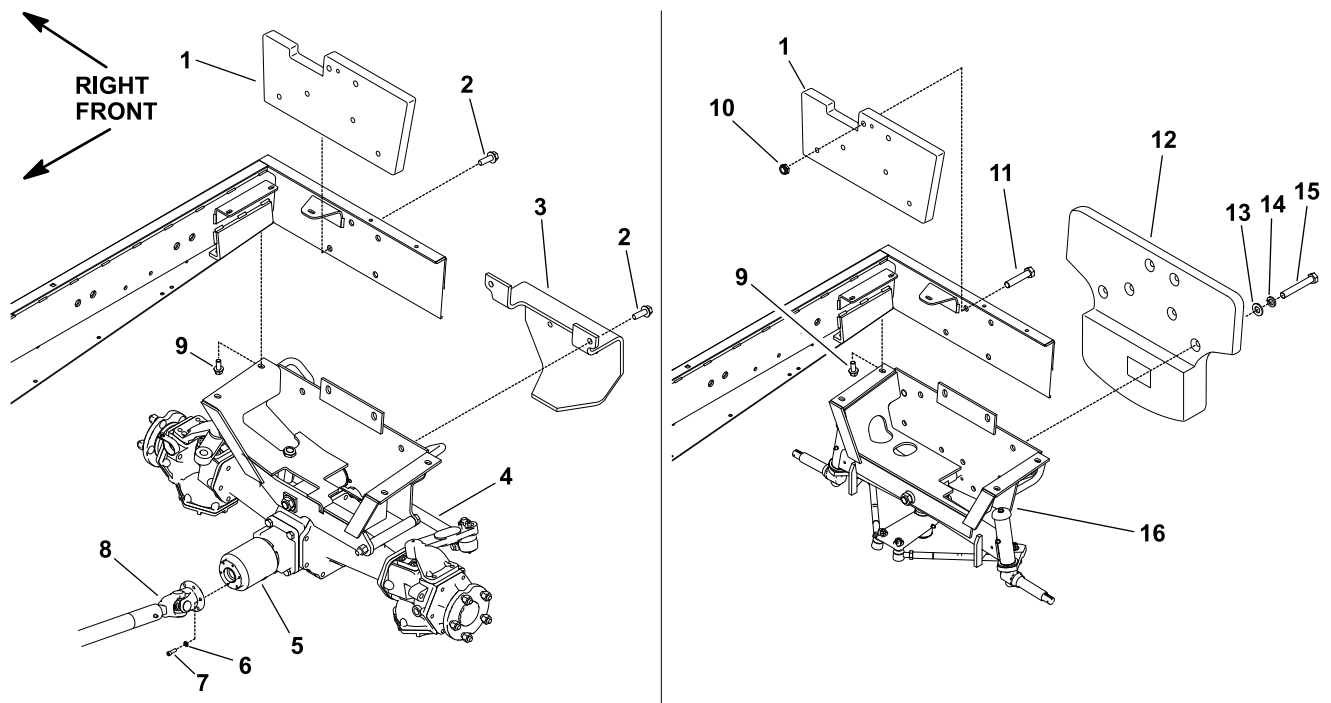
Installing the Steering Column (continued)

8. Position the tower panel to the machine and secure the panel with the 6 phillips-head screws.
9. Install the knob on the end of the parking brake rod.
10. Slide the foam collar onto the steering column.



11. Slide the steering wheel onto the steering column and secure the steering wheel with the flat washer and locknut; torque the locknut to **27 to 35 N·m (20 to 26 ft-lb)**.
12. Install the steering wheel cover (item 1 in [Figure 179](#)) onto the steering wheel.

Rear Frame and Axle Assembly



g223992

Figure 180

- | | | |
|---|-------------------------------|--|
| 1. Rear weight | 7. Socket-head screw (6 each) | 13. Flat washer (4 each) |
| 2. Flange-head screw (4 each) | 8. Driveshaft | 14. Lock washer (4 each) |
| 3. Rear bumper | 9. Flange-head screw (4 each) | 15. Bolt (4 each) |
| 4. Rear frame and axle assembly (4-wheel drive) | 10. Locknut (2 each) | 16. Rear frame and axle assembly (2-wheel drive) |
| 5. Bi-directional clutch | 11. Bolt (2 each) | |
| 6. Lock washer (6 each) | 12. Rear weight | |

Removing the Rear Frame and Axle Assembly

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

Note: For assembly purposes, tag the hydraulic hoses to show their correct position on the steering cylinder.
3. Disconnect the hydraulic hoses from the steering cylinder. Install clean caps or plugs on the hydraulic hoses and fittings to prevent system contamination.
4. On 4-wheel drive machines, remove the 6 socket-head screws (item 7 in [Figure 180](#)) and 6 lock washers that secure the driveshaft to the bi-directional clutch. Position the driveshaft away from the bi-directional clutch.
5. If the machine has the rear weight(s) attached to the frame, remove the weight(s).
6. Remove the fasteners that secure the rear of axle frame to the machine frame as shown in [Figure 180](#).
7. Raise the rear of the machine so that both wheels are off the ground. Support the rear of the machine frame with jack stands or appropriate blocking.

Removing the Rear Frame and Axle Assembly (continued)

8. Remove the 4 flange-head screws (item 9 in [Figure 180](#)) that secure the rear frame and axle assembly to the machine frame.
9. Carefully move the rear frame and axle assembly from the machine.

Installing the Rear Frame and Axle Assembly

1. Carefully position the rear frame and axle assembly to the machine frame.
Note: The flange-head screws (item 9 in [Figure 180](#)) used to secure the rear frame and axle assembly to the machine frame have a patch lock to prevent the screws from loosening. When installing the rear frame and axle to machine, either replace the flange-head screws or clean the screw threads and apply Loctite #242 (or equivalent) to the threads of the screws.
2. Align mounting holes in the rear frame and axle assembly. Install and tighten the 4 flange-head screws (item 9 in [Figure 180](#)) to secure the rear frame and axle assembly. While you tighten the screws, ensure that the mounting holes on the rear of the frame align with the axle frame holes.
3. Secure the rear of axle frame to the machine frame with the fasteners that were removed previously ([Figure 180](#)).
4. If equipped with rear weight(s), attach the weight(s) to the rear of the machine.
5. On 4-wheel drive machines, position the driveshaft to the bidirectional clutch. Secure the driveshaft to the bidirectional clutch with the 6 socket-head screws and 6 lock washers.
6. Remove the caps or plugs that were installed to the hydraulic hoses and fittings during the removal process.
7. Use the tags that you attached during removal to correctly connect the hydraulic hoses to the steering cylinder.
8. Lower the machine to the ground.
9. Check the hydraulic-fluid level in the reservoir (front axle) and adjust as necessary; refer to the *Traction Unit Operator's Manual*.
10. Start the engine and check for component interference as the steering wheel is turned from lock to lock.
11. Check the rear wheel toe-in and adjust if necessary; refer to the *Traction Unit Operator's Manual*.

Rear Axle (2-Wheel Drive)

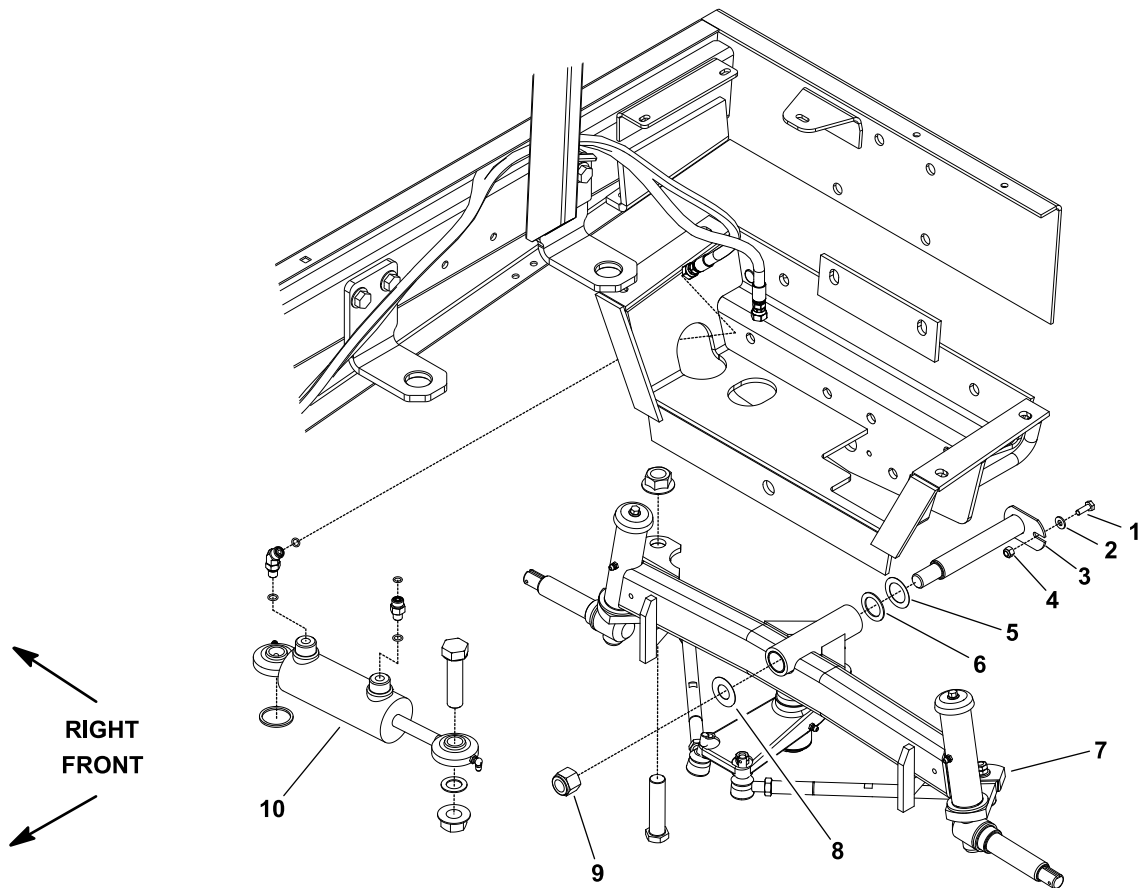


Figure 181

- | | | | |
|----------------|--|--|-----------------------|
| 1. Bolt | 4. Locknut | 7. Rear axle | 10. Steering cylinder |
| 2. Flat washer | 5. Flat washer | 8. Thrust washer (0.766 inch inner diameter) | |
| 3. Pivot pin | 6. Thrust washer (1.030 inch inner diameter) | 9. Locknut | |

Note: For repair information regarding the rear axle on 4-wheel drive machines; refer to [Chapter 8: Drive Axles \(page 8–1\)](#).

Removing the Rear Axle

1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.
Note: For assembly purposes, tag the hydraulic hoses to show their correct position on the steering cylinder.
2. Disconnect the hydraulic hoses from the steering cylinder. Install clean caps or plugs on the hydraulic hoses and fittings to prevent system contamination.
3. Remove the locknut (item 9 in [Figure 181](#)) that secures the end of the axle pivot pin to the rear frame.
4. Raise the machine (just ahead of the rear wheels) until pressure is taken off the axle pivot pin. Support the machine with jack stands to prevent it from falling.
5. Remove the locknut (item 4 in [Figure 181](#)), bolt, and flat washer that secure the pivot pin to the rear frame.

Removing the Rear Axle (continued)

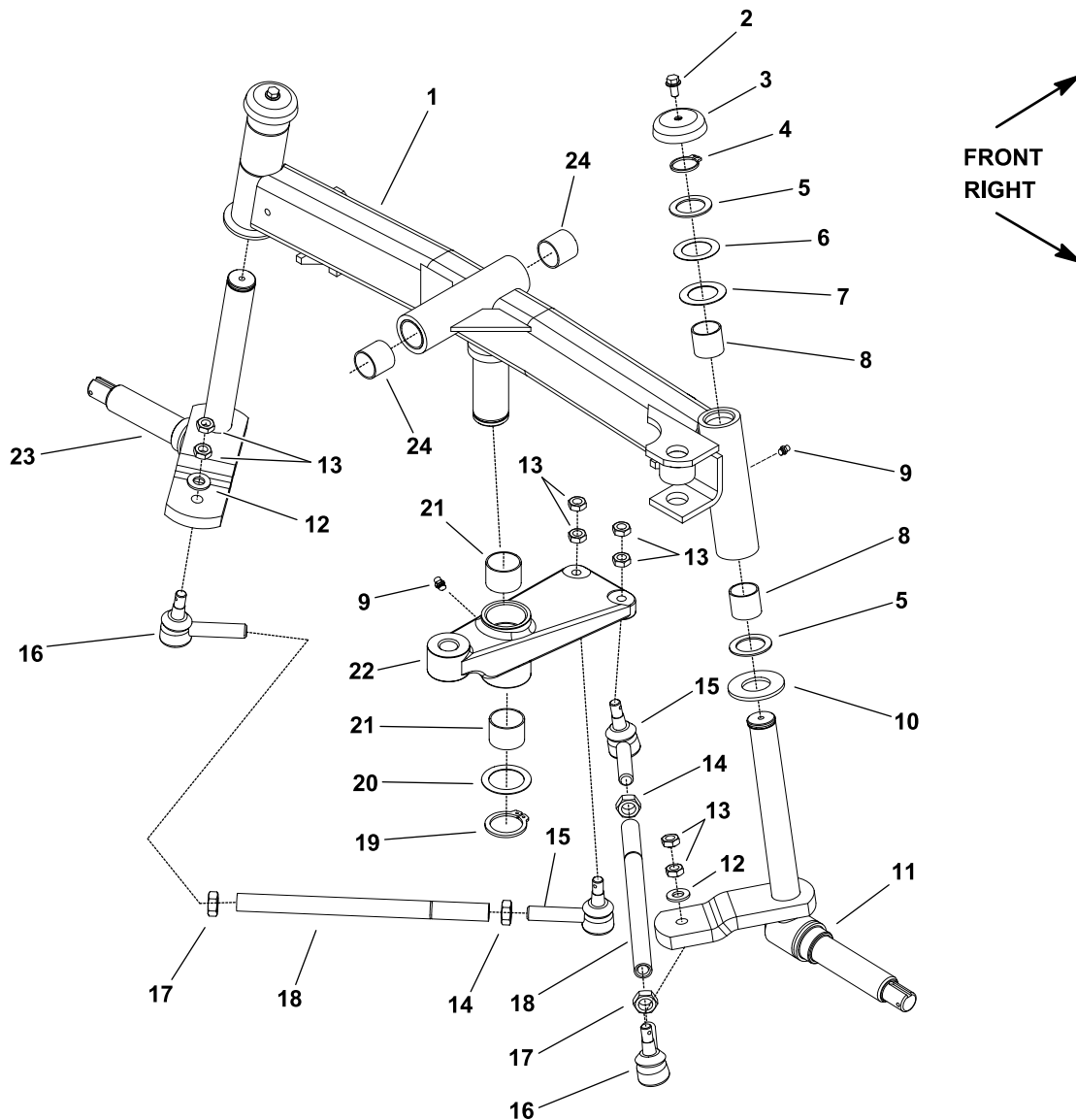
Note: Several washers (items 5, 6, and 8 in [Figure 181](#)) are installed between the axle pivot tube and the rear frame to adjust clearance between the axle pivot tube and rear frame. Before removing the axle pivot pin, note the location of the washers.

6. Pull the axle pivot pin out. This will release the rear axle and washer(s) from the frame. Carefully pull the entire axle and wheel assembly out from under the machine.
7. Locate and retrieve the 2 thrust washers (items 6 and 8 in [Figure 181](#)) and flat washer.

Installing the Rear Axle

1. Clean the rear axle pivot pin. Inspect the pin for wear or damage and replace if necessary.
2. Position the axle to the rear frame. Install small inner diameter thrust washer (item 8 in [Figure 181](#)) in front of the axle tube and large inner diameter thrust washer (item 6 in [Figure 181](#)) directly behind the axle tube. Place the flat washer (item 5 in [Figure 181](#)) as necessary between the large inner diameter thrust washer and rear frame to allow 0.8 to 2.3 mm (0.030 to 0.090 inch) axle tube end-play. Slide the pivot pin through the rear frame, washers, and axle.
3. Secure the pivot pin to the rear frame with the bolt (item 1 in [Figure 181](#)), flat washer, and locknut.
4. Tighten the locknut (item 9 in [Figure 181](#)) until the shoulder of the pivot pin bottoms against the rear frame. Ensure that the axle can still pivot freely after the locknut is tightened.
5. Remove the jack stands and lower the machine to the ground.
6. Remove the caps or plugs that were installed to the hydraulic hoses and fittings during the removal process.
7. Use the tags that you attached during removal to correctly connect the hydraulic hoses to the steering cylinder.
8. Check the hydraulic-fluid level in the hydraulic reservoir (front axle); refer to the *Traction Unit Operator's Manual*.
9. Lubricate the rear axle pivot bushings through the grease fitting on the axle pivot tube; refer to the *Traction Unit Operator's Manual*.
10. Operate the machine and check the steering cylinder hydraulic connections for leaks.

Servicing the Rear Axle (2-Wheel Drive)



g223802

Figure 182

- | | | |
|--|--|-------------------------------------|
| 1. Rear axle | 9. Grease fitting (4 each) | 17. Jam nut (2 each) |
| 2. Flange-head screw | 10. Thrust washer | 18. Tie rod (2 each) |
| 3. Spindle cap | 11. Right spindle | 19. Retaining ring |
| 4. Retaining ring | 12. Flat washer (2 each) | 20. Thrust washer |
| 5. Thrust washer (0.060 inch thick) (2 each) | 13. Jam nut (8 each) | 21. Steering pivot bushing (2 each) |
| 6. Flat washer (0.018 inch thick) | 14. Jam nut (left-hand thread) (2 each) | 22. Steering pivot plate |
| 7. Flat washer (0.032 inch thick) | 15. Ball joint (left-hand thread) (2 each) | 23. Left spindle |
| 8. Spindle bushing (2 each) | 16. Ball joint (2 each) | 24. Axle pivot bushing (2 each) |

Note: For repair information regarding the rear axle on 4-wheel drive machines; refer to [Chapter 8: Drive Axles \(page 8–1\)](#).

Axle Pivot Bushings

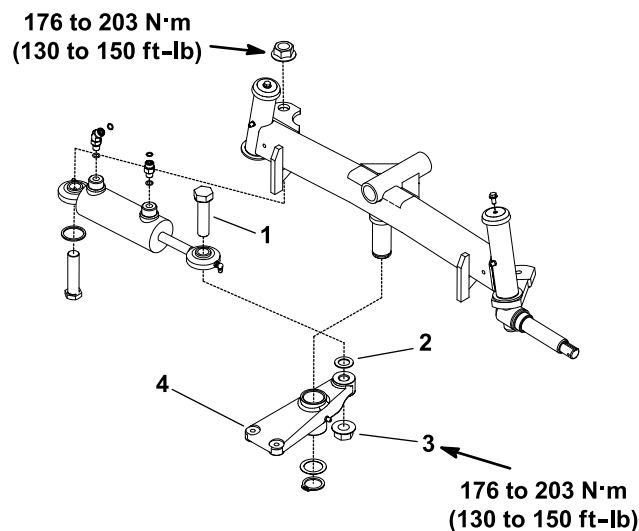
The rear axle must be held in place snugly by the axle pivot pin. Excessive movement of the axle, which is characterized by erratic steering, can indicate worn axle pivot bushings. To correct the problem, replace the axle pivot bushings (item 24 in [Figure 182](#)).

1. Remove the rear axle from the machine; refer to [Removing the Rear Axle \(page 7–11\)](#).
2. Use a drift punch and hammer to drive both axle pivot bushings out of the axle pivot tube. Clean the inside of the tube to remove any dirt or unwanted material.
3. Apply grease to the inner and outer surfaces of new bushings. Use an arbor press to install the bushings into the front and back of the axle pivot tube. The bushings must be flush with the axle tube.
4. Install the rear axle to the machine; refer to [Installing the Rear Axle \(page 7–12\)](#).
5. Lubricate the bushings through the grease fitting on the axle pivot tube.

Steering Pivot Bushings

The steering pivot must fit snugly onto the mounting pin. Excessive movement of the steering pivot may indicate worn steering pivot bushings (item 21 in [Figure 182](#)) or tie rod ball joints (item 15 and 16 in [Figure 182](#)).

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



g224021

Figure 183

- | | |
|------------------|-------------------------|
| 1. Bolt | 3. Locknut |
| 2. Thrust washer | 4. Steering pivot plate |

2. Remove the locknut, bolt, and thrust washer that secure the steering cylinder rod end to the steering pivot plate ([Figure 183](#)).
3. Remove the 4 jam nuts to allow both tie rod ends to be disconnected from the pivot plate. Inspect all the tie rod end ball joints for wear or damage and replace as necessary.
4. Remove the retaining ring and thrust washer that secure the steering pivot plate (item 22 in [Figure 182](#)) to the rear axle. Slide the steering pivot off of the mounting pin at the bottom of the axle.

Steering Pivot Bushings (continued)

5. Use a drift punch and hammer to drive both the steering pivot bushings out of the steering pivot. Clean the inside of the steering pivot to remove any dirt or unwanted material. Also, clean the mounting pin at the bottom of the rear axle.
6. Apply grease to the inner and outer surfaces of new bushings. Use an arbor press to install the bushings into the top and bottom of the steering pivot. The bushings must be flush with the pivot plate.
7. Slide the steering pivot onto the axle mounting pin. Secure the pivot in place with the thrust washer and retaining ring.
8. Connect each tie rod end to the pivot with the 2 jam nuts. For each tie rod, tighten the first jam nut and then tighten the second jam nut against the first to secure the tie rod end.
9. Install the thrust washer, bolt, and locknut to secure the steering cylinder rod end to the steering pivot plate ([Figure 183](#)); torque the locknut to **176 to 203 N·m (130 to 150 ft-lb)**.
10. Lubricate the bushings through the grease fitting on the steering pivot plate.



Rear Axle Spindle Bushings

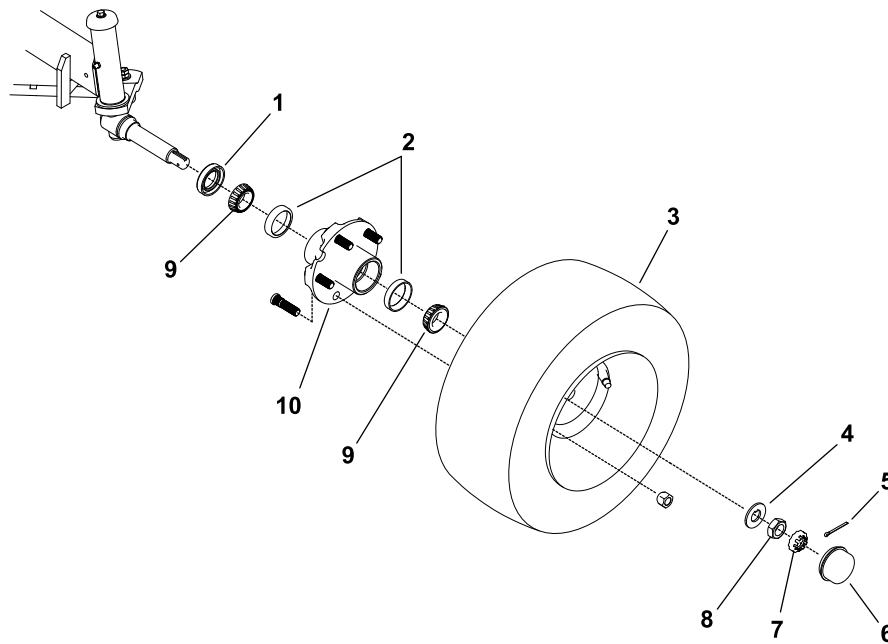
The rear wheel spindles must fit snugly in the rear axle. Excessive movement of the spindle in the axle indicates that the spindle bushings (item 8 in [Figure 182](#)) are probably worn and must be replaced.

1. Remove the rear axle from the machine; refer to [Removing the Rear Axle \(page 7–11\)](#).
2. Remove the 2 jam nuts and flat washer that secure the tie rod end to the spindle arm. Disconnect the tie rod end from the spindle arm.
3. Remove the flange-head screw, spindle cap, retaining ring, and washers that secure the wheel spindle into the axle tube. Slide the spindle, washers, and wheel assembly out of the axle tube to expose the spindle bushings.
4. Use a punch and hammer to drive both bushings out of the axle tube. Ensure that you do not damage the inner surface of the axle tube. Clean the inner surface of the axle tube to remove any dirt or unwanted material.
5. Apply grease to the inner and outer surfaces of new bushings. Use an arbor press to install the bushings into the top and bottom of the axle tube. The bushings must be flush with the axle tube.
6. Clean the spindle shaft. Inspect the spindle for wear and replace if worn or damaged.
7. Install the 2 thrust washers (items 10 and 5 in [Figure 182](#)) onto the spindle shaft and slide the shaft up through the axle tube. Hold the wheel and spindle shaft assembly in place and install the flat washer(s) (items 7 and 6 in [Figure 182](#)), thrust washer, and retaining ring onto the end of the spindle shaft.
8. End-play of spindle should be 0.8 to 2.3 mm (0.030 to 0.090 inch) after assembly. If necessary, add or remove the flat washers (items 6 and 7 in [Figure 182](#)) to adjust end-play.
9. Install the spindle cap and secure with the flange-head screw.
10. Connect the tie rod end to the spindle bracket with the flat washer and 2 jam nuts. Tighten the first jam nut and then tighten the second jam nut against the first to secure the tie rod end to the spindle.
11. Install the rear axle to the machine; refer to [Installing the Rear Axle \(page 7–12\)](#).

Rear Axle Spindle Bushings (continued)

12. Lubricate the steering spindles through the grease fittings on the rear axle; refer to the *Traction Unit Operator's Manual*.
13. Check the rear wheel toe-in; refer to the *Traction Unit Operator's Manual*.
14. After all adjustments have been made, ensure that there is no contact between any steering components as the wheels move from lock to lock. Adjust if necessary.

Rear Wheel Bearings (2-Wheel Drive)



g224228

Figure 184

- | | | |
|-------------------------|---------------|--------------------------|
| 1. Oil seal | 5. Cotter pin | 9. Bearing cone (2 each) |
| 2. Bearing cup (2 each) | 6. Dust cap | 10. Wheel hub |
| 3. Rear wheel | 7. Retainer | |
| 4. Tab washer | 8. Jam nut | |

Note: For repair information regarding the rear axle on 4-wheel drive machines; refer to [Chapter 8: Drive Axles \(page 8–1\)](#).

Disassembling the Rear Wheel Bearings

1. Raise the rear of the machine until the wheel is off the ground. Support the machine with jack stands or blocks to prevent it from falling.
2. Remove the rear wheel; refer to [Wheels \(page 7–4\)](#).
3. Remove the dust cap from the wheel hub.
4. Remove the cotter pin, retainer, jam nut, and tab washer. Slide the wheel hub from the spindle shaft.
5. Pull the seal out of the wheel hub. Discard the seal.
6. Remove the bearing cones from both sides of the wheel hub. Clean the bearings in solvent. Ensure that the bearings are in good operating condition. Clean the inside of the wheel hub. Check the bearing cups for wear, pitting, or other noticeable damage. Replace the parts that are worn or damaged.

Assembling the Rear Wheel Bearings

1. If bearing cups were removed from the wheel hub, press them into the hub until they seat against the shoulder of the hub.

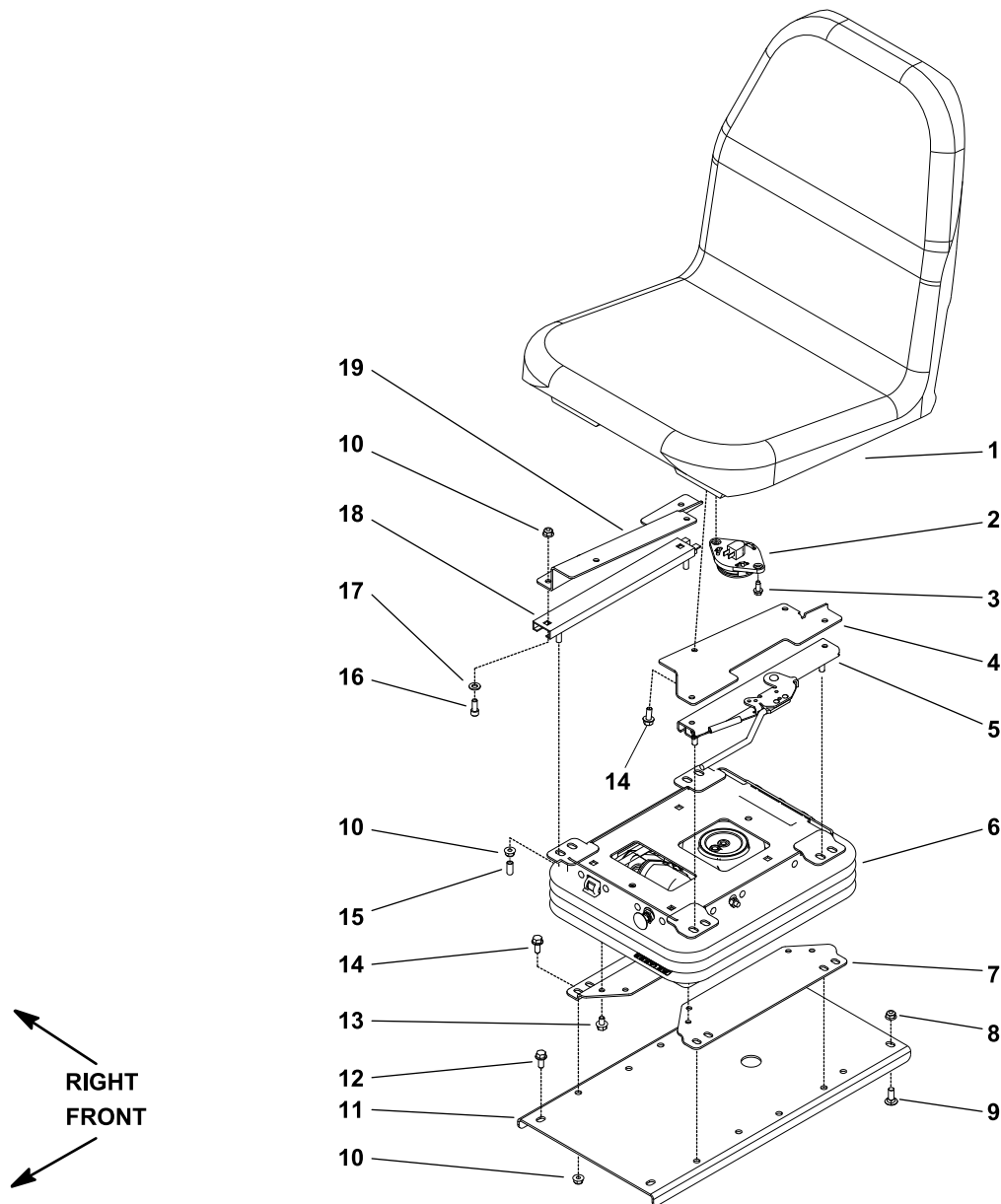
IMPORTANT

The seal must be pressed in so that it is flush with the end of the wheel hub. The lip of the seal must be toward the bearing.

Assembling the Rear Wheel Bearings (continued)

2. Pack both the bearings with grease. Install 1 bearing into the cup on inboard side of the wheel hub. Lubricate the inner surface of the new seal and press it into the wheel hub.
3. Pack inside of the wheel hub with some grease (not full). Position remaining bearing into the outer bearing cup.
4. Slide the wheel hub assembly onto the spindle shaft and secure it in place with the tab washer and jam nut. Do not tighten the nut or install the cotter pin.
5. Rotate the wheel hub by hand and tighten the jam nut to **8.5 to 11.3 N·m (75 to 100 in-lb)** to set the bearings. Then, loosen the nut until the hub has end-play.
6. Rotate the wheel hub by hand and tighten the jam nut to **1.7 to 2.3 N·m (15 to 20 in-lb)**. After you tighten the jam nut, ensure that the wheel hub does not have any free play.
7. Install the retainer with slot aligned to the cotter pin hole in the spindle. Install the cotter pin.
8. Install the dust cap.
9. Install the rear wheel; refer to [Wheels \(page 7-4\)](#).
10. Remove the jack stands or blocks and lower the machine to the ground.

Operator Seat



g223702

Figure 185

- | | | |
|--------------------------------|--------------------------------|--------------------------------|
| 1. Seat | 8. Flange nut (2 each) | 15. Wire cap (4 each) |
| 2. Seat switch | 9. Carriage screw (2 each) | 16. Socket-head screw (4 each) |
| 3. Washer-head screw (2 each) | 10. Flange nut (12 each) | 17. Flat washer (4 each) |
| 4. Seat bracket (left) | 11. Seat base | 18. Seat adjuster |
| 5. Seat adjuster with latch | 12. Flange-head screw (2 each) | 19. Seat bracket (right) |
| 6. Seat suspension | 13. Flange-head screw (4 each) | |
| 7. Lower seat bracket (2 each) | 14. Flange-head screw (8 each) | |

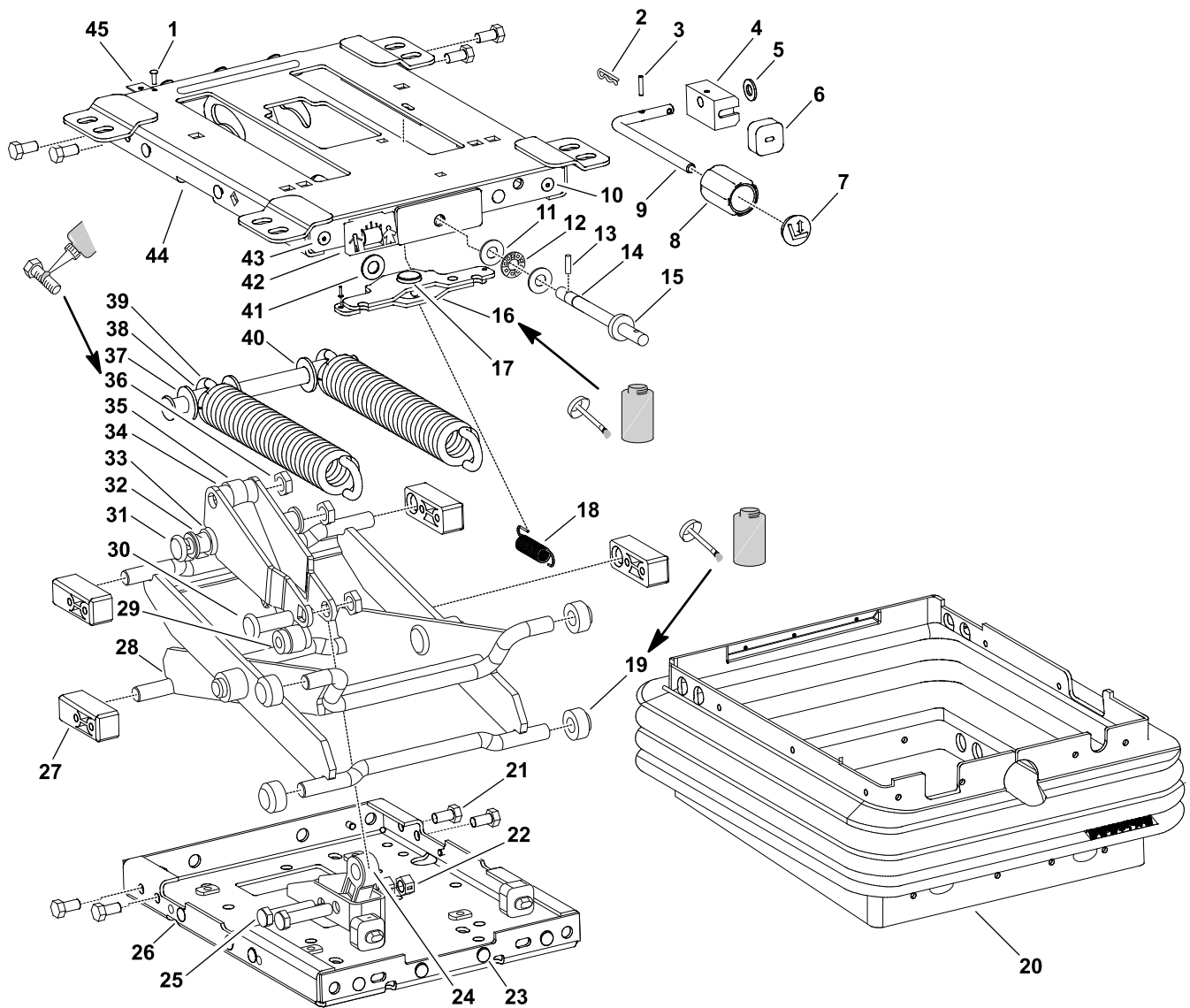
Removing the Operator Seat

1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.
2. Disconnect the negative battery cable from the battery; refer to [Servicing the Battery \(page 6–80\)](#).
3. Disconnect the electrical connector from the seat switch. On pneumatic seat suspension systems, disconnect the electrical connector from the suspension.
4. Remove the 2 flange-head screws (item 12 in [Figure 185](#)) and 2 flange nuts (item 8 in [Figure 185](#)) that secure the seat base to the machine.
5. Remove the seat and seat base from the machine.
6. Remove the seat components as necessary ([Figure 185](#)).

Installing the Operator Seat

1. Install the seat components ([Figure 185](#)).
2. Position the seat and seat base to the machine.
3. Secure the seat base to the machine with the 2 flange-head screws (item 12 in [Figure 185](#)) and 2 flange nuts (item 8 in [Figure 185](#)).
4. Connect the electrical connector to the seat switch. On pneumatic seat suspension systems, connect the electrical connector to the suspension.
5. Connect the negative battery cable to the battery; refer to [Servicing the Battery \(page 6–80\)](#).

Mechanical Seat Suspension

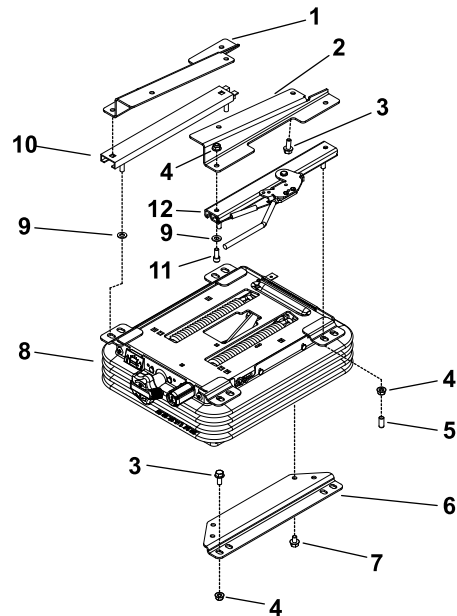


g243926

Figure 186

- | | | | |
|--------------------------------|-----------------------------------|----------------------------------|-------------------------------|
| 1. Rivet (2 each) | 13. Roll pin | 25. Lower shock bolt (2 each) | 37. Flat washer |
| 2. Cotter pin | 14. Weight adjust spacer | 26. Lower housing | 38. Spring shaft |
| 3. Roll pin | 15. Weight adjust shaft | 27. Shaft block (4 each) | 39. Extension spring (2 each) |
| 4. Up-stop bumper block | 16. Weight adjuster | 28. Scissor assembly | 40. Spring bushing (2 each) |
| 5. Flat washer | 17. Weight adjust nut | 29. Lower shock bushing (2 each) | 41. Flat washer |
| 6. Bumper (3 each) | 18. Extension spring | 30. Roller pin | 42. Weight indicator assembly |
| 7. Height adjust knob cap | 19. Roller (4 each) | 31. Pivot pin | 43. Male snap rivet (2 each) |
| 8. Height adjust knob | 20. Suspension boot | 32. Bearing tube (2 each) | 44. Upper housing |
| 9. Height adjust rod | 21. Thread forming screw (8 each) | 33. Drive arm | 45. Weight adjust tape |
| 10. Female snap rivet (2 each) | 22. Locknut (2 each) | 34. Upper shock bushing (2 each) | |
| 11. Thrust race (2 each) | 23. Push clip (21 each) | 35. Damper | |
| 12. Thrust bearing | 24. Guide link | 36. Hex nut (3 each) | |

Removing the Mechanical Seat Suspension



g223699

Figure 187

- | | | |
|-------------------------------|--------------------------------|---------------------------------------|
| 1. Seat bracket (right) | 5. Wire cap (4 each) | 9. Flat washer (8 each) |
| 2. Seat bracket (left) | 6. Lower seat bracket (2 each) | 10. Seat adjuster |
| 3. Flange-head screw (8 each) | 7. Flange-head screw (4 each) | 11. Socket-head screw (4 each) |
| 4. Flange nut (12 each) | 8. Mechanical suspension | 12. Seat adjuster with latch assembly |

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

IMPORTANT

Do not damage the electrical harness when removing the seat suspension from the machine.

2. Remove the seat and seat suspension from the machine; refer to [Operator Seat \(page 7–19\)](#).
3. Remove the mechanical seat suspension components as necessary ([Figure 186](#) and [Figure 187](#)). If the seat adjusters are being removed, record the seat adjuster mounting holes used.

Installing the Mechanical Seat Suspension

1. Install all the mechanical seat suspension components that were removed ([Figure 186](#) and [Figure 187](#)). If removed, use the seat adjuster mounting holes that were recorded during removal.

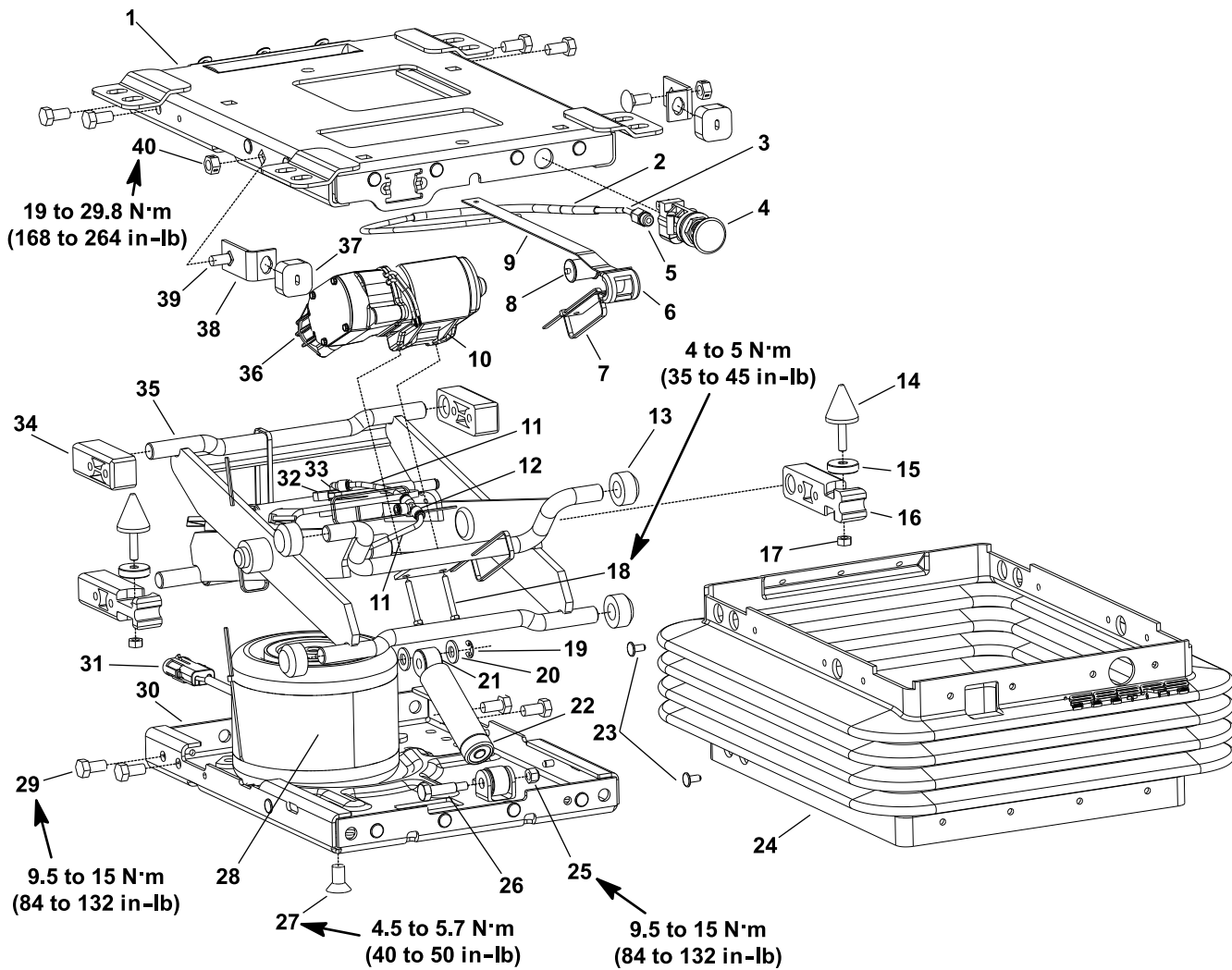
IMPORTANT

Do not damage the electrical harness when installing the seat suspension to the machine.

Installing the Mechanical Seat Suspension (continued)

2. Install the seat and seat suspension to the machine; refer to [Operator Seat \(page 7–19\)](#). Ensure to connect the harness electrical connector to the seat switch.

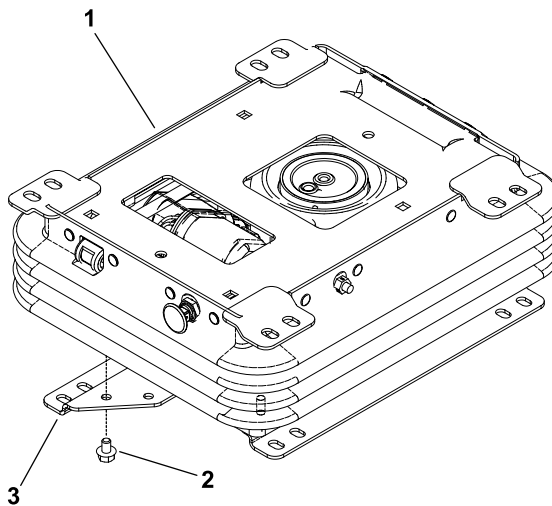
Pneumatic Seat Suspension



g223803

Figure 188

- | | | |
|-------------------------------|----------------------------------|-----------------------------------|
| 1. Upper housing | 15. Bumper spacer (2 each) | 29. Thread forming screw (8 each) |
| 2. Convoluted tubing | 16. Scissor pivot block (2 each) | 30. Lower housing |
| 3. Nylon tubing | 17. Hex nut (2 each) | 31. Wire harness |
| 4. Air control valve | 18. Flange-head screw (2 each) | 32. Bolt |
| 5. Connector | 19. Retaining ring | 33. 90° elbow stud |
| 6. Weight tape guide | 20. Flat washer (2 each) | 34. Shaft block (2 each) |
| 7. Cable tie (9 each) | 21. Shock bushing (4 each) | 35. Scissor assembly |
| 8. Weight tape roller | 22. Damper | 36. Compressor |
| 9. Weight tape adjuster | 23. Clip (21 each) | 37. Bumper (2 each) |
| 10. Compressor clamp | 24. Suspension boot | 38. Up stop bracket (2 each) |
| 11. Nylon tubing (2 each) | 25. Locknut | 39. Carriage bolt (2 each) |
| 12. Tee fitting | 26. Shock mount bolt | 40. Locknut (2 each) |
| 13. Roller (4 each) | 27. Screw | |
| 14. Down stop bumper (2 each) | 28. Air spring | |



g224018

Figure 189

- | | | |
|----------------------------------|-------------------------------|--------------------------------|
| 1. Pneumatic suspension assembly | 2. Flange-head screw (4 each) | 3. Lower seat bracket (2 each) |
|----------------------------------|-------------------------------|--------------------------------|

Removing the Pneumatic Seat Suspension

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

IMPORTANT

Do not damage the electrical harness when removing the seat suspension from the machine.

2. Remove the seat and seat suspension from the machine; refer to [Operator Seat \(page 7–19\)](#).
3. Remove the pneumatic seat suspension components as necessary ([Figure 188](#) and [Figure 189](#)).

Installing the Pneumatic Seat Suspension

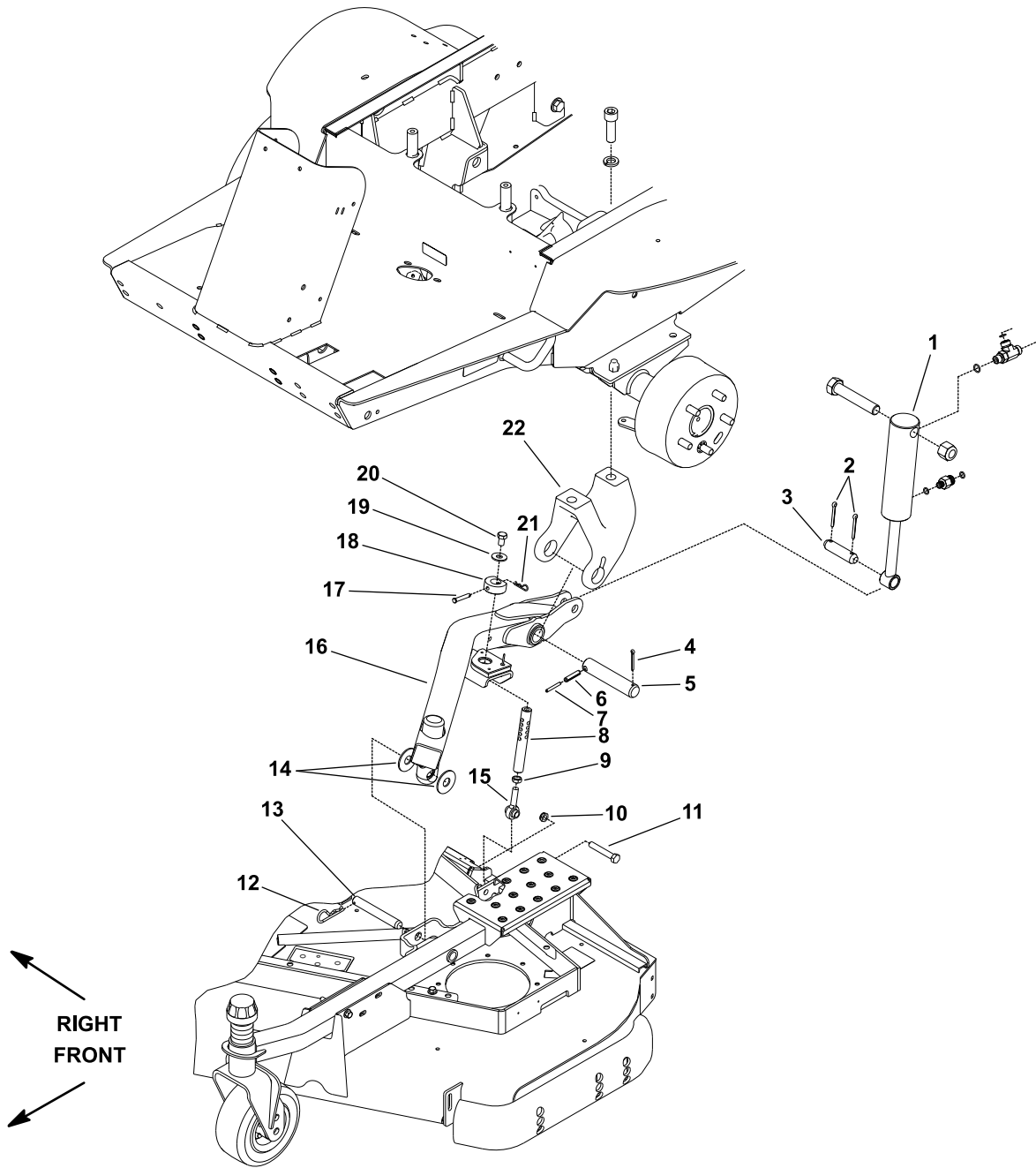
1. Install the pneumatic seat suspension components ([Figure 188](#) and [Figure 189](#)). Refer to [Figure 188](#) for fastener torque values for assembly purposes.

IMPORTANT

Do not damage the electrical harness when installing the seat suspension to the machine.

2. Install the seat and seat suspension to the machine; refer to [Operator Seat \(page 7–19\)](#). Ensure to connect the harness electrical connector to the seat switch.

Lift Arms

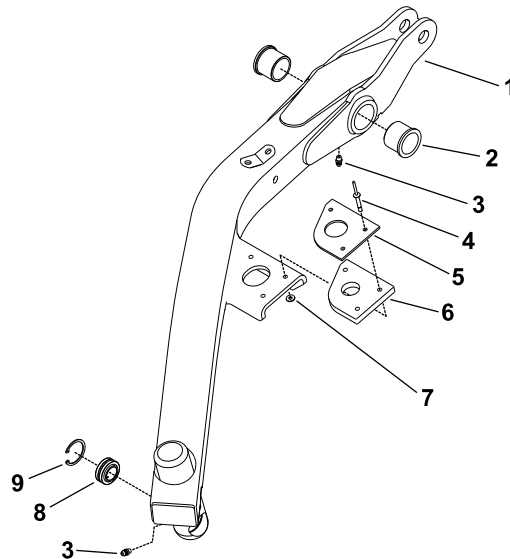


g223996

Figure 190

- | | | |
|------------------------|----------------------------|--------------------------|
| 1. Lift cylinder | 9. Jam nut | 17. Clevis pin |
| 2. Cotter pin (2 each) | 10. Locknut | 18. Height-of-cut collar |
| 3. Cylinder pin | 11. Bolt | 19. Flat washer |
| 4. Cotter pin | 12. Hairpin cotter | 20. Bolt |
| 5. Pivot pin | 13. Clevis pin | 21. Hairpin cotter |
| 6. Roll pin | 14. Thrust washer (2 each) | 22. Carrier bracket |
| 7. Roll pin | 15. Rod end | |
| 8. Height-of-cut tube | 16. Lift arm (left) | |

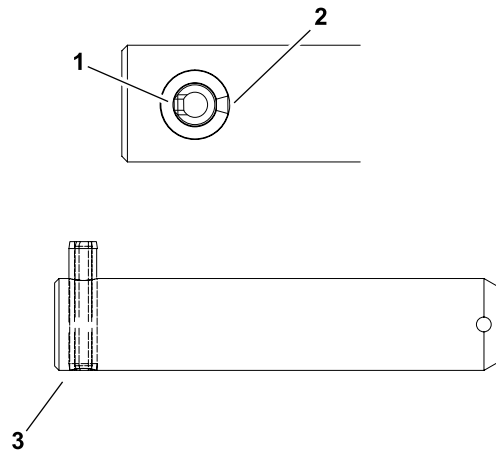
Removing the Lift Arms



g224019

Figure 191

- | | | |
|----------------------------|-------------------|--------------------------|
| 1. Lift arm (left) | 4. Rivet (3 each) | 7. Plain washer (3 each) |
| 2. Flange bushing (2 each) | 5. Plastic pad | 8. Spherical bearing |
| 3. Grease fitting (2 each) | 6. Rubber pad | 9. Retaining ring |



g224020

Figure 192

- | | |
|-------------------------|---|
| 1. Inner roll pin split | 3. Roll pin ends flush with pivot pin surface |
| 2. outer roll pin split | |

1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.
2. Remove the cutting deck from the lift arm; refer to the *Cutting Unit Operator's Manual*.
3. Disconnect the brake return spring from the lift arm.
4. Remove the lift arm components from the machine ([Figure 190](#)).
5. If necessary, disassemble the lift arm ([Figure 191](#)).

Installing the Lift Arms

1. If the lift arm was disassembled, install the lift arm components ([Figure 191](#)).
2. Install the lift arm components to the machine ([Figure 190](#)).
 - A. If the roll pins (items 6 and 7 in [Figure 190](#)) were removed from the pivot pin, install the roll pins so that one end is flush with the pivot pin and the inner roll pin split should be opposite to the outer roll pin split ([Figure 192](#)).
3. Connect the brake return spring to the lift arm.
4. Mount the cutting deck to the lift arm; refer to the *Cutting Unit Operator's Manual*.
5. Refer to the *Cutting Unit Operator's Manual* for lift arm adjustment procedures.



Table of Contents

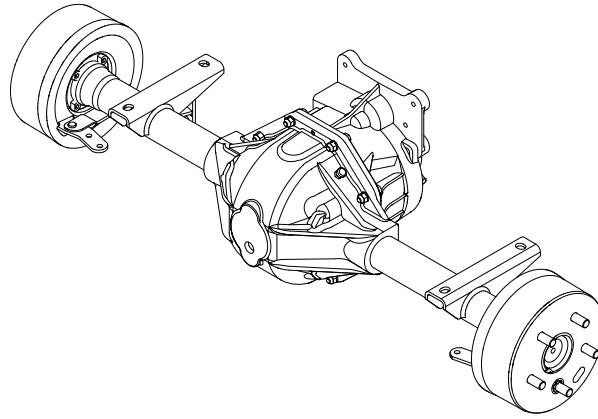
Specifications	8-2
General Information	8-3
Front Axle.....	8-3
4-Wheel Drive Rear Axle.....	8-3
Special Tools	8-5
Differential Gear Holder	8-5
Service and Repairs	8-6
Servicing the Brake.....	8-6
Front Axle Shafts and Bearings.....	8-8
Front Axle (Machine Serial Number before 316000000).....	8-16
Front Axle (Machine Serial Number after 316000000).....	8-19
Servicing the Front Axle	8-22
Ring to Pinion Gear Engagement (Front Axle)	8-40
Rear Axle Driveshaft (4-Wheel Drive)	8-43
Servicing the Rear Axle Driveshaft Cross and Bearing (4-Wheel Drive)	8-45
Rear Axle (4-Wheel Drive)	8-46
Bevel Gear Case and Axle Case (4-Wheel Drive Axle).....	8-49
Differential Shafts (4-Wheel Drive Axle)	8-57
Axle Shafts (4-Wheel Drive Axle)	8-59
Input Shaft/Pinion Gear (4-Wheel Drive Axle)	8-61
Differential Gear Assembly (4-Wheel Drive Axle).....	8-64
Pinion Gear to Ring Gear Engagement (4-Wheel Drive Axle).....	8-70
Bi-Directional Clutch (4-Wheel Drive).....	8-73
Servicing the Bi-Directional Clutch (4-Wheel Drive)	8-75

Specifications

Item	Description
Front axle (hydraulic reservoir) fluid	Refer to the <i>Traction Unit Operator's Manual</i>
Front axle (hydraulic reservoir) capacity	5.7 L (1.5 US gallons) Refer to the <i>Traction Unit Operator's Manual</i> for checking the procedure
4-wheel drive rear axle lubricant	GL-5 API, SAE 80W-90 gear lube
4-wheel drive rear axle lubricant capacity	2.9 L (0.76 US gallons) Refer to the <i>Traction Unit Operator's Manual</i> for checking the procedure
4-wheel drive bi-directional clutch lubricant	Mobil fluid 424
4-wheel drive bi-directional clutch capacity	35 ml (1.2 fl oz) Refer to the <i>Traction Unit Operator's Manual</i> for checking the procedure

General Information

Front Axle



g225887

Figure 193

The Groundsmaster 3280-D (for models 30344 and 30345) use a Schafer axle, model A20AA150-1. The Groundsmaster 3280-D (except models 30344 and 30345) and 3320 use a Dana axle, model GT-20. The differential and axle form the final drive of the power train (Figure 193).

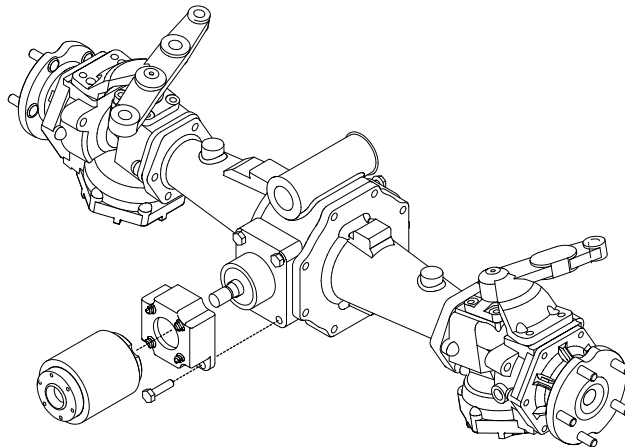
The differential has a heavy duty case with automotive type, cut gears that rotate on tapered roller bearings. Single-row, pre-set, tapered roller bearings are used on the outside ends of the axle shafts.

The entire drive line of the axle assembly is made of alloy steel. The axle has a die-cast aluminum housing that also serves as the hydraulic-fluid reservoir.

Power is transmitted from the hydraulic motor/hydrostatic transmission output gear to the axle pinion spur gear. The pinion spur gear transmits power directly to the differential drive gears, to turn the axles and front wheels.

The differential axle has a one-piece axle shaft with the flange being part of the axle stem.

4-Wheel Drive Rear Axle

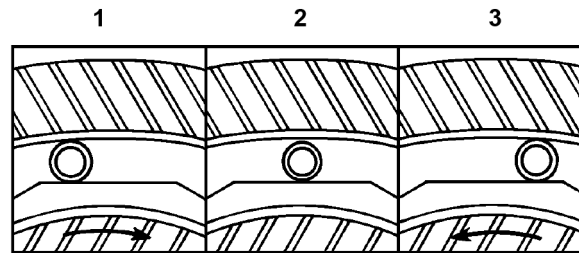


g225898

Figure 194

4-Wheel Drive Rear Axle (continued)

The 4-wheel drive rear axle used on the Groundsmaster 3280-D is a steerable, mechanical drive axle. A driveshaft connected to the front axle output shaft provides power to the 4-wheel drive rear axle. The driveshaft incorporates a bi-directional clutch that transfers power from the driveshaft to the 4-wheel drive rear axle input shaft ([Figure 194](#)).



g225899

Figure 195

1. Forward clutch engagement
2. Neutral (freewheeling)
3. Reverse clutch engagement

Any time the front wheels change speed (e.g., initially pressing the traction pedal, climbing an incline, and tires slipping), the rear axle driveshaft speed also changes. As soon as the driveshaft and the rear axle input shaft turn at slightly different speeds, the bi-directional clutch will engage and power is transferred to the rear axle ([Figure 195](#)). The result is automatic 4-wheel drive. The clutch engages in either forward or reverse direction.

Note: The bi-directional clutch may not operate properly if different size tires are used or if correct tire pressure is not maintained.

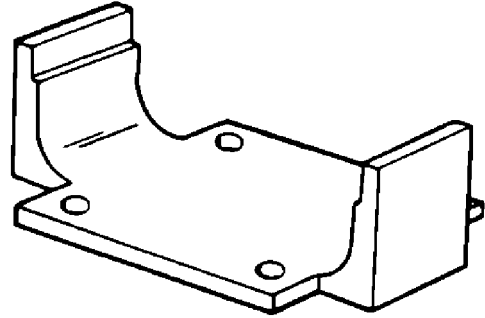
Special Tools

You can order the special tools from your Toro Distributor.

Differential Gear Holder

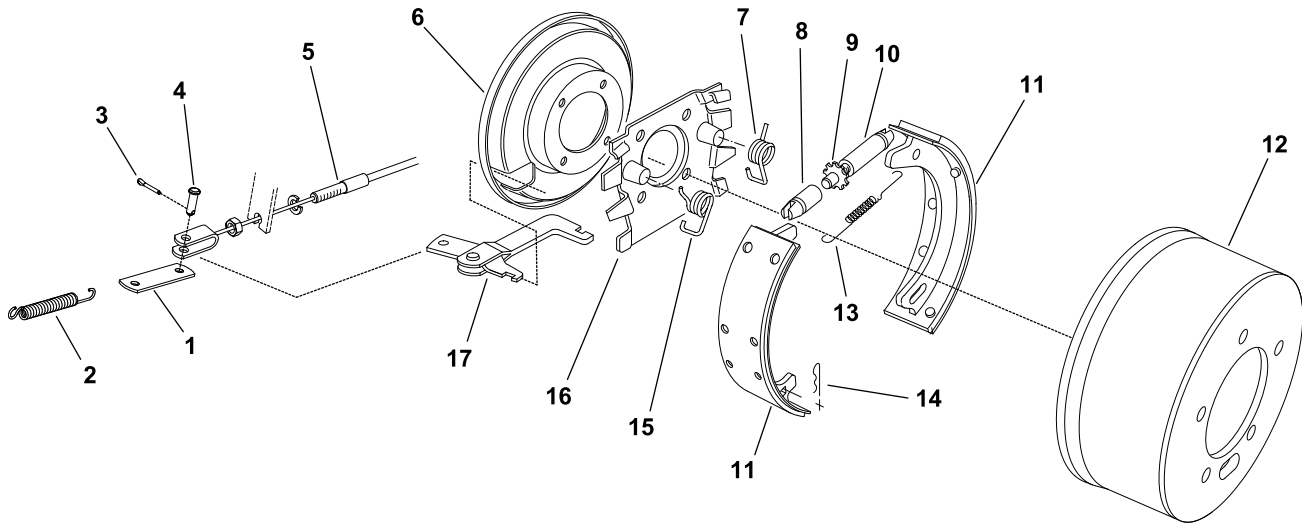
Toro Part No. TOR4027

Remove the gear cover from right hand side of the differential and bolt this tool in place to lock spur gear in position when removing the nut that secures the pinion coupler.



Service and Repairs

Servicing the Brake



g225901

Figure 196

- | | | |
|------------------------|--------------------------|--------------------------|
| 1. Brake cable link | 7. Return spring (right) | 13. Adjuster spring |
| 2. Brake return spring | 8. Star wheel socket | 14. Brake lever retainer |
| 3. Cotter pin | 9. Star wheel adjuster | 15. Return spring (left) |
| 4. Clevis pin | 10. Pivot nut | 16. Brake spider |
| 5. Brake cable | 11. Brake shoe set | 17. Brake lever |
| 6. Dust shield | 12. Brake drum | |

Disassembling the Brake

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 wheel assembly from the front axle; refer to [Removing the Wheel \(page 7–4\)](#).
3. Remove the brake return spring (item 2 in [Figure 196](#)) from the brake cable link. Remove the cotter pin and clevis pin, and disconnect the brake cable from the brake lever.

Note: If the brake drum is severely worn, it may be necessary to loosen the brake shoes before removing the brake drum. Loosen the brake shoes by turning the star wheel adjuster inside the brake drum assembly.

4. Pull the brake drum from the machine.
5. Inspect the braking surface of the brake drum. If there is excessive wear or scoring, replace the brake drum.



CAUTION



The springs are under tension and could possibly slip during removal.

Be careful when removing the adjuster and brake return springs.

Disassembling the Brake (continued)

6. Remove the adjuster spring (item 13 in [Figure 196](#)).
7. Spread the upper ends of the brake shoes (item 11 in [Figure 196](#)), and remove the star wheel socket, star wheel adjuster, and pivot nut.
8. Remove the brake lever retainers (item 14 in [Figure 196](#)).
9. Pull the brake lever from the brake shoes.
10. Remove the return springs (items 7 and 15 in [Figure 196](#)) and brake shoe by prying the end of the spring up and out of the brake shoe. Use a brake spring pliers or flat blade screwdriver.
11. Slide both brake shoes from the brake spider, and remove the shoes from the machine.

Assembling the Brake

1. Slide the brake shoes (item 11 in [Figure 196](#)) up onto the brake spider.



CAUTION

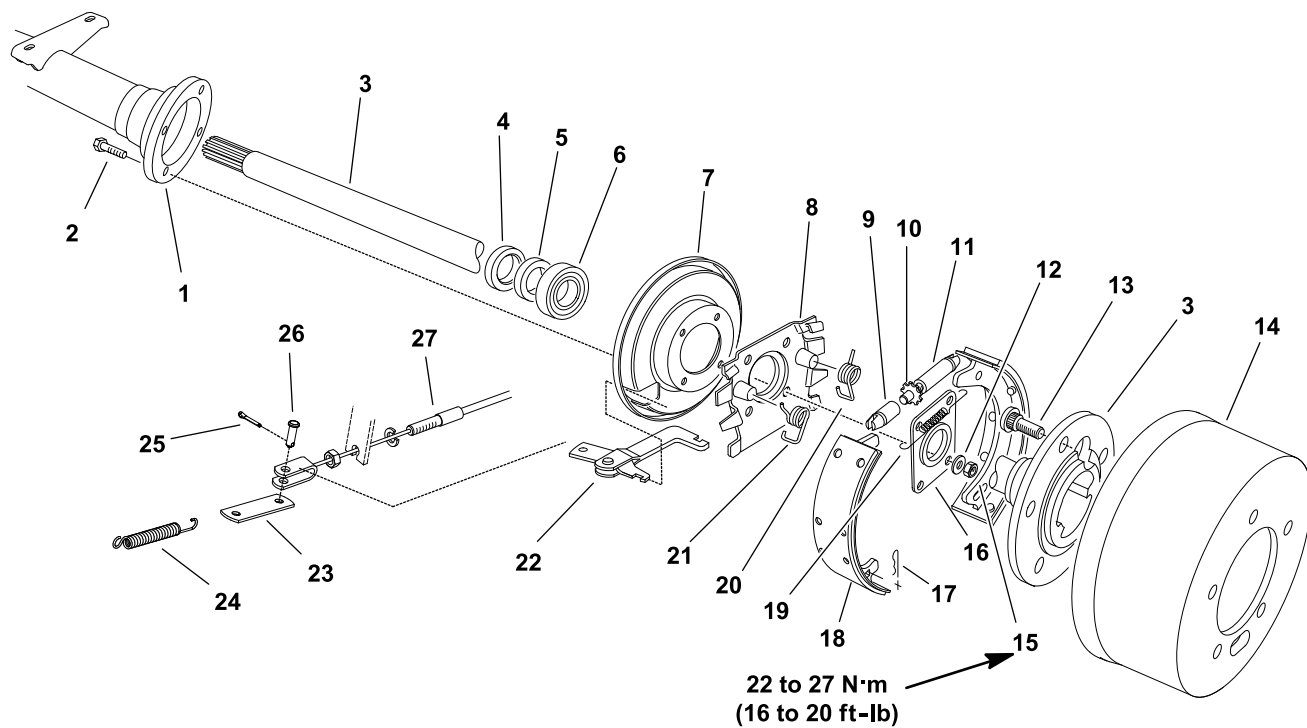


The springs are under tension and could possibly slip during installation.

Be careful when installing the brake return and adjuster springs.

2. Position the return springs (items 7 and 15 in [Figure 196](#)) to the brake shoes.
3. Position the brake lever (item 17 in [Figure 196](#)) to the brake shoes. Secure the brake lever to the shoes with the brake lever retainers.
4. Spread the upper ends of the brake shoes, and install the star wheel socket, star wheel adjuster, and pivot nut.
5. Install the adjuster spring (item 13 in [Figure 196](#)).
6. Install the brake drum on the wheel studs.
7. Secure the brake cable to the brake lever with the clevis pin (item 4 in [Figure 196](#)) and cotter pin. Attach the brake return spring to the brake cable link.
8. Install the wheel assembly to the front axle; refer to [Installing the Wheel \(page 7–5\)](#).
9. Check and adjust the brakes; refer to the *Traction Unit Operator's Manual*.

Front Axle Shafts and Bearings



g225902

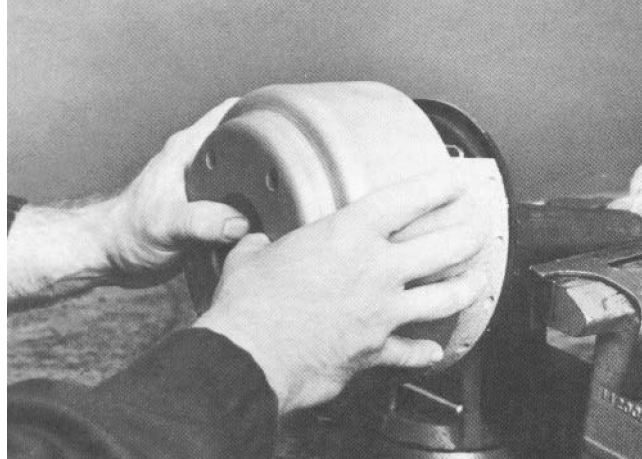
Figure 197

- | | | |
|---|--|---------------------------|
| 1. Front axle housing | 10. Star wheel adjuster | 19. Adjuster spring |
| 2. Socket-head screw (4 each per wheel) | 11. Pivot nut | 20. Return spring (right) |
| 3. Axle shaft | 12. Hardened washer (4 each per wheel) | 21. Return spring (left) |
| 4. Inner axle oil seal | 13. Wheel stud (5 each per wheel) | 22. Brake lever |
| 5. Bearing retainer | 14. Brake drum | 23. Brake cable link |
| 6. Bearing | 15. Locknut (4 each per wheel) | 24. Brake return spring |
| 7. Dust shield | 16. Outer seal plate | 25. Cotter pin |
| 8. Brake spider | 17. Brake lever retainer | 26. Clevis pin |
| 9. Star wheel socket | 18. Brake shoe | 27. Brake cable |

Note: It is not necessary to remove the front axle assembly from the machine when servicing the front axle shafts.

Disassembling the Front Axle Shafts and Bearings

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 brake return spring (item 24 in [Figure 197](#)) from the brake cable link. Remove the cotter pin and clevis pin, and disconnect the brake cable from the brake lever.
3. Remove the wheel assembly from the front axle; refer to [Removing the Wheel \(page 7–4\)](#).

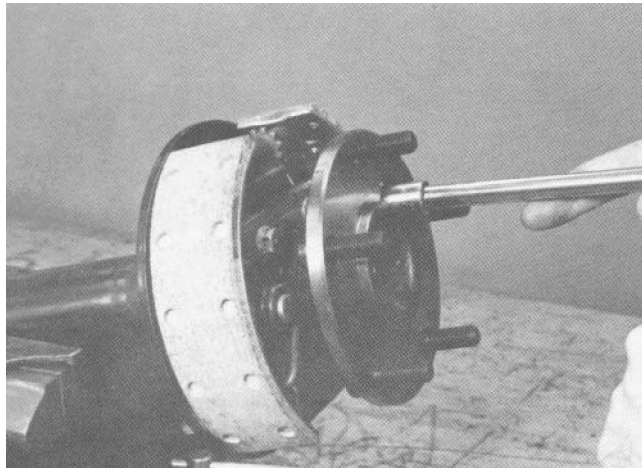


g225903

Figure 198

-
4. Slide the brake drum from the machine ([Figure 198](#)).

Note: If the brake drum is severely worn, it may be necessary to loosen the brake shoes before removing the brake drum. Loosen the brake shoes by turning the star wheel adjuster (item 10 in [Figure 197](#)) inside the brake drum assembly.



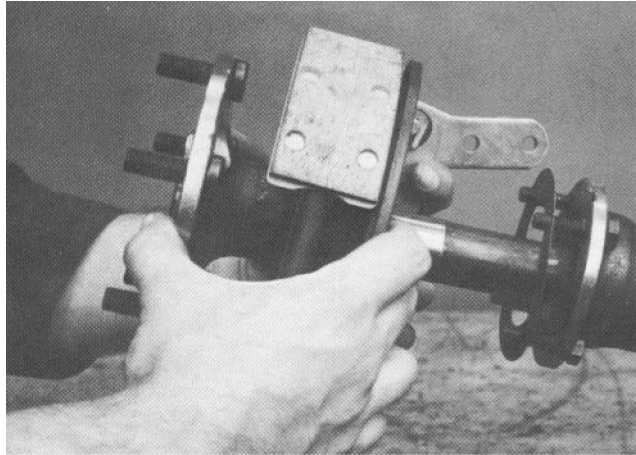
g225904

Figure 199

-
5. Remove the 4 locknuts, 4 hardened washers, and 4 socket-head screws that secure the brake assembly and outer seal plate to the axle housing ([Figure 199](#)). Use the hole in the axle shaft flange to get access to the locknuts.

IMPORTANT

Hold the socket-head screws with a wrench to prevent the screw head from rotating and damaging the axle tube.

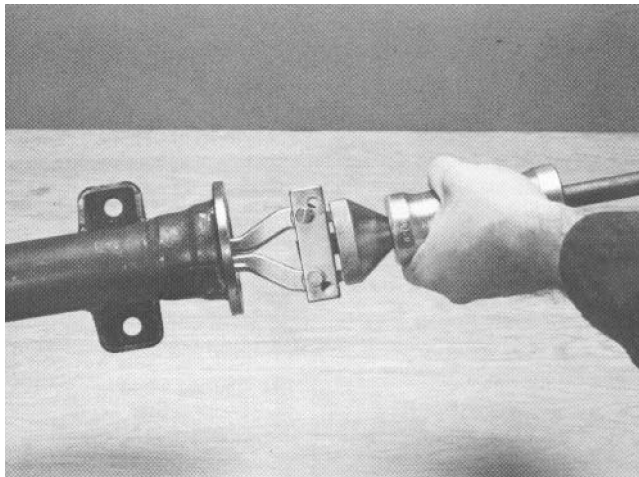


g225905

Figure 200

-
6. Pull the axle shaft and brake assembly out of the axle housing (Figure 200).

Note: If necessary, remove the bearing race from the axle housing with a bearing puller.

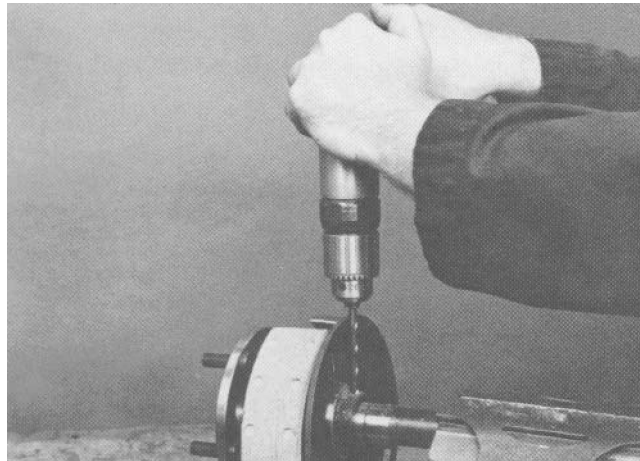


g225888

Figure 201

-
7. Remove and discard the inner axle shaft seal (Figure 201).

Disassembling the Front Axle Shafts and Bearings (continued)



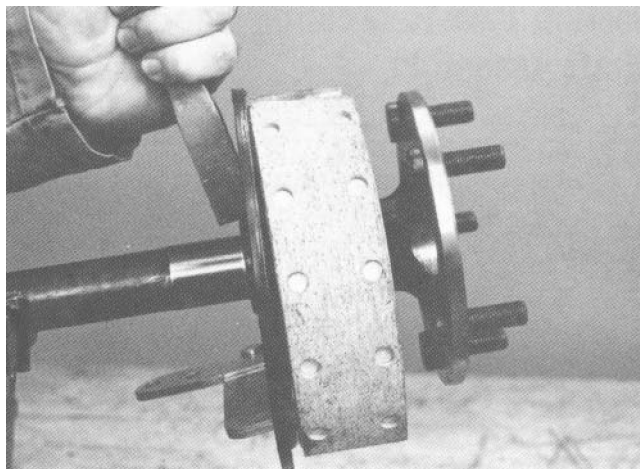
g225889

Figure 202

- Center punch and drill a 6 mm (1/4 inch) hole (approximate) into the outside of the bearing retainer to a depth of about 3/4 the thickness of the retainer (Figure 202).

IMPORTANT

Drilling completely through the retainer ring will damage the axle shaft.



g225890

Figure 203



WARNING

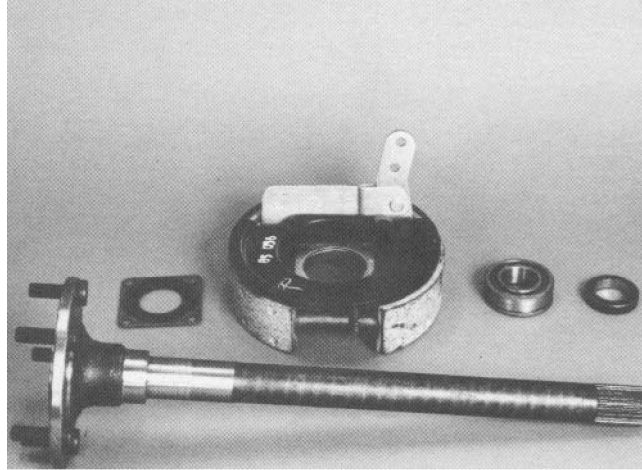


Wear protective safety goggles when breaking the retaining ring. Personal injury could result from flying metal particles. Keep bystanders away during this procedure.

- Place a chisel in position across the drilled hole and strike sharply to break the retainer (Figure 203). Remove and discard the retainer.
- Remove the bearing from the axle shaft.

Disassembling the Front Axle Shafts and Bearings (continued)

11. Remove and discard the outer seal plate.



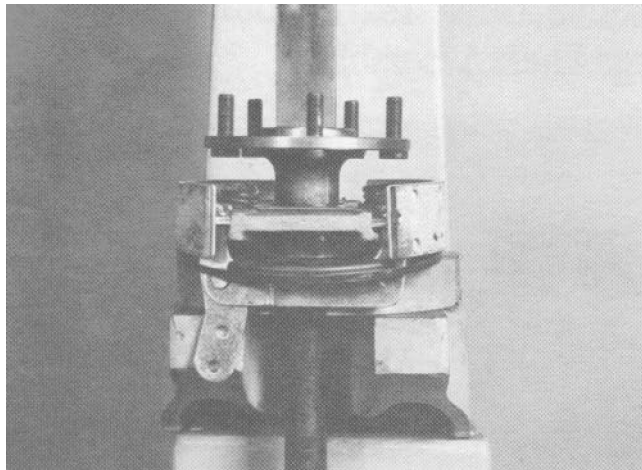
g225891

Figure 204

-
12. Inspect all the components for wear and damage (Figure 204). Replace the axle shaft if the seal has grooved the axle surface more than 0.40 mm (1/64 inch).

Assembling the Front Axle Shafts and Bearings

1. Coat a new outer seal plate with a thin layer of fluid and place the outer seal plate, brake assembly, and dust shield in position on the axle shaft.



g225892

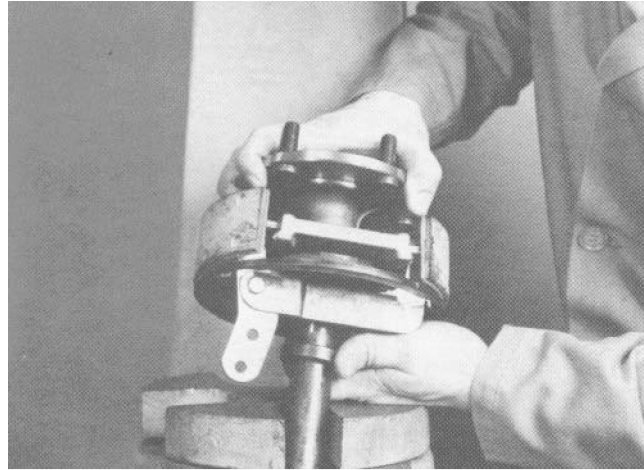
Figure 205

-
2. Pack the bearing with grease and press it onto the axle shaft (Figure 205).

IMPORTANT

Drive the bearing onto the axle shaft by pressing on the inner race of the bearing only.

Assembling the Front Axle Shafts and Bearings (continued)



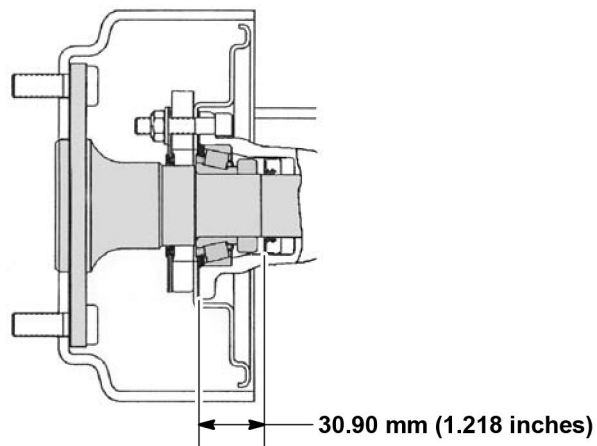
g225893

Figure 206

-
- Slide a new bearing retainer on the axle shaft. Support the shaft and retainer in a suitable press and press the bearing retainer firmly against the bearing ([Figure 206](#)).

IMPORTANT

Do not heat the bearing retainer to install. Heat will destroy the close tolerance press fit.

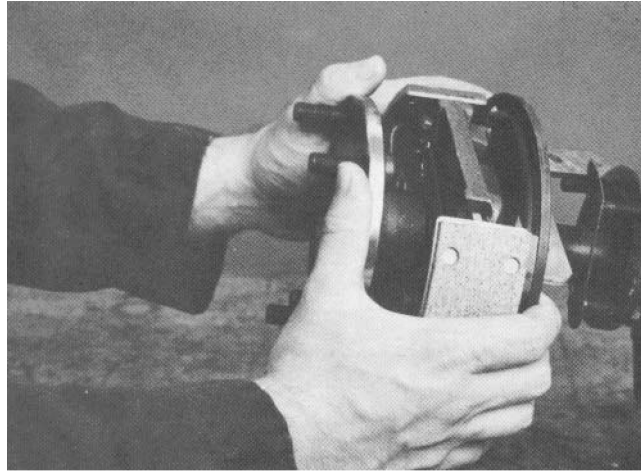


g225894

Figure 207

-
- Prepare a new inner shaft seal for assembly. Put a light coat of No. 1 Permatex (or equivalent) on the outer diameter (surface that contacts the axle housing), and a thin layer of fluid on the inner diameter (surface that contacts the axle shaft). Install new seal to a depth of 30.90 mm (1.218 inches) into the axle housing ([Figure 207](#)).

Assembling the Front Axle Shafts and Bearings (continued)

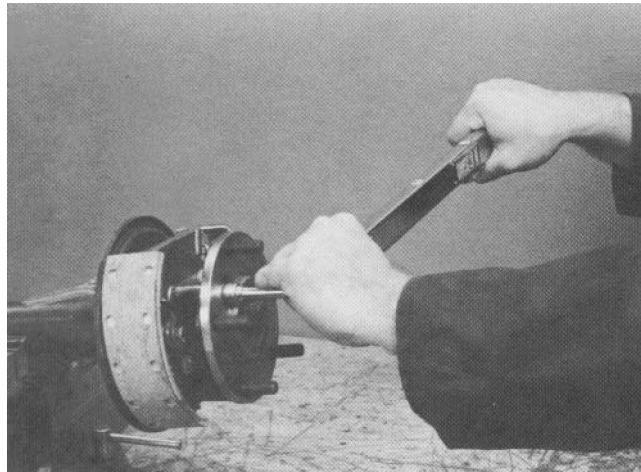


g225895

Figure 208

5. Apply a 1.60 mm (1/16 inch) bead of Loctite Ultra Gray Silicone (gasket eliminator) to the axle housing flange. Align the dust shield and brake assembly with the axle housing flange and push the axle shaft assembly all the way into the axle housing. Ensure that you do not damage the oil seal and bearing ([Figure 208](#)).

Note: Liquid gasket kit (Toro Part No. 92-8775) includes Loctite ultra gray silicone (gasket eliminator) and application instructions.



g225896

Figure 209



6. Install the 4 socket-head screws, 4 hardened washers, and 4 locknuts. Tighten the nuts evenly in an alternating pattern so that the bearing is drawn into the axle housing ([Figure 209](#)). Torque the nuts to **22 to 27 N·m (16 to 20 ft-lb)**.

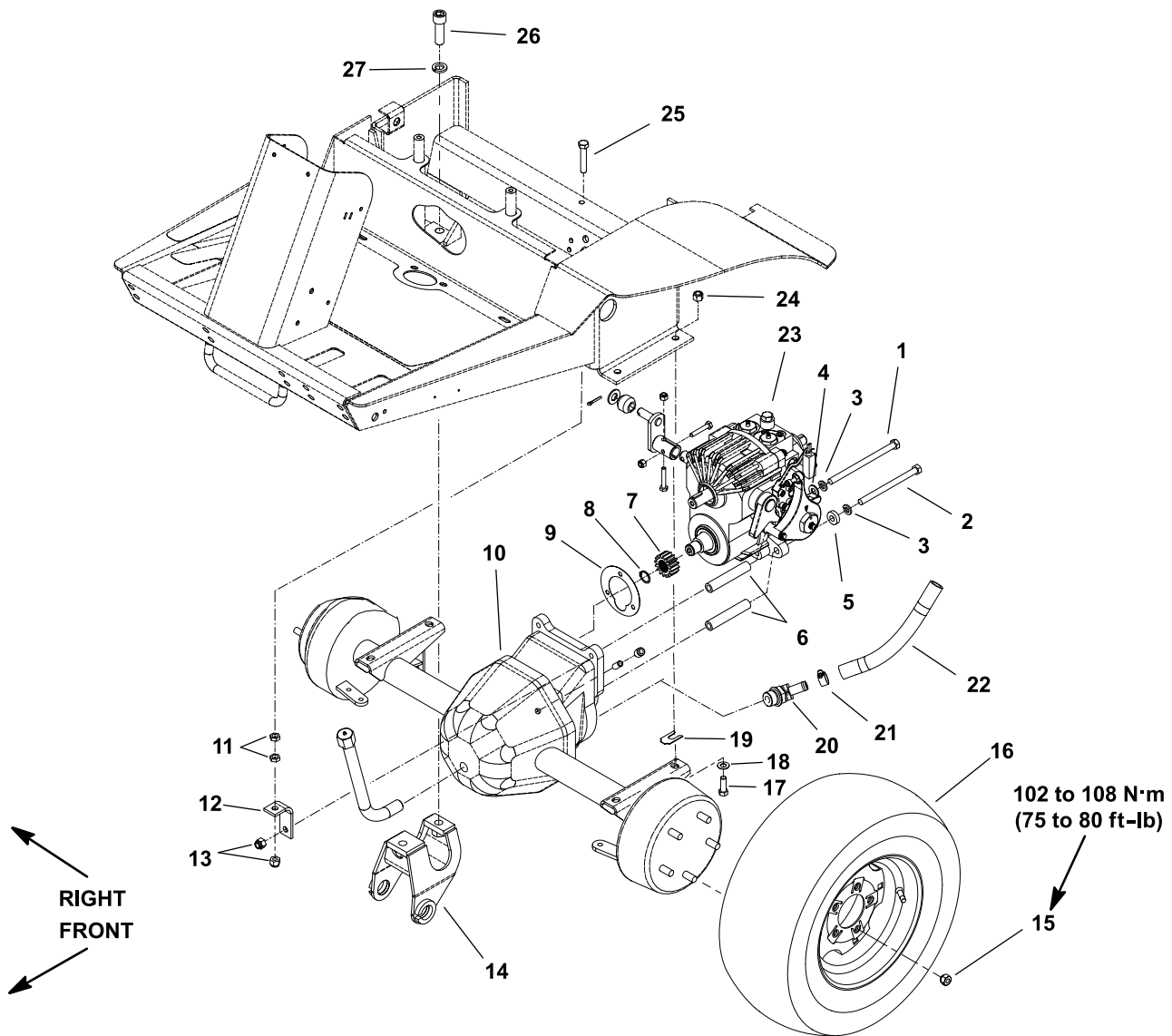
IMPORTANT

When tightening the locknuts, hold the socket-head screws with a wrench to prevent the screw head from damaging the axle tube.

Assembling the Front Axle Shafts and Bearings (continued)

7. Slide the brake drum onto the wheel studs.
8. Secure the brake cable to the brake lever with the clevis pin (item 26 in [Figure 197](#)) and cotter pin. Attach the brake return spring to the brake cable link.
9. Install the wheel assembly to the front axle; refer to [Installing the Wheel \(page 7–5\)](#).
10. Check and adjust the brakes; refer to the *Traction Unit Operator's Manual*.

Front Axle (Machine Serial Number before 316000000)



g230990

Figure 210

- | | | |
|-----------------------------|--------------------------------------|--------------------------------|
| 1. Bolt | 10. Front axle assembly | 19. Axle shim (as necessary) |
| 2. Bolt (3 each) | 11. Jam nut | 20. Hydraulic fitting |
| 3. Lock washer (4 each) | 12. Transmission anchor | 21. Hose clamp |
| 4. Flat washer | 13. Locknut | 22. Hydraulic hose |
| 5. Spacer | 14. Carrier bracket (2 each) | 23. Transmission |
| 6. Mounting spacer (4 each) | 15. Wheel-lug nut (5 each per wheel) | 24. Locknut (4 each) |
| 7. Pinion gear | 16. Tire and wheel assembly | 25. Bolt |
| 8. Snap ring | 17. Bolt (4 each) | 26. Socket-head screw (4 each) |
| 9. Gasket | 18. Flat washer (4 each) | 27. Lock washer (4 each) |

Removing the Front Axle

1. Park machine on a level surface, lower cutting deck (or implement), shut off the engine, engage parking brake and remove key from the key switch.
2. Remove the cutting deck (or implement); refer to the *Cutting Unit Operator's Manual*.
3. To prevent contamination of the hydraulic system, clean transmission and front axle.
4. Drain oil from front axle; refer to the *Traction Unit Operator's Manual*.
5. Loosen hose clamp (item 21 in [Figure 210](#)) and pull hydraulic hose from fitting on axle.
6. Remove lift arms from machine; refer to [Lift Arms \(page 7–26\)](#).
7. Remove fuel tank; refer to [Removing the Fuel Tank \(page 3–10\)](#) or [Removing the Fuel Tank \(page 4–16\)](#).
8. Remove carrier brackets (item 14 in [Figure 210](#)) from machine frame.

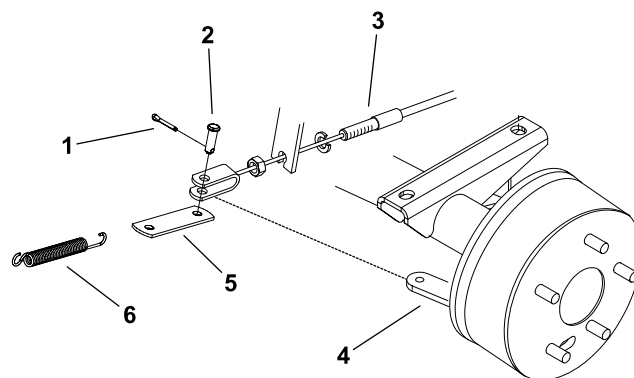


CAUTION



When removing wheels, use correct blocks, hoists and jacks. Ensure that the machine is parked on a solid, level surface such as a concrete floor. Prior to raising machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use jack stands or solid wood blocks to support the raised machine. If the machine is not properly supported by blocks or jack stands, the machine may move or fall, which may result in personal injury.

9. Chock rear wheels and jack up front of machine; refer to [Jacking Instructions \(page 1–6\)](#). Support machine with jack stands or solid wood blocks. Release parking brake.
10. Remove front wheel-lug nuts and pull front wheels from front axle.
11. Remove hydrostatic transmission from machine; refer to [Removing the Hydrostatic Transmission \(page 5–91\)](#).



g226659

Figure 211

- | | | |
|---------------|----------------|------------------------|
| 1. Cotter pin | 3. Brake cable | 5. Brake cable link |
| 2. Clevis pin | 4. Brake lever | 6. Brake return spring |

12. Remove the cotter pin and clevis pin to disconnect the brake cable from brake actuating lever on each brake ([Figure 211](#)). Loosen jam nut to remove brake cable from each end of axle bracket.

Removing the Front Axle (continued)

13. Put a jack or blocking under front axle to prevent it from falling. Remove bolts, flat washers, and locknuts that secure axle mounting pads to frame. Retrieve and note location of axle shims (item 19 in [Figure 210](#)).
14. Carefully lower front axle and remove from machine.

Installing the Front Axle

1. Position front axle to machine frame and support axle in place.
2. Place axle shims in location noted during disassembly. Install bolts, flat washers, and locknuts that secure axle mounting pads to frame. Leave fasteners loose to allow alignment of transmission.
3. Connect the brake cables to the brake actuating levers on each brake ([Figure 211](#)). Secure brake cables to axle brackets with jam nuts.

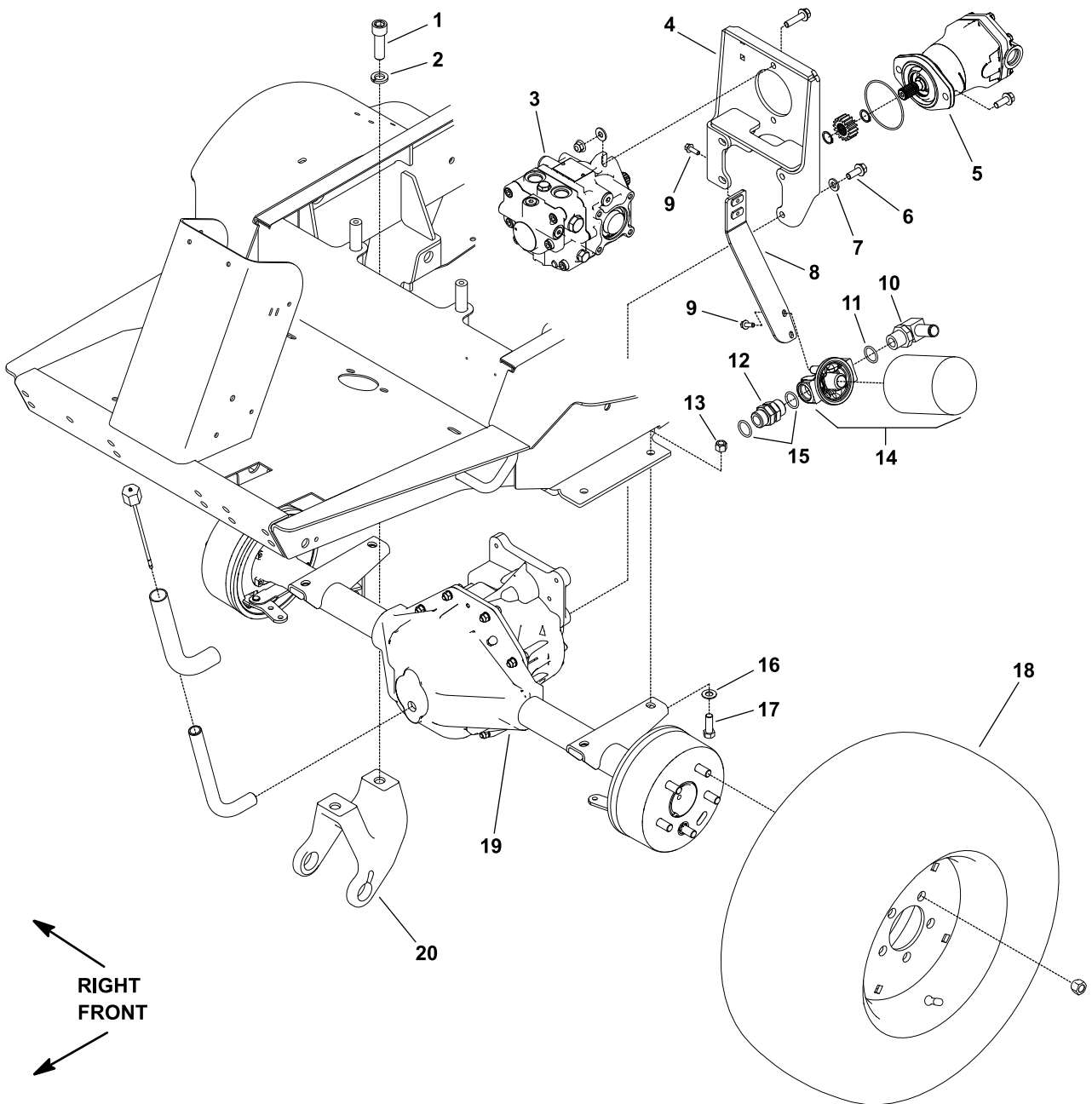
IMPORTANT

When installing hydrostatic transmission, ensure that the transmission driveshaft alignment is checked and adjusted if necessary.



4. Install hydrostatic transmission to machine; refer to [Installing the Hydrostatic Transmission \(page 5–92\)](#).
5. Install front wheels to axle and secure with wheel-lug nuts. Torque wheel-lug nuts in a crossing pattern to **102 to 108 N·m (75 to 80 ft-lb)**.
6. Install carrier brackets (item 14 in [Figure 210](#)) to the machine frame.
7. Install lift arms to the machine; refer to [Lift Arms \(page 7–26\)](#).
8. Install fuel tank; refer to [Installing the Fuel Tank \(page 3–11\)](#) or [Installing the Fuel Tank \(page 4–17\)](#).
9. Install hydraulic hose (item 22 in [Figure 210](#)) to fitting on axle and secure with hose clamp.
10. Lower the machine to ground.
11. Fill hydraulic reservoir (front axle) with hydraulic fluid; refer to the *Traction Unit Operator's Manual*.
12. Install the cutting deck (or implement); refer to the *Cutting Unit Operator's Manual*.

Front Axle (Machine Serial Number after 316000000)



g225897

Figure 212

- | | | |
|-------------------------------|-------------------------------|------------------------------|
| 1. Socket-head screw (4 each) | 8. Filter bracket | 15. O-ring (2 each) |
| 2. Lock washer (4 each) | 9. Flange-head screw (4 each) | 16. Flat washer (4 each) |
| 3. Hydraulic pump | 10. 90° hydraulic fitting | 17. Bolt (4 each) |
| 4. Pump bracket | 11. O-ring | 18. Front wheel assembly |
| 5. Hydraulic motor | 12. Straight thread fitting | 19. Front axle |
| 6. Flange-head screw (4 each) | 13. Locknut (4 each) | 20. Carrier bracket (2 each) |
| 7. Hardened washer | 14. Oil filter | |

Removing the 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. Remove the cutting deck (or implement); refer to the *Cutting Unit Operator's Manual*.
3. Clean the hydraulic components and front axle to prevent contamination.
4. Drain the hydraulic fluid from the hydraulic reservoir (front axle); refer to the *Operator's Manual*.

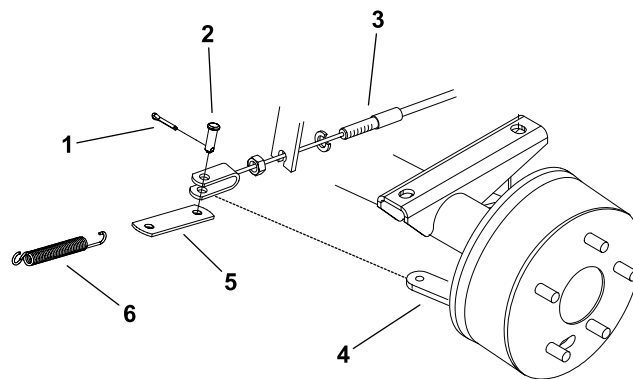


CAUTION



Before opening the hydraulic system, operate all the hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid; refer to [Releasing Pressure from the Hydraulic System \(page 5–6\)](#).

5. Remove the 2 flange-head screws (item 9 in [Figure 212](#)) that secure the oil filter to the filter bracket, and remove the straight thread fitting (with the oil filter) from the front axle. Remove and discard the O-ring from the fitting.
6. Remove the lift arms from the machine; refer to [Removing the Lift Arms \(page 7–27\)](#).
7. Remove the fuel tank; refer to [Removing the Fuel Tank \(page 4–16\)](#).
8. Remove the 2 carrier brackets (item 20 in [Figure 212](#)) from the machine frame.
9. Remove the 2 front wheels from the front axle; refer to [Removing the Wheel \(page 7–4\)](#).
10. Remove the hydraulic motor from the machine; refer to [Removing the Front Axle Drive Motor \(page 5–108\)](#).



g226659

Figure 213

- | | | |
|---------------|----------------|------------------------|
| 1. Cotter pin | 3. Brake cable | 5. Brake cable link |
| 2. Clevis pin | 4. Brake lever | 6. Brake return spring |

11. Remove the cotter pin (item 1 in [Figure 213](#)) and clevis pin, and disconnect the brake cable from the brake lever on each brake. Loosen the jam nut to remove the brake cable from each end of the axle bracket.
12. Put a jack or blocking under the front axle to prevent it from falling. Remove the 4 bolts (item 17 in [Figure 212](#)), 4 flat washers, and 4 locknuts that secure the axle mounting pads to the frame. Retrieve and note the location of the axle shims.

Removing the Front Axle (continued)

13. Carefully lower the front axle and remove the axle from the machine.

Installing the Front Axle

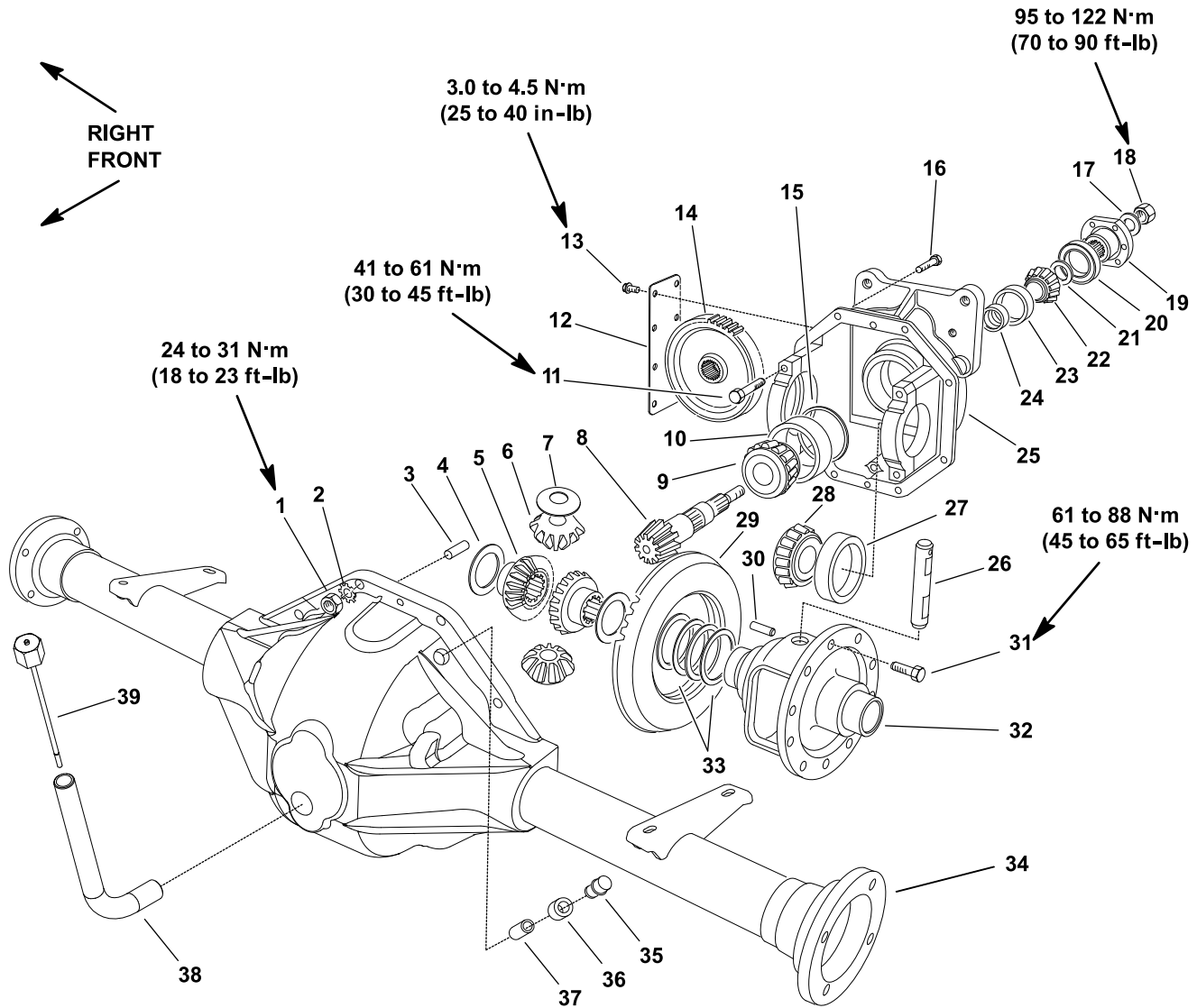
1. Position the front axle to the machine frame and support the axle in place.
2. Place the axle shims in the location that you noted during disassembly. Install the 4 bolts (item 17 in [Figure 212](#)), 4 flat washers, and 4 locknuts that secure the axle mounting pads to the frame. Leave the fasteners loose to allow alignment of hydraulic motor.
3. Connect the brake cable (item 3 in [Figure 213](#)) to the brake lever on each brake. Secure the brake cables to the axle brackets with the jam nuts.

IMPORTANT

When installing the hydraulic motor, ensure that the hydraulic motor driveshaft alignment is checked and adjusted if necessary.

4. Install the hydraulic motor to the machine; refer to [Installing the Front Axle Drive Motor \(page 5–108\)](#).
5. Install the 2 front wheels to the front axle; refer to [Installing the Wheel \(page 7–5\)](#).
6. Install the 2 carrier brackets (item 20 in [Figure 212](#)) to the machine frame.
7. Install the lift arms to the machine; refer to [Installing the Lift Arms \(page 7–28\)](#).
8. Install the fuel tank; refer to [Installing the Fuel Tank \(page 4–17\)](#).
9. Lubricate and install new O-ring to the straight thread fitting. Install the straight thread fitting (with the oil filter) to the front axle and secure the oil filter to the filter bracket with the 2 flange-head screws (item 9 in [Figure 212](#)).
10. Fill the hydraulic reservoir (front axle) with hydraulic fluid; refer to the *Traction Unit Operator's Manual*.
11. Install the cutting deck (or implement); refer to the *Cutting Unit Operator's Manual*.

Servicing the Front Axle



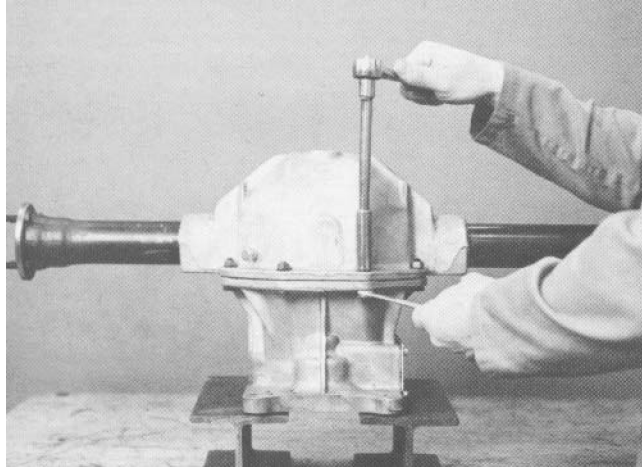
g226662

Figure 214

- | | | |
|-------------------------------------|---------------------------------|--|
| 1. Hex nut (8 each) | 14. Spur gear | 27. Differential bearing cup (2 each) |
| 2. Lock washer (8 each) | 15. Shim | 28. Differential bearing cone (2 each) |
| 3. Dowel pin (2 each) | 16. Bolt (8 each) | 29. Ring gear |
| 4. Thrust washer (2 each) | 17. Washer | 30. Lock pin |
| 5. Side bevel gear (2 each) | 18. Nut | 31. Bolt (5 each) |
| 6. Pinion mate bevel gear (2 each) | 19. Flange coupler | 32. Differential case |
| 7. Spherical thrust washer (2 each) | 20. Seal | 33. Shim pack |
| 8. Drive pinion | 21. Shim pack | 34. Front axle housing |
| 9. Bearing cone | 22. Outer bearing cone | 35. Vent |
| 10. Bearing cup | 23. Outer bearing cup | 36. Fitting |
| 11. Bolt (4 each) | 24. Bearing spacer | 37. Pipe nipple |
| 12. Gear cover | 25. Rear axle (carrier) housing | 38. Oil fill tube |
| 13. Screw (8 each) | 26. Pinion mate shaft | 39. Dipstick |

Disassembling the Front Axle

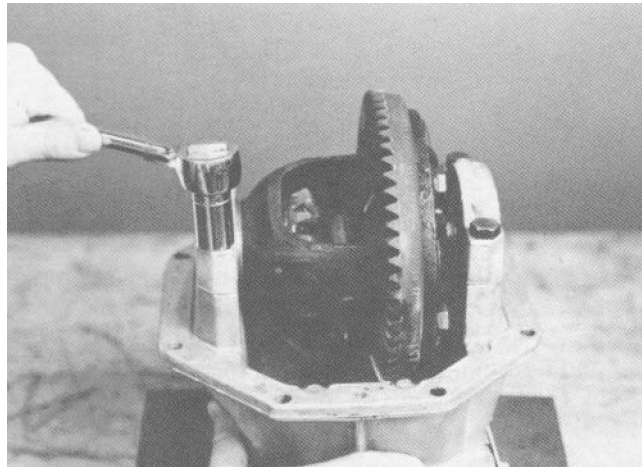
1. Remove the right and left-hand axle assemblies; refer to [Disassembling the Front Axle Shafts and Bearings](#) (page 8–9).



g225906

Figure 215

-
2. Remove the 8 housing bolts, 8 hex nuts, and 8 lock washers that secure the axle housings. Separate the front and rear axle housings ([Figure 215](#)). Clean all gasket material from the housing mating surfaces.



g225907

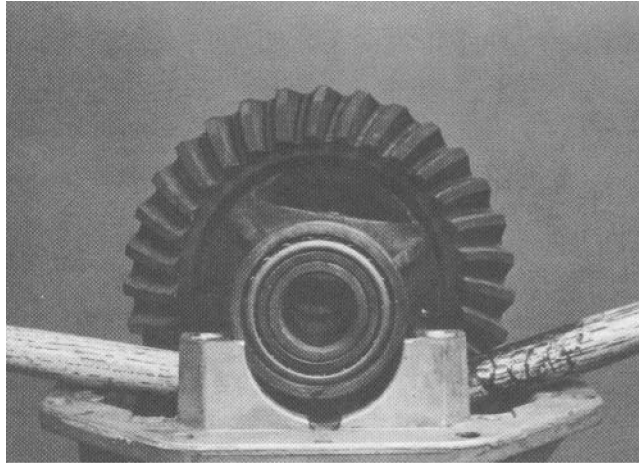
Figure 216

-
3. Remove the 4 bearing bolts, and remove the caps. Place the caps in a safe place to avoid damaging their machined surfaces ([Figure 216](#)).

IMPORTANT

The bearing caps are marked for identification. The letters or numbers are in horizontal and vertical positions. Record them for reference during assembly. Always install them in the same position.

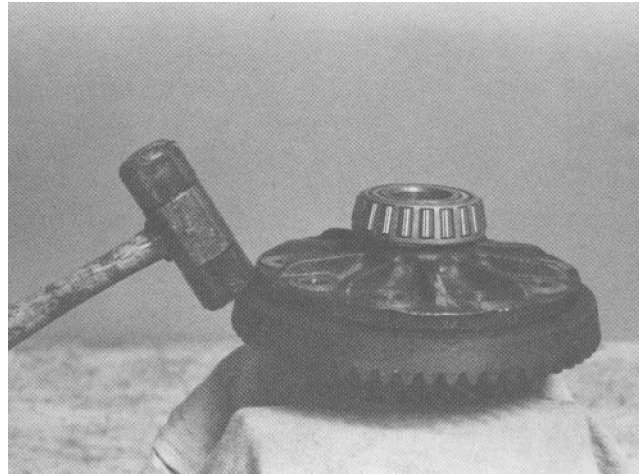
Disassembling the Front Axle (continued)



g225908

Figure 217

-
4. To remove the differential assembly, place 2 wooden devices (e.g., hammer handles) under the differential case and pry firmly upward. Mark the bearing cups and cones, they must be installed in matched sets ([Figure 217](#)).



g225909

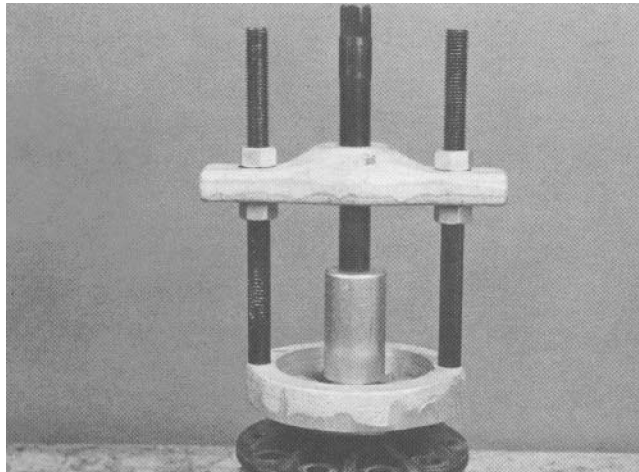
Figure 218

Note: Protect the ring gear when removing it from the differential case; this will avoid damage of the ring gear teeth.

5. Remove the ring gear bolts. Use a hard wooden block and hammer, drive the ring gear from the differential case ([Figure 218](#)).

Note: Whenever the ring gear bolts are removed, they are to be replaced with new bolts.

Disassembling the Front Axle (continued)

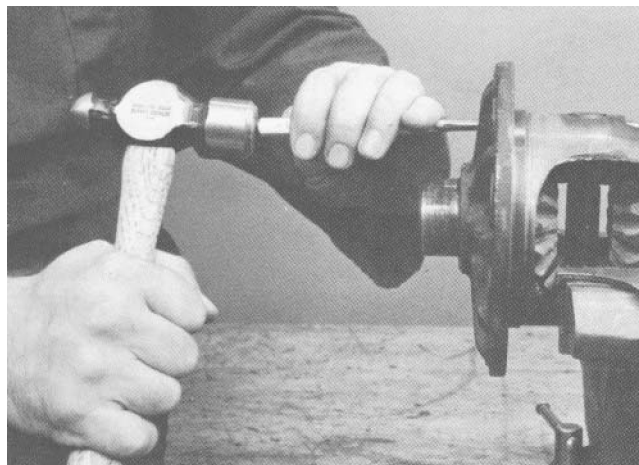


g225910

Figure 219

6. Do not remove the bearings from the differential case unless there is a bearing failure. Whenever the bearings are removed (regardless of usage) they must be replaced with new ones. Remove the case side bearing with a puller as shown in [Figure 219](#).

If the bearings are removed from the differential case, locate and retrieve the shims from the case. For assembly purposes, note the location of the shim.



g225911

Figure 220



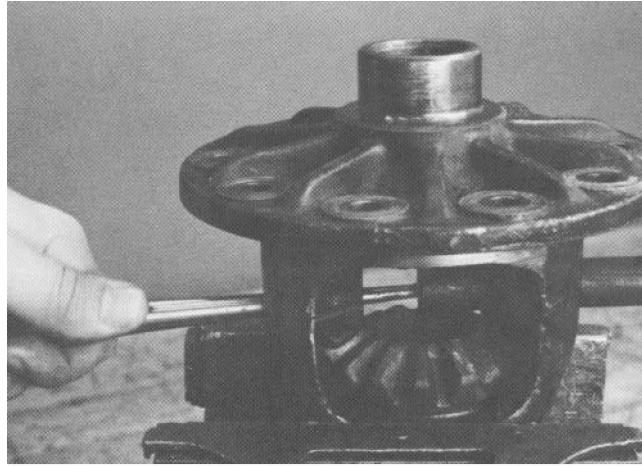
WARNING



To prevent personal injury, always wear a face shield or safety goggles when striking a drift punch with a hammer.

7. Put the case in a vise. Drive the lock pin out of the pinion mate shaft ([Figure 220](#)). Use a small drift punch.

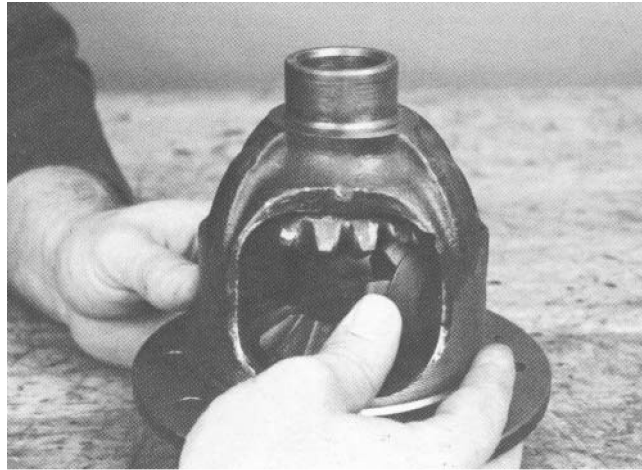
Disassembling the Front Axle (continued)



g225912

Figure 221

-
8. While supporting the differential in a vise, drive the pinion mate shaft from the differential with a long drift punch (Figure 221).

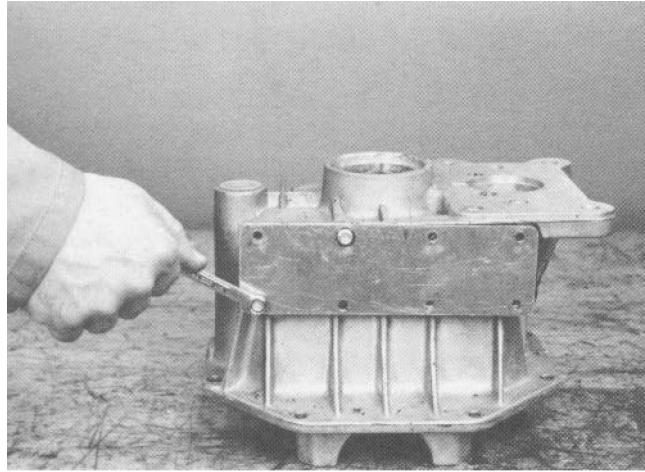


g225913

Figure 222

-
9. To remove the side gears and pinion mate gears, rotate the side gears. This will allow the pinion mate gears to turn to the opening of the case (Figure 222). Remove the pinion mate gears and spherical washers behind the gears. Inspect all differential components including the machined surfaces of the case. If there is a gear damage, replace the entire gear set as damage to 1 gear will most likely damage other gears as well. If necessary, replace the complete differential assembly.

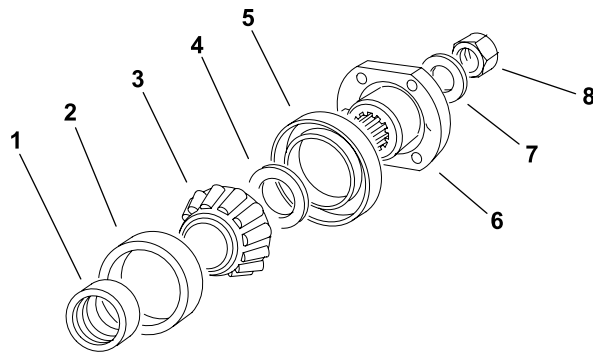
Disassembling the Front Axle (continued)



g225914

Figure 223

-
10. Remove the 8 side cover bolts, and remove the side cover from the carrier assembly ([Figure 223](#)). Clean the gasket material from the mating surfaces before assembly.



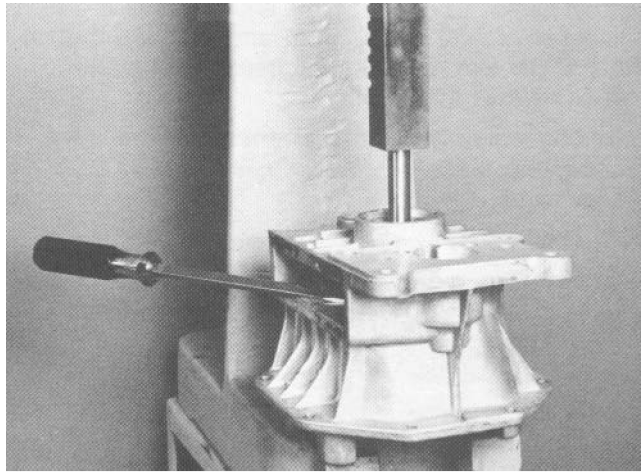
g226660

Figure 224

- | | | |
|-----------------------|-------------------|-----------|
| 1. Bearing spacer | 4. Shim | 7. Washer |
| 2. Outer bearing cup | 5. Seal | 8. Nut |
| 3. Outer bearing cone | 6. Flange coupler | |

-
11. Install the differential gear holder to carrier to retain the spur gear; refer to the [Differential Gear Holder \(page 8-5\)](#). Remove the nut, washer, flange coupler, and seal from the pinion shaft ([Figure 224](#)).

Disassembling the Front Axle (continued)



g225915

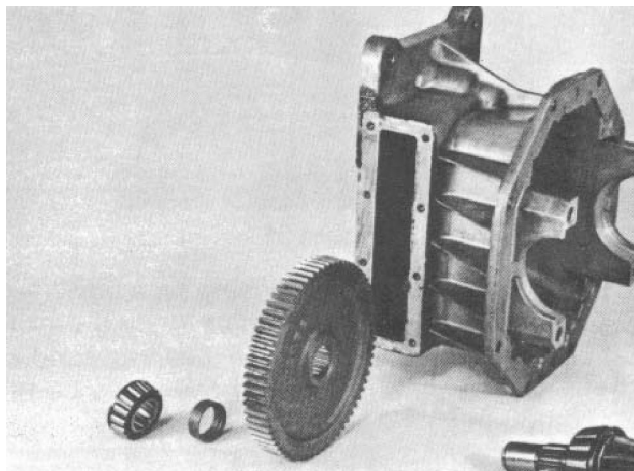
Figure 225

-
12. Position the housing assembly on a suitable press. Place a 3 mm (1/8 inch) piece of steel or a screwdriver blade under the edge of the spur gear. This will prevent the spur gear from cocking and possibly cracking the housing (Figure 225).

IMPORTANT

Do not allow the pinion shaft to drop on the floor during removal as damage will result.

Carefully press the drive pinion shaft from the housing. When the pinion is close to being pressed completely out of the bearing, reach under the housing and catch the pinion in your hand to prevent any damage to the pinion.

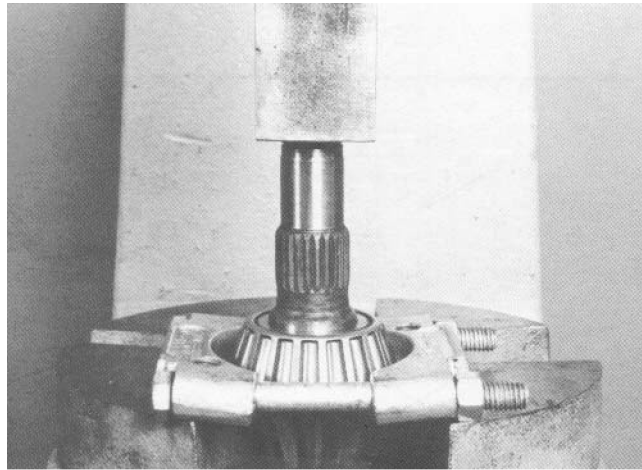


g225916

Figure 226

-
13. Removing the drive pinion releases the spur gear (Figure 226).
14. Remove the oil seal from the housing. Then remove the bearing shim, outer pinion bearing cone, and bearing spacer from the housing (Figure 224).

Disassembling the Front Axle (continued)



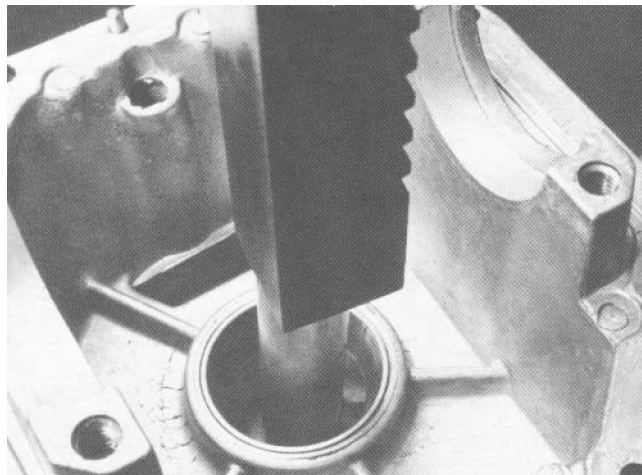
g225917

Figure 227

-
15. Clamp the inner pinion bearing with a universal bearing remover ([Figure 227](#)). Position the unit in a press and carefully push the drive pinion out of the bearing.

IMPORTANT

Do not allow the pinion to drop on the floor during removal as damage will result.

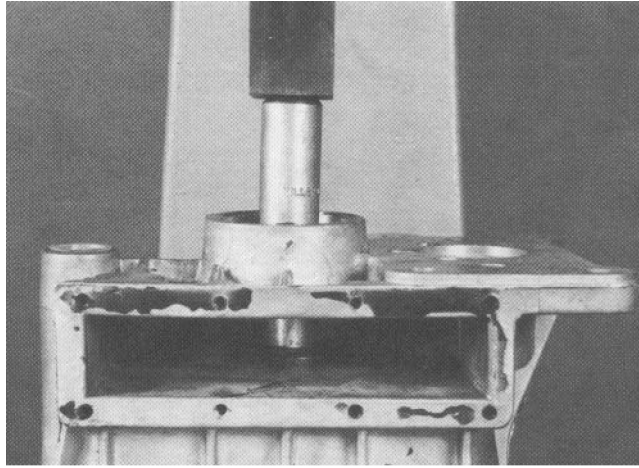


g225918

Figure 228

-
16. To remove the outer pinion bearing cup, position the housing in a press. Place a press plate of the proper size against the cup. Press the cup out of the housing ([Figure 228](#)).
17. Position the front housing on a press bed with the bearing saddles resting on the press bed. Protect the bearing saddles with a piece of wood if the press bed is rough.

Disassembling the Front Axle (continued)



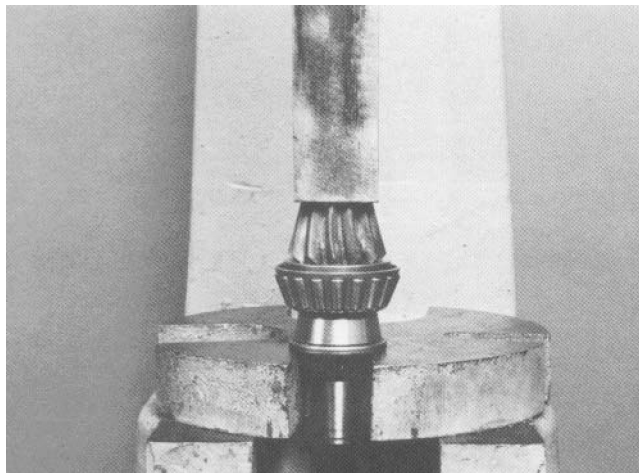
g225919

Figure 229

Insert a press plate of the proper size and press the inner bearing cup toward the inside of the housing. Retain the shims located under the bearing cup (Figure 229). If the shims are damaged, replace with new shims of the same thickness.

Assembling the Front Axle

1. Inspect the differential parts for damage before assembling.
 - A. If any bearings are damaged they must be replaced with new ones. Replace all the bearings that were removed.
 - B. Check the ring, pinion, and spur gear for abnormal wear or damage; replace the components that are worn.
 - C. Inspect the housings for cracks and external damage that could affect the operation of the axle assembly.
 - D. Inspect the differential case for wear in the side gear and pinion mate area. Replace the case if its machined areas are scored or if the pinion mate shaft fits loosely in the bore.

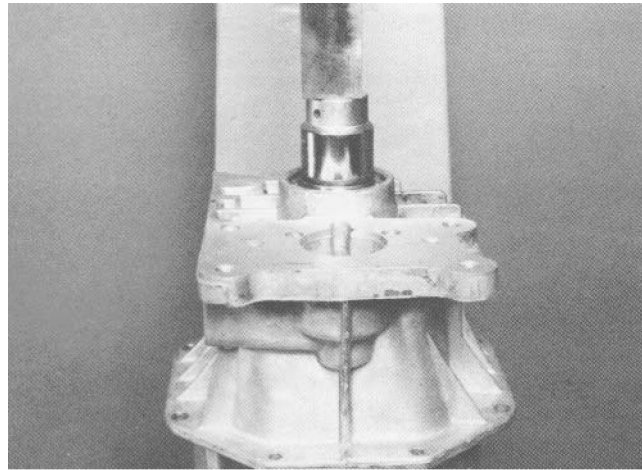


g225920

Figure 230

-
2. Press new pinion inner bearing cone onto the pinion drive gear. Support the bearing on the inner cup of the bearing only when installing (Figure 230).

Assembling the Front Axle (continued)



g225921

Figure 231

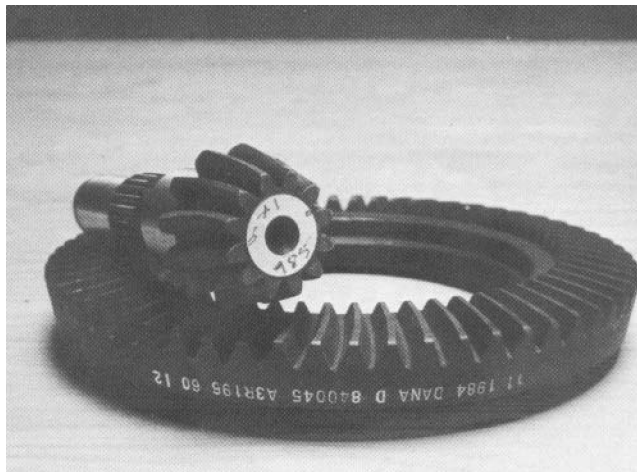
-
- Put the front housing on a press. Use a press plate, push new pinion outer bearing cup into the housing until it bottoms in the housing ([Figure 231](#)).

IMPORTANT

Correct engagement between the ring gear and pinion gear is critical to axle performance and durability.

Note: A complete upper housing assembly for differential repairs is available. Using this assembly eliminates the need for shimming to establish the correct contact pattern between the ring and pinion gears.

- Determine the correct inner bearing shims for use with ring and pinion gear sets:
 - When you install the original ring and pinion gears, the original bearing shims or new shims of the same thickness should be used. In this case, proceed directly to [step 5](#).



g225922

Figure 232

Assembling the Front Axle (continued)

- B. When you install new ring and pinion gears (supplied in matched sets only) ensure that the numbers etched on both the pinion and ring gear match (Figure 232).

Compare the +, -, or 0 markings of the old and new pinions. Adjust the thickness of a new shim pack to compensate for the difference in these 2 numbers.

For example: If the old pinion reads +2 and the new pinion reads -2, add 0.004 inch of bearing shims to the original shim pack thickness.

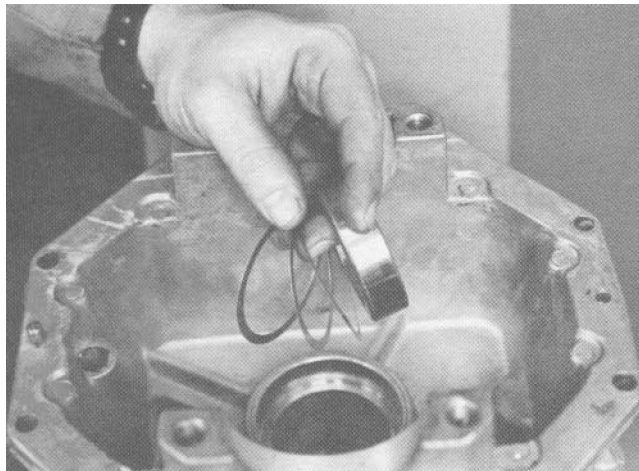
Note: The following information is provided to help you understand the adjustment required for proper engagement of new ring and pinion gears.

To ensure proper engagement, an additional number is etched into the button end of each pinion gear. This number indicates modifications that must be made to the pinion to ring gear distance for each particular gear set. This distance is controlled by adding or removing shims behind the inner bearing cup.

A pinion gear etched 0 is considered standard, and has a 1.210 inches pinion to ring gear distance.

A pinion gear etched +3 requires a pinion to ring gear distance of 1.213 inches (+0.003 inch from standard). Removing 0.003 inch of bearing shims moves the pinion gear away from the ring gear, increasing the pinion to ring gear distance.

A pinion gear etched -3 requires a pinion to ring gear distance of 1.207 inches (-0.003 inch from standard). Adding 0.003 inch of bearing shims moves the pinion gear closer to the ring gear, decreasing the pinion to ring gear distance.



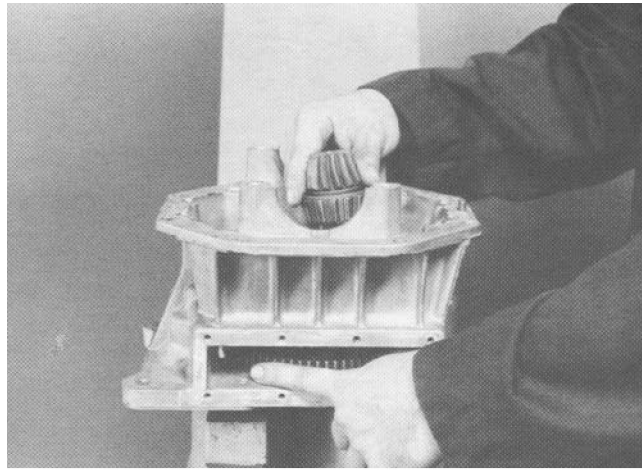
g225923

Figure 233

-
5. Install the correct bearing shims and a new inner bearing cup using a press plate of proper diameter. Push the bearing into the housing until it bottoms out against the shims (Figure 233).

Note: Pinion bearing shims are available in 0.08 mm (0.003 inch), 0.13 mm (0.005 inch), 0.25 mm (0.010 inch), and 0.76 mm (0.030 inch) thickness.

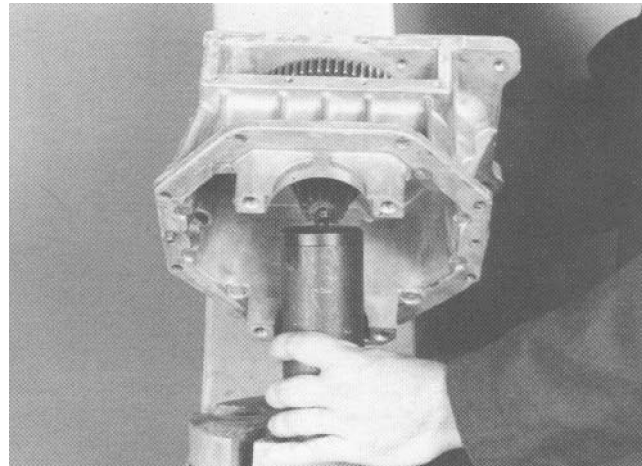
Assembling the Front Axle (continued)



g225924

Figure 234

-
6. Insert the spur gear into the front housing with the chamfered area of the center spline toward the pinion gear. Tap the pinion gear with a soft mallet to engage the splines in the spur gear ([Figure 234](#)).

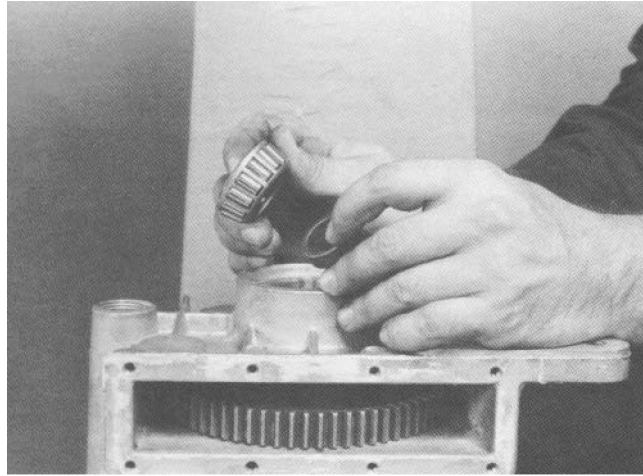


g225925

Figure 235

-
7. Support the drive pinion in a suitable press ([Figure 235](#)).

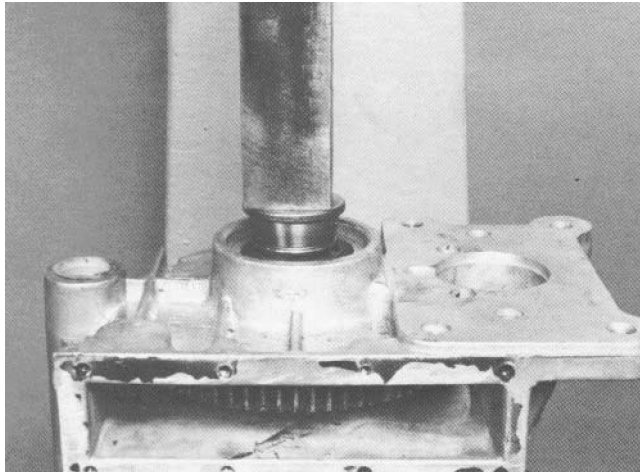
Assembling the Front Axle (continued)



g225926

Figure 236

8. Install the outer bearing spacer with the chamfer toward the pinion splines and position new outer bearing cone on the pinion shaft (Figure 236).



g225927

Figure 237



9. With a hollow press sleeve of proper diameter, press on the outer bearing cone race until the drive pinion seats in the carrier and a slight drag is felt when the gear is rotated by hand (Figure 237). If more than **0.2 to 1.5 N·m (2 to 13 in-lb)** torque is required to rotate the pinion and spur gear, tap the pinion shaft with a soft mallet until the drag is reduced.
10. Apply permatex No. 2 (or equivalent) to the outer diameter of the seal, external splines of the pinion shaft, and internal splines of the pinion coupler. Install the differential gear holder to carrier to retain the spur gear; refer to the [Differential Gear Holder \(page 8-5\)](#).

Assembling the Front Axle (continued)

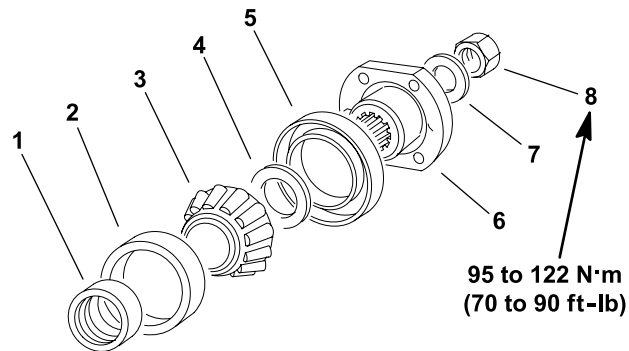


Figure 238

- | | | |
|-----------------------|-------------------|-----------|
| 1. Bearing spacer | 4. Shim | 7. Washer |
| 2. Outer bearing cup | 5. Seal | 8. Nut |
| 3. Outer bearing cone | 6. Flange coupler | |



11. Install the seal into the housing. Install the shim, flange coupler, washer, and nut onto end of the pinion shaft ([Figure 238](#)). Torque the nut that secures the pinion coupler to **95 to 122 N·m (70 to 90 ft-lb)**.

12. Check the pinion shaft end-play.

Pinion shaft end-play: 0.00 to 0.13 mm. (0.000 to 0.005 inch)

If end-play is incorrect, remove the nut, washer, and flange coupler. Replace the shim with appropriate thicker or thinner shim and assemble. Ensure that the pinion shaft end-play is correct before you proceed with assembly procedure.

Note: Pinion shaft shims are available in 2.39 mm (0.094 inch) to 3.05 mm (0.120 inch) thickness, and in 3.18 mm (0.125 inch) to 3.84 mm (0.151 inch) thickness in 0.05 mm (0.002 inch) increments.

13. Remove the differential gear holder from the carrier.

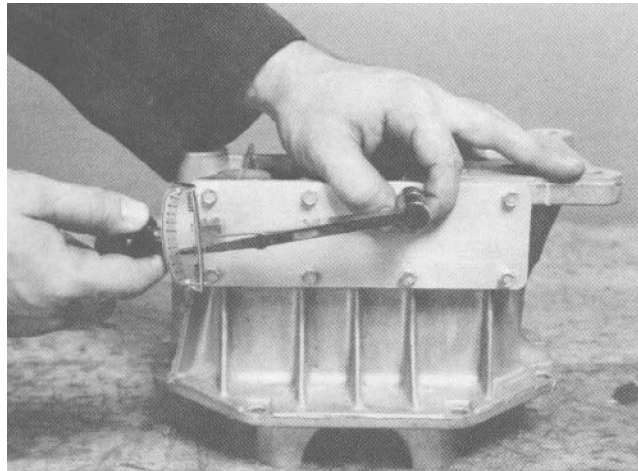


Figure 239



14. Ensure that all gasket material has been removed from the mating surfaces of the spur gear cover and carrier before assembly. Apply Permatex No. 2 or silicone sealant to the mating surface of the spur gear cover and carrier.

Assembling the Front Axle (continued)

Install the spur gear cover (Figure 239). Torque the bolts to **3 to 4.5 N·m (25 to 40 in-lb)**.

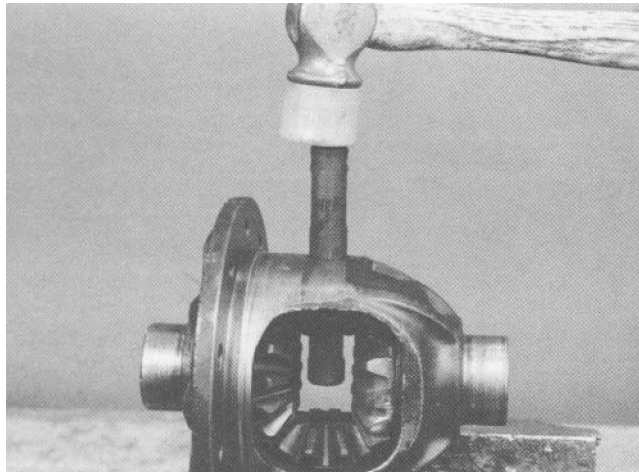


g225929

Figure 240

-
15. Place the differential case in a vise (Figure 240). Apply grease to new side gear thrust washers and hubs of the side gears. Apply grease to new pinion mate spherical washers and pinion mate gears. Place the side gears and thrust washers in the case. Install the pinion gears while holding the side gears in place.

Rotate the side gears until the holes of the washers and pinion gears line up with the holes of the case. If the gears cannot be rotated by hand, install 1 of the axle shafts into the side gear spline and use a pipe wrench to turn the shafts.



g225930

Figure 241

-
16. Install the pinion shaft. Grease the shaft to aid assembly. Ensure that the hole in the pinion shaft lines up with the hole in the differential case (Figure 241).

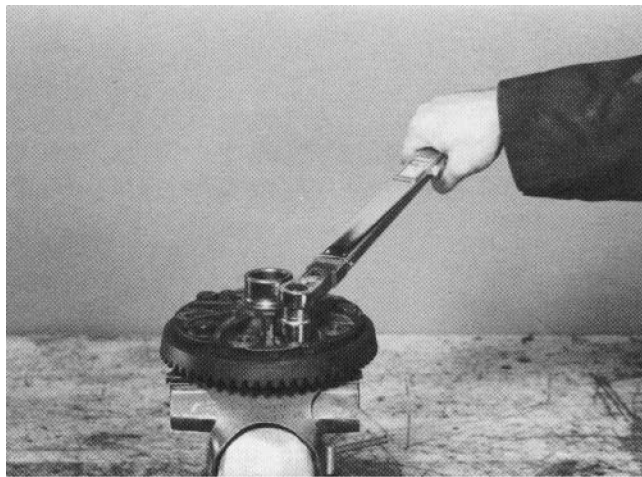
Assembling the Front Axle (continued)



g225931

Figure 242

-
17. Assemble the lock pin. Drive the pin to the approximate center location of the pinion mate shaft. Peen the metal of the case to lock the pin in place (Figure 242).



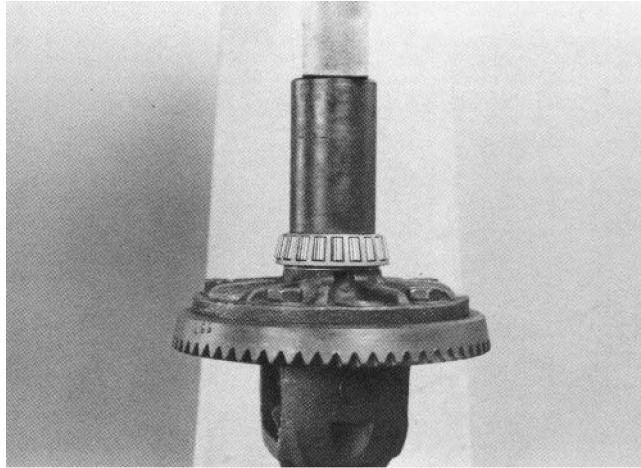
g226482

Figure 243



18. Position the ring gear onto the differential case and thread new bolts into the ring gear. Tighten the bolts, alternating back and forth across the gear to allow the gear to be pulled evenly into place. Torque the bolts to **61 to 88 N·m (45 to 65 ft-lb)** to secure assembly (Figure 243).

Assembling the Front Axle (continued)



g225933

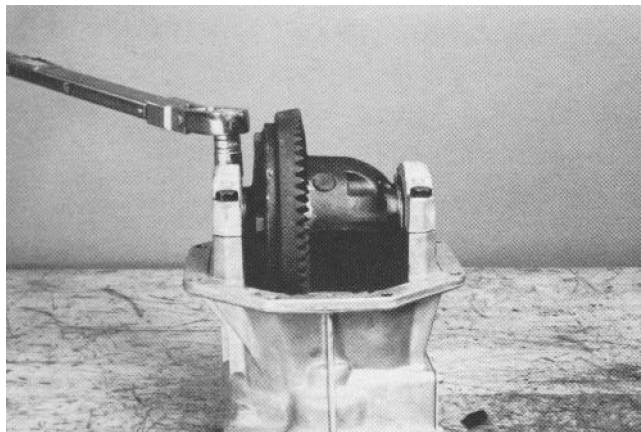
Figure 244

-
19. When you install new differential bearings, use the original shims or use new shims of the same thickness. Press new differential bearings onto the differential case. If a new differential case is being installed, start with a 0.50 mm (0.020 inch) pack of shims under each differential bearing ([Figure 244](#)).

Note: Shims are available in 0.08 mm (0.003 inch), 0.13 mm (0.005 inch), 0.25 mm (0.010 inch), and 0.76 mm (0.030 inch) thickness.

20. Assemble new differential bearing cups onto the differential bearing cones. Seat differential assembly with drive gear on proper side of carrier into the carrier bearing cradles.

Note: This application requires that the ring gear teeth face toward the spur gear cover.



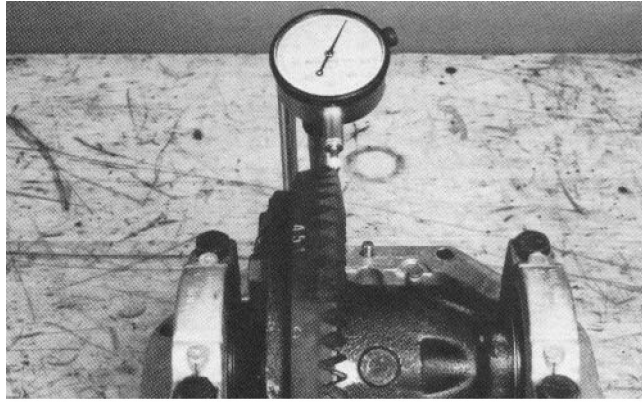
g225934

Figure 245



21. The bearing cradles are designed to apply a slight preload to the bearings. It is important to push both of the bearing assemblies simultaneously into their saddles. Install the bearing caps into their original position as marked during disassembly. Torque the bolts to **41 to 61 N·m (30 to 45 ft-lb)** ([Figure 245](#)).

Assembling the Front Axle (continued)



g225935

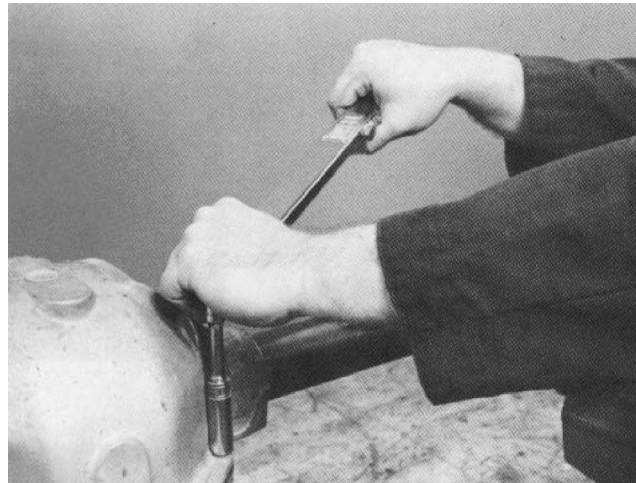
Figure 246



22. Use a dial indicator, check the ring gear backlash in 3 equally spaced points. The ring gear backlash should be 0.076 to 0.178 mm (0.003 to 0.007 inch) and must not vary more than 0.05 mm (0.002 inch) between the points checked ([Figure 246](#)).

If the backlash is not in this range, move the shims which are located below the differential bearings, from one side to the other until the correct backlash is attained.

23. Check the ring to pinion gear engagement; refer to [Ring to Pinion Gear Engagement \(Front Axle\)](#) (page 8–40).



g225936

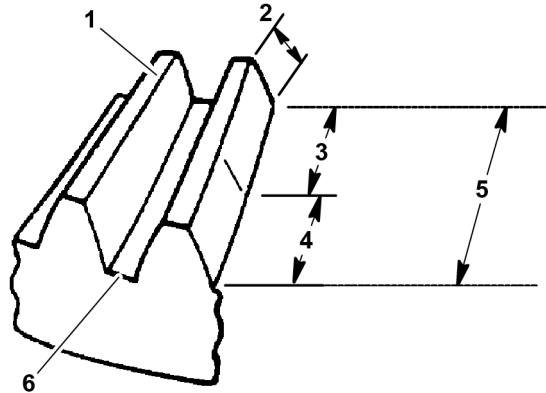
Figure 247



24. Apply silicone sealant between the front and the rear axle housings and install the 8 housing bolts. Torque the bolts to **24 to 31 N·m (18 to 23 ft-lb)** ([Figure 247](#)).
25. Install the right and left-hand axle assemblies; refer to [Front Axle Shafts and Bearings](#) (page 8–8).

Ring to Pinion Gear Engagement (Front Axle)

Final position of the front axle pinion is verified by using the gear contact pattern method as described in the following procedure.



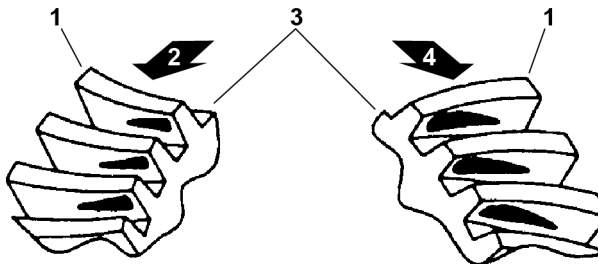
g226484

Figure 248

- | | | |
|-------------|---------|---------------------------|
| 1. Top land | 3. Toe | 5. Lengthwise bearing arc |
| 2. Profile | 4. Heel | 6. Root |

Gear tooth definitions (Figure 248):

- **Toe** - the portion of the tooth surface at the end toward the center.
 - **Heel** - the portion of the gear tooth at the outer end.
 - **Top Land** - top surface of tooth.
1. Paint the teeth of the ring gear, both drive and coast side, with a gear marking compound, such as DyKem® steel blue.



g226485

Figure 249

- | | |
|---------------|---------------|
| 1. Heel | 3. Toe |
| 2. Drive side | 4. Coast side |

2. While applying a light load to the ring gear, rotate the pinion gear until the ring gear has made 1 complete revolution. The drive side pattern should be located at the toe portion of the tooth. The coast pattern should also be at the toe portion of the tooth (Figure 249).

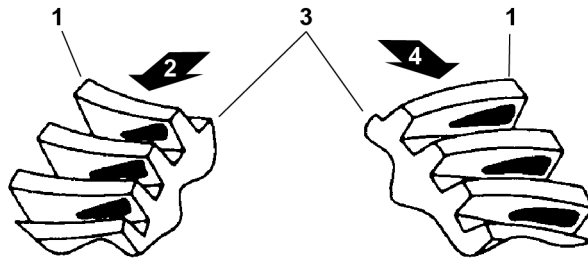
Study the patterns in the following illustrations and correct engagement as necessary.

Note: When making changes, note that 2 variables are involved. Example: If you have the backlash set correctly to specifications and you change the pinion position shim, you may have to adjust backlash to the correct specification before checking the pattern.

Every gear has a characteristic pattern. The illustrations show typical patterns only and explain how patterns shift as the gear location is changed. When making pinion position changes, shims should be changed in the range of 0.05 to 0.10 mm (0.002 to 0.004 inch) until a correct pattern has been obtained.

When a change in backlash is required, backlash shims should be changed in the range of 1-1/2 times the amount of backlash necessary to bring the gears into specification. For example, if the backlash necessary to be changed by 0.10 mm (0.004 inch), the shim pack should be changed by 0.15 mm (0.006 inch) as a starting point.

High backlash is corrected by moving the ring gear closer to the pinion. Low backlash is corrected by moving the ring gear away from the pinion. These corrections are made by switching shims from one side of the differential case to the other.

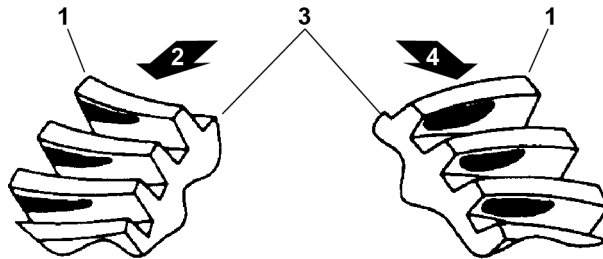


g226455

Figure 250

- | | |
|---------------|---------------|
| 1. Heel | 3. Toe |
| 2. Drive side | 4. Coast side |

Example 1: Backlash correct. Thicker pinion position shims necessary ([Figure 250](#)).

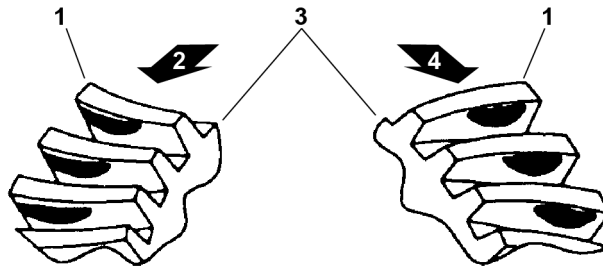


g226456

Figure 251

- | | |
|---------------|---------------|
| 1. Heel | 3. Toe |
| 2. Drive side | 4. Coast side |

Example 2: Backlash correct. Thinner pinion position shims necessary ([Figure 251](#)).



g226457

Figure 252

- | | |
|---------------|---------------|
| 1. Heel | 3. Toe |
| 2. Drive side | 4. Coast side |

Example 3: Backlash incorrect. Thinner pinion position shim necessary. Adjust backlash to match (Figure 252).

Gear Pattern Movement Summary

1. Decreasing backlash moves the ring gear closer to the pinion.
 Drive pattern (convex side of gear) moves lower and toward the toe.
 Coast pattern (concave side of gear) moves slightly higher and toward the heel.
2. Increasing backlash moves the ring gear away from the pinion.
 Drive pattern (convex side of gear) moves higher and toward the heel.
 Coast pattern (concave side of gear) moves slightly lower and toward the toe.
3. Thicker pinion position shim with the backlash constant moves the pinion closer to the ring gear.
 Drive pattern (convex side of gear) moves deeper on the tooth (flank contact) and slightly toward the toe.
 Coast pattern (concave side of gear) moves deeper on the tooth and toward the heel.
4. Thinner pinion position shim with backlash constant moves the pinion further from the ring gear.
 Drive pattern (convex side of gear) moves toward the top of the tooth (face contact) and toward the heel.
 Coast pattern (concave side of gear) moves toward the top of the tooth (face contact) and toward the heel.

Rear Axle Driveshaft (4-Wheel Drive)

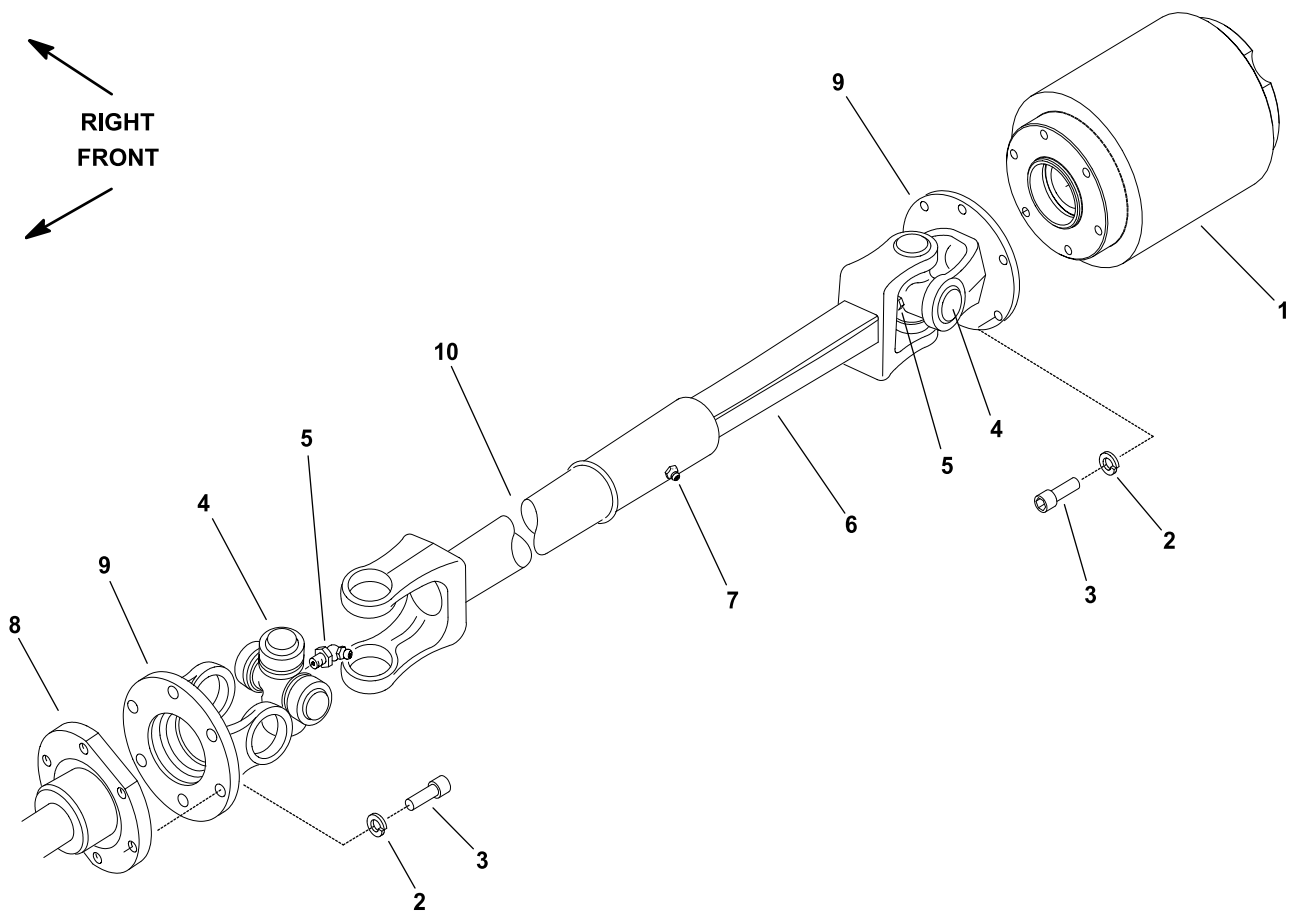


Figure 253

- | | | |
|--|----------------------------|-------------------------|
| 1. Bi-directional clutch | 5. Grease fitting (2 each) | 9. Yoke flange (2 each) |
| 2. Lock washer (6 each per flange) | 6. Yoke and shaft | 10. Yoke and tube |
| 3. Socket-head screw (6 each per flange) | 7. Grease fitting | |
| 4. Cross and bearing kit (2 each) | 8. Front axle flange | |

Removing the Rear Axle Driveshaft (4-Wheel Drive)

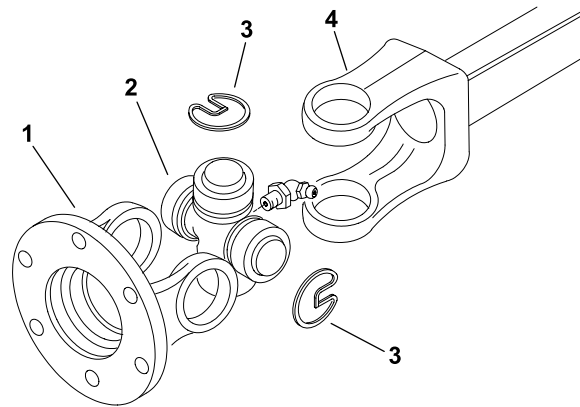
1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Support the driveshaft to prevent it from falling.
3. Remove the 6 socket-head screws and 6 lock washers that secure the driveshaft front yoke flange to the front axle flange (item 8 in [Figure 253](#)).
4. Remove the 6 socket-head screws and 6 lock washers that secure the driveshaft rear yoke flange to the bi-directional clutch (item 1 in [Figure 253](#)).
5. Remove the rear axle driveshaft from the machine.

IMPORTANT

If the driveshaft tube and shaft were separated, ensure that the driveshaft yokes are aligned when the tube and shaft are assembled (Figure 253). Misalignment of the yokes will result in shortened driveshaft life and will cause unnecessary vibration.

1. Position the rear axle driveshaft to the machine. Ensure that the driveshaft tube (item 10 in Figure 253) is toward the rear axle.
2. Secure the yokes of the driveshaft to the front axle flange and bi-directional clutch with the fasteners that are previously removed.
3. Lubricate the driveshaft grease fittings; refer to the *Traction Unit Operator's Manual*.

Servicing the Rear Axle Driveshaft Cross and Bearing (4-Wheel Drive)



g226486

Figure 254

- | | |
|--------------------------|-----------------------|
| 1. End yoke | 3. Snap ring (4 each) |
| 2. Cross and bearing kit | 4. Shaft yoke |

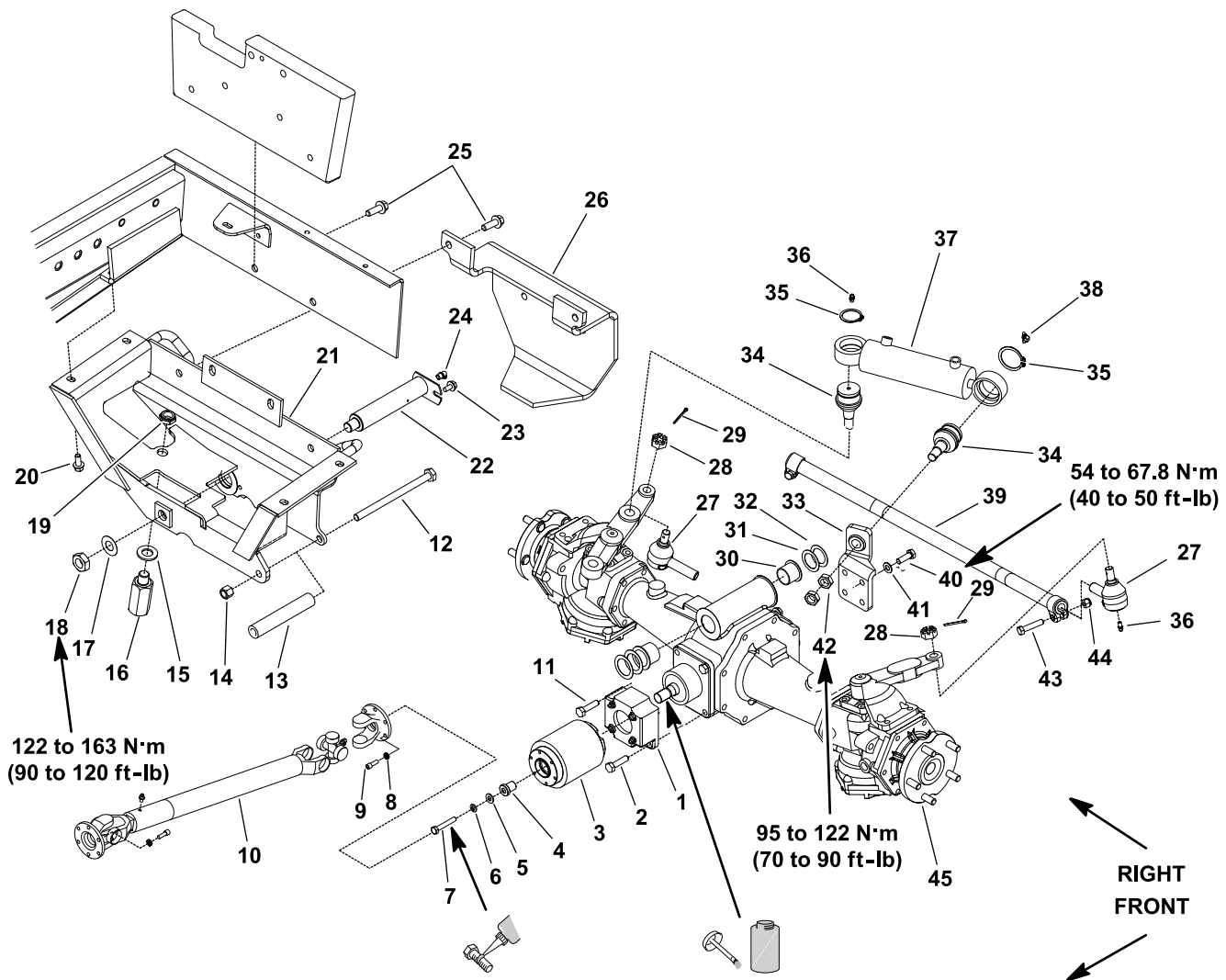
-
1. Remove the rear axle driveshaft from the machine; refer to [Removing the Rear Axle Driveshaft \(4-Wheel Drive\)](#) (page 8–43).
 2. Remove the snap rings that secure the bearings in the yokes.

IMPORTANT

Support the yokes when removing and installing the bearings to prevent damage.

3. Use a press to remove the cross and bearings from the yokes. Clean the driveshaft yokes.
4. Install new cross and bearings as follows:
 - A. Apply a thick layer of grease to the bearing bores in the end yoke and shaft yoke.
 - B. Press 1 bearing partially into the yoke.
 - C. Insert the cross into the yoke and bearing.
 - D. Hold the cross in alignment and press the bearing in until it hits the yoke.
 - E. Install the snap ring into the yoke groove to secure the installed bearing.
 - F. Place second bearing into yoke bore and onto cross shaft. Press the bearing into the yoke and secure with the snap ring.
 - G. Repeat the procedure for other yoke.
 - H. Apply grease to the cross until it comes out of all the 4 bearing cups.
5. 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.
6. Install the driveshaft to the machine; refer to [Installing the Rear Axle Driveshaft \(4-Wheel Drive\)](#) (page 8–44).

Rear Axle (4-Wheel Drive)



g226663

Figure 255

- | | | |
|-------------------------------|--------------------------------|---|
| 1. Clutch locator adapter | 16. Oscillation stop | 31. Thrust washer (as necessary) |
| 2. Bolt (2 each) | 17. Thrust washer | 32. Thrust washer (as necessary) |
| 3. Bi-directional clutch | 18. Jam nut | 33. Steering cylinder support bracket |
| 4. Spacer | 19. Locknut | 34. Steering cylinder ball joint (2 each) |
| 5. Flat washer | 20. Flange-head screw (4 each) | 35. Retaining ring (2 each) |
| 6. Lock washer | 21. Axle support | 36. Grease fitting |
| 7. Bolt | 22. Axle pin | 37. Steering cylinder |
| 8. Lock washer (6 each) | 23. Washer-head screw | 38. Grease fitting |
| 9. Socket-head screw (6 each) | 24. Grease fitting | 39. Tie rod |
| 10. Driveshaft assembly | 25. Flange-head screw (4 each) | 40. Bolt (4 each) |
| 11. Bolt (2 each) | 26. Rear bumper | 41. Washer (4 each) |
| 12. Bolt | 27. Tie rod end (2 each) | 42. Jam nut (4 each) |
| 13. Axle stop | 28. Slotted hex nut (2 each) | 43. Bolt (2 each) |
| 14. Locknut | 29. Cotter pin (2 each) | 44. Locknut (2 each) |
| 15. Flat washer | 30. Flange bushing (2 each) | 45. Rear axle assembly |

Note: For repair information regarding the rear axle on 2-wheel drive machines; refer to [Chapter 7: Chassis \(page 7–1\)](#).

Removing the Rear Axle (4-Wheel Drive)

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Drain the hydraulic fluid from the rear axle; refer to the *Traction Unit Operator's Manual*.
3. Remove the 2 rear wheels from the rear axle; refer to [Removing the Wheel \(page 7–4\)](#).
4. Remove the 6 socket-head screws (item 9 in [Figure 255](#)) and 6 lock washers that secure the driveshaft assembly to the bi-directional clutch on the rear axle. Position the end of the driveshaft away from the clutch.
5. Remove the steering cylinder from the rear axle; refer to [Removing the Steering Cylinder \(4-Wheel Drive\) \(page 5–123\)](#).
6. If the machine has rear weight(s) attached to the frame, remove the weight(s).
7. Support the rear axle to prevent it from falling. Remove the 4 flange-head screws (item 20 in [Figure 255](#)) that secure the rear axle support to the machine frame. Lower the rear axle and rear axle support from the machine.
8. Remove the jam nut (item 18 in [Figure 255](#)) and thrust washer from the axle pin that secures the rear axle to the rear axle support. Remove the washer-head screw that secures the flange of the axle pin to the rear axle support.
9. Remove the axle pin. Separate the rear axle support from the rear axle. Note the location of the thrust washers on both ends of the axle mounting boss.

Installing the Rear Axle (4-Wheel Drive)



1. Position the rear axle support to the axle. Install the thrust washers (items 31 and 32 in [Figure 255](#)) between the axle boss and the axle support to minimize clearance.
2. Install the axle pin (item 22 in [Figure 255](#)) to secure the axle to the rear axle support. Install the thrust washer and jam nut onto the pivot pin. Torque the jam nut to **122 to 163 N·m (90 to 120 ft-lb)**. Secure the pivot pin to the axle support with the washer-head screw.
3. Position the axle and axle support under the machine with a jack. Raise the assembly to the machine frame and align the mounting holes of axle support and the machine frame.
4. Secure the rear axle support to the frame with the 4 flange-head screws (item 20 in [Figure 255](#)).
5. Install the steering cylinder to the axle assembly; refer to [Installing the Steering Cylinder \(4-Wheel Drive\) \(page 5–124\)](#).
6. Position the end of the driveshaft to the bi-directional clutch on the rear axle. Secure the driveshaft to the clutch with the 6 socket-head screws (item 9 in [Figure 255](#)) and 6 lock washers.
7. Install the 2 rear wheels to the rear axle; refer to [Installing the Wheel \(page 7–5\)](#).
8. If equipped with the rear weight(s), attach the weight(s) to the rear of the machine.
9. Fill the axle and input gearbox with SAE 80W–90 weight gear lube; refer to the *Traction Unit Operator's Manual*.

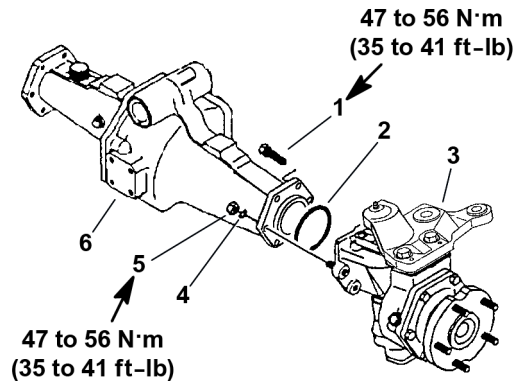
Installing the Rear Axle (4-Wheel Drive) (continued)

10. Start the engine and check for component interference as the steering wheel is turned from lock to lock.
11. Check the rear wheel toe-in and adjust if necessary; refer to the *Traction Unit Operator's Manual*.
12. Check the steering stop bolt adjustment on both sides of the axle. At full right and left turns, a gap of 2.2 mm (0.088 inch) should exist between the bevel gear case casting and the stop bolt on the axle case.

Bevel Gear Case and Axle Case (4-Wheel Drive Axle)

The following procedures assume the 4-wheel drive rear axle assembly has been removed from the machine.

Removing the Bevel Gear Case and Axle Case (4-Wheel Drive Axle)



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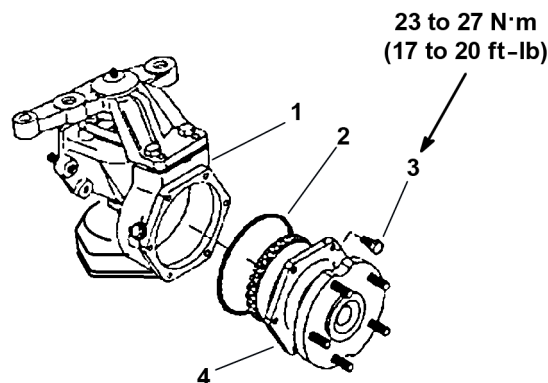
Figure 256

- | | | |
|-------------------|---------------------------------------|---------------------|
| 1. Mounting screw | 3. Bevel gear case/axle case assembly | 5. Locknut assembly |
| 2. O-ring | 4. Lock washer | 6. Axle support |

1. Remove the mounting screws, nuts, and lock washers, and remove the bevel gear case/axle case assembly and O-ring from the axle support (Figure 256).
2. Mark both right and left bevel gear case/axle case assemblies.

IMPORTANT

Do not interchange the right and left bevel gear case/axle case assemblies.



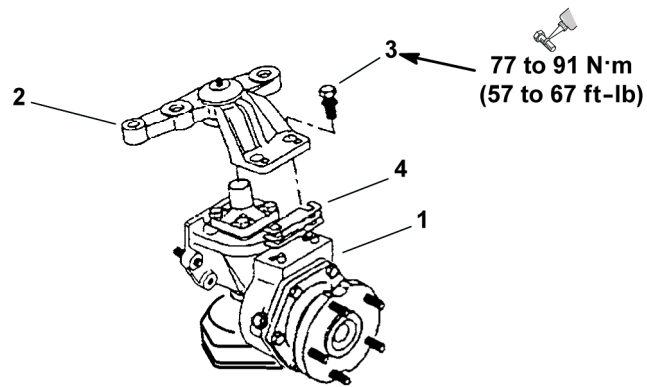
g226487

Figure 257

- | | |
|--------------|------------------------|
| 1. Axle case | 3. Mounting screw |
| 2. O-ring | 4. Axle cover assembly |

3. Remove the axle cover mounting screws, and remove the axle cover from the axle case as an assembly (Figure 257).

Removing the Bevel Gear Case and Axle Case (4-Wheel Drive Axle) (continued)

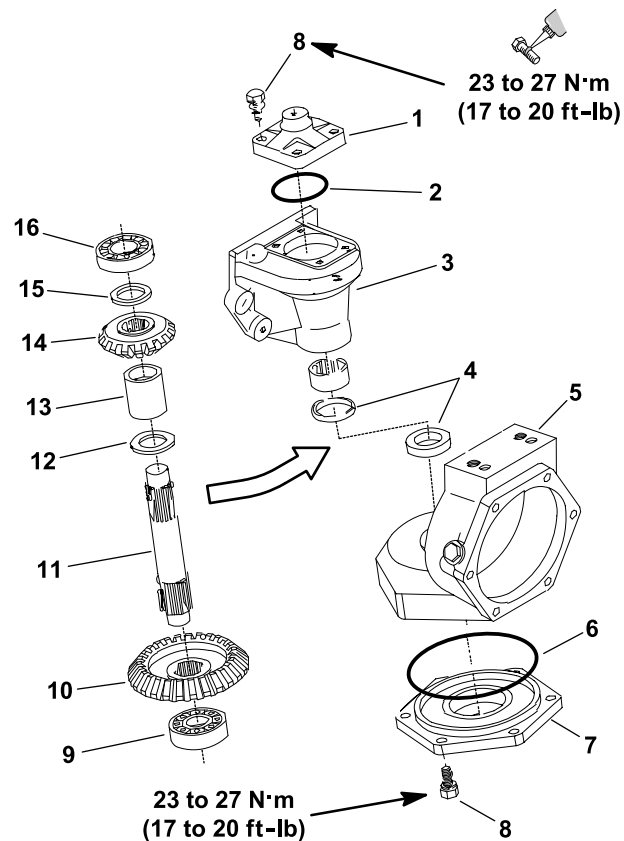


g226460

Figure 258

- | | |
|----------------------|-------------------|
| 1. Axle case | 3. Mounting screw |
| 2. Axle case support | 4. Support shim |
-
4. Remove the axle case support mounting screws, axle case support, and support shims ([Figure 258](#)).

Removing the Bevel Gear Case and Axle Case (4-Wheel Drive Axle) (continued)



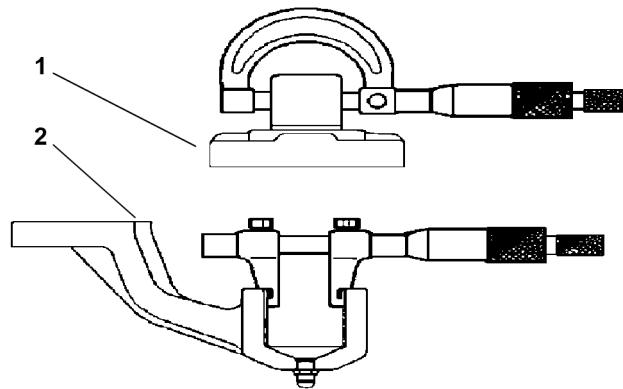
g226461

Figure 259

- | | | |
|------------------------|----------------------|----------------------|
| 1. Knuckle pin | 7. Axle case cover | 13. Spacer |
| 2. O-ring | 8. Mounting screws | 14. Upper bevel gear |
| 3. Bevel gear case | 9. Lower bearing | 15. Collar |
| 4. Shaft seal (2 each) | 10. Lower bevel gear | 16. Upper bearing |
| 5. Axle case | 11. Bevel gear shaft | |
| 6. O-ring | 12. Thrust washer | |

5. Remove the knuckle pin mounting screws and knuckle pin. Remove and discard the O-ring (Figure 259).
6. Hold the bevel gear case, lightly tap the upper end of the bevel gear shaft out of the upper bearing and upper bevel gear.
7. Pull the bevel gear case from the axle case and remove the upper bevel gear, collar, spacer, and thrust washer from the gear case.
8. Remove the axle case cover screws, cover, and O-ring from the axle case.
9. Remove the plug and sealing washer (not shown) from the center of the axle case cover. Hold the axle case cover, lightly tap the lower end of the bevel gear shaft out of the lower bearing and lower bevel gear.
10. Remove and discard the bevel gear shaft seals from the bevel gear case and axle case (Figure 259).

Inspecting the Bevel Gear Case and Axle Case



g226462

Figure 260

1. Knuckle pin
2. Axle case support

1. Measure the knuckle pin outer diameter and the axle case support bushing inner diameter to determine the bushing to pin clearance ([Figure 260](#)). Replace the components as necessary.

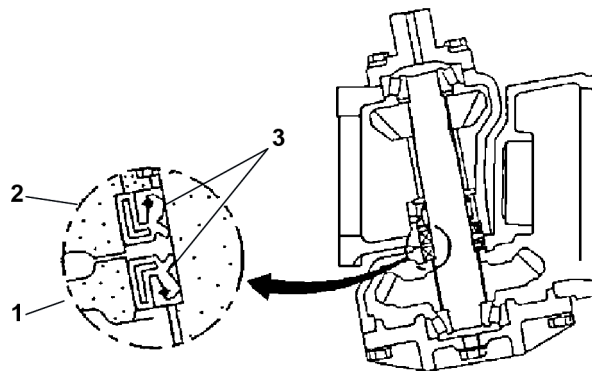
Bushing to pin clearance: 0.05 to 0.40 mm (0.002 to 0.016 inch)

Knuckle pin outer diameter (factory specification): 24.95 to 24.98 mm (0.982 to 0.983 inch)

Axle case support bushing inner diameter (factory specification): 25.00 to 25.08 mm (0.984 to 0.987 inch)

2. Inspect all gears, shafts, bearings, cases, and covers for damage and wear. Replace the components as necessary.

Installing the Bevel Gear Case and Axle Case (4-Wheel Drive Axle)



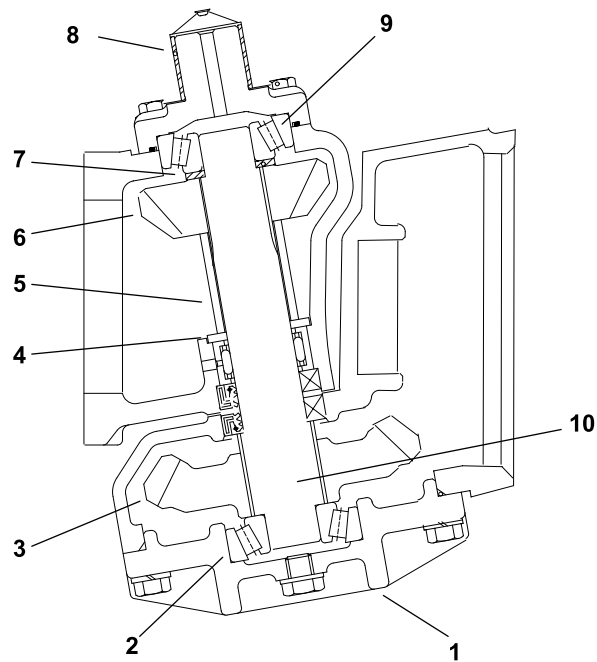
g226463

Figure 261

1. Axle case
2. Bevel gear case
3. Shaft seal

1. Coat new shaft seals with grease and install the shaft seals in the axle case and bevel gear case ([Figure 261](#)).

Installing the Bevel Gear Case and Axle Case (4-Wheel Drive Axle) (continued)



g226464

Figure 262

- | | | |
|---------------------|---------------------|----------------------|
| 1. Axle case cover | 5. Spacer | 9. Upper bearing |
| 2. Lower bearing | 6. Upper bevel gear | 10. Bevel gear shaft |
| 3. Lower bevel gear | 7. Collar | |
| 4. Thrust washer | 8. Knuckle pin | |



2. Install the lower bevel gear and bevel gear shaft in the axle case cover. Coat a new O-ring with grease and install the axle case cover (Figure 262). Tighten the cover screws to **23 to 27 N·m (17 to 20 ft-lb)**.

3. Slide the bevel gear case over the bevel gear shaft and install the thrust washer, spacer, bevel gear, and collar. Ensure that the bevel gear shaft is completely seated in the upper and lower bearings (Figure 262).



4. Install the new O-ring and then knuckle pin. Use medium strength Loctite threadlocker and tighten the knuckle pin mounting screws to **23 to 27 N·m (17 to 20 ft-lb)**.

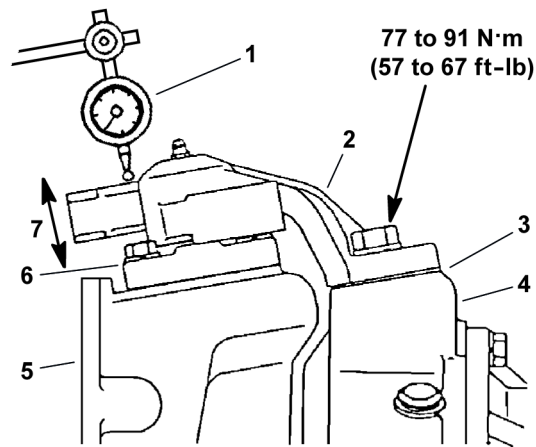
5. Determine necessary quantity of the support shims.

- A. Lubricate the axle case support bushing with a thin coat of grease and slide the axle case support onto the knuckle pin.



- B. Position the support shims that were removed during disassembly between the axle case support and the axle case. Install the mounting screws into the axle case. Slowly tighten the screws while frequently checking for clearance (vertical end-play) between the axle case support and the knuckle pin. If binding of components is noted before the screws are fully tightened, add additional support shims. Torque the screws to **77 to 91 N·m (57 to 67 ft-lb)**.

Installing the Bevel Gear Case and Axle Case (4-Wheel Drive Axle) (continued)



g226465

Figure 263

- | | | |
|--------------------------|--------------------|----------------------|
| 1. Dial indicator | 4. Axle case | 7. Vertical end-play |
| 2. Axle case support | 5. Bevel gear case | |
| 3. Support shim location | 6. Knuckle pin | |

-
- C. Use a dial indicator to measure vertical end-play of the axle case ([Figure 263](#)).

Axle case assembly end-play: 0.02 to 0.20 mm (0.001 to 0.008 inch)

- D. Adjust end-play by increasing or reducing the number of axle case support shims.

Note: Axle case support shims are available in 0.10 mm (0.004 inch), 0.20 mm (0.008 inch), and 0.40 mm (0.016 inch) thickness.

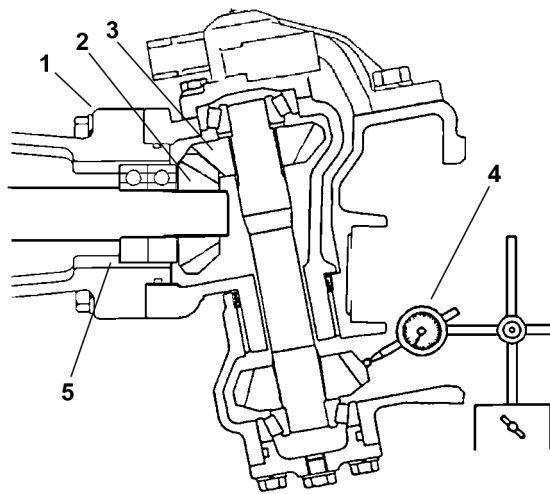


6. After correct support shims have been determined, remove the mounting screws and apply heavy strength thread-locking compound to the screw threads. Install the screws; torque the screws to **77 to 91 N·m (57 to 67 ft-lb)**.

IMPORTANT

Correct engagement between the bevel gears is critical to axle performance and durability.

Installing the Bevel Gear Case and Axle Case (4-Wheel Drive Axle) (continued)



g226466

Figure 264

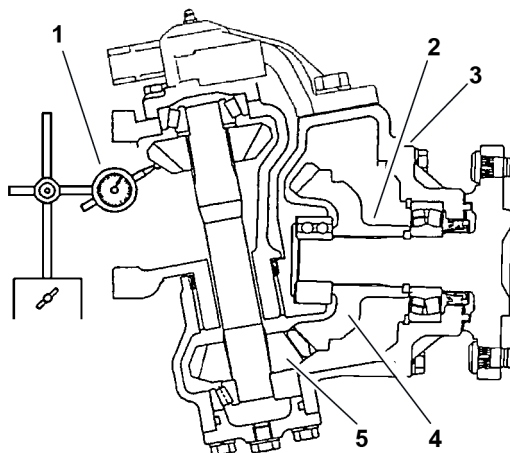
- | | | |
|----------------------------|---------------------|-----------------------|
| 1. Axle support | 3. Upper bevel gear | 5. Axle bearing shims |
| 2. Differential shaft gear | 4. Dial indicator | |

7. Temporarily install the bevel gear case/axle case assembly on the axle support. Position a dial indicator at the teeth center. Prevent the axle from turning and measure the upper bevel gear to the differential shaft gear backlash ([Figure 264](#)).

Upper bevel gear backlash: 0.10 to 0.40 mm (0.004 to 0.016 inch)

8. Adjust backlash by increasing or reducing the axle bearing shim thickness; refer to the [Differential Shafts \(4-Wheel Drive Axle\)](#) (page 8–57).

Note: Axle bearing shims are available in 0.10 mm (0.004 inch), 0.20 mm (0.008 inch), and 0.50 mm (0.020 inch) thickness.



g226467

Figure 265

- | | | |
|-----------------------|------------------------|---------------------|
| 1. Dial indicator | 3. Axle cover assembly | 5. Lower bevel gear |
| 2. Axle bearing shims | 4. Axle gear | |

9. Remove the bevel gear case/axle case assembly from the axle support. Coat a new O-ring with grease and temporarily install the axle cover assembly.

Installing the Bevel Gear Case and Axle Case (4-Wheel Drive Axle) (continued)

Position a dial indicator at the tooth's center. Prevent the axle from turning and measure the lower bevel gear to the axle gear backlash ([Figure 265](#)).

Lower bevel gear backlash: 0.10 to 0.40 mm (0.004 to 0.016 inch)

10. Adjust backlash by increasing or reducing the axle bearing shim thickness; refer to the [Axle Shafts \(4-Wheel Drive Axle\)](#) (page 8–59).

Note: Axle bearing shims are available in 0.20 mm (0.008 inch), 0.30 mm (0.012 inch), and 0.50 mm (0.020 inch) thickness.



11. Tighten the axle cover screws to **23 to 27 N·m (17 to 20 ft-lb)**.
12. Coat a new O-ring with grease and install the bevel gear case/axle case assembly on the axle support. Tighten the mounting screws and nuts to **47 to 56 N·m (35 to 41 ft-lb)** ([Figure 256](#)).

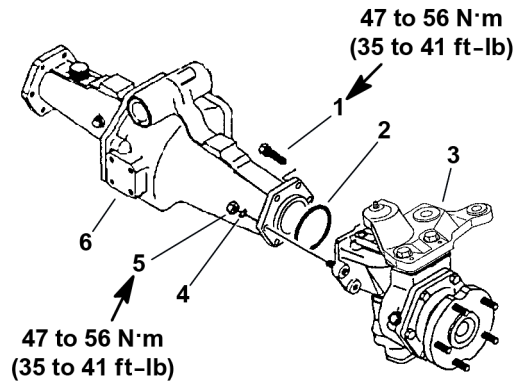
Differential Shafts (4-Wheel Drive Axle)

The following procedures assume the 4-wheel drive rear axle assembly has been removed from the machine.

Removing the Differential Shaft (4-Wheel Drive Axle)

IMPORTANT

Do not interchange the right and left differential shafts assemblies. Mark the right and left shafts before disassembly.

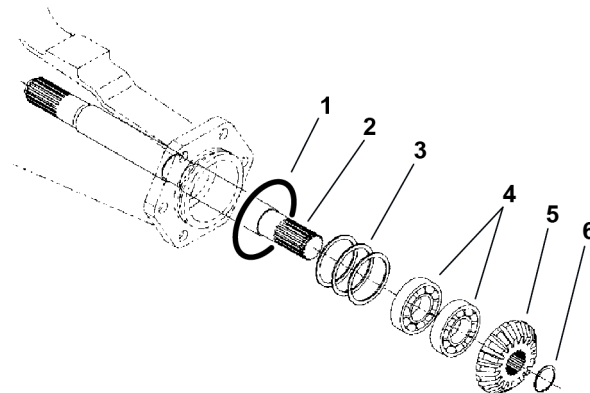


g226459

Figure 266

- | | | |
|-------------------|---------------------------------------|-----------------|
| 1. Mounting screw | 3. Bevel gear case/axle case assembly | 5. Locknut |
| 2. O-ring | 4. Lock washer | 6. Axle support |

-
1. Remove the mounting screws, nuts, and lock washers, and remove the bevel gear case/axle case assembly and O-ring from the axle support (Figure 266).
 2. Mark and pull the differential shaft assembly from the axle support.



g226469

Figure 267

- | | | |
|-----------------------|---------------------|-------------------|
| 1. O-ring | 3. Bearing shims | 5. Bevel gear |
| 2. Differential shaft | 4. Bearing (2 each) | 6. Retaining ring |

-
3. Remove the retaining ring and bevel gear (Figure 267).
 4. Drive the differential shaft out of the bearings, and remove the bearings and bearing shims.

Removing the Differential Shaft (4-Wheel Drive Axle) (continued)

5. Inspect all gears, shafts, bearings, and cases for damage and wear. Replace the components as necessary.

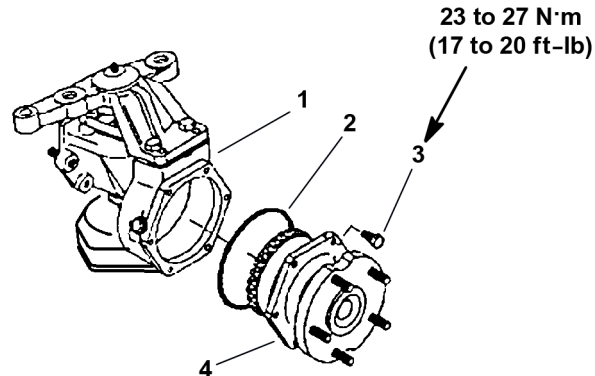
Installing the Differential Shaft (4-Wheel Drive Axle)

1. Press the bearings onto the differential shaft. Place correct combination of bearing shims in the axle support and drive the differential shaft and bearing assembly into the axle support.
2. Install the bevel gear and retaining ring.
3. Coat new O-ring with grease. Align the differential shaft splines with the differential gear assembly and slide the differential shaft assembly onto the axle support.
4. Install the bevel gear case/axle case assembly; refer to [Bevel Gear Case and Axle Case \(4-Wheel Drive Axle\) \(page 8–49\)](#).

Axle Shafts (4-Wheel Drive Axle)

The following procedures assume the 4-wheel drive rear axle assembly has been removed from the machine.

Removing the Axle Shaft (4-Wheel Drive Axle)

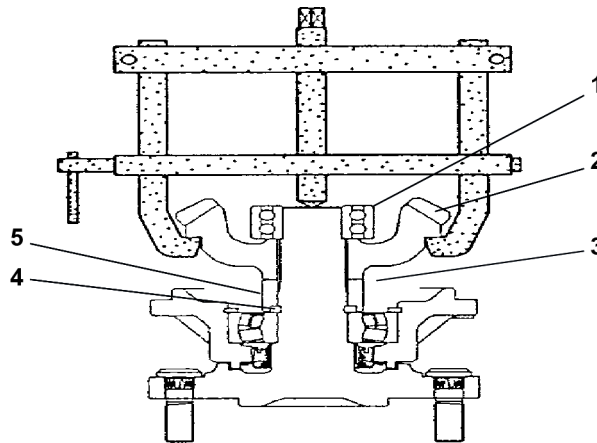


g226470

Figure 268

- | | |
|--------------|------------------------|
| 1. Axle case | 3. Mounting screw |
| 2. O-ring | 4. Axle cover assembly |

1. Remove the axle cover mounting screws, and remove the axle cover from the axle case as an assembly (Figure 268).

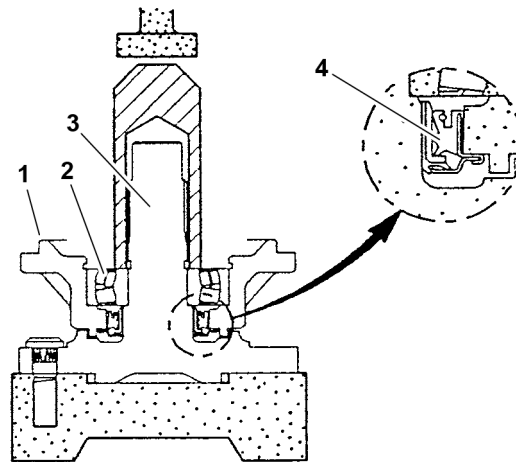


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Figure 269

- | | | |
|---------------|-------------------|-----------|
| 1. Bearing | 3. Shims | 5. Spacer |
| 2. Bevel gear | 4. Retaining ring | |
2. Use a bearing puller to remove the bearing and bevel gear (Figure 269).
 3. Remove the shims, spacer, and retaining ring. Drive the axle out of the bearing and cover. Remove and discard the axle shaft seal.
 4. Inspect all gears, shafts, bearings, spacers, and cases for damage and wear. Replace the components as necessary.

Installing the Axle Shaft (4-Wheel Drive Axle)



g226488

Figure 270

- | | |
|---------------|--------------------|
| 1. Axle cover | 3. Axle shaft |
| 2. Bearing | 4. Axle shaft seal |

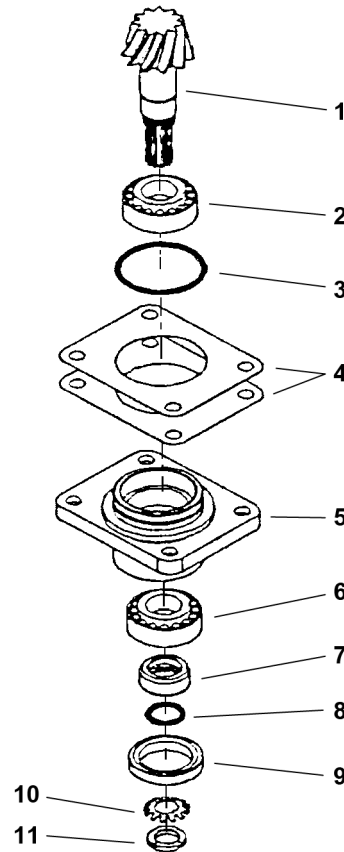
1. Coat new axle shaft seal with grease and install the shaft seal in the axle cover (Figure 270).
2. Press the axle cover and bearing assembly onto the axle shaft. Press only on the inner race of the cover bearing (Figure 270).
3. Install the retaining ring, spacer, and correct combination of bearing shims. Install the bevel gear and bearing.
4. Coat a new O-ring with grease and install the axle cover assembly. Tighten the axle cover screws to **23 to 27 N·m (17 to 20 ft-lb)**.



Input Shaft/Pinion Gear (4-Wheel Drive Axle)

The following procedures assume the 4-wheel drive rear axle assembly has been removed from the machine.

Removing the Input Shaft/Pinion Gear (4-Wheel Drive Axle)



g226489

Figure 271

- | | | |
|----------------------------|------------------|------------------|
| 1. Input shaft/pinion gear | 5. Bearing case | 9. Oil seal |
| 2. Inner bearing | 6. Outer bearing | 10. Stake washer |
| 3. Bearing case O-ring | 7. Seal collar | 11. Locknut |
| 4. Bearing case shims | 8. O-ring | |

1. Remove the input shaft/pinion gear assembly from the axle support, and remove the shims and bearing case O-ring.
2. Release the stake washer and remove the locknut. Remove and discard the stake washer.
3. Drive the input shaft/pinion gear out from the outer bearing cone and bearing case. Remove and discard the oil seal and O-ring.
4. Inspect all gears, shafts, bearings, spacers, and cases for damage and wear. Replace the components as necessary.

Note: Replacement input shaft/pinion gears are only available in matched ring and pinion sets.

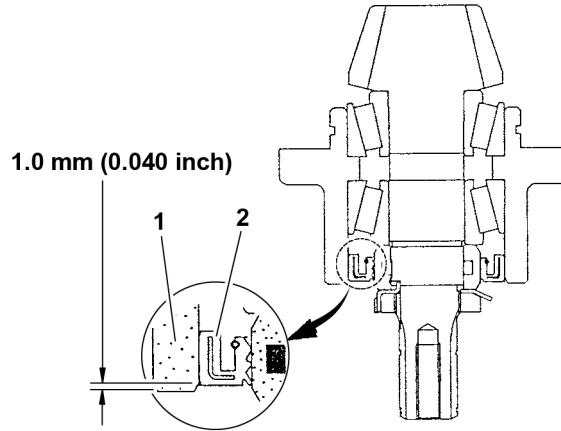
Installing the Input Shaft/Pinion Gear (4-Wheel Drive Axle)

Note: When installing new bearing cones, press only on the inner race of the bearing cone.

Installing the Input Shaft/Pinion Gear (4-Wheel Drive Axle) (continued)

1. If the inner bearing cone was removed, press a new bearing cone all the way onto the input shaft/pinion gear.
2. Place the shaft and bearing assembly in the bearing case and install the outer bearing cone.

Note: The bearings must be completely seated. There should be no input shaft/pinion gear end-play.



g226490

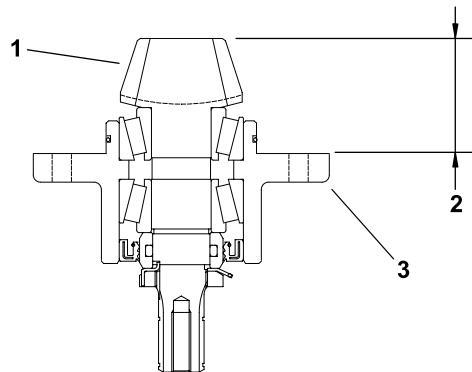
Figure 272

1. Bearing case
2. Oil seal

3. Coat a new oil seal with grease and install the seal as shown in [Figure 272](#).
4. Coat a new O-ring with grease. Install the O-ring in the seal collar, and install the collar.
5. Install a new stake washer, and install the locknut finger tight.
6. Set the bearing preload by securing the bearing case in a vise. Thread a M12 x 1.5 bolt into the splined end of the input shaft/pinion gear.



7. Slowly tighten the locknut until **0.4 to 0.7 N·m (4.0 to 6.0 in-lb)** of force is required to rotate the input shaft/pinion gear in the bearing case.
8. Secure the locknut with the stake washer.



g226491

Figure 273

1. Input shaft/pinion gear
2. Design cone center distance
3. Bearing case

Installing the Input Shaft/Pinion Gear (4-Wheel Drive Axle) (continued)

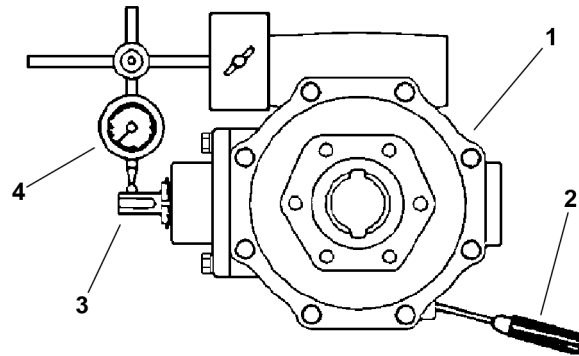
9. Use a depth gauge to measure the distance from the end face of the input shaft/pinion gear to the mating surface of the bearing case. Subtract the design cone center distance from this distance to determine initial shim thickness ([Figure 273](#)).

Design cone center distance (distance from mating surface of the axle support to the end face of the pinion gear): 47.50 ± 0.05 mm (1.870 ± 0.002 inch)

Note: Bearing case shims are available in 0.10 mm (0.004 inch) and 0.20 mm (0.008 inch) thickness.



10. Coat a new O-ring with grease. Place shims on the bearing case and temporarily install the input shaft/pinion gear assembly into the axle case. Tighten the mounting screws to **47 to 56 N·m (35 to 41 ft-lb)**.



g226492

Figure 274

- | | |
|----------------|----------------------------|
| 1. Axle case | 3. Input shaft/pinion gear |
| 2. Screwdriver | 4. Dial indicator |

11. Insert a screwdriver through the drain plug hole to hold the ring gear and measure the pinion gear to ring gear backlash ([Figure 274](#)).
Pinion gear to ring gear backlash: 0.10 to 0.40 mm (0.004 to 0.016 inch)
12. Adjust backlash by increasing or reducing the bearing case shim thickness.
13. Check the pinion gear to ring gear engagement; refer to [Pinion Gear to Ring Gear Engagement \(4-Wheel Drive Axle\)](#) (page 8–70).



14. Place the correct combination of shims on the bearing case. Tighten the mounting screws to **47 to 56 N·m (35 to 41 ft-lb)**.

Differential Gear Assembly (4-Wheel Drive Axle)

The following procedures assume the 4-wheel drive rear axle assembly has been removed from the machine.

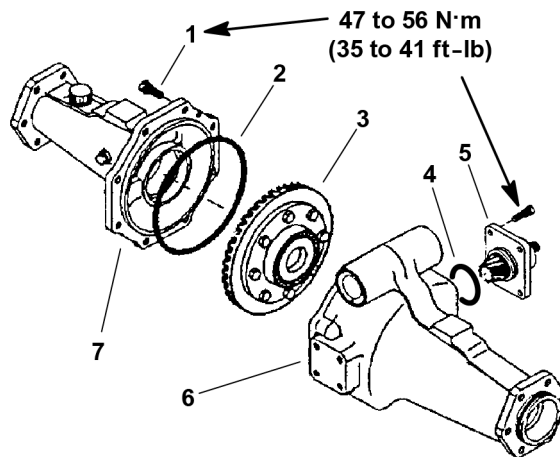
Removing the Differential Gear Assembly (4-Wheel Drive Axle)

1. Remove the bevel gear case/axle case assemblies; refer to [Bevel Gear Case and Axle Case \(4-Wheel Drive Axle\)](#) (page 8–49).

IMPORTANT

Do not interchange the right and left differential shafts assemblies.

2. For assembly purposes, mark the differential shaft assemblies. Pull the differential shaft assemblies from the axle support.



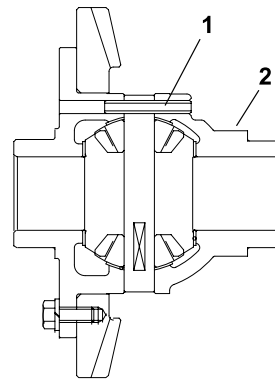
g226493

Figure 275

- | | | |
|-------------------------------|-------------------------|------------------------|
| 1. Case screw | 4. O-ring | 7. Axle support (left) |
| 2. O-ring | 5. Pinion gear assembly | |
| 3. Differential gear assembly | 6. Axle support (right) | |

3. Remove the input shaft/pinion gear assembly, shims, and O-ring from the axle support ([Figure 275](#)).
4. Remove the axle support case screws. Separate the axle support halves and remove the O-ring.
5. Remove the differential gear assembly, bearings, and adjusting shims from the axle case.

Removing the Differential Gear Assembly (4-Wheel Drive Axle) (continued)



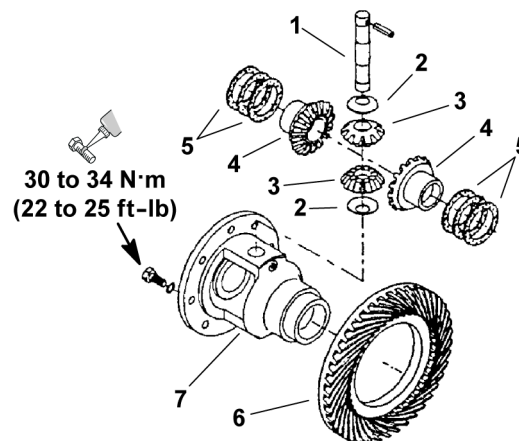
g226494

Figure 276

1. Spring pin
2. Differential case

6. Drive the spring pin from the differential case with a punch and hammer. Discard the spring pin (Figure 276).

Note: Mark and arrange all components so that they can be assembled in their original position.



g226495

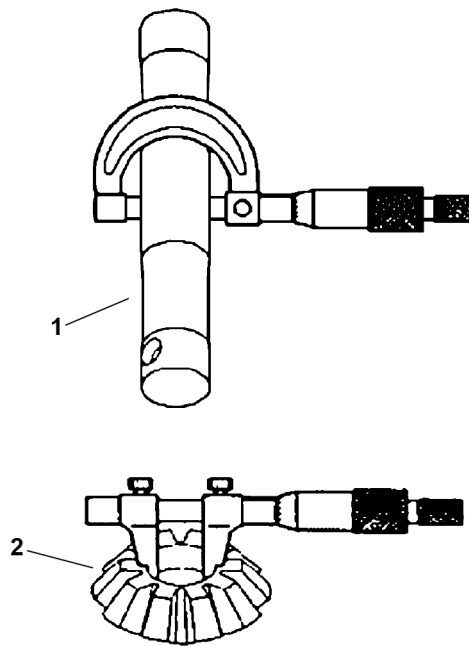
Figure 277

1. Differential pinion shaft
2. Pinion washer (2 each)
3. Pinion gear (2 each)
4. Side gear (2 each)
5. Side gear shims
6. Ring gear
7. Differential case

7. Remove the differential pinion shaft, pinion gears and pinion washers. Remove the differential side gears and side gear shims. Remove the ring gear only if it will be replaced (Figure 277).

Note: Replacement ring gears are only available in matched ring and pinion sets.

Inspecting the Differential Gear Assembly (continued)



g226497

Figure 279

1. Pinion shaft
2. Pinion gear

2. Measure the differential pinion shaft outer diameter and the pinion gear inner diameter to determine the pinion shaft to pinion gear clearance ([Figure 279](#)). Replace the components as necessary.

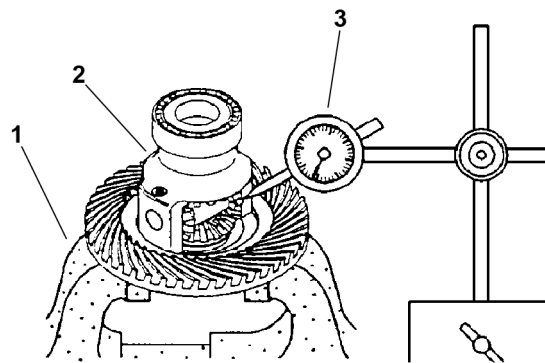
Pinion shaft to pinion gear clearance: 0.03 to 0.25 mm (0.001 to 0.010 inch)

Pinion shaft outer diameter (factory specification): 13.97 to 13.98 mm (0.550 to 0.551 inch)

Pinion gear inner diameter (factory specification): 14.00 to 14.02 mm (0.551 to 0.552 inch)

3. Inspect all the gears, shafts, bearings, cases, and covers for damage and wear. Replace the components as necessary.

Installing the Differential Gear Assembly (4-Wheel Drive Axle)



g226498

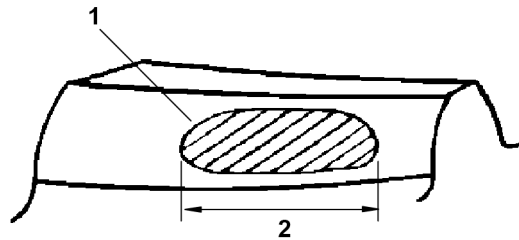
Figure 280

1. Vise
2. Differential gear case
3. Dial indicator

Installing the Differential Gear Assembly (4-Wheel Drive Axle) (continued)



1. If the ring gear was removed from the differential case, use medium strength Loctite threadlocker and tighten the mounting screws to **30 to 34 N·m (22 to 25 ft-lb)**.
2. Apply molybdenum disulfide lubricant (Threebond 1901 or equivalent) to the splines and bearing surfaces of the differential pinion gears, pinion washers, and side gears.
3. Install the side gear shims and side gears in their original location in the differential case.
4. Place the differential pinion gears and pinion washers in their original location in the differential case. Temporarily install the differential pinion shaft.
5. Secure the differential case in a soft jawed vise. Position a dial indicator on a tooth of the differential pinion gear. Press the pinion and side gear against the differential case and measure the pinion gear to side gear backlash ([Figure 280](#)).
Pinion gear to side gear backlash: 0.10 to 0.40 mm (0.004 to 0.016 inch)
6. Adjust backlash by increasing or reducing the side gear shim thickness.
Note: Side gear shims are available in 1.10 mm (0.043 inch), 1.20 mm (0.047 inch), and 1.30 mm (0.051 inch) thickness.
7. Apply gear marking compound, such as DyKem steel blue lightly over several gear teeth.
8. While applying a light load to either side gear, rotate either pinion gear until the side gears have made 1 complete revolution.



g226499

Figure 281

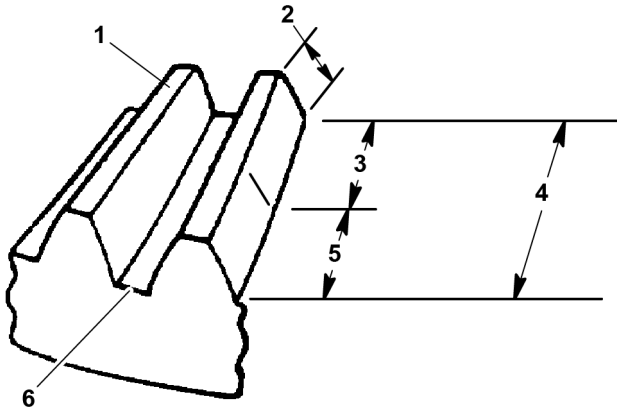
1. More than 35% total tooth contact
 2. 1/3 to 1/2 of entire width from small end of tooth
-
9. Ideal tooth contact should cover more than 35% of each tooth surface. The contact area should be in the center of each tooth and extend 1/3 to 1/2 way across each tooth from the toe (small) end ([Figure 281](#)).
 10. Adjust the side gear shims if necessary to correct tooth contact. Check the differential pinion gear to side gear backlash if any changes are made.
 11. After backlash and tooth contact have been adjusted, align the hole in the differential pinion shaft with the hole in the differential case and install a new spring pin.
 12. Install the differential gear assembly in the right side axle support half.
-
13. Coat a new O-ring with grease and install the left side axle support half. Tighten the axle support case screws to **47 to 56 N·m (35 to 41 ft-lb)**.
 14. Install the input shaft/pinion gear assembly; refer to the [Input Shaft/Pinion Gear \(4-Wheel Drive Axle\)](#) (page 8–61).

Installing the Differential Gear Assembly (4-Wheel Drive Axle) (continued)

15. Coat new O-rings with grease, align the differential shaft splines with the differential gear assembly and slide the differential shaft assemblies onto the axle support.
16. Install the bevel gear case/axle case assemblies; refer to [Bevel Gear Case and Axle Case \(4-Wheel Drive Axle\) \(page 8–49\)](#).

Pinion Gear to Ring Gear Engagement (4-Wheel Drive Axle)

The final position of the pinion gear is verified by using the gear contact pattern method as described in the following procedure.



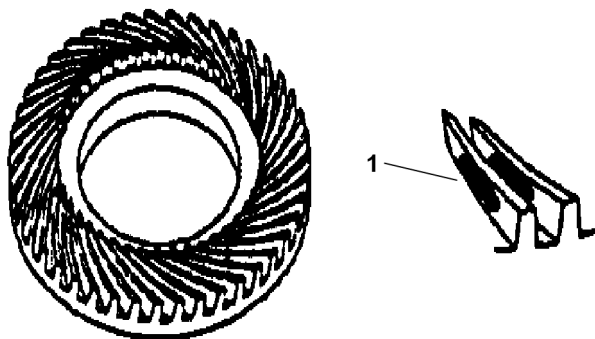
g226500

Figure 282

- | | | |
|-------------|---------------------------|---------|
| 1. Top land | 3. Toe | 5. Heel |
| 2. Profile | 4. Lengthwise bearing arc | 6. Root |

Gear tooth definitions (Figure 282):

- **Toe** - the portion of the tooth surface at the end toward the center.
 - **Heel** - the portion of the gear tooth at the outer end.
 - **Top Land** - top surface of tooth.
1. Paint the teeth of the ring gear, both drive and coast side, with a gear marking compound, such as DyKem steel blue.
 2. Install the input shaft/pinion gear assembly into the axle case.
 3. While applying a light load to the ring gear, rotate the pinion gear in the direction of forward travel until the ring gear has made 1 complete revolution.

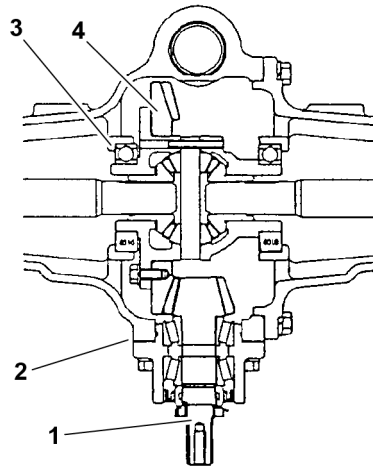


g226501

Figure 283

1. More than 35% total tooth contact

Ideal tooth contact observed on the ring gear should cover more than 35% of each tooth surface. The contact area should be in the center of each tooth and extend 1/3 to 1/2 way across each tooth from the toe end (Figure 283).



g226502

Figure 284

- | | |
|---|--|
| <ol style="list-style-type: none"> 1. Input shaft/pinion gear 2. Bearing case shims | <ol style="list-style-type: none"> 3. Differential bearing shims 4. Differential gear case |
|---|--|

Adjustments to the gear contact position are made by moving the input shaft/pinion gear (bearing case shims) or by moving the differential gear case (differential bearing shims) (Figure 284).

Note: Bearing case shims are available in 0.10 mm (0.004 inch) and 0.20 mm (0.008 inch) thickness.

Note: Differential bearing shims are available in 0.10 mm (0.004 inch), 0.20 mm (0.008 inch), and 0.40 mm (0.016 inch) thickness.

Study the different contact patterns (Figure 285 and Figure 286) and correct gear engagement as necessary.

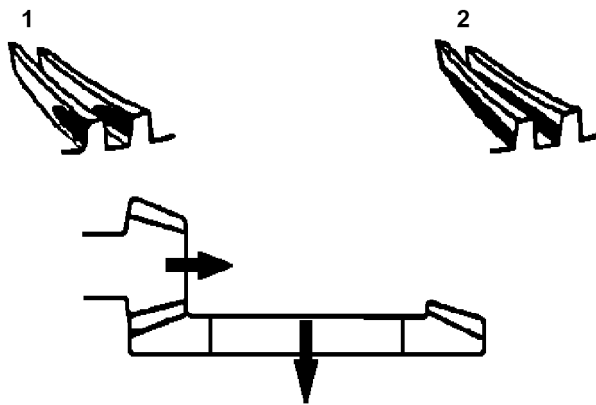
Note: When making changes, note that 2 variables are involved; refer to the [Gear Pattern Movement Summary](#) (page 8–71).

Example: If the pinion gear to ring gear backlash is set correctly to specifications and the bearing case shim is changed to adjust tooth contact, it may be necessary to adjust backlash to the correct specification before checking the contact pattern.

Gear Pattern Movement Summary

Every gear has a characteristic pattern. The illustrations show typical patterns only and explain how patterns shift as the gear location is changed.

Gear Pattern Movement Summary (continued)

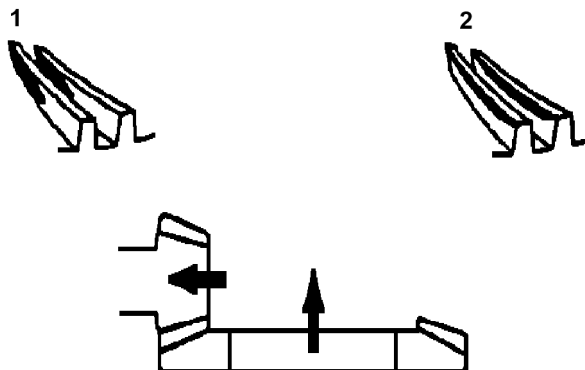


g226503

Figure 285

1. Heel contact
 2. Base contact
-

1. If contact is toward the heel or base of the gear ([Figure 285](#)), do as follows:
 - A. Install the thicker or additional bearing case shim(s) to move the pinion shaft toward the ring gear.
 - B. Install the thinner or remove differential bearing shim(s) to move the ring gear backward.
 - C. Repeat until proper tooth contact and pinion gear to ring gear backlash are correct.



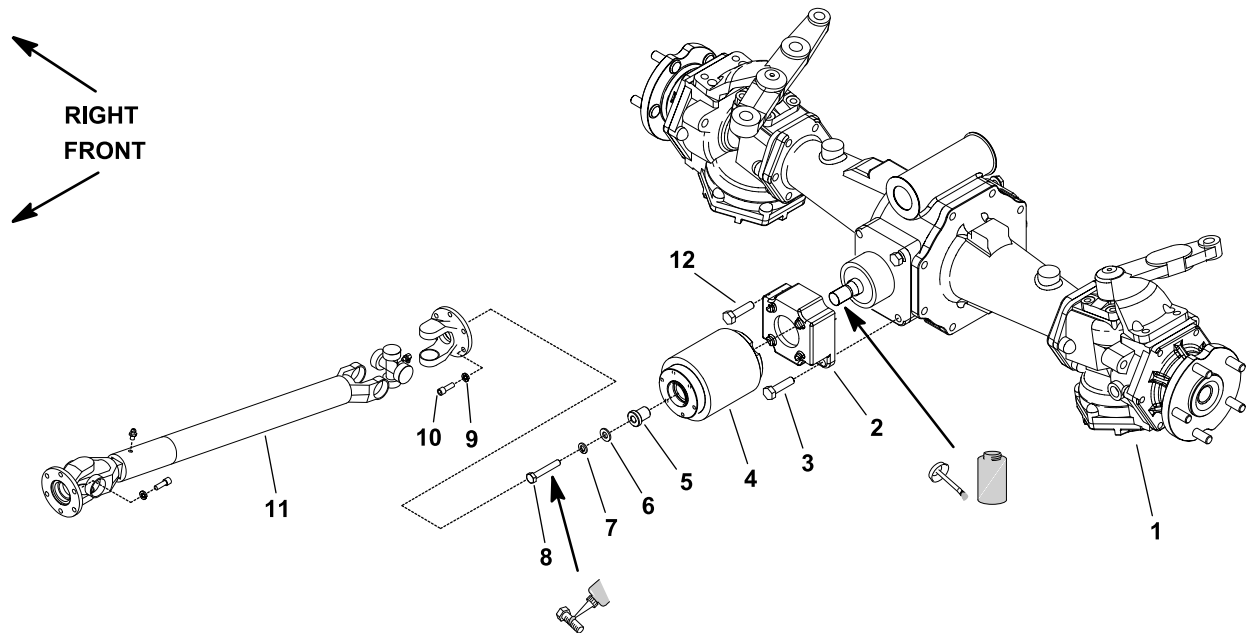
g226504

Figure 286

1. Toe contact
 2. Tip contact
-

2. If contact is toward the toe or tip of the gear ([Figure 286](#)), do as follows:
 - A. Install the thinner or remove bearing case shim(s) to move the pinion shaft away from the ring gear.
 - B. Install the thicker or additional differential bearing shim(s) to move the ring gear forward.
 - C. Repeat until proper tooth contact and pinion gear to ring gear backlash are correct.

Bi-Directional Clutch (4-Wheel Drive)



g226505

Figure 287

- | | | |
|---------------------------|----------------|--------------------------------|
| 1. Rear axle assembly | 5. Spacer | 9. Lock washer (6 each) |
| 2. Clutch locator adapter | 6. Flat washer | 10. Socket-head screw (6 each) |
| 3. Bolt (2 each) | 7. Lock washer | 11. Driveshaft assembly |
| 4. Bi-directional clutch | 8. Bolt | 12. Bolt (2 each) |

Removing the Bi-Directional Clutch (4-Wheel Drive)

1. Park the machine on a level surface, lower the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch.
2. Drain oil from the bi-directional clutch; refer to the *Traction Unit Operator's Manual*.
3. Remove the 6 socket-head screws (item 10 in [Figure 287](#)) and 6 lock washers that secure the driveshaft to the bi-directional clutch on the rear axle. Position the end of the driveshaft away from the clutch.
4. Remove the bolt (item 8 in [Figure 287](#)), lock washer, and flat washer that secure the clutch to the rear axle. Locate and retrieve the spacer.
5. Pull the bi-directional clutch from the rear axle input shaft.

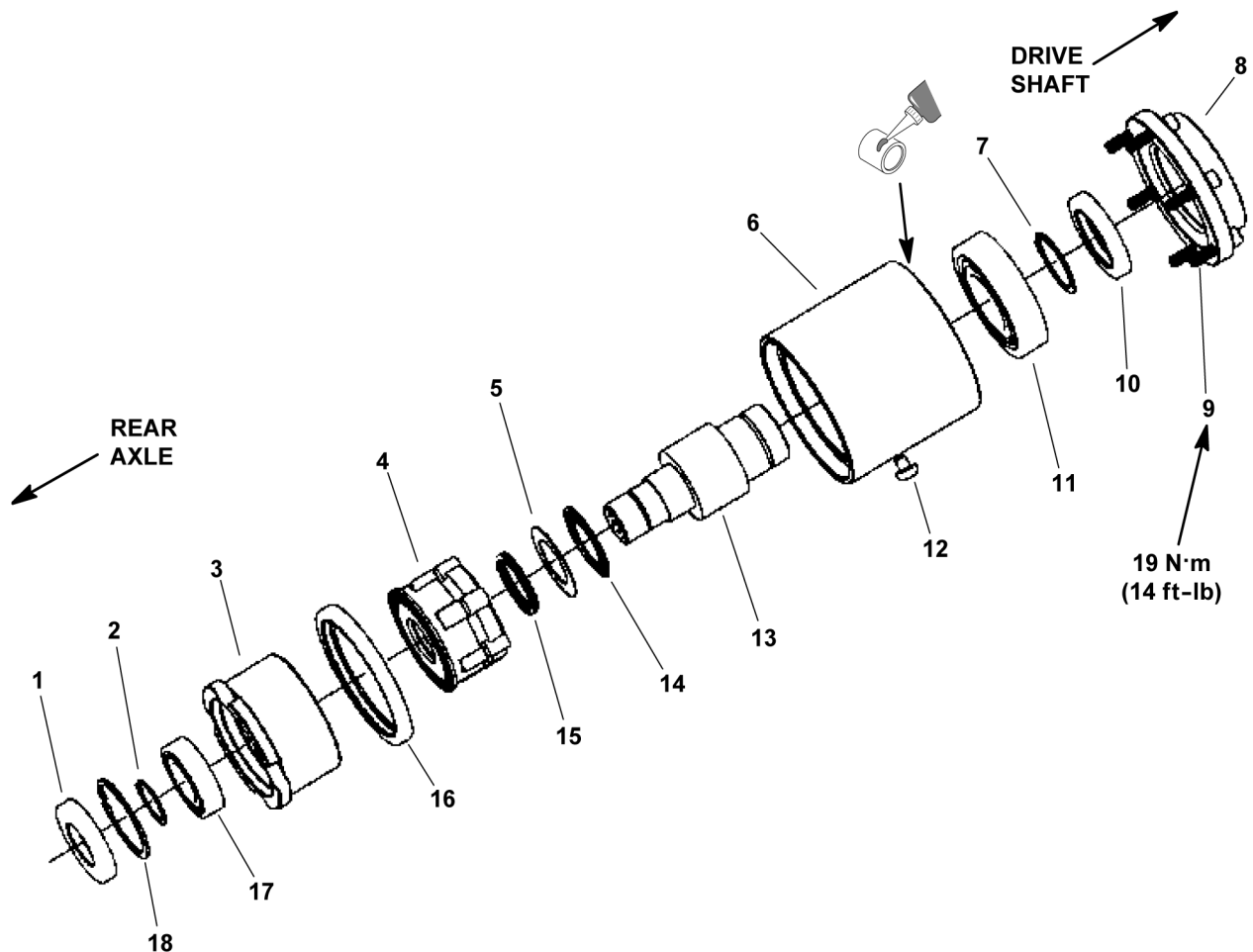
Installing the Bi-Directional Clutch (4-Wheel Drive)

1. Apply anti-seize lubricant to the splines of the rear axle input shaft.
2. Slide the bi-directional clutch onto the rear axle input shaft. Align the notches in the clutch housing with the bolt heads on the axle clutch locator adapter.
3. Apply Loctite #242 (or equivalent) to the threads of the bolt (item 8 in [Figure 287](#)) that secures the clutch to the rear axle shaft.
4. Secure the clutch to the axle shaft with the bolt, lock washer, flat washer, and spacer.
5. Position the end of the driveshaft to the bi-directional clutch on the rear axle. Secure the driveshaft to the clutch with the 6 socket-head screws (item 10 in [Figure 287](#)) and 6 lock washers.

Installing the Bi-Directional Clutch (4-Wheel Drive) (continued)

6. Fill the clutch with oil to the correct level; refer to the *Traction Unit Operator's Manual*.

Servicing the Bi-Directional Clutch (4-Wheel Drive)



g226506

Figure 288

- | | | |
|-------------------------|-------------------------------------|--------------------|
| 1. Oil seal | 7. Snap ring | 13. Hub |
| 2. Snap ring | 8. End plate | 14. Needle bearing |
| 3. Bearing housing | 9. Socket-head screw (6 each) | 15. Wave spring |
| 4. Roller cage assembly | 10. Oil seal | 16. Oil seal |
| 5. Thrust washer | 11. Bearing | 17. Bearing |
| 6. Housing | 12. Phillips-head screw with O-ring | 18. Retaining ring |

Disassembling the Bi-Directional Clutch (4-Wheel Drive)

1. Clean the external surface of the clutch before disassembly.
2. Disassemble the clutch as shown in [Figure 288](#).

Assembling the Bi-Directional Clutch (4-Wheel Drive)



1. Lightly lubricate the clutch components with a clean Mobil Fluid 424 before assembly.
2. Assemble the clutch as shown in [Figure 288](#).
3. When you install the oil seals, ensure that the seal lips are facing in.
4. Apply Hylomar jointing compound (or equivalent) to the end plate (item 8 in [Figure 288](#)) mating surface before you install the end plate.

Assembling the Bi-Directional Clutch (4-Wheel Drive) (continued)



5. Secure the end plate with the 6 socket-head screws; torque the screws to **19 N·m (14 ft-lb)**.



Table of Contents

General Information 9-2

Service and Repairs 9-3

 PTO Drive Belt 9-3

 PTO Driveshaft 9-4

 Servicing the PTO Driveshaft Cross and Bearing 9-7

 PTO Shaft 9-8

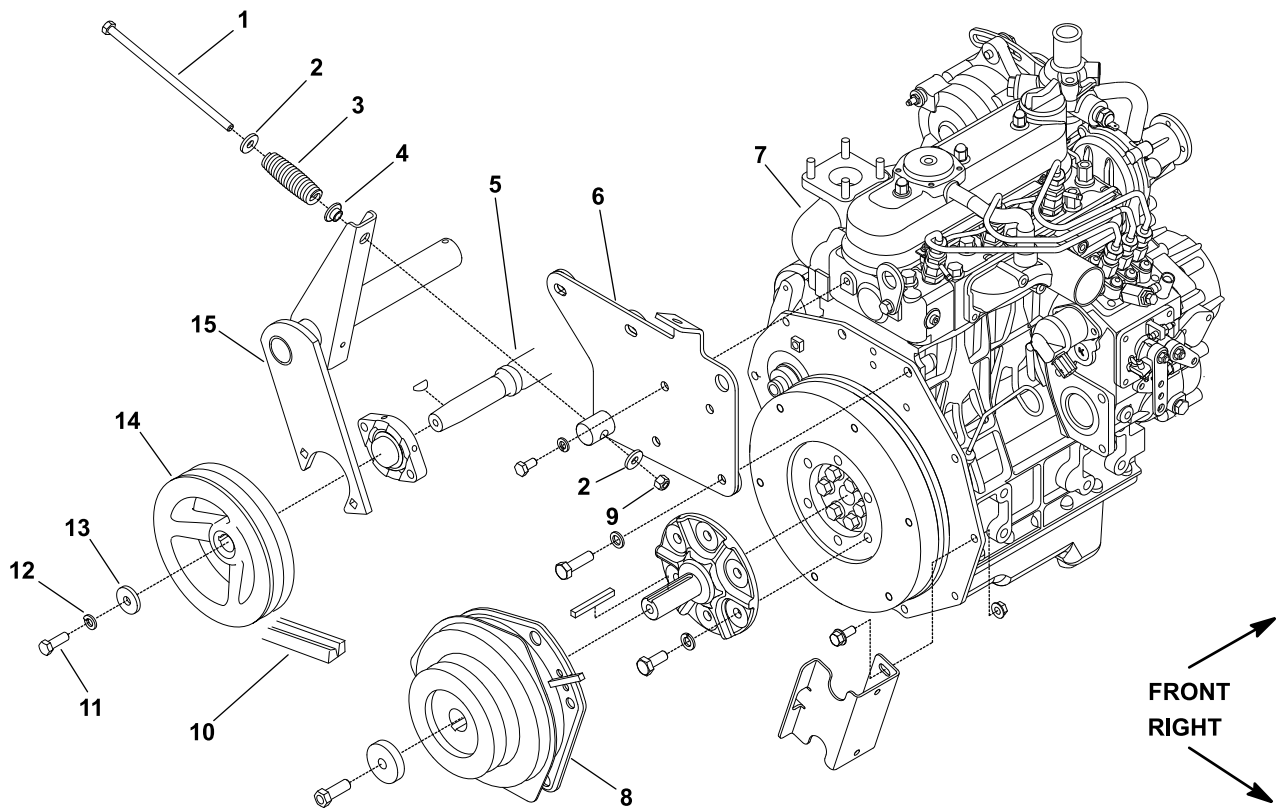
 Aligning the PTO Pulley to the Electric Clutch Pulley 9-11

General Information

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

Service and Repairs

PTO Drive Belt



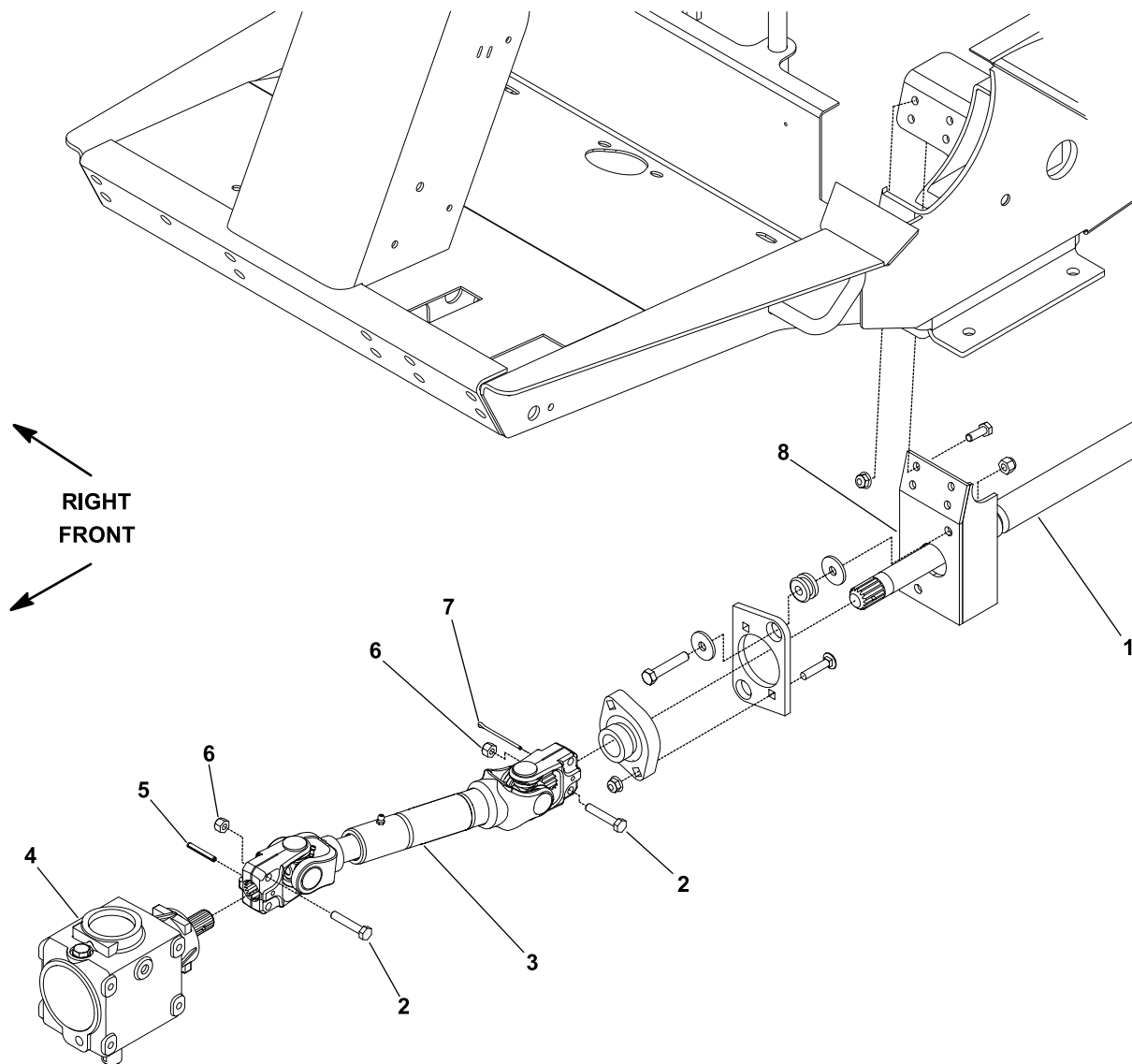
g220804

Figure 289

- | | | |
|-------------------------|-------------------------|-----------------------|
| 1. Bolt | 6. Muffer mount bracket | 11. Bolt |
| 2. Flat washer (2 each) | 7. Kubota diesel engine | 12. Lock washer |
| 3. Compression spring | 8. Electric clutch | 13. Flat washer |
| 4. Spacer | 9. Locknut | 14. PTO pulley |
| 5. PTO shaft | 10. PTO drive belt | 15. PTO tension shaft |

Note: Refer to the *Traction Unit Operator's Manual* for information regarding PTO Belt Adjustment and Installation.

PTO Driveshaft



g220803

Figure 290

- | | | |
|-------------------|-------------------------|------------------------|
| 1. PTO shaft | 4. Cutting deck gearbox | 7. Cotter pin |
| 2. Bolt (4 each) | 5. Roll pin | 8. PTO bearing bracket |
| 3. PTO driveshaft | 6. Locknut (4 each) | |



WARNING



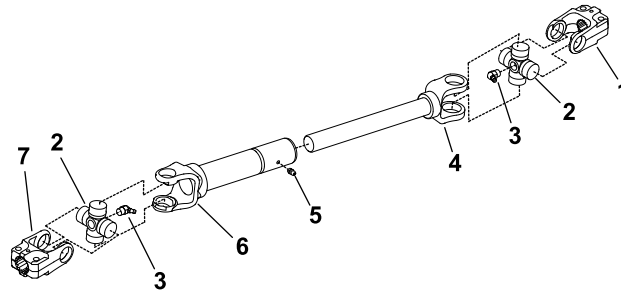
Do not start the engine and engage the PTO switch when the PTO driveshaft is disconnected from the cutting deck (or implement). If you start the engine and the PTO shaft is allowed to rotate, serious personal injury and machine damage could result.

Disconnect the PTO electric clutch electrical connector whenever the PTO driveshaft is disconnected from the cutting deck (or implement).

Removing the PTO Driveshaft

1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.
2. Disconnect the end yoke of the PTO driveshaft (item 3 in [Figure 290](#)) from the PTO shaft as follows:
 - A. Straighten the cotter pin and remove the cotter pin from the end yoke and PTO shaft.
 - B. Loosen the 2 bolts and 2 locknuts.
 - C. Slide the driveshaft end yoke from the PTO shaft.
3. Disconnect the end yoke of the 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 2 locknuts.
 - C. Slide the driveshaft end yoke from the gearbox shaft.
4. Remove the PTO driveshaft from the machine.

Installing the PTO Driveshaft



g220802

Figure 291

- | | |
|--|-------------------|
| 1. End yoke | 5. Grease fitting |
| 2. Universal joint kit (cross and bearings) (2 each) | 6. Slip tube yoke |
| 3. Grease fitting (2 each) | 7. End yoke |
| 4. Slip shaft yoke | |

IMPORTANT

If the driveshaft tube and shaft were separated, ensure that the slip shaft yoke and slip tube yoke are aligned when the tube and shaft are assembled ([Figure 291](#)). Misalignment of the yokes will result in shortened driveshaft life and will cause unnecessary vibration when the cutting deck (or implement) is operated.

1. Position the PTO driveshaft to the machine.

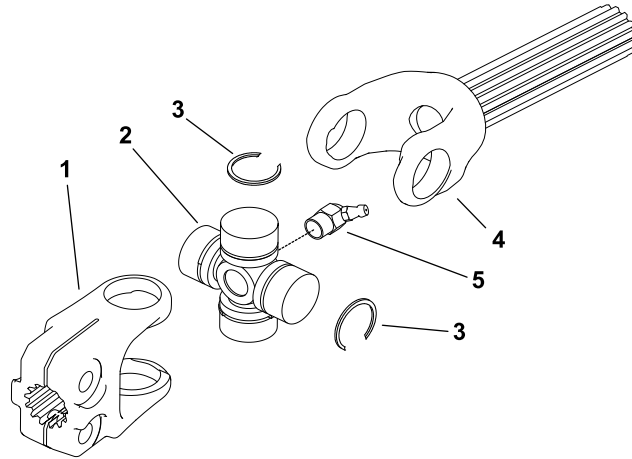
Note: Ensure that the slip shaft yoke (item 4 in [Figure 291](#)) is toward the cutting deck gearbox shaft.

2. Align the splines and slide the PTO driveshaft end yokes onto the PTO shaft and gearbox shaft.

Installing the PTO Driveshaft (continued)

3. Secure the end yokes of the PTO driveshaft as follows:
 - A. Install a cotter pin (item 7 in [Figure 290](#)) in the end yoke and PTO shaft.
 - B. Install a roll pin (item 5 in [Figure 290](#)) in the end yoke and gearbox shaft.
 - C. Install the 4 bolts in the driveshaft end yokes. Alternate direction that the bolt is installed on each yoke.
 - D. Install and tighten the 4 locknuts to secure the end yokes to the gearbox shaft and PTO shaft.
4. Lubricate the PTO driveshaft grease fittings; refer to the *Traction Unit Operator's Manual*.

Servicing the PTO Driveshaft Cross and Bearing



g221216

Figure 292

1. End yoke
2. Cross and bearing kit
3. Snap ring (4 each)
4. Shaft yoke
5. Grease fitting

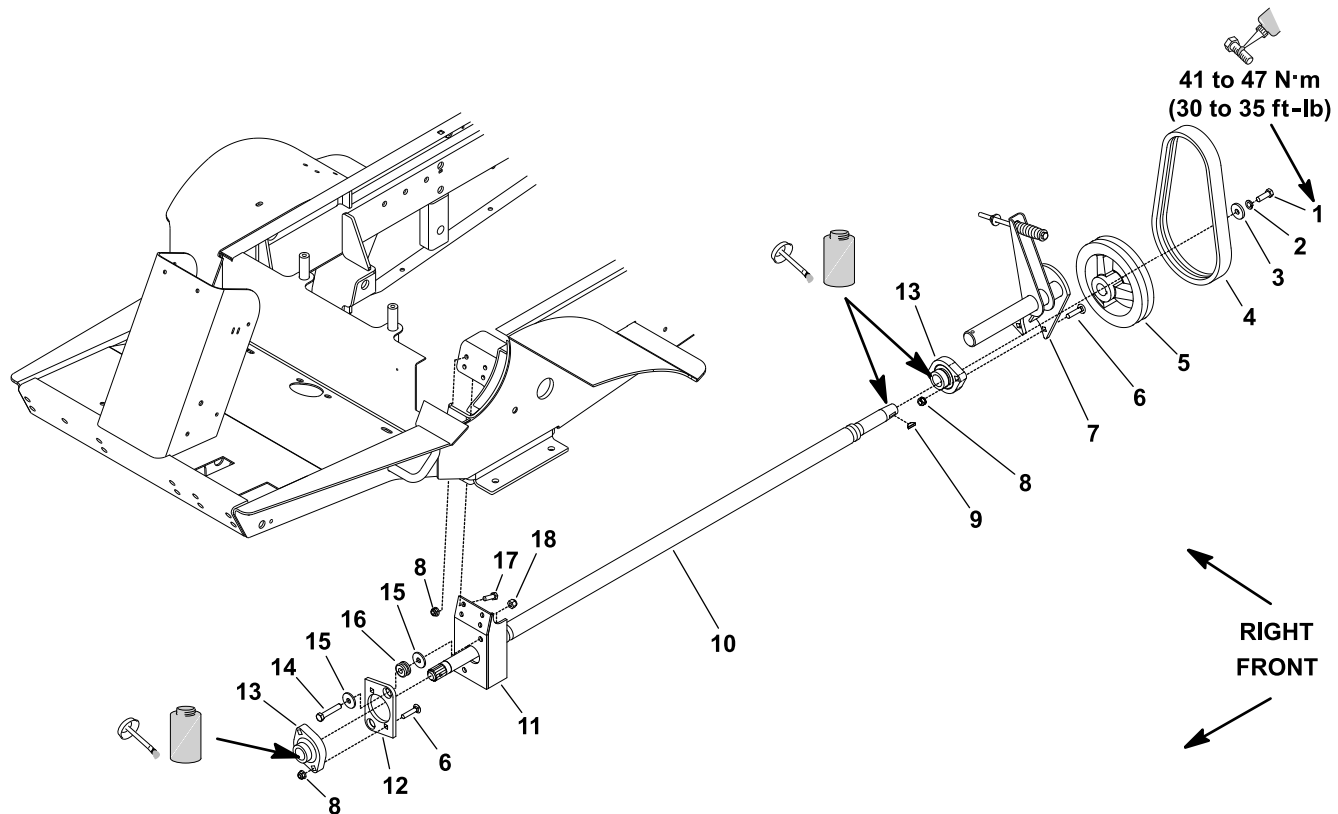
-
1. Remove the PTO driveshaft from the machine; refer to [Removing the PTO Driveshaft \(page 9–5\)](#).
 2. Remove the snap rings that secure the bearings in the yokes.

IMPORTANT

Support the yokes when removing and installing the bearings to prevent damage.

3. Use a press to remove the cross and bearings from the yokes. Clean the driveshaft yokes.
4. Install new cross and bearings as follows:
 - A. Apply a thick layer of grease to the bearing bores in the end yoke and shaft yoke.
 - B. Press 1 bearing partially into the yoke.
 - C. Insert the cross into the yoke and bearing.
 - D. Hold the cross in alignment and press the bearing in until it hits the yoke.
 - E. Install the snap ring into the yoke groove to secure installed bearing.
 - F. Place second bearing into the yoke bore and onto the cross shaft. Press the bearing into the yoke and secure with the snap ring.
 - G. Repeat the procedure for the other yoke.
 - H. Apply grease to the cross until it comes out of all the 4 bearing cups.
5. Ensure that the assembled joint moves without any binding. Lightly rap the yoke lugs with a soft-faced hammer to remove slight binding. If binding continues, disassemble the joint to identify the source of binding.
6. Install the driveshaft to the machine; refer to [Installing the PTO Driveshaft \(page 9–5\)](#).

PTO Shaft



g220805

Figure 293

- | | | |
|----------------------------|---------------------------|-----------------------------|
| 1. Bolt | 7. PTO tension shaft | 13. Flange bearing (2 each) |
| 2. Lock washer | 8. Flange nut (8 each) | 14. Bolt (2 each) |
| 3. Flat washer | 9. Woodruff key | 15. Flat washer (4 each) |
| 4. PTO drive belt | 10. PTO shaft | 16. Rubber mount (2 each) |
| 5. PTO pulley | 11. PTO bearing bracket | 17. Bolt (4 each) |
| 6. Carriage screw (4 each) | 12. Bushing support plate | 18. Locknut (2 each) |



WARNING



Do not start the engine and engage the PTO switch when the PTO driveshaft is disconnected from the cutting deck (or implement). If you start the engine and the PTO shaft is allowed to rotate, serious personal injury and machine damage could result.

Disconnect the PTO electric clutch electrical connector whenever the PTO driveshaft is disconnected from the cutting deck (or implement).

Removing the PTO Shaft

1. Park the machine on a level surface, lower the cutting deck (or implement), shut off the engine, set the parking brake, and remove the key from the key switch.
2. Remove the PTO driveshaft from the machine; refer to [Removing the PTO Driveshaft \(page 9-5\)](#).
3. Remove the PTO drive belt from the machine; refer to the *Traction Unit Operator's Manual*.

Removing the PTO Shaft (continued)


4. Remove the rear frame and axle assembly from the machine; refer to [Removing the Rear Frame and Axle Assembly \(page 7–9\)](#).
5. Remove the bolt (item 1 in [Figure 293](#)), lock washer, and flat washer that secure the pulley to the PTO shaft. Use a puller, remove the pulley from the PTO shaft. Locate and retrieve the woodruff key.
6. Loosen the set screws that secure the front and rear flange bearing locking collars to the PTO shaft. Use the blind hole in each bearing collar as a striking point, unlock the collars from the PTO shaft with a punch by rotating the collars clockwise as viewed while facing forward.
7. Support the PTO shaft to prevent it from falling.
8. Remove the 2 carriage screws (item 6 in [Figure 293](#)) and 2 flange nuts that secure the rear flange bearing to the PTO tension shaft.
9. Remove the 4 bolts (item 17 in [Figure 293](#)) and 4 flange nuts that secure the PTO bearing bracket to the frame.

IMPORTANT

Ensure that you do not damage the hydraulic lines or other parts while removing the PTO shaft from the machine.

10. Carefully lower the PTO shaft and remove the shaft from the machine.
11. Slide the flange bearings, bearing bracket, and support plate from the PTO shaft.
12. If necessary, disassemble the front flange bearing, bearing bracket, and support plate ([Figure 293](#)).

Installing the PTO Shaft

1. If separated, assemble the front flange bearing, bearing bracket, and support plate as follows:
 - A. Secure the flange bearing to the support plate with the 2 carriage screws and 2 flange nuts.
 - B. Lubricate the rubber mounts with soapy water and install the mounts into the support plate. Ensure that the mounts slide completely into the support plate.
 - C. Secure the support plate to the bearing bracket with the 2 bolts (item 14 in [Figure 293](#)), 4 washers, and 2 locknuts. Ensure that the washers are placed on both sides of the rubber mounts.
 -  D. Ensure that the bearing support plate is fully seated against the shoulders of the rubber mounts and also parallel within 3 mm (0.12 inch) to the bearing bracket.
2. Apply anti-seize lubricant to the flange bearing bores. Install the flange bearings onto the PTO shaft with the locking collars orientated toward the front of the shaft.

IMPORTANT

Ensure that you do not damage the hydraulic lines or other parts while installing the PTO shaft to the machine.

Installing the PTO Shaft (continued)

3. Carefully raise the PTO shaft to the machine.
4. Secure the PTO bearing bracket to the frame with the 4 bolts (item 17 in [Figure 293](#)) and 4 flange nuts.
5. Secure the rear flange bearing to the PTO tension shaft with the 2 carriage screws (item 6 in [Figure 293](#)) and 2 locknuts.
6. Clean the tapers of the PTO shaft and pulley. Apply anti-seize lubricant to the PTO shaft taper. Position the woodruff key into the shaft slot. Install the pulley onto the PTO shaft.



7. Apply Loctite #242 (or equivalent) to the threads of the bolt (item 1 in [Figure 293](#)) that secures the pulley to the PTO shaft. Secure the pulley to the PTO shaft with the bolt, lock washer, and flat washer; torque the bolt to **41 to 47 N·m (30 to 35 ft-lb)**.
8. Install the PTO drive belt to the machine; refer to the *Traction Unit Operator's Manual*. Do not fully tension the belt.
9. Align the PTO pulley to the electric clutch pulley; refer to [Aligning the PTO Pulley to the Electric Clutch Pulley \(page 9–11\)](#).



10. After the pulleys are aligned properly, ensure that the flange bearing locking collars are locked to the PTO shaft and secured with the set screws. Torque the set screws to **9.6 to 11.3 N·m (85 to 100 in-lb)**. Also, ensure that the PTO drive belt is properly tensioned; refer to the *Traction Unit Operator's Manual*.
11. Install the rear frame and axle assembly to the machine; refer to [Installing the Rear Frame and Axle Assembly \(page 7–10\)](#).
12. Install the PTO driveshaft to the machine; refer to [Installing the PTO Driveshaft \(page 9–5\)](#).

Aligning the PTO Pulley to the Electric Clutch Pulley

Checking the Pulley Alignment

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

Note: Because the clutch pulley and PTO pulley have different thicknesses, check the pulley alignment at the pulley grooves.



2. Measure at the bottom of the pulleys, check that the clutch and PTO pulley grooves are aligned within 1.5 mm (0.06 inch).
3. If the pulley grooves are not aligned within 1.5 mm (0.06 inch), loosen the PTO bearing locking collars and move the PTO shaft to get proper pulley alignment.

Adjusting the Pulley Alignment

1. With the PTO belt installed, adjust the belt tension bolt until the compression spring starts to compress.
2. Loosen and remove the set screws that secure the front and rear flange bearing locking collars to the PTO shaft. Use the blind hole in each bearing collar as a striking point, unlock the collars from the PTO shaft with a punch by rotating the collars clockwise as viewed while facing forward.
3. Shift the position of the PTO shaft and pulley until the PTO pulley groove is aligned with the clutch pulley groove.
4. Use the blind hole in each bearing collar as a striking point, lock the collars to the PTO shaft with a punch by rotating the collars counterclockwise as viewed while facing forward.
5. After you tighten the locking collars on the PTO flange bearings, check the pulley alignment again to ensure that the alignment did not change.



6. Apply Loctite #242 to the locking collar set screws, install the set screws into the collars, and torque the set screws to **9.6 to 11.3 N·m (85 to 100 in-lb)**.
7. Adjust the PTO drive belt tension; refer to the *Traction Unit Operator's Manual*.



Table of Contents

General Information	10-2
Specifications.....	10-2
Cutting Unit Operator's Manual	10-2
Troubleshooting.....	10-3
Factors That Can Affect Quality of Cut	10-3
Adjustments	10-4
Castor Wheel Tire Pressure	10-4
Service and Repairs	10-5
Cutting Deck	10-5
Idler Assembly	10-6
Blade Spindle.....	10-8
Servicing the Blade Spindle	10-10
Gearbox	10-14
Castor Forks and Wheels.....	10-18
Cutting Deck Rollers and Skids.....	10-20

General Information



g223997

Figure 294

Specifications

Several cutting units are available for the Groundsmaster 3280-D and 3320 machines. Refer to the *Cutting Unit Operator's Manual* for specifications and optional accessories for the cutting unit used on your machine.

Note: This chapter gives information about troubleshooting and repair of 72 inch base cutting deck. The 52, 60, 62, and 72 inch side discharge cutting decks, 62 inch base cutting deck information is not covered in this chapter.

Cutting Unit Operator's Manual

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

Troubleshooting

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 cutting deck or 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 unit weight, tire pressures, hydraulic counterbalance settings, and turf conditions.

Factors That Can Affect Quality of Cut

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: Gasoline Engine (page 3-1) or Chapter 4: Diesel Engine (page 4-1) . 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 including castor tires. Adjust to the pressures specified in the <i>Operator's Manual</i> .
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	Ensure that all cutting deck height-of-cut adjustments are the same. Adjust the deck as specified in the <i>Cutting Unit Operator's Manual</i> . 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. Roller and castor wheel condition	All rollers and caster wheels should rotate freely. Replace the bearings 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.

Adjustments



CAUTION



Do not work on the cutting deck or lift arms with the engine running. Always shut off the engine and remove the key from the key switch before working on the cutting deck.

Refer to the *Cutting Unit Operator's Manual* for adjustment procedures for the cutting unit on the Groundsmaster 3280-D and 3320.

Castor Wheel Tire Pressure



Castor tires on the cutting deck should be inflated to 345 kPa (50 psi).

Service and Repairs



WARNING



Do not start the engine and engage the PTO switch when the PTO driveshaft is disconnected from the cutting deck. If you start the engine and the PTO shaft is allowed to rotate, serious personal injury and machine damage could result.

If the PTO driveshaft is disconnected from the cutting deck, disconnect the PTO electric clutch electrical connector.



CAUTION



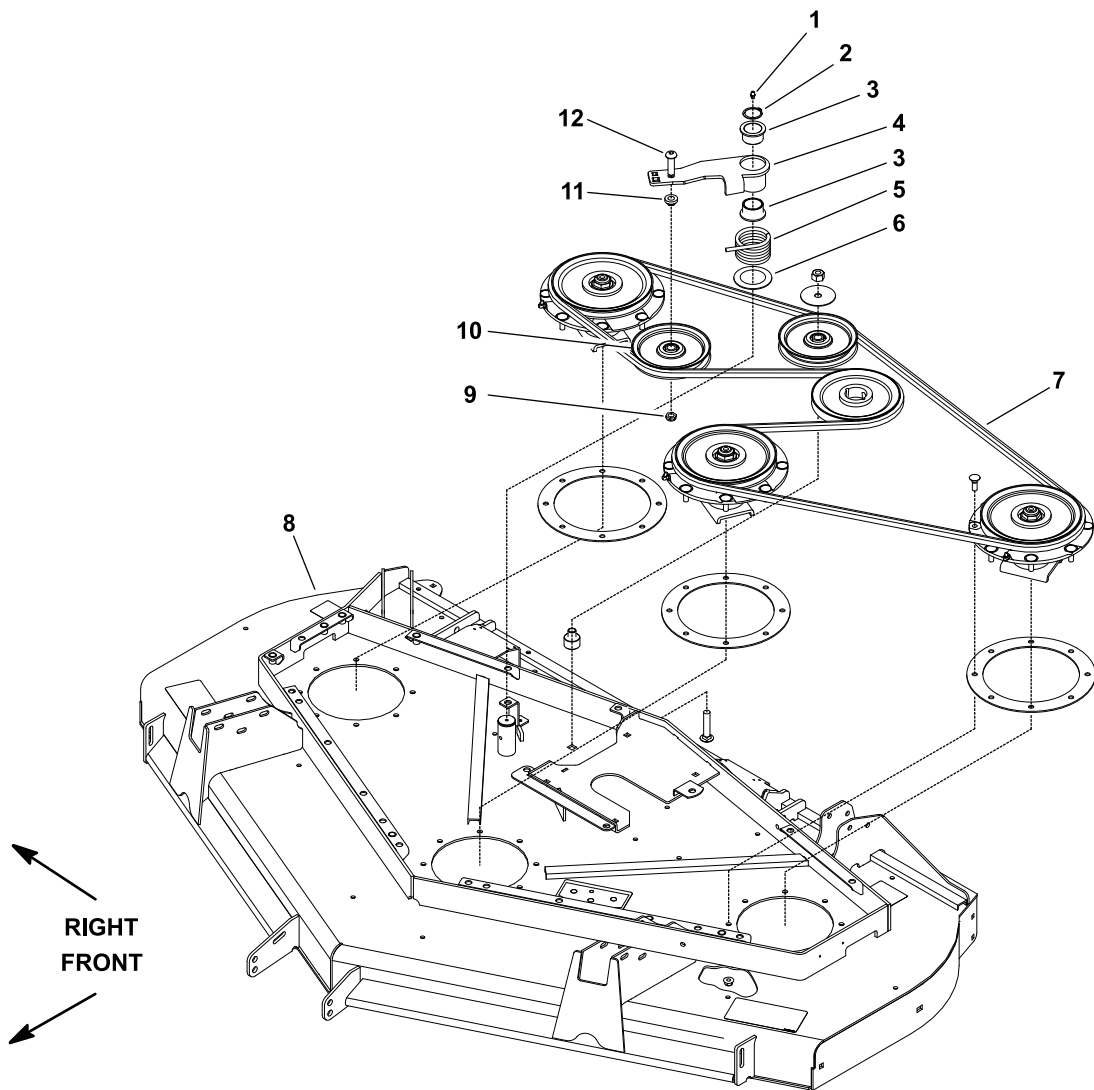
Do not work on the cutting deck or lift arms with the engine running.

Always shut off the engine and remove the key from the key switch before working on the cutting deck.

Cutting Deck

Refer to specific *Cutting Unit Operator's Manual* for cutting deck removal and installation procedure.

Idler Assembly



g223995

Figure 295

- | | | |
|----------------------------|-------------------|-----------------------|
| 1. Grease fitting | 5. Torsion spring | 9. Locknut |
| 2. Snap ring | 6. Washer | 10. Idler pulley |
| 3. Flange bushing (2 each) | 7. Drive belt | 11. Idler spacer |
| 4. Idler arm | 8. Cutting deck | 12. Button-head screw |

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. Remove the belt covers from the top of the cutting deck. Remove the drive belt from the deck pulleys; refer to the *Cutting Unit Operator's Manual*.
3. 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 tension from the torsion spring of the idler arm.

4. Carefully push the torsion spring end down and away from the idler arm to unhook the spring from the arm.
5. Remove the snap ring (item 2 in [Figure 295](#)) that retains the idler arm assembly to the cutting deck.
6. Remove the idler components as shown in [Figure 295](#).

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 295](#)).
2. Insert a nut driver or small piece of pipe onto the torsion spring end of the idler arm.



CAUTION

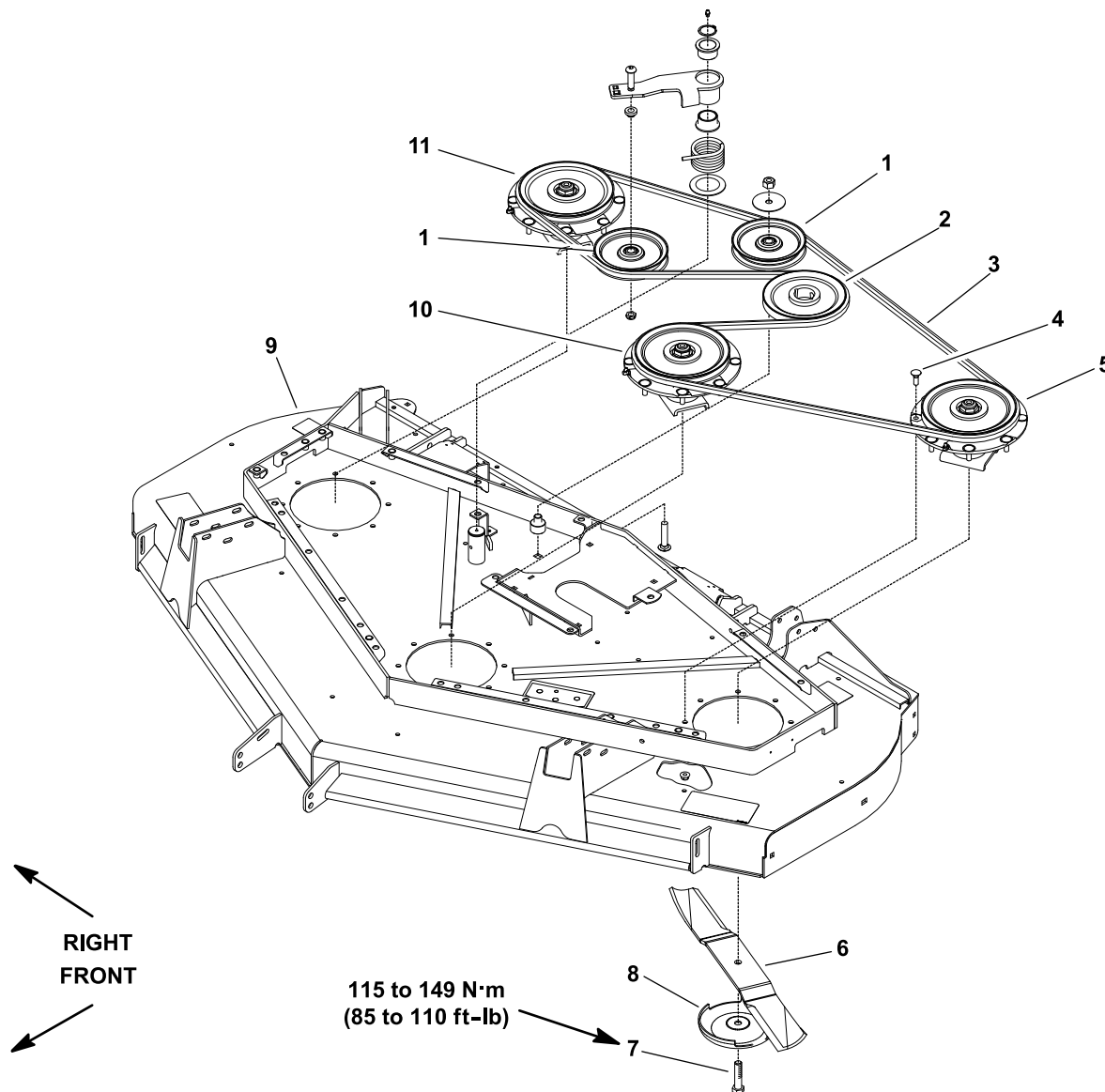


The spring is under heavy load and can cause personal injury.

Be careful when applying tension to the torsion spring of the idler arm.

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; refer to the *Cutting Unit Operator's Manual*.
5. Install the belt covers to the cutting deck; refer to the *Cutting Unit Operator's Manual*.

Blade Spindle



g223993

Figure 296

- | | | |
|--|----------------------------|-----------------------------|
| 1. Idler pulley (2 each) | 5. Left spindle assembly | 9. Cutting deck |
| 2. Drive pulley | 6. Cutting blade (3 each) | 10. Center spindle assembly |
| 3. Drive belt | 7. Blade bolt (3 each) | 11. Right spindle assembly |
| 4. Ribbed neck bolt (8 each per spindle) | 8. Anti-scalp cup (3 each) | |

Removing the Blade Spindle

1. Park the machine on a level surface, raise the cutting deck, shut off the engine, set the parking brake, and remove the key from the key switch. Support the cutting deck so that it cannot fall accidentally.
2. Remove the belt covers from the top of the cutting deck. Remove the drive belt from the deck pulleys; refer to the *Cutting Unit Operator's Manual*.
3. Remove the cutting blade (item 6 in [Figure 296](#)), anti-scalp cup, and blade bolt from the spindle; refer to the *Cutting Unit Operator's Manual*.

Removing the Blade Spindle (continued)

4. Remove the 8 ribbed neck bolts and 8 flange nuts that secure the spindle assembly to the deck, and remove the spindle assembly from the deck.

Installing the Blade Spindle

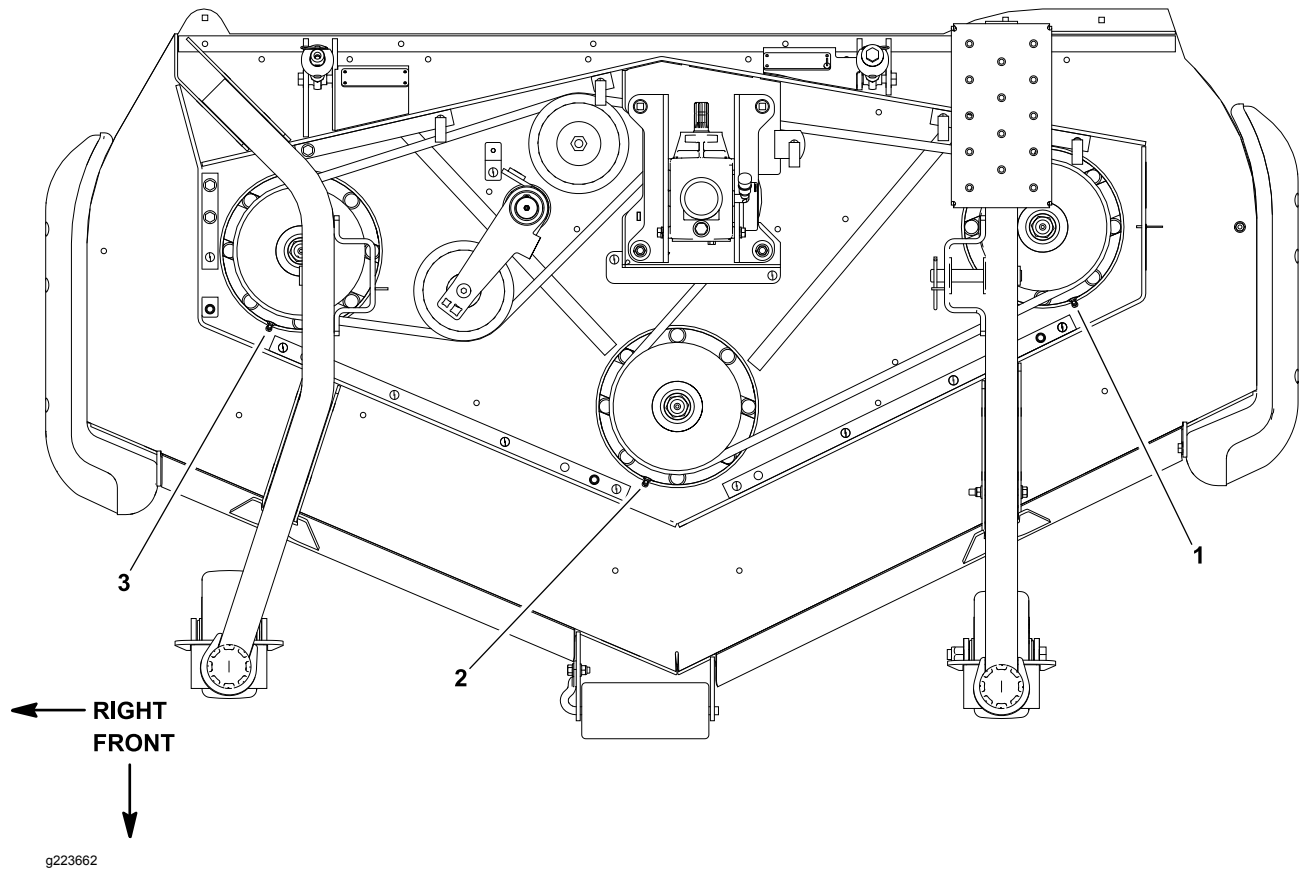


Figure 297

1. Left spindle grease fitting
2. Center spindle grease fitting
3. Right spindle grease fitting

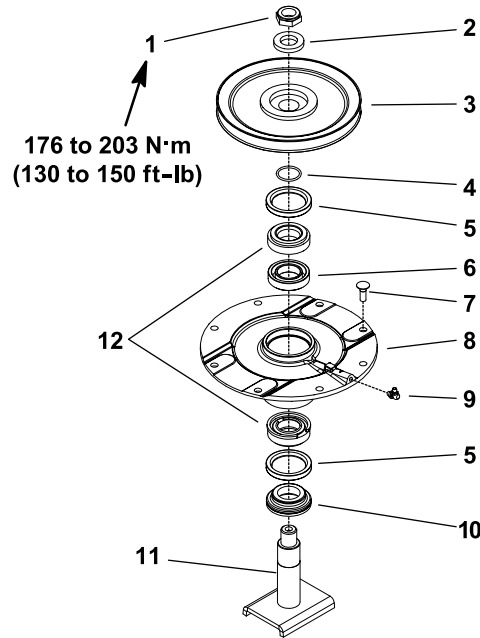
1. Position the spindle on the cutting deck and note the orientation of the grease fitting (Figure 297). Secure the spindle assembly to the deck with the 8 ribbed neck bolts and 8 flange nuts.



2. Install the cutting blade, anti-scalp cup, and blade bolt; refer to the *Cutting Unit Operator's Manual*. Torque the blade bolt to **115 to 149 N·m (85 to 110 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; refer to the *Cutting Unit Operator's Manual*.
5. Lubricate the spindle grease fittings.
6. Install the belt covers to the cutting deck; refer to the *Cutting Unit Operator's Manual*.

Servicing the Blade Spindle

Disassembling the Blade Spindle



g223663

Figure 298

- | | | |
|----------------------------|------------------------------|-------------------|
| 1. Locknut | 5. Oil seal (2 each) | 9. Grease fitting |
| 2. Special hardened washer | 6. Bearing spacer | 10. Shaft spacer |
| 3. Pulley | 7. Ribbed neck bolt (8 each) | 11. Spindle shaft |
| 4. O-ring | 8. Spindle housing | 12. Bearing set |

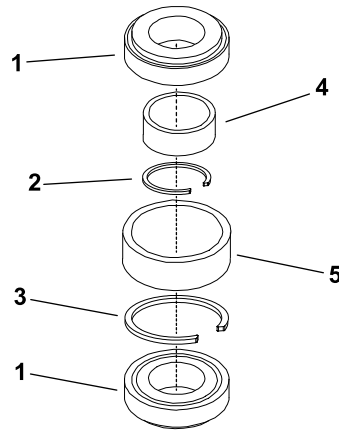
1. Remove the locknut from the top of the spindle shaft.
2. Remove the special hardened washer and pulley from the shaft.
3. Use an arbor press to remove the spindle shaft from the spindle housing.

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



g189007

Figure 299

- | | | |
|----------------|--------------------|-----------------|
| 1. Bearing | 3. Large snap ring | 5. Outer spacer |
| 2. Spacer ring | 4. Inner spacer | |

Note: A replacement spindle bearing set contains 2 bearings, a spacer ring, and a large snap ring (items 1, 2, and 3 in [Figure 299](#)). 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 299](#)). 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.

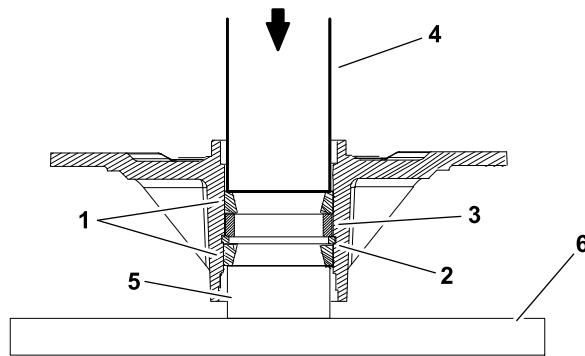
-
1. If the large snap ring was removed from the spindle housing, install the snap ring into the housing groove.

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.

Assembling the Blade Spindle (continued)



g223664

Figure 300

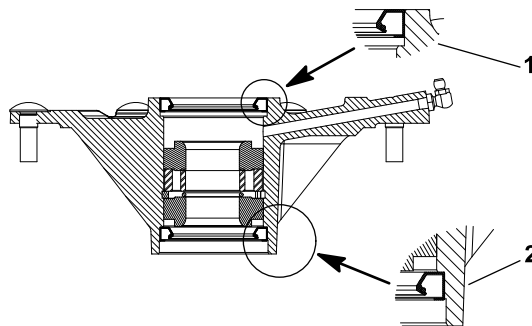
- | | | |
|--------------------|-----------------|---------------------|
| 1. Bearing cup | 3. Outer spacer | 5. Support |
| 2. Large snap ring | 4. Arbor press | 6. Arbor press base |

3. Use an arbor press to push the bearing cups into the top and bottom of the spindle housing (Figure 300).

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.

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.



g223665

Figure 301

- | | |
|----------------------------|-----------------------------|
| 1. Upper seal installation | 2. Bottom seal installation |
|----------------------------|-----------------------------|

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 301).

IMPORTANT

If you are replacing the bearings, ensure that you use the spacer ring that is included with a new bearing set (Figure 299).

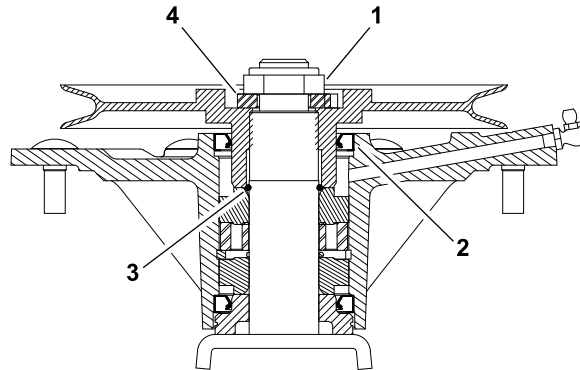
Assembling the Blade Spindle (continued)

- 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 **1.5 mm (0.060 inch)** recessed to the housing surface (Figure 301).

- 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.
- 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.
- 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.



g223666

Figure 302

- | | |
|---------------|--------------------|
| 1. Locknut | 3. O-ring |
| 2. Upper seal | 4. Hardened washer |

-
- Install the O-ring to the top of the spindle shaft (Figure 302).



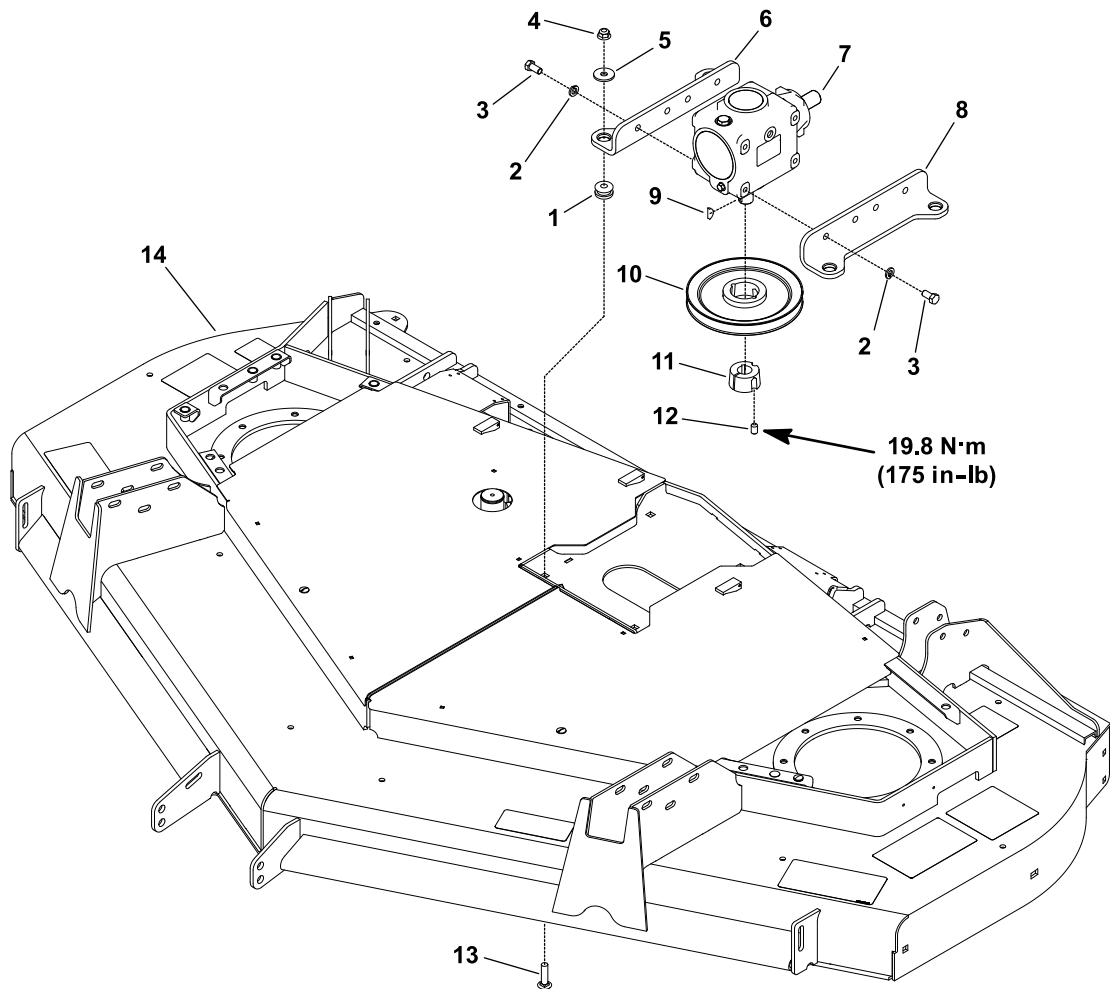
- Install the pulley (hub down), special hardened washer, and locknut to the spindle shaft (Figure 302); torque the locknut to **176 to 203 N·m (130 to 150 ft-lb)**.

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.

- 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.
- Rotate the spindle shaft to ensure that it turns freely.

Gearbox



g223994

Figure 303

- | | | |
|-------------------------|--------------------------|-----------------------------|
| 1. Mount (4 each) | 6. Right gearbox bracket | 11. Taper lock bushing |
| 2. Lock washer (4 each) | 7. Gearbox | 12. Set screw (2 each) |
| 3. Bolt (4 each) | 8. Left gearbox bracket | 13. Carriage screw (4 each) |
| 4. Flange nut (4 each) | 9. Woodruff key | 14. Cutting deck |
| 5. Washer (4 each) | 10. Drive pulley | |

Removing the Gearbox

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 belt covers from the top of the cutting deck. Remove the drive belt from the deck pulleys; refer to the *Cutting Unit Operator's Manual*

Removing the Gearbox (continued)



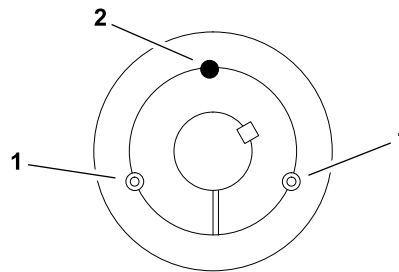
WARNING



Do not start the engine and engage the PTO switch when the PTO driveshaft is disconnected from the cutting deck. If you start the engine and the PTO shaft is allowed to rotate, serious personal injury and machine damage could result.

If the PTO driveshaft is disconnected from the cutting deck, disconnect the PTO electric clutch electrical connector.

3. Disconnect the PTO driveshaft from the gearbox; refer to [Removing the PTO Driveshaft \(page 9–5\)](#).
4. Remove the 4 bolts (item 3 in [Figure 303](#)) and 4 lock washers that secure the gearbox assembly to the gearbox brackets.
5. Remove the 4 carriage screws, 4 flange nuts, 4 washers, and 4 mounts that secure the left and right gearbox brackets (items 8 and 6 in [Figure 303](#)) to the deck mounting plate, and remove the brackets from the deck.
6. Remove the gearbox assembly (with the drive pulley attached) from the deck. Drain the lubricant from the gearbox.
7. Remove the 2 set screws (item 12 in [Figure 303](#)) that secure the taper lock bushing to the drive pulley on the gearbox shaft.



g223657

Figure 304

1. Set screw installation position
2. Set screw removal position

8. 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 304](#)).
9. Slide the bushing and pulley from the gearbox shaft.
10. Locate and retrieve the woodruff key.

Removing the Gearbox (continued)

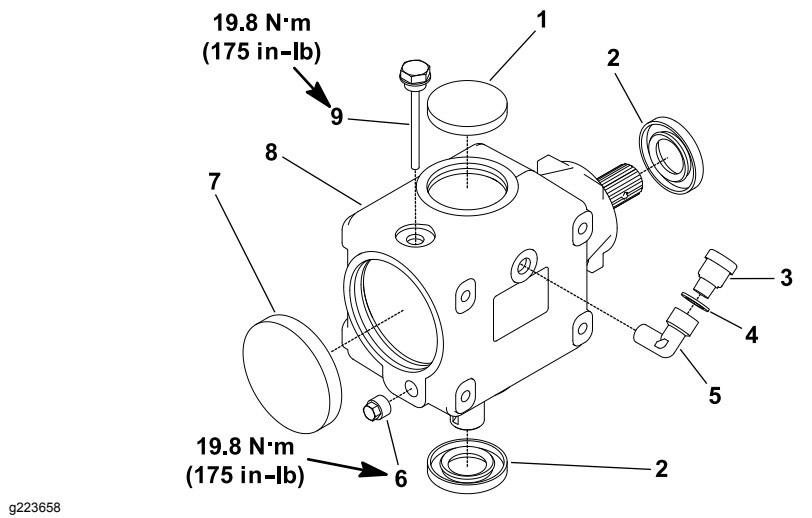


Figure 305

- | | | |
|----------------------|----------------------|-------------|
| 1. Oil cap | 4. Washer | 7. Oil cap |
| 2. Oil seal (2 each) | 5. 90° elbow fitting | 8. Gearbox |
| 3. Breather plug | 6. Plug | 9. Dipstick |
-

Removing the Gearbox (continued)

11. If necessary, remove and replace the oil seals and oil caps in the gearbox (Figure 305).

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 (Figure 305).
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.

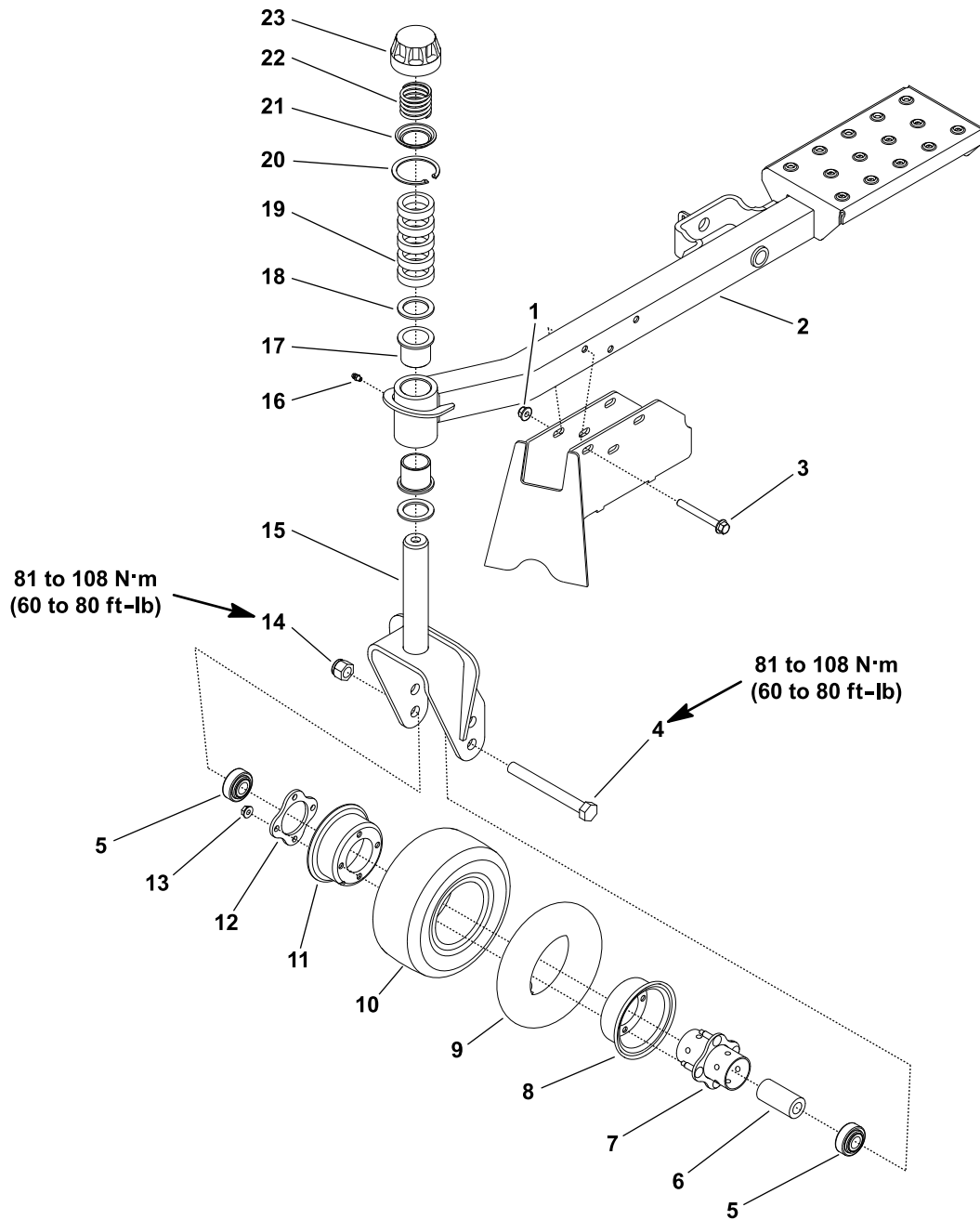


4. Apply oil to the threads of the set screws and install the screws into the threads of the pulley (Figure 304). Alternately and evenly torque the set screws to **19.8 N·m (175 in-lb)**.
5. Fill the allen recess in the set screws and bushing threads with grease to prevent dirt from packing into the crevices.
6. Position the gearbox assembly (with the drive pulley attached) to the deck.
7. Position and secure the left and right gearbox brackets (items 8 and 6 in Figure 303) to the deck mounting plate with the 4 carriage screws, 4 flange nuts, 4 washers, and 4 mounts.
8. Secure the gearbox assembly to the gearbox brackets with the 4 bolts (item 3 in Figure 303) and 4 lock washers.
9. Connect the PTO driveshaft to the gearbox; refer to [Installing the PTO Driveshaft \(page 9–5\)](#).
10. Install the drive belt and belt covers to the cutting deck; refer to the *Cutting Unit Operator's Manual*.



11. Torque the plug (item 6 in Figure 305) in the gearbox to **19.8 N·m (175 in-lb)**. Fill the gearbox with lubricant; refer to the *Cutting Unit Operator's Manual*. Install the dipstick in gearbox; torque the dipstick to **19.8 N·m (175 in-lb)**.

Castor Forks and Wheels



g223659

Figure 306

- | | | |
|--------------------------------|-------------------------|-----------------------------|
| 1. Flange nut (5 each per arm) | 9. Inner tube | 17. Flange bushing (2 each) |
| 2. Castor arm (left) | 10. Castor tire | 18. Thrust washer (2 each) |
| 3. Bolt (5 each per arm) | 11. Wheel rim half | 19. Spacer |
| 4. Bolt | 12. Plate | 20. Retaining ring |
| 5. Bearing (2 each) | 13. Flange nut (4 each) | 21. Cap washer |
| 6. Inner bearing spacer | 14. Locknut | 22. Compression spring |
| 7. Wheel hub | 15. Castor fork | 23. Cap |
| 8. Wheel rim half | 16. Grease fitting | |

Disassembling the Castor Forks and Wheels

1. Disassemble the castor forks and wheels as necessary ([Figure 306](#)).

Assembling the Castor Forks and Wheels

1. Assemble the castor forks and wheels. Ensure that the thrust washers (item 18 in [Figure 306](#)) are positioned directly above and below the castor arm bushings.
2. If the bearings were removed from the wheel hub, do the following steps:
 - A. Press first bearing into the hub until it contacts the shoulder of the hub.
 - B. Place the inner bearing spacer in the hub and then press the second bearing into the hub.
 - C. Check that the spacer fits tightly between the bearings after hub assembly.
3. If the castor fork was removed from the castor arm, lubricate the grease fitting.
4. Refer to the *Cutting Unit Operator's Manual* for castor wheel adjustment.

Cutting Deck Rollers and Skids

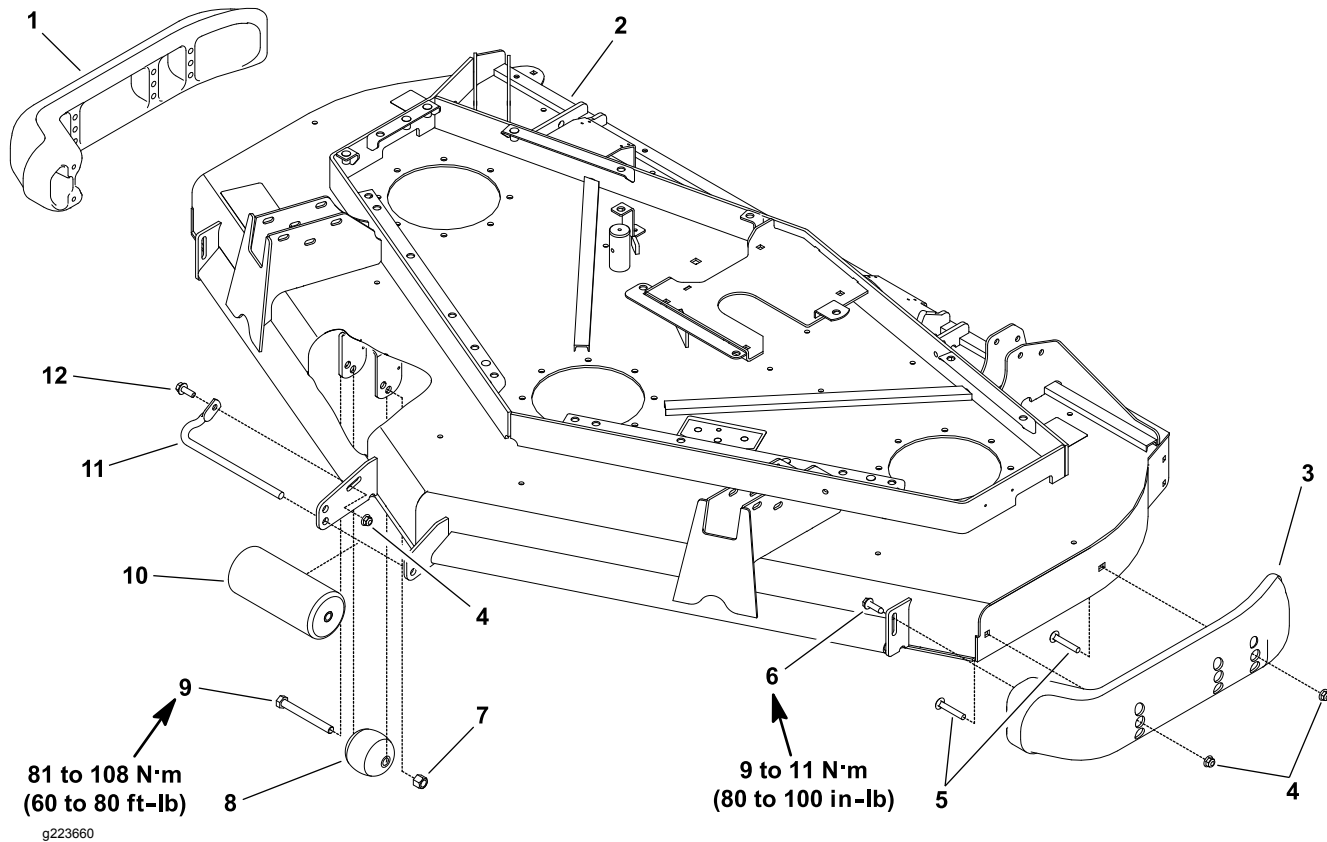


Figure 307

- | | | |
|------------------------|-------------------------------|-----------------------|
| 1. Right skid | 5. Carriage screw (4 each) | 9. Bolt (2 each) |
| 2. Cutting deck | 6. Washer-head screw (2 each) | 10. Roller |
| 3. Left skid | 7. Locknut (2 each) | 11. Roller shaft |
| 4. Flange nut (5 each) | 8. Roller (2 each) | 12. Flange-head screw |

Removing the Cutting Deck Rollers and Skids

1. Remove the skids and rollers from the cutting deck (Figure 307).

Installing the Cutting Deck Rollers and Skids

1. Install the skids to the cutting deck (Figure 307). Ensure to install the skids in the same mounting hole height position (lower or upper).
2. When you install the rollers to the deck, tighten the nut until the roller will not rotate, then loosen the nut only enough to allow the roller to rotate freely. Ensure to install all the cutting deck rollers in the same mounting hole height position (lower or upper).



Table of Contents

General Information	11-2
Operator's Manual	11-2
Electrical Components and Schematics	11-2
Cab Heater System	11-2
Service and Repairs	11-3
Roof Assembly	11-3
Heating Components	11-5
Mixing Box Assembly	11-7
Heater Core	11-10
Blower Fan	11-12
Windshield Wiper Assembly	11-14

General Information

The information in this chapter pertains to the operator cab of the Groundsmaster 3280-D machine.

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 Schematics

Information regarding the Groundsmaster 3280-D electrical cab components (switches and relays) are included in [Chapter 6: Electrical System \(page 6–1\)](#). The Electrical Schematics and Wire Harness Drawings for the operator cab in [Appendix A \(page A–1\)](#).

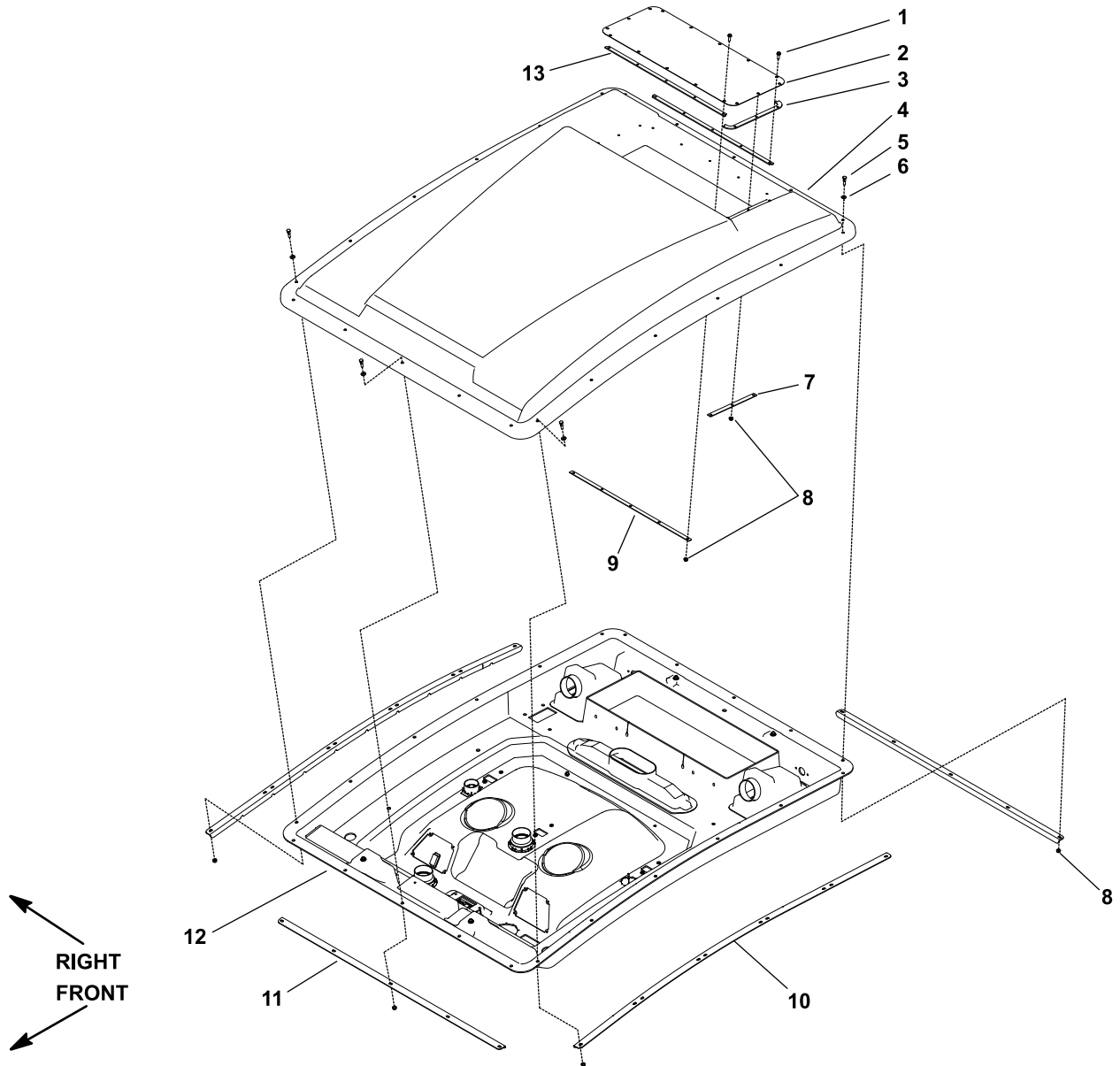
Cab Heater System

The cab heater system used on the Groundsmaster 3280-D 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.
4. The operator controls to adjust the fan speed and to control the cab air temperature.

Service and Repairs

Roof Assembly



g243575

Figure 308

- | | | |
|-----------------------------------|------------------------------|-----------------------------------|
| 1. Washer-head screw (16 each) | 6. Flat washer (22 each) | 11. Cab strap (2 each) |
| 2. Roof cover | 7. Short roof strap (2 each) | 12. Headliner assembly |
| 3. Short side cover seal (2 each) | 8. Flange nut (38 each) | 13. Long side cover seal (2 each) |
| 4. Roof | 9. Long roof strap (2 each) | |
| 5. Shoulder screw (22 each) | 10. Side cab strap (2 each) | |

Get access to the heater core components by removing the roof.

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.
2. Remove the 16 washer-head screws (item 1 in [Figure 308](#)) that secure the roof cover, cover seals, and roof straps to the roof.
3. Remove the 22 shoulder screws (item 5 in [Figure 308](#)), 22 flat washers, and 22 flange nuts that secure the roof and cab straps to the headliner.
4. Carefully lift the roof from the headliner and cab.
5. 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.
3. Secure the roof to the headliner with the 22 shoulder screws (item 5 in [Figure 308](#)), 22 flat washers, cab straps, and 22 flange nuts that were removed.
4. Secure the roof cover, cover seals, and roof straps to the roof with the 16 washer-head screws that were removed.

Heating Components

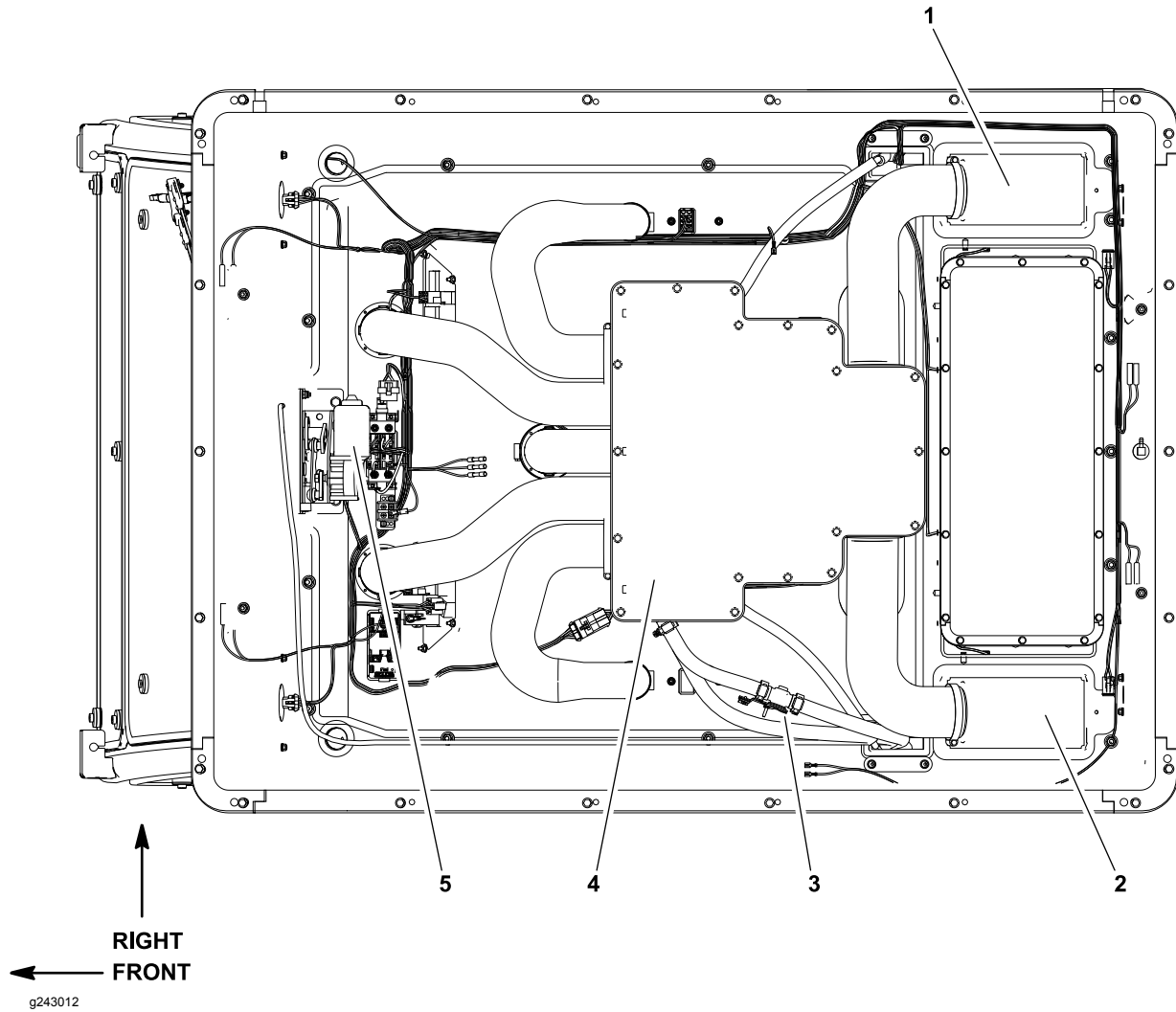
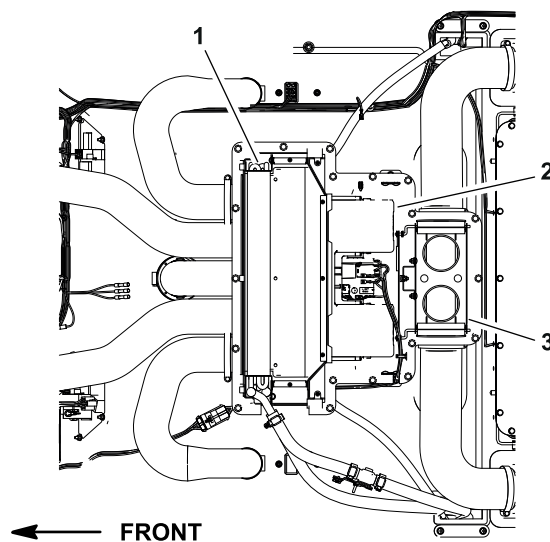


Figure 309

- | | | |
|----------------------------|------------------------|-------------------------|
| 1. Right intake air filter | 3. Heater valve | 5. Wiper motor assembly |
| 2. Left intake air filter | 4. Mixing box assembly | |

Heating Components (continued)



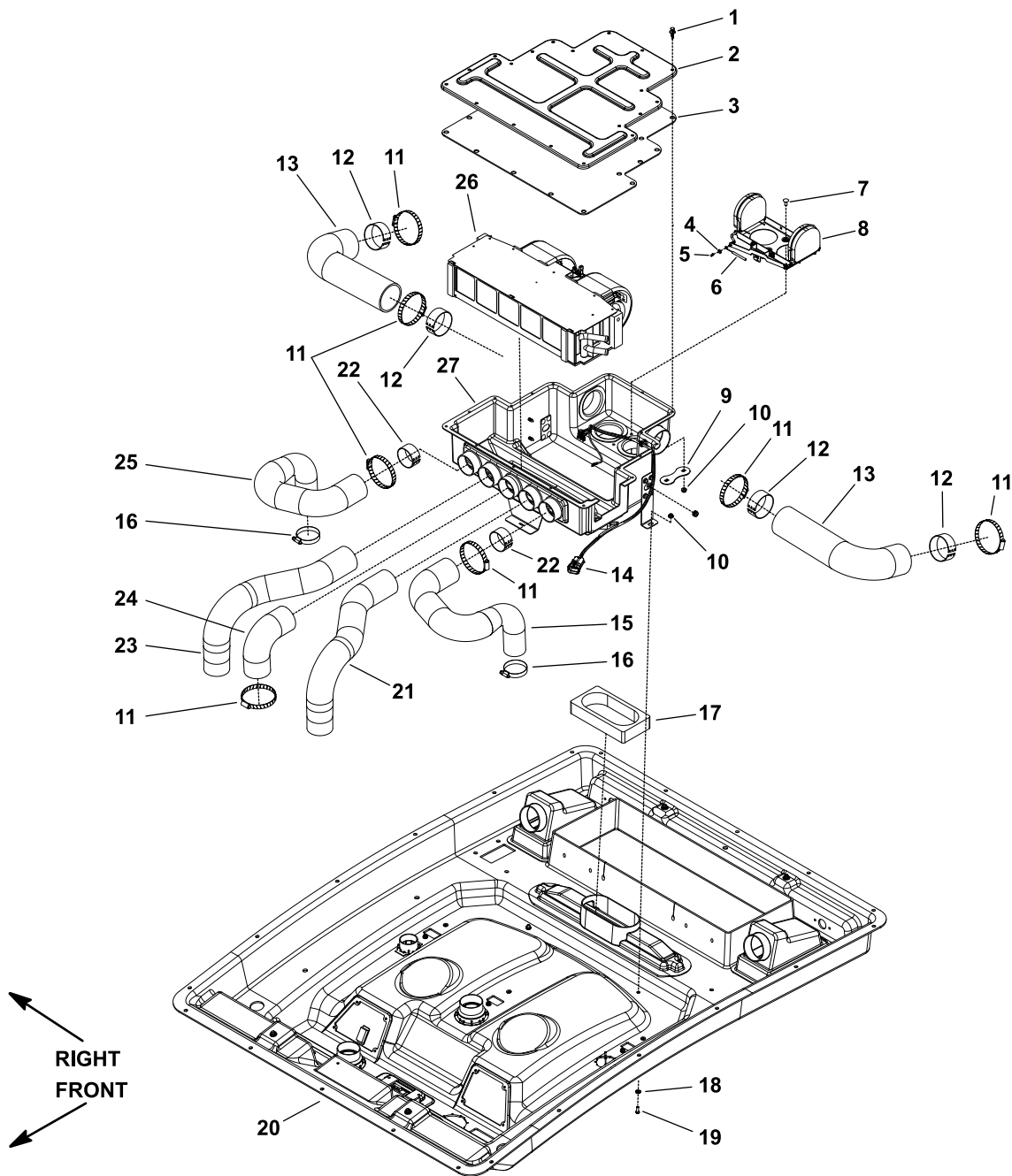
g243014

Figure 310

- | | | |
|----------------|---------------|--------------------------|
| 1. Heater core | 2. Blower fan | 3. Air diverter assembly |
|----------------|---------------|--------------------------|

Get access to the cab heating components by removing the cab roof; refer to [Removing the Roof Assembly \(page 11–4\)](#). After you remove the cab roof, refer to [Figure 309](#) and [Figure 310](#) to identify the components used for heating the operator cab.

Mixing Box Assembly



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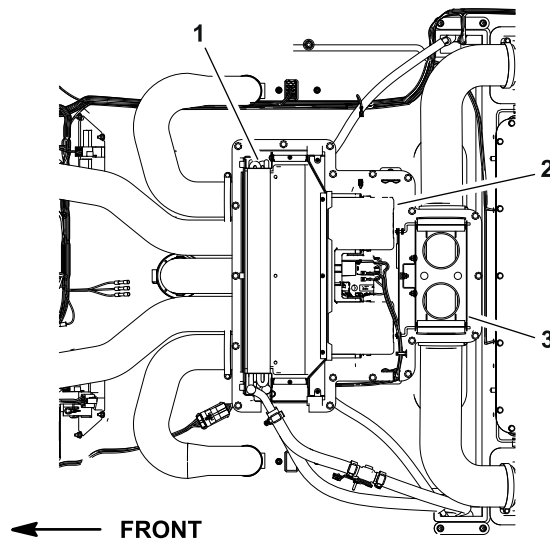
Figure 311

- | | | | |
|----------------------------|-----------------------------|--------------------------------|-------------------------------|
| 1. Rivet (19 each) | 8. Air diverter assembly | 15. Vent hose (left) | 22. Tube support (2 each) |
| 2. Mixing box cover | 9. Support plate | 16. Hose clamp (2 each) | 23. Vent hose (right defrost) |
| 3. Cover insulation | 10. Flange nut (4 each) | 17. Mixing box inlet foam | 24. Vent hose (center) |
| 4. Flat washer (4 each) | 11. Hose clamp (7 each) | 18. Flat washer (2 each) | 25. Vent hose (right) |
| 5. Hairpin cotter (4 each) | 12. Tube support (4 each) | 19. Button-head screw (2 each) | 26. Heater core/fan assembly |
| 6. Control cable | 13. Intake hose (2 each) | 20. Cab headliner | 27. Mixing box |
| 7. Carriage screw (2 each) | 14. Mixing box wire harness | 21. Vent hose (left defrost) | |

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 from the top of the cab to get access to the mixing box assembly; refer to [Removing the Roof Assembly \(page 11–4\)](#).
 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 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 [Heating Components \(page 11–5\)](#) or [Blower Fan \(page 11–12\)](#) for information on removing and installing these components.
4. Disconnect the electrical connectors from the mixing box wire harness.
 5. Remove the mixing box components as shown in [Figure 311](#) and [Figure 312](#).

Installing the Mixing Box Assembly



g243014

Figure 312

- | | | |
|----------------|---------------|--------------------------|
| 1. Heater core | 2. Blower fan | 3. Air diverter assembly |
|----------------|---------------|--------------------------|

1. Install all the mixing box components that were removed ([Figure 311](#) and [Figure 312](#)).
2. Ensure to connect the electrical connectors to the mixing box wire harness.
3. 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.

Installing the Mixing Box Assembly (continued)

4. Operate the heater system to ensure that there are no coolant leaks in the cab headliner.
5. When you complete all the service in the cab headliner, secure the roof to the top of the cab; refer to [Installing the Roof Assembly \(page 11–4\)](#).

Heater Core

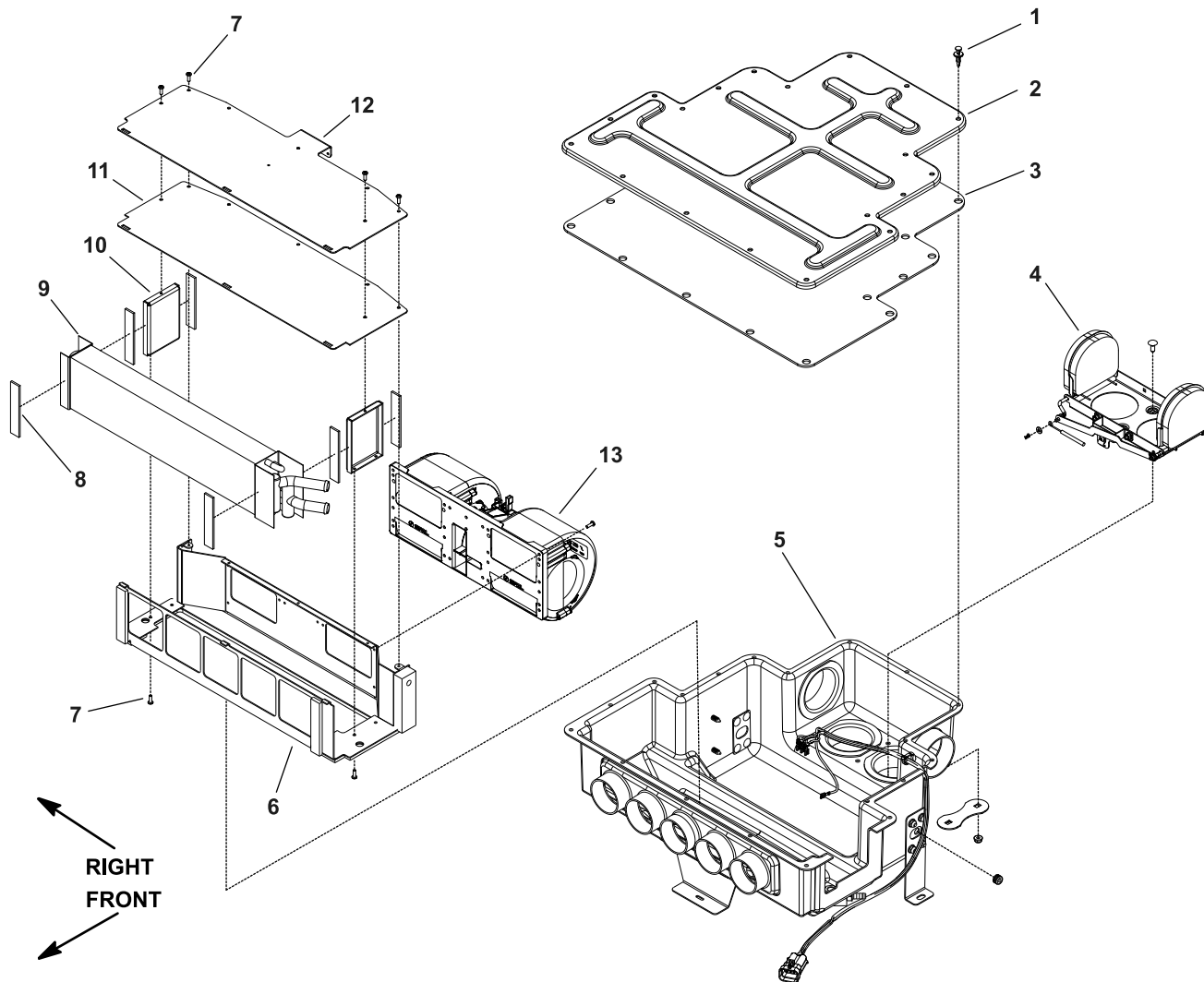


Figure 313

- | | | |
|--------------------------|--|-------------------------|
| 1. Rivet (19 each) | 6. Mount bracket | 11. Cover gasket |
| 2. Mixing box cover | 7. Tap screw (11 each) | 12. Mount bracket cover |
| 3. Cover insulation | 8. Gasket (6 each) | 13. Blower fan |
| 4. Air diverter assembly | 9. Heater core | |
| 5. Mixing box | 10. Heater core mount bracket (2 each) | |

Note: The heater core can be removed and installed with the mixing box (item 5 in [Figure 313](#)) attached to the cab headliner.

Removing the Heater Core

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 from the top of the cab to get access to the heater core; refer to [Removing the Roof Assembly \(page 11-4\)](#).
3. For assembly purposes, label the heater hoses. Loosen the hose clamps and disconnect both the heater hoses from the tubes on the heater core.

Removing the Heater Core (continued)

4. 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.
5. Remove the 7 tap screws (item 7 in [Figure 313](#)) that secure the mount bracket cover to the mount bracket. Lift the cover and position it away from the mount bracket.
6. Carefully lift the heater core from the mount bracket.
7. Inspect the gaskets and insulation in the mixing box assembly for tears or other damage. Replace all the sealing components that were damaged.

Installing the Heater Core

1. Carefully install the heater core into the mount bracket in the mixing box.
2. Position the mount bracket cover to the mount bracket. Secure the cover to the mount bracket with the 7 tap screws (item 7 in [Figure 313](#)).
3. 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 cover and into the hole in the mixing box. Press the pin into the rivet to secure the rivet in place.
4. 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.
5. Operate the heater system to ensure that there are no coolant leaks in the headliner.
6. Secure the roof to the top of the cab; refer to [Installing the Roof Assembly \(page 11–4\)](#).

Blower Fan

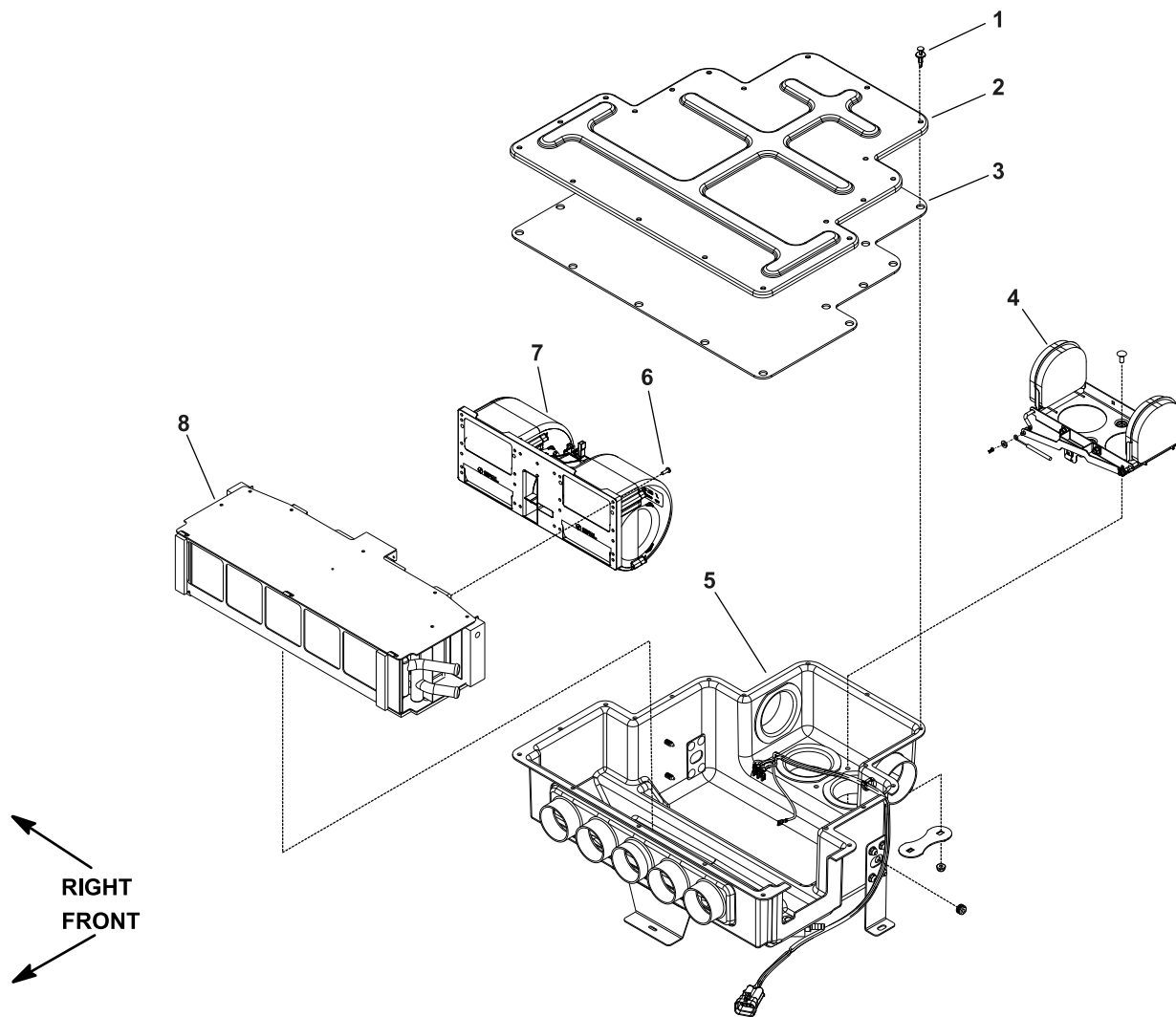


Figure 314

- | | | |
|---------------------|--------------------------|-------------------------|
| 1. Rivet (19 each) | 4. Air diverter assembly | 7. Blower fan |
| 2. Mixing box cover | 5. Mixing box | 8. Heater core assembly |
| 3. Cover insulation | 6. Tap screw (6 each) | |

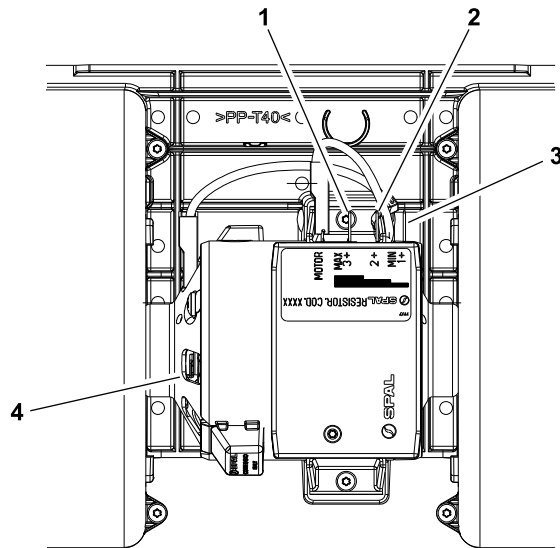
Note: The blower fan can be removed and installed with the mixing box (item 5 in [Figure 314](#)) attached to the cab headliner.

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 from the top of the cab to get access to the blower fan; refer to [Removing the Roof Assembly \(page 11–4\)](#).
3. For assembly purposes, label the heater hoses. Loosen the hose clamps and disconnect both the heater hoses from the tubes on the heater core.
4. 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.

Removing the Blower Fan (continued)

- C. Remove the mixing box cover.



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Figure 315

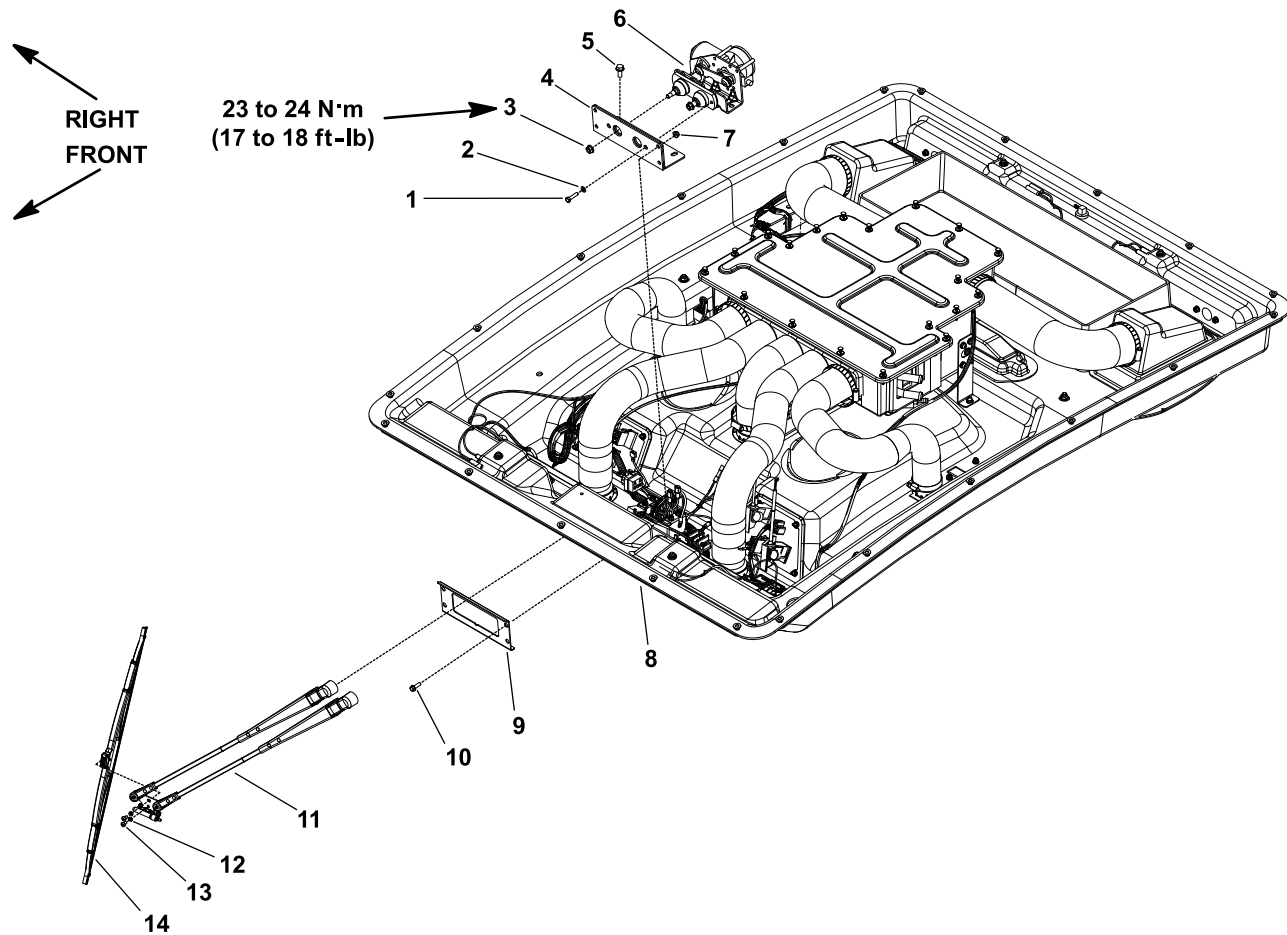
- | | | | |
|---------------------------|--------------------------|-----------------------------|-------------------------------|
| 1. Terminal 3
(orange) | 2. Terminal 2
(brown) | 3. MIN terminal
(violet) | 4. Ground terminal
(black) |
|---------------------------|--------------------------|-----------------------------|-------------------------------|

5. Note the location of the wire harness connectors on the blower fan assembly ([Figure 315](#)), disconnect the wire harness connectors from the fan.
6. Carefully raise the heater core assembly with attached blower fan from the mixing box.
7. Remove the 6 tap screws (item 6 in [Figure 314](#)) that secure the blower fan to the heater core assembly, and remove the blower fan.

Installing the Blower Fan

1. Position the blower fan to the heater core and secure the fan with the 6 tap screws.
2. Carefully lower the heater core assembly with attached blower fan into the mixing box.
3. Connect the wire harness connectors to the blower fan assembly ([Figure 315](#)).
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 hoses with the hose clamps.
6. Operate the heater system to ensure that there are no coolant leaks in the headliner.
7. Secure the roof to the top of the cab; refer to [Installing the Roof Assembly \(page 11-4\)](#).

Windshield Wiper Assembly



g243015

Figure 316

- | | | |
|-------------------------------|--------------------------------|--------------------------|
| 1. Bolt | 6. Wiper motor | 11. Wiper arm assembly |
| 2. Lock washer | 7. Flange nut (4 each) | 12. Lock washer (2 each) |
| 3. Flange nut (2 each) | 8. Cab headliner | 13. Screw (2 each) |
| 4. Wiper bracket | 9. Washer plate | 14. Wiper blade |
| 5. Washer-head screw (2 each) | 10. Washer-head screw (4 each) | |

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 screws (item 13 in [Figure 316](#)) 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 2 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 from the top of the cab to get access to the wiper motor assembly; refer to [Removing the Roof Assembly \(page 11–4\)](#).
5. Remove the wiper motor components as shown in [Figure 316](#).

Assembling the Windshield Wiper Assembly

1. If necessary, install the wiper motor components that were removed ([Figure 316](#)) and do the following:
 - A. If the wiper bracket (item 4 in [Figure 316](#)) 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 to the top of the cab; refer to [Installing the Roof Assembly \(page 11–4\)](#).
2. If the wiper arm 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 2 flange nuts. Install the wiper arm caps over the 2 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 with the 2 screws and 2 lock washers.



Table of Contents

Appendix A A-1

Electrical Drawing Designations A-3

Hydraulic Schematic-3280-D (Serial Numbers below 270000400) and 3320 (Serial Numbers below 280000000) A-5

Hydraulic Schematic-3280-D (Serial Numbers 270000400 to 311000000) and 3320 (Serial Numbers 280000000 to 311000000)..... A-6

Hydraulic Schematic-3280-D (Serial Numbers 311000001 through 316000000)..... A-7

Hydraulic Schematic-3280-D (Machine Serial Numbers after 316000000)..... A-8

Electrical Schematic-3320 A-9

Electrical Schematic (Machine Serial Number before 311000000) A-10

Electrical Schematic (Machine Serial Number 311000000 and Up) A-11

Electrical Schematic-Operator Cab..... A-12

Electrical Schematic-Operator Cab..... A-13

Wire Harness Drawing-Main-3320 (Serial Numbers below 260000000)..... A-14

Wire Harness Diagram-Main-3320 (Serial Numbers below 260000000) A-15

Wire Harness Drawing-Main-3320 (Serial Numbers above 260000000) A-16

Wire Harness Diagram-Main-3320 (Serial Numbers above 260000000)..... A-17

Wire Harness Drawing-Main-3280-D (Serial Numbers below 260000000)..... A-18

Wire Harness Diagram-Main-3280-D (Serial Numbers below 260000000)..... A-19

Wire Harness Drawing-Main-3280-D (Machine Serial Number 260000000 to 270000600)..... A-20

Wire Harness Diagram-Main-3280-D (Machine Serial Number 260000000 to 270000600)..... A-21

Wire Harness Drawing-Main-3280-D (Machine Serial Number 270000601 to 311000000)..... A-22

Wire Harness Diagram-Main-3280-D (Machine Serial Number 270000601 to 311000000)..... A-23

Wire Harness Drawing-Main-3280-D (Machine Serial Number 311000000 to 316000000)..... A-24

Wire Harness Diagram-Main-3280-D (Machine Serial Number 311000000 to 316000000)..... A-25

Wire Harness Drawing-Main-3280-D (Machine Serial Number 316000000 to 400000000)..... A-26

Wire Harness Diagram-Main-3280-D (Machine Serial Number 316000000 to 400000000)..... A-27

Wire Harness Drawing-Main-3280-D (Machine Serial Number 400000000 and Up)..... A-28

Wire Harness Diagram-Main-3280-D (Machine Serial Number 400000000 and Up)..... A-29

Wire Harness Drawing-Cab Model 30298 Power A-30

Wire Harness Diagram-Cab Model 30298 Power..... A-31

Wire Harness Drawing-Cab Model 30298 Headliner..... A-32

Wire Harness Diagram-Cab Model 30298 Headliner..... A-33

Wire Harness Drawing-Cab Model 30298 Front Mount Accessory Power Supply..... A-34

Wire Harness Diagram-Cab Model 30298 Front Mount Accessory Power Supply A-35

Wire Harness Drawing-Cab Model 30298 Heat/Air Conditioning Blower A-36

Wire Harness Diagram-Cab Model 30298 Heat/Air Conditioning Blower..... A-37

Wire Harness Drawing-Light Kit Model 30405 (Machines without Cab) A-38

Wire Harness Diagram-Light Kit Model 30405 (Machines without Cab).....	A-39
Wire Harness Drawing-North American Light Kit Model 30701 (Machines Serial Number 315000000 and Up)	A-40
Wire Harness Diagram-North American Light Kit Model 30701 (Machines Serial Number 315000000 and Up)	A-41

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

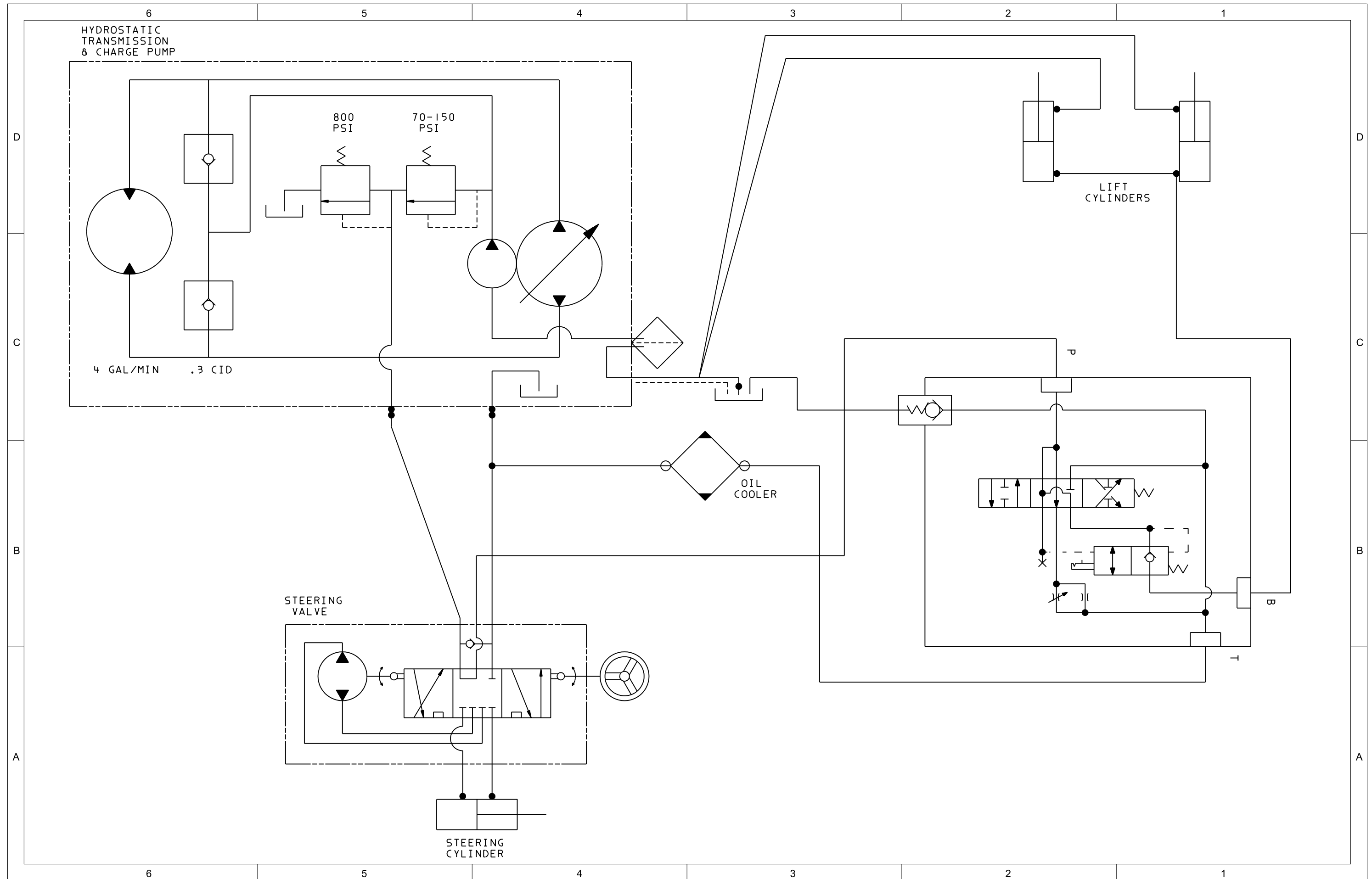
The individual wires of the electrical harness diagrams in this chapter identify both the wire color and the wire size.

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)

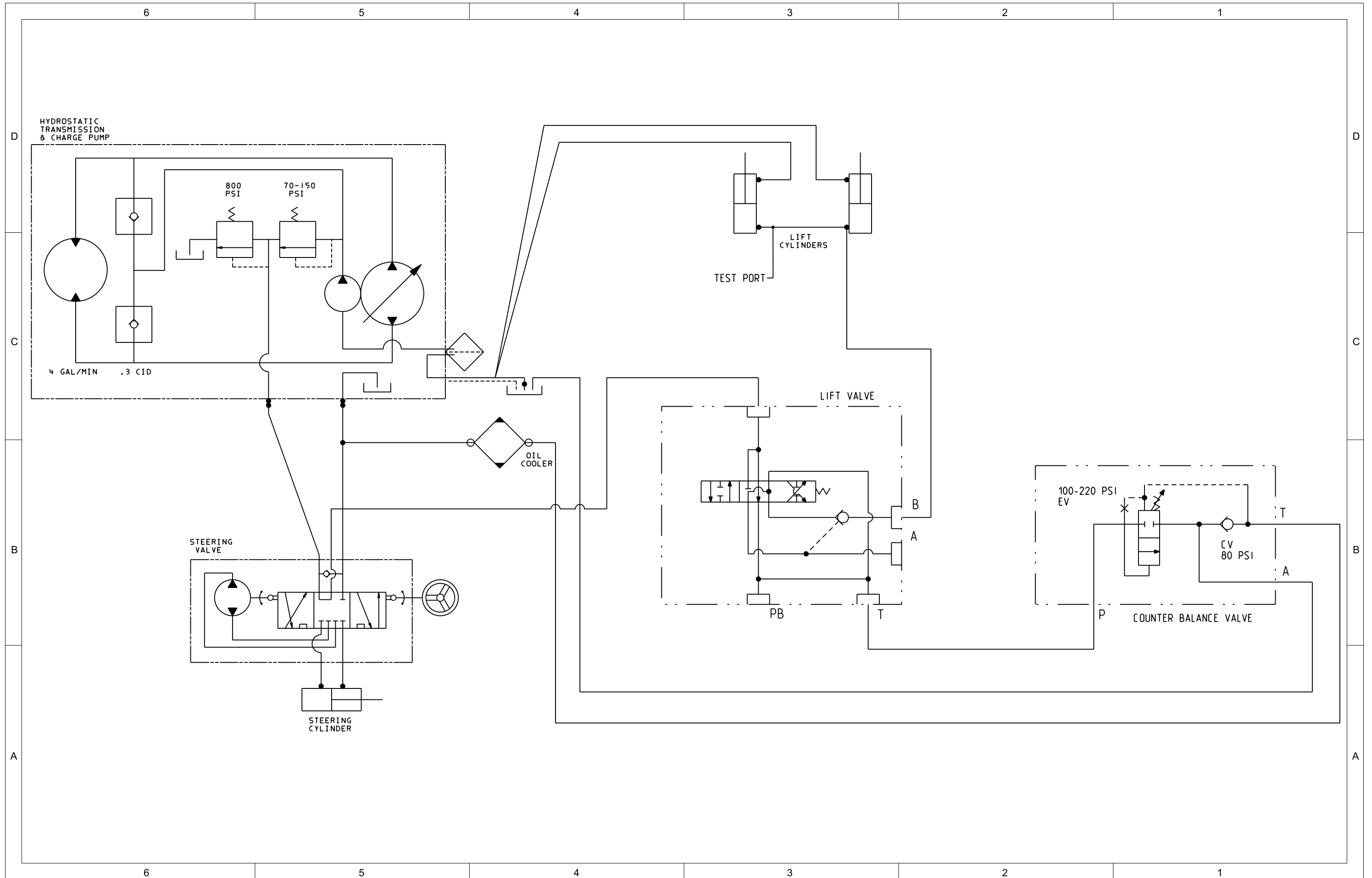
AWG Equivalents for Metric Wire		
Diagram Label	Metric Size	AWG Equivalent
050	0.5 mm	20 GA
175	0.75 mm	18 GA
100	1.0 mm	16 GA
150	1.5 mm	14 GA

Hydraulic Schematic-3280-D (Serial Numbers below 270000400) and 3320 (Serial Numbers below 280000000)

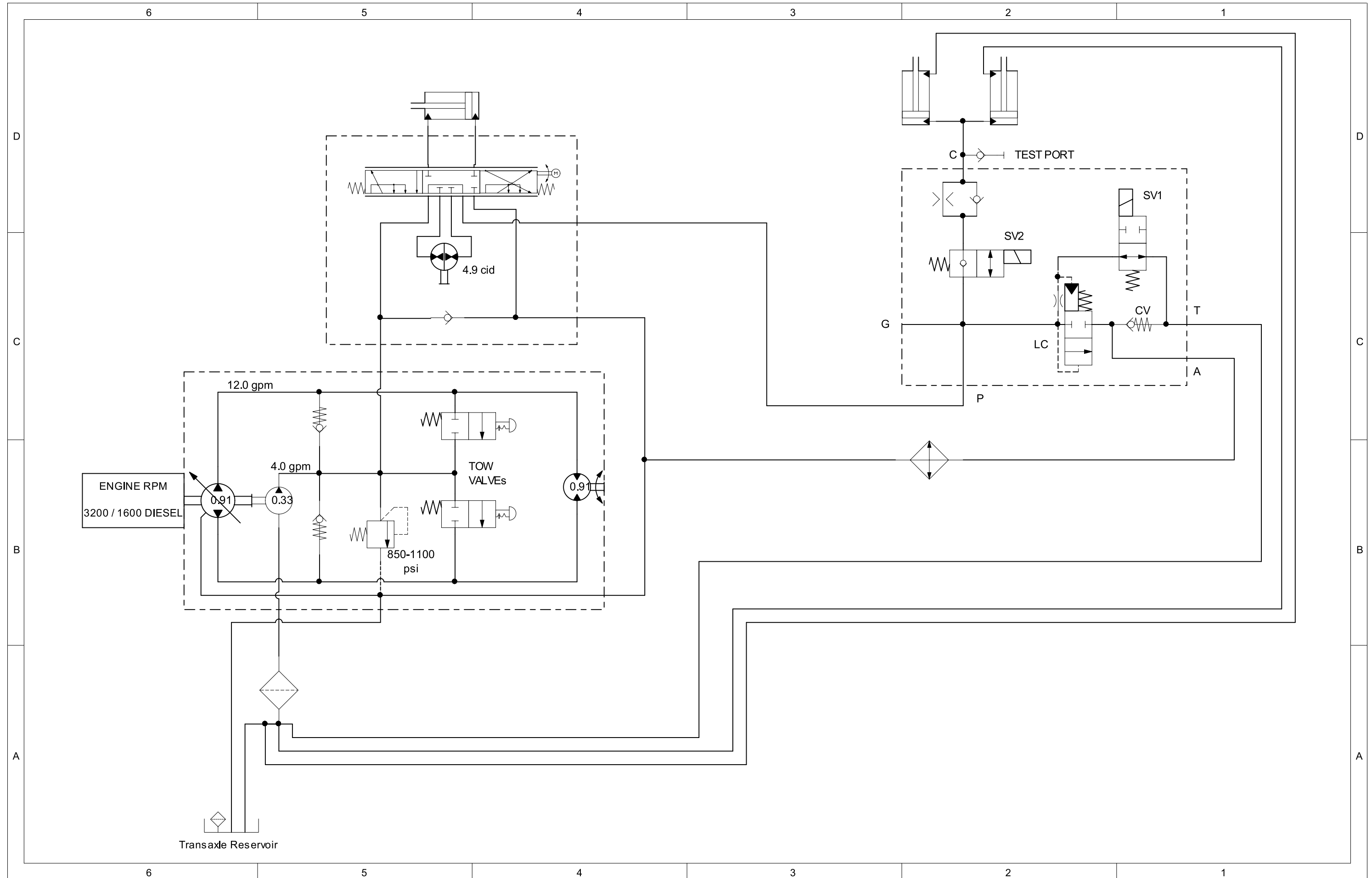


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Hydraulic Schematic-3280-D (Serial Numbers 270000400 to 311000000) and 3320 (Serial Numbers 280000000 to 311000000)

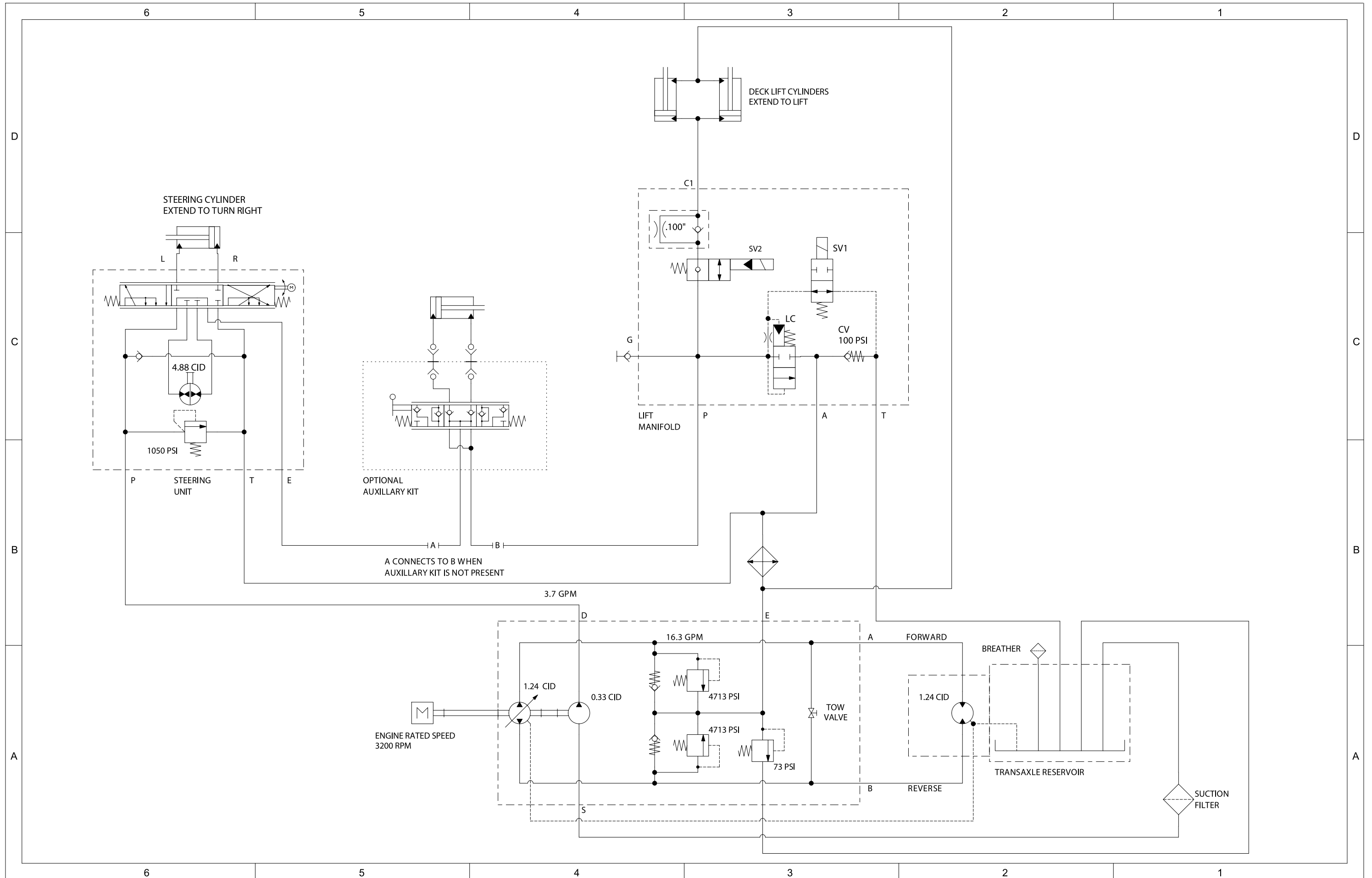


Hydraulic Schematic-3280-D (Serial Numbers 311000001 through 316000000)

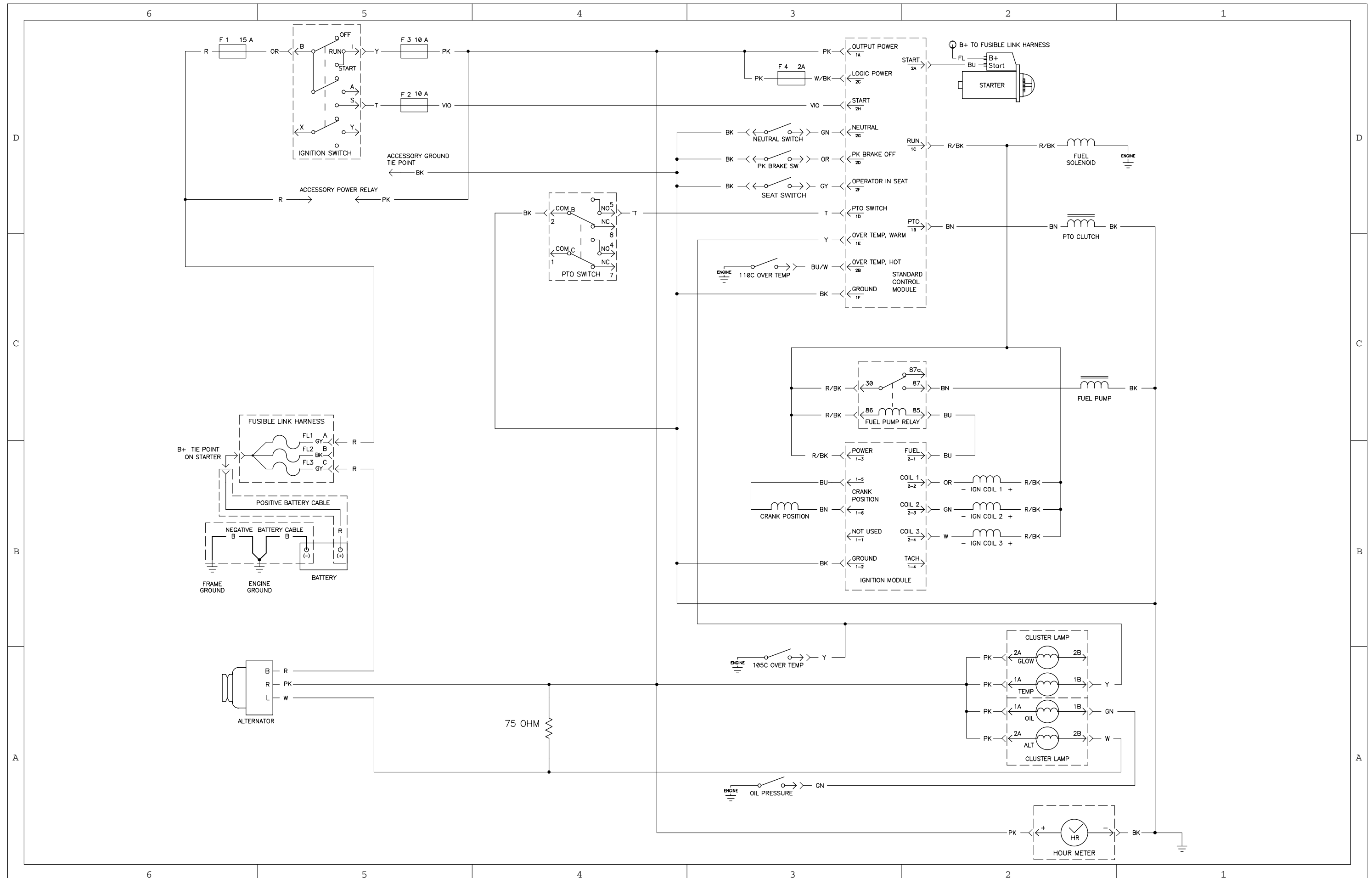


g243933

Hydraulic Schematic-3280-D (Machine Serial Numbers after 316000000)

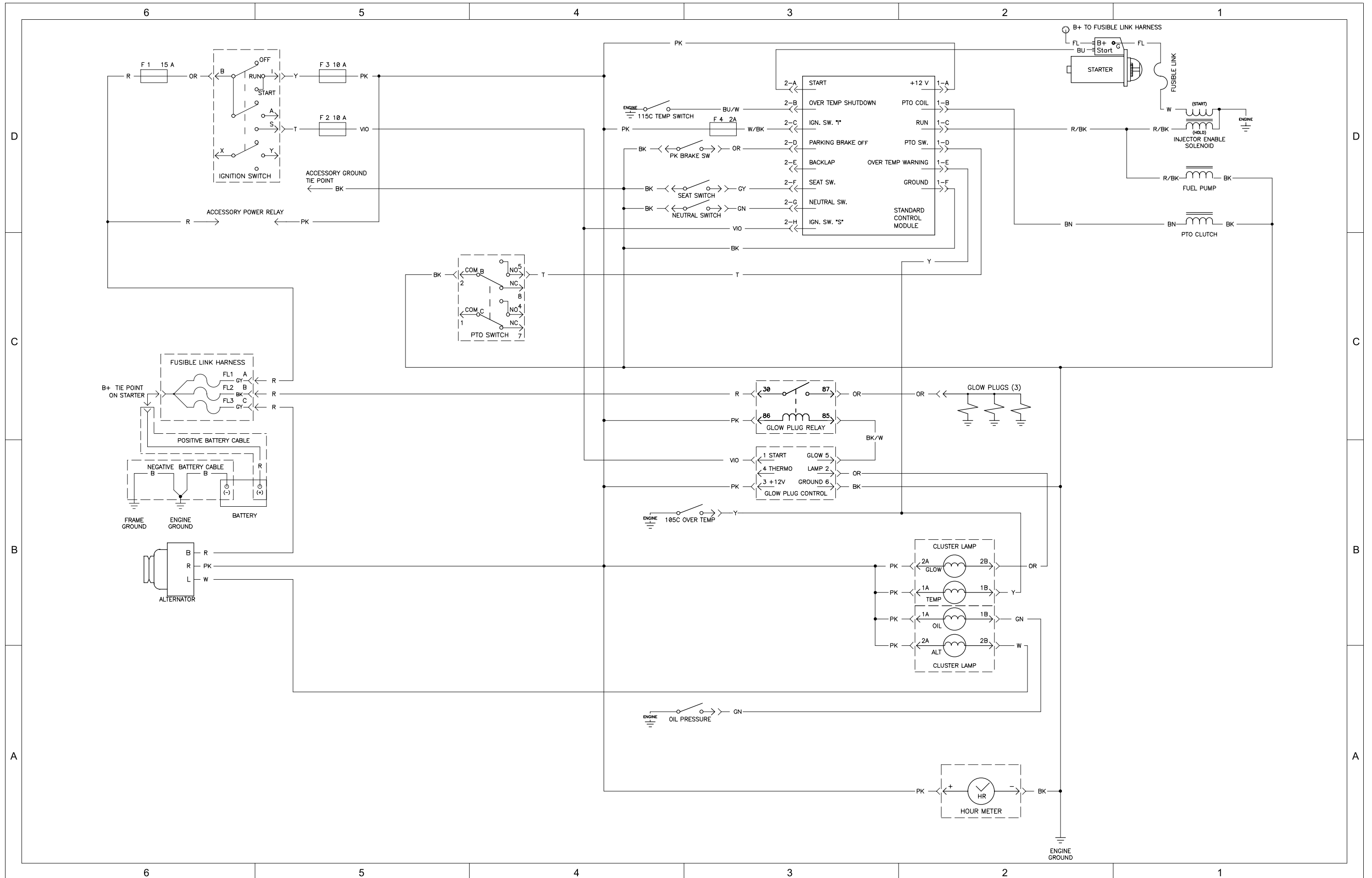


Electrical Schematic-3320

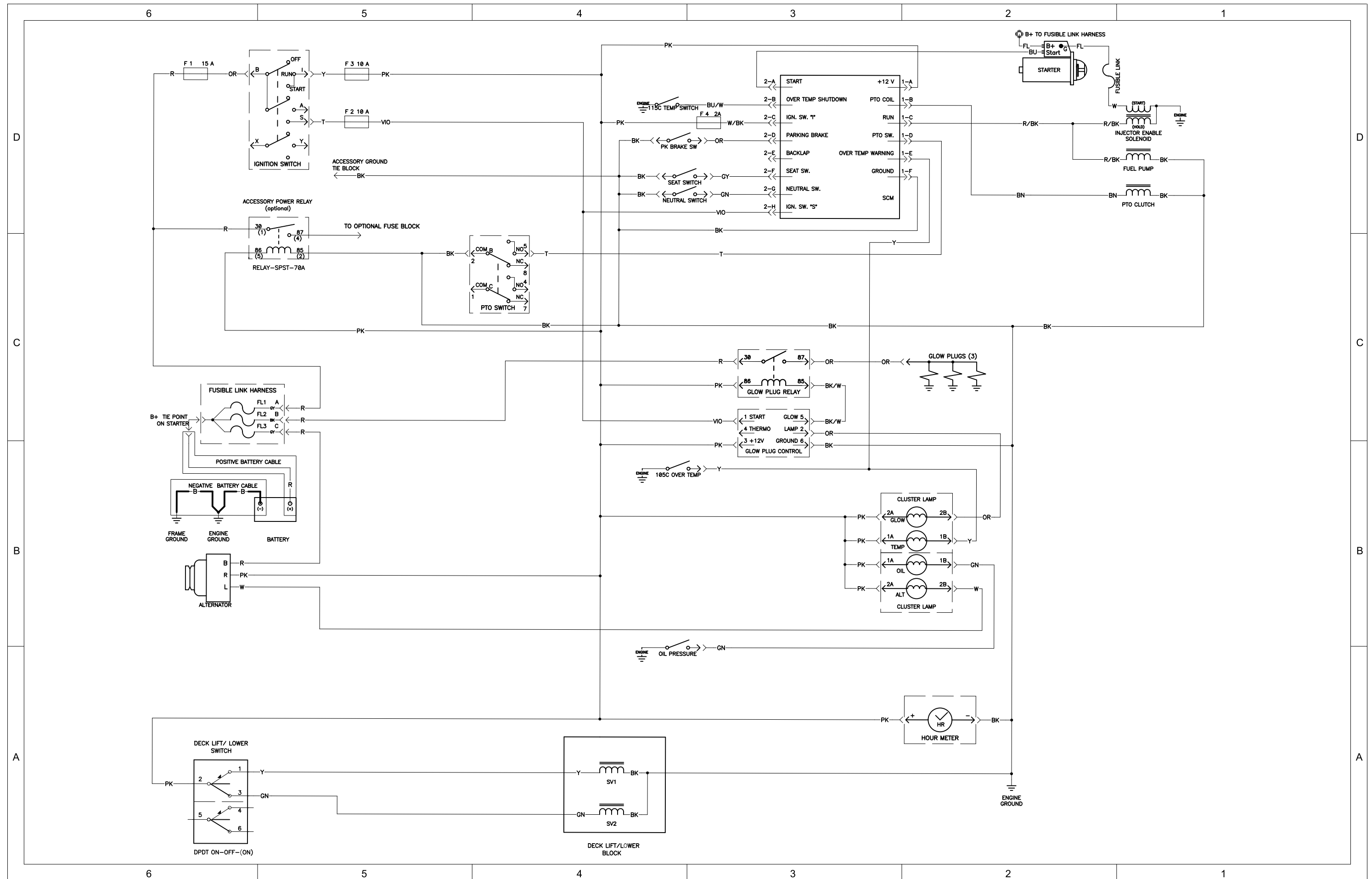


g231003

Electrical Schematic (Machine Serial Number before 311000000)

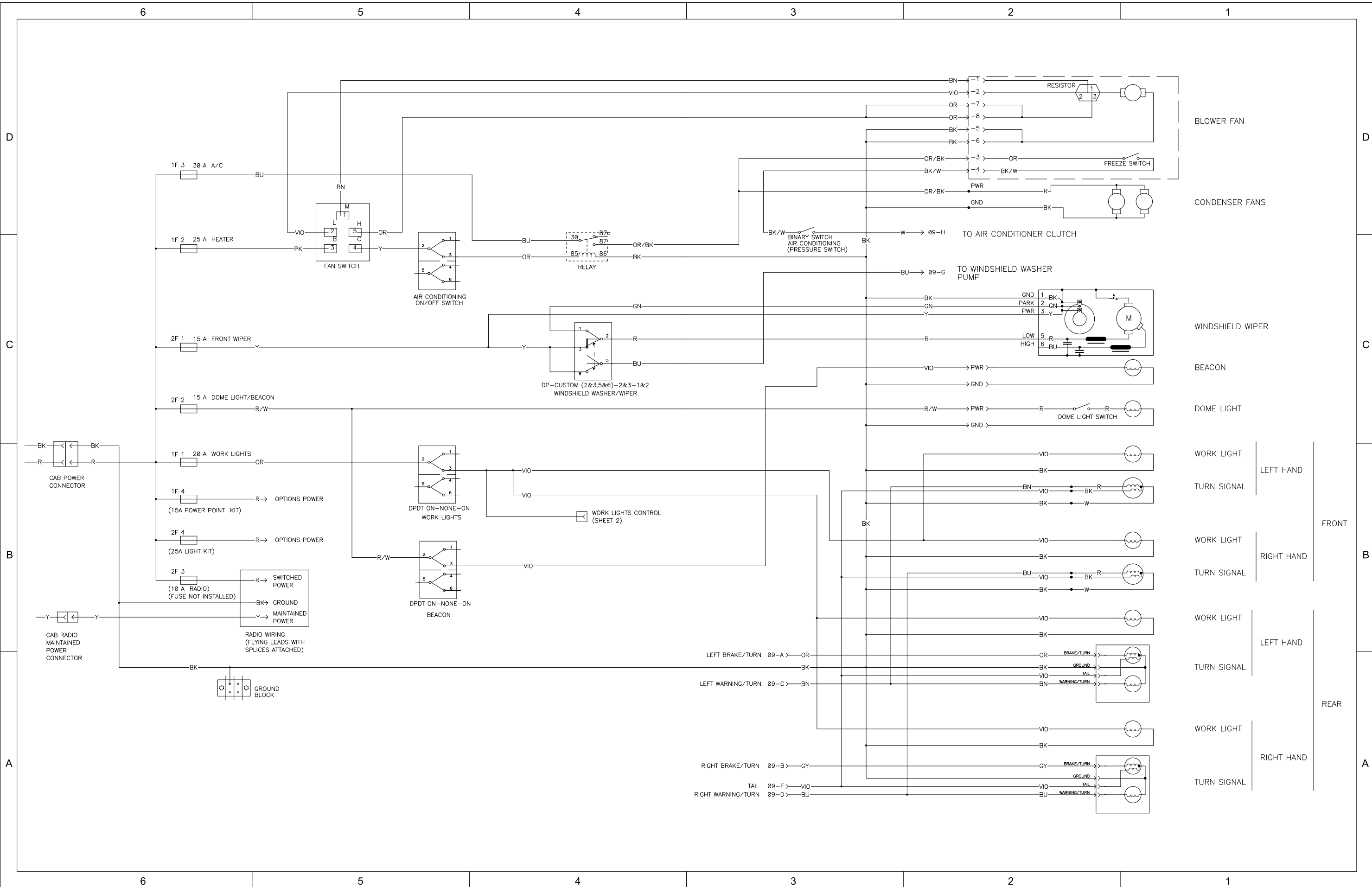


Electrical Schematic (Machine Serial Number 31100000 and Up)

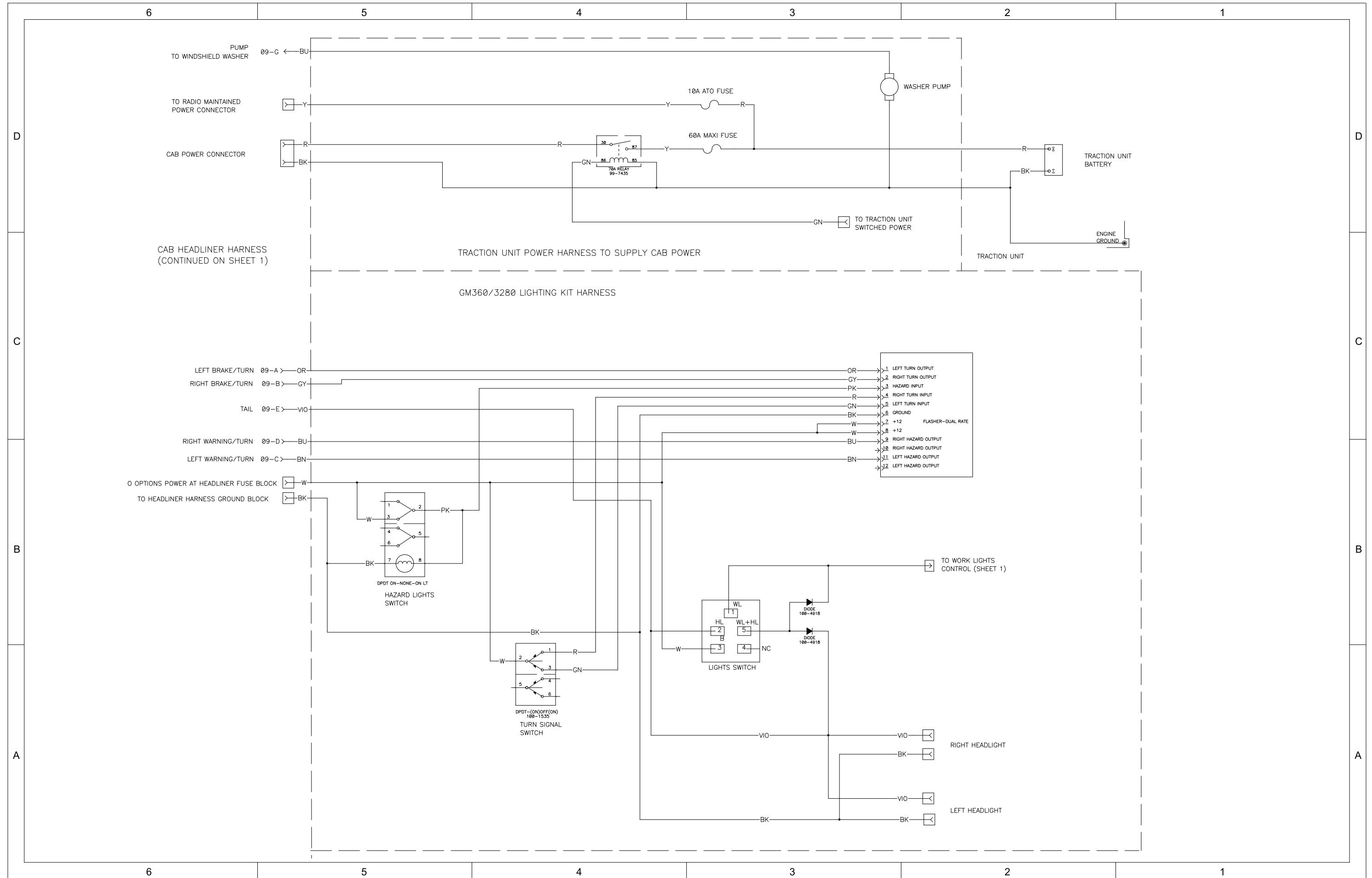


g243927

Electrical Schematic-Operator Cab

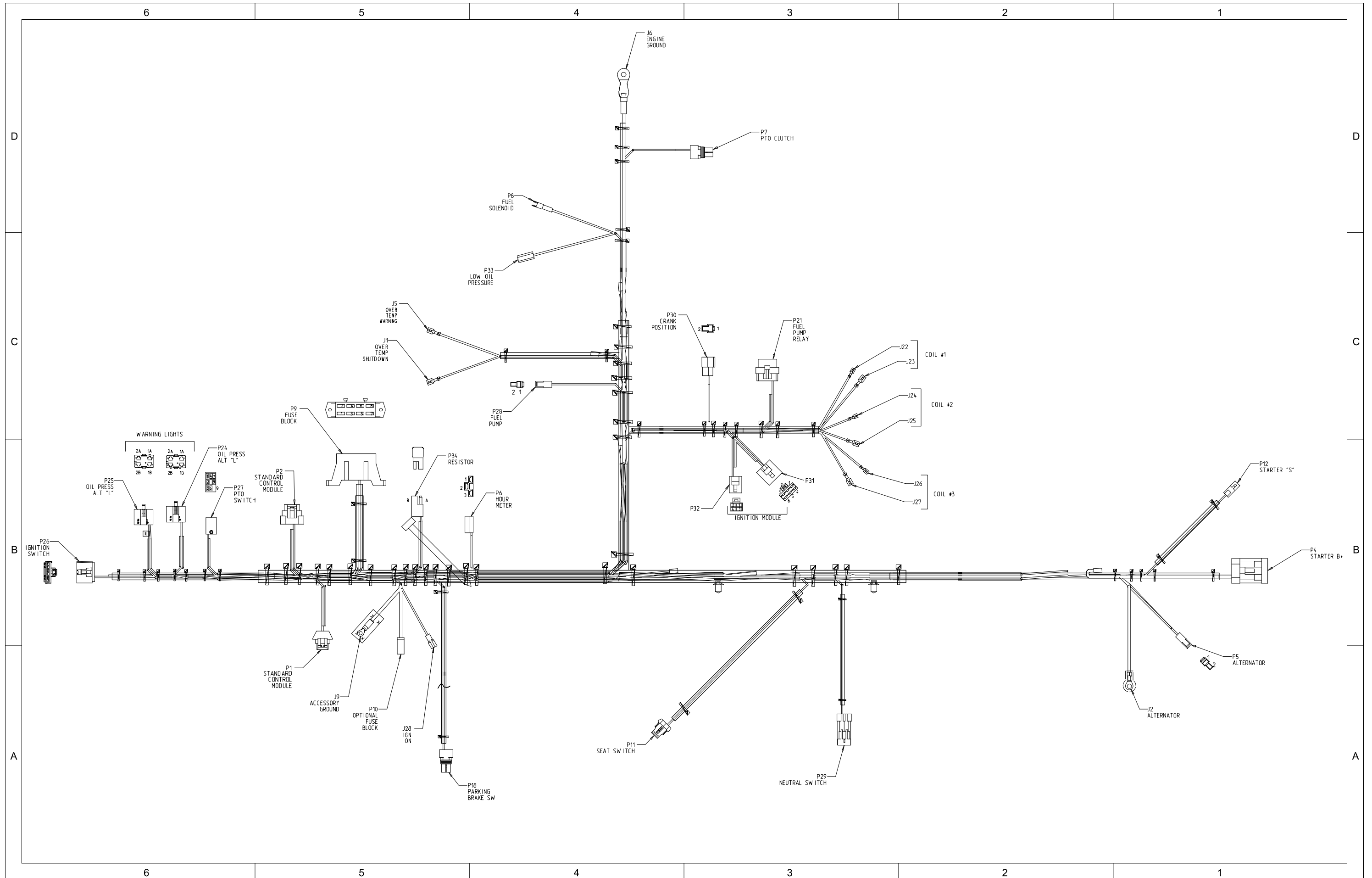


Electrical Schematic-Operator Cab

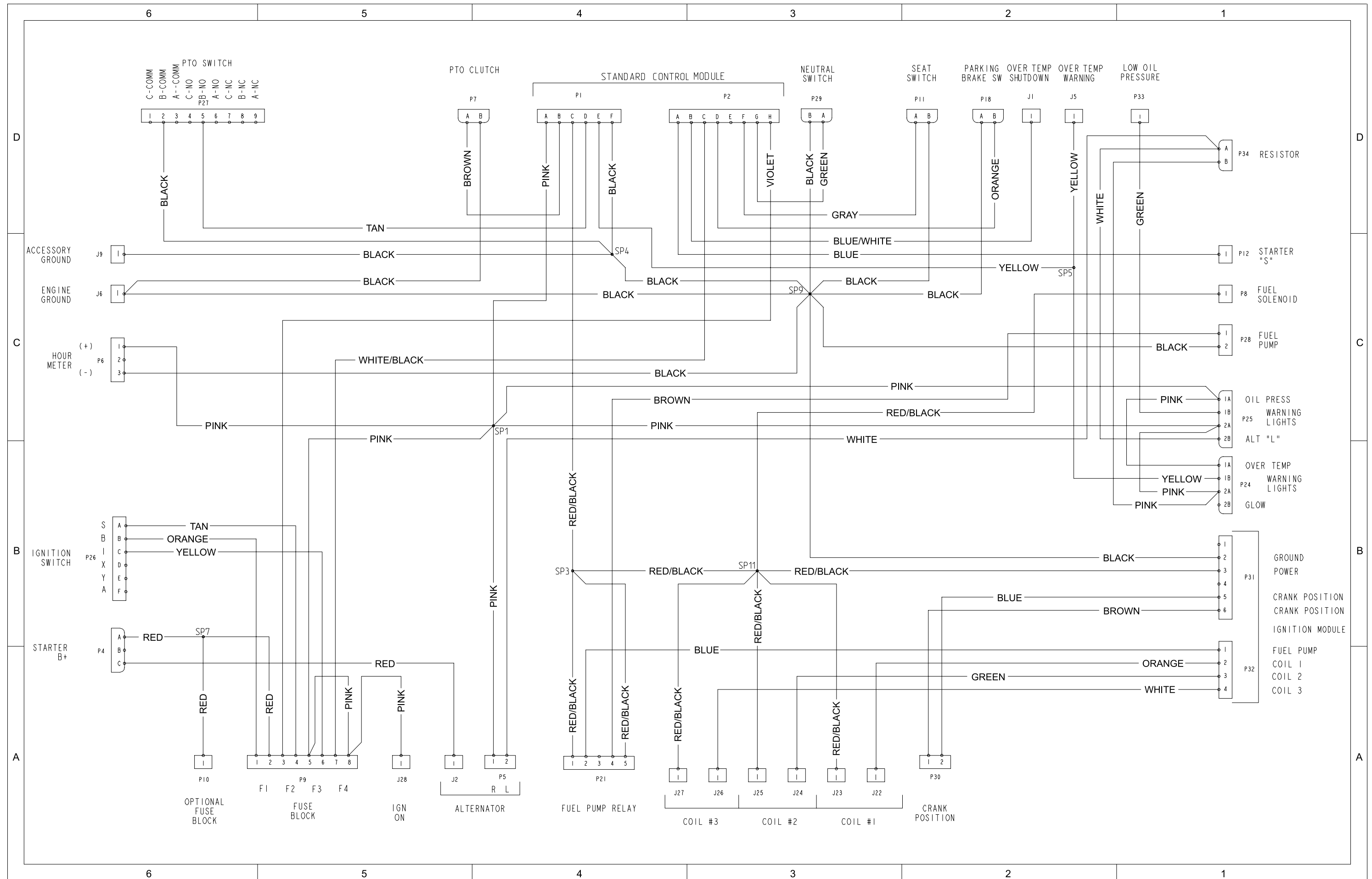


g226450

Wire Harness Drawing-Main-3320 (Serial Numbers below 26000000)

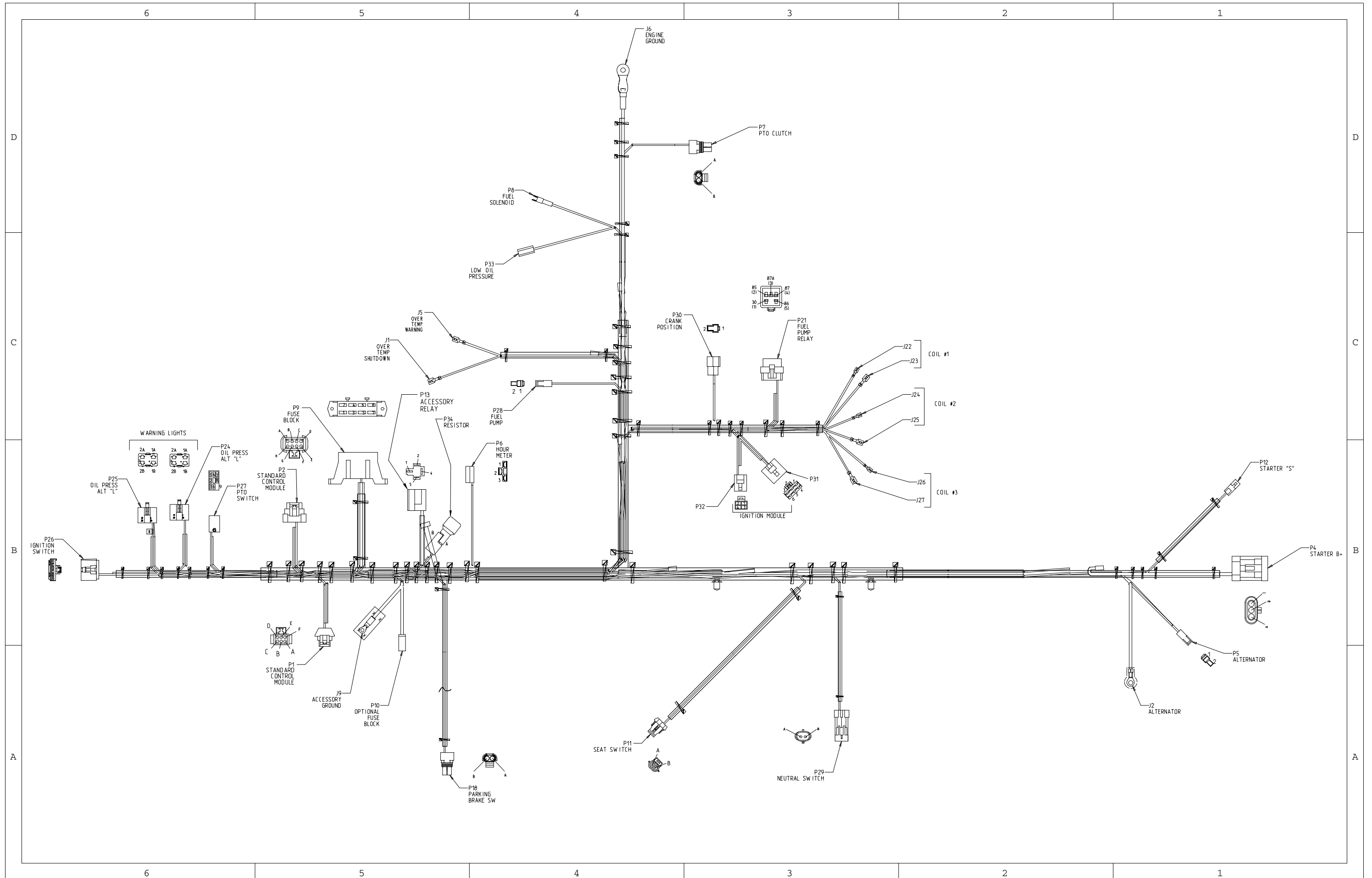


Wire Harness Diagram-Main-3320 (Serial Numbers below 260000000)

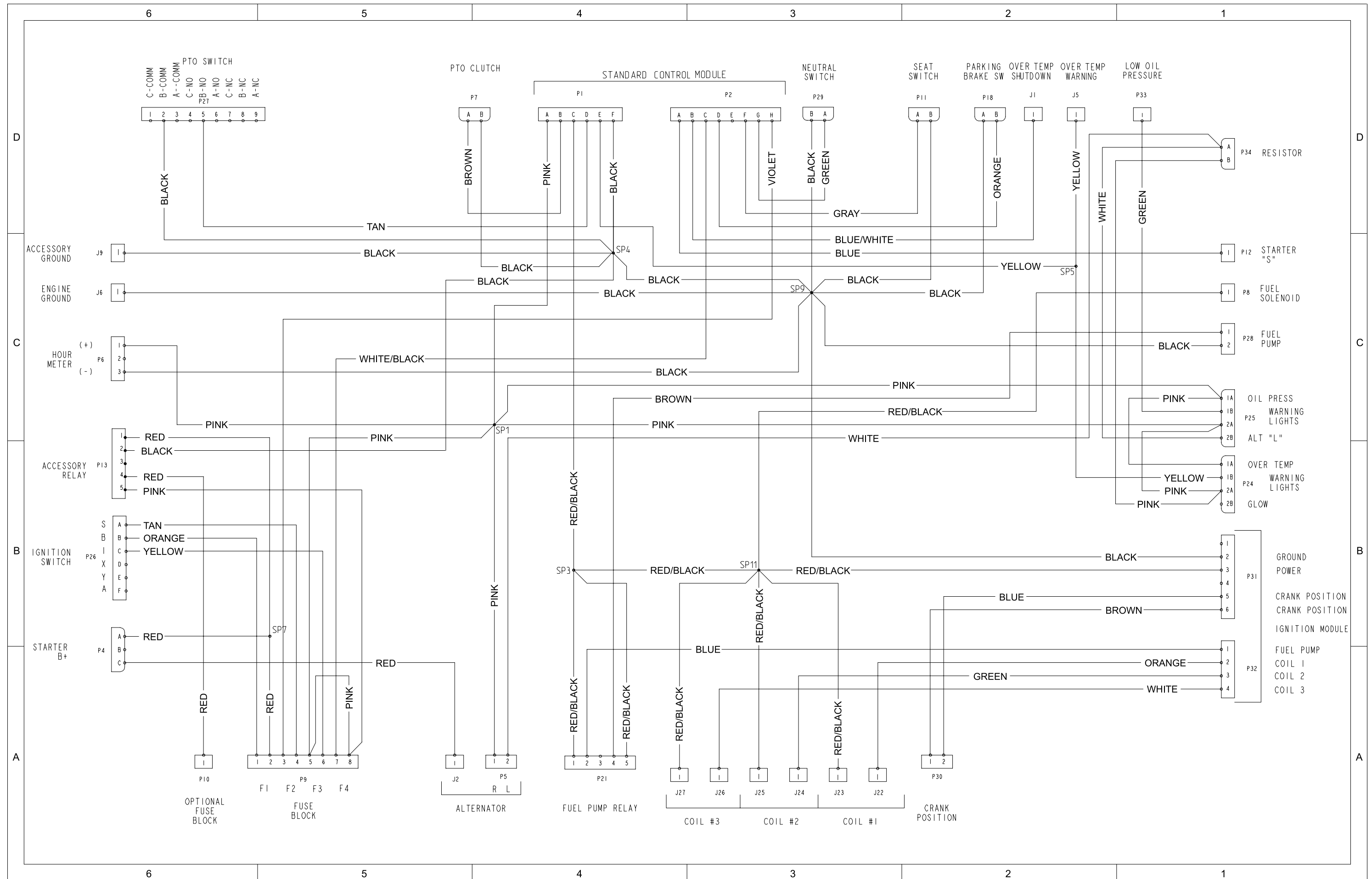


g231010

Wire Harness Drawing-Main-3320 (Serial Numbers above 26000000)

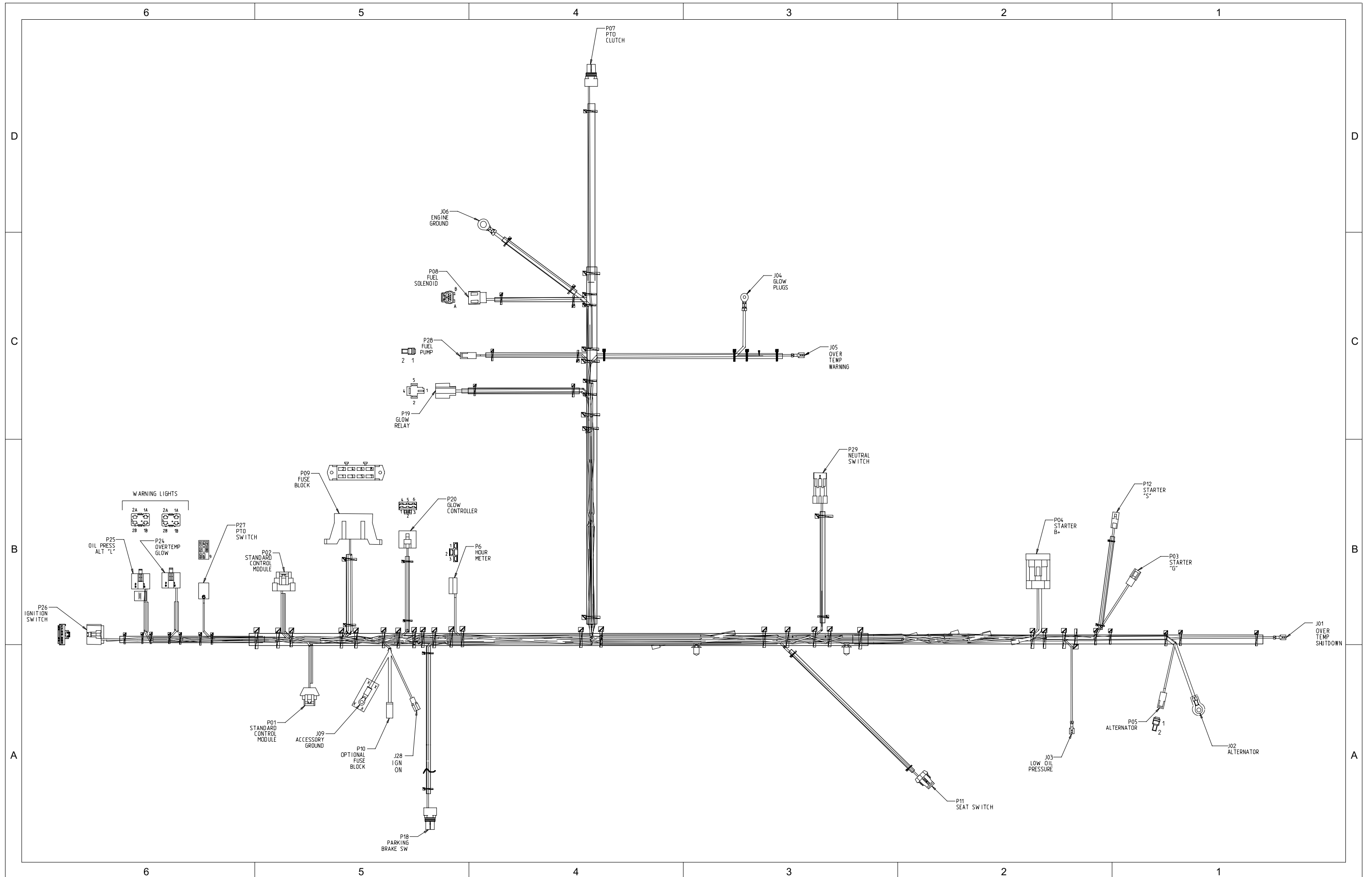


Wire Harness Diagram-Main-3320 (Serial Numbers above 260000000)

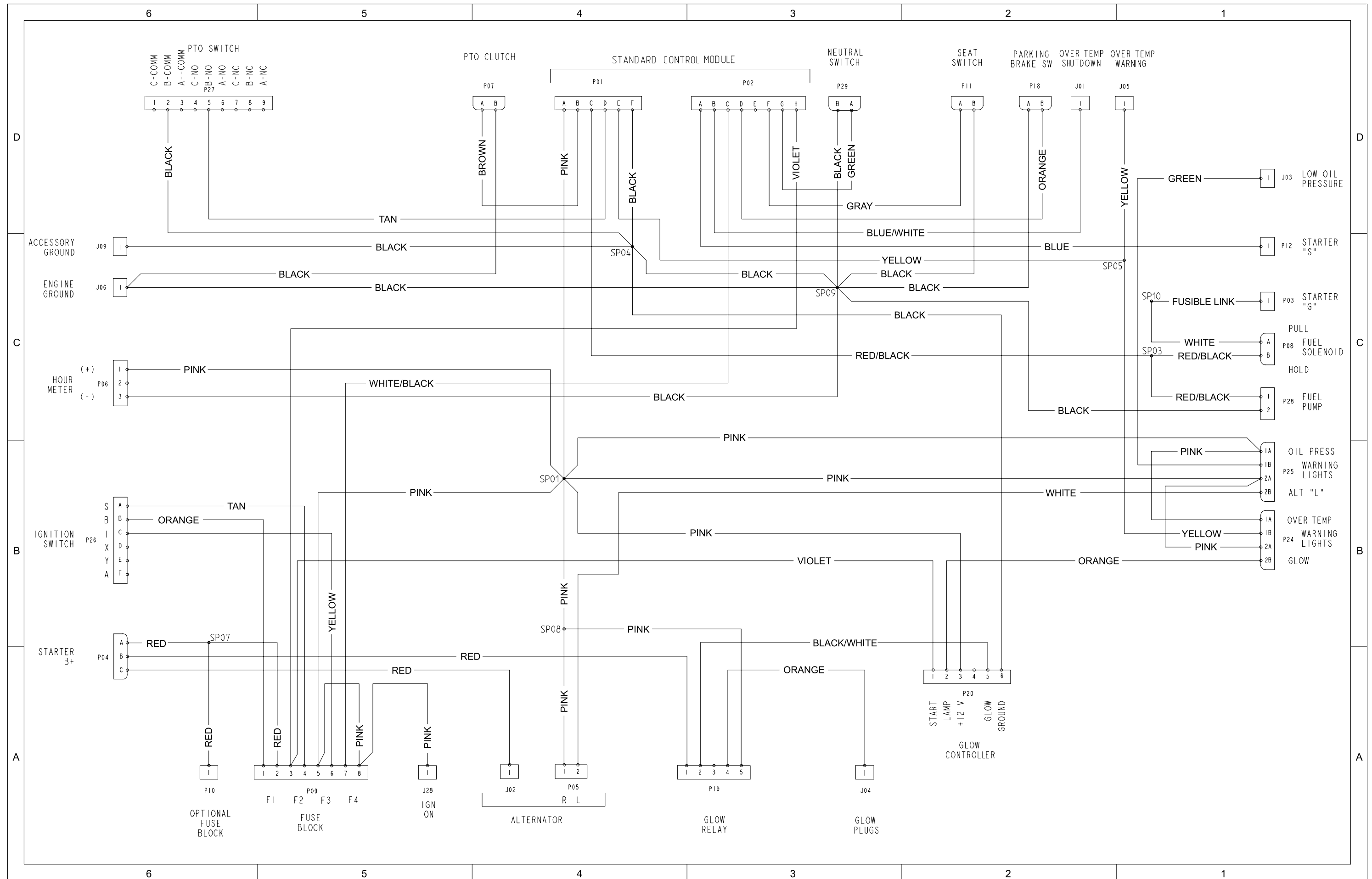


g231012

Wire Harness Drawing-Main-3280-D (Serial Numbers below 26000000)

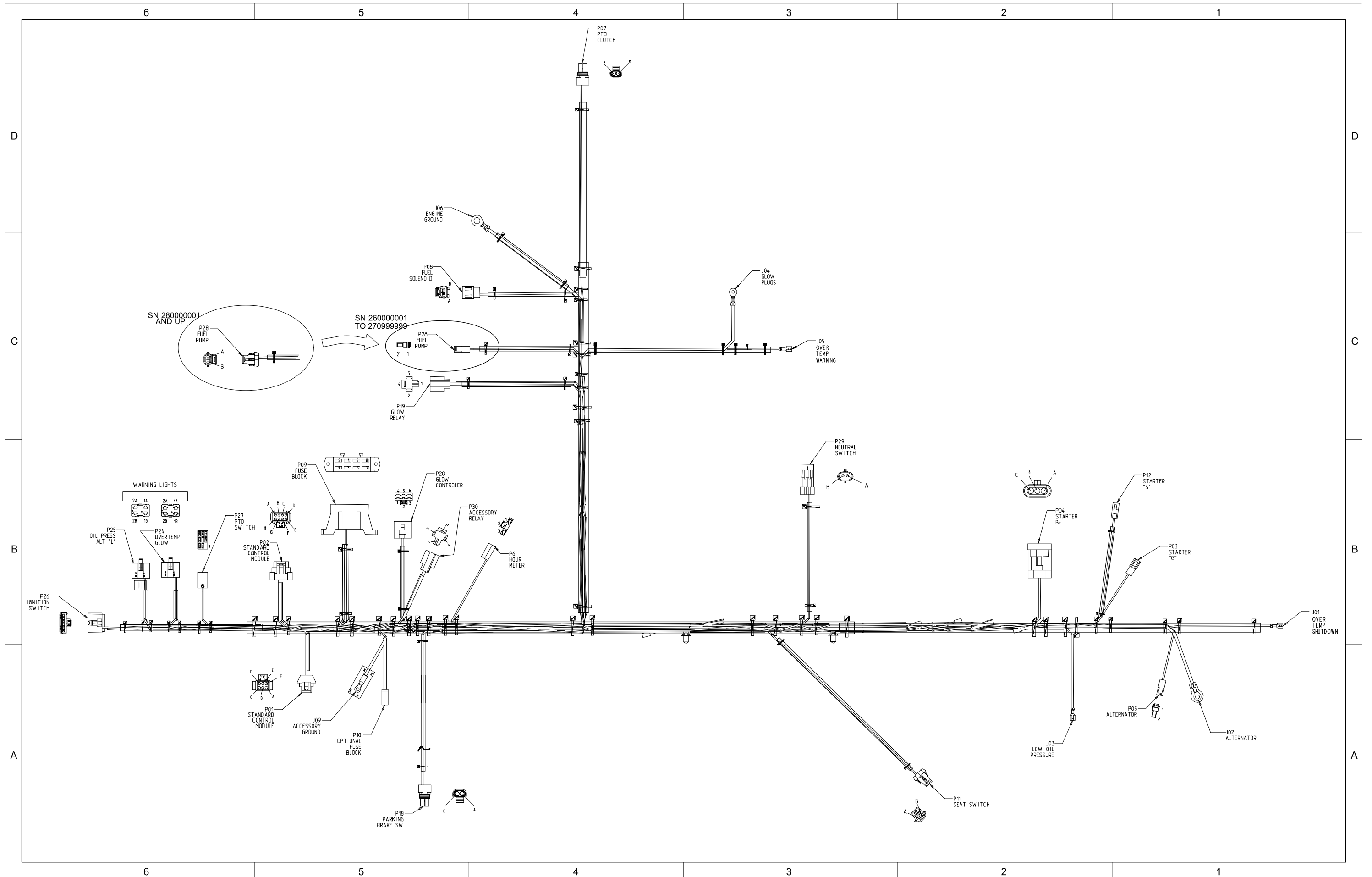


Wire Harness Diagram-Main-3280-D (Serial Numbers below 260000000)

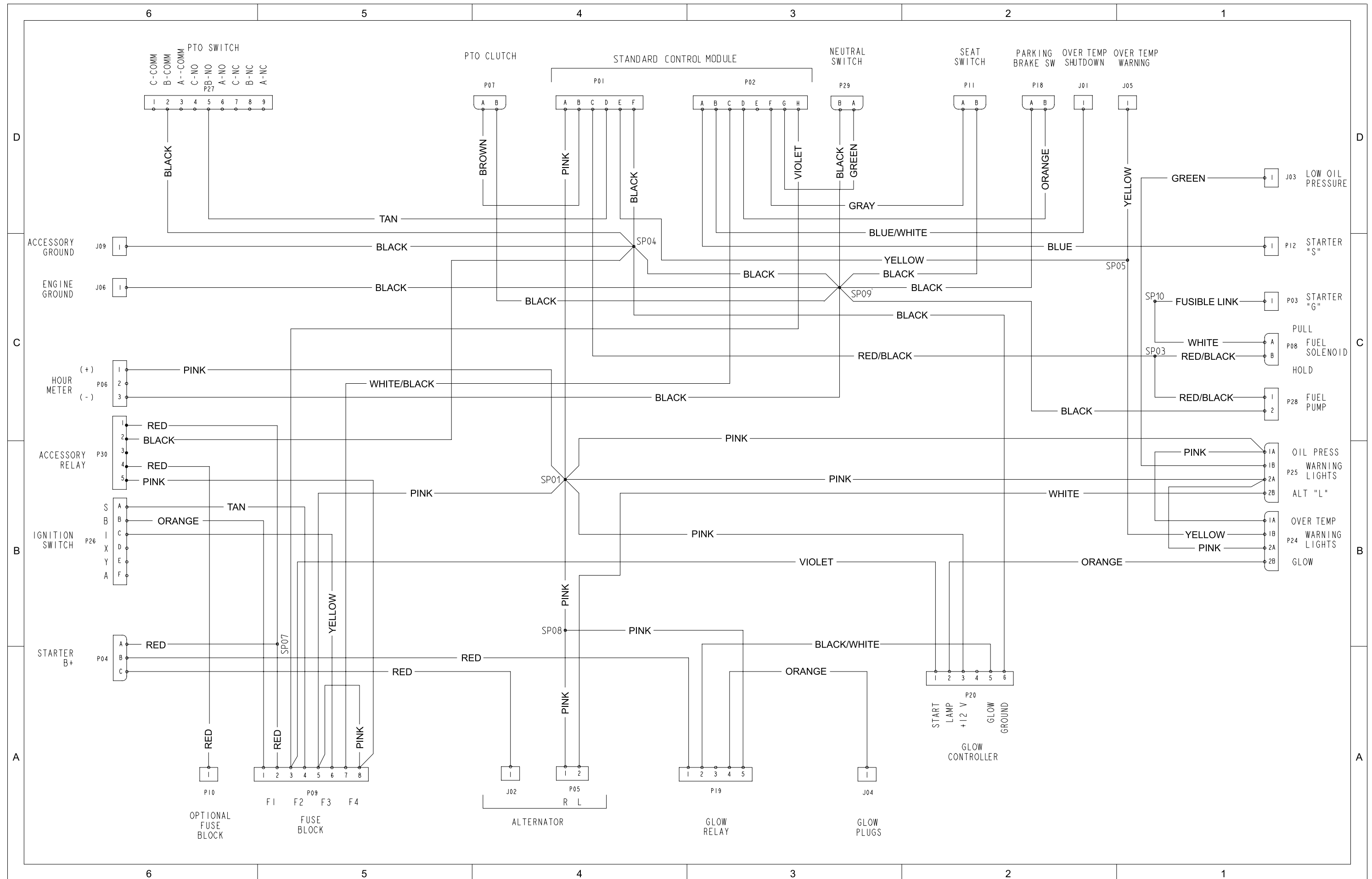


g231006

Wire Harness Drawing-Main-3280-D (Machine Serial Number 260000000 to 270000600)

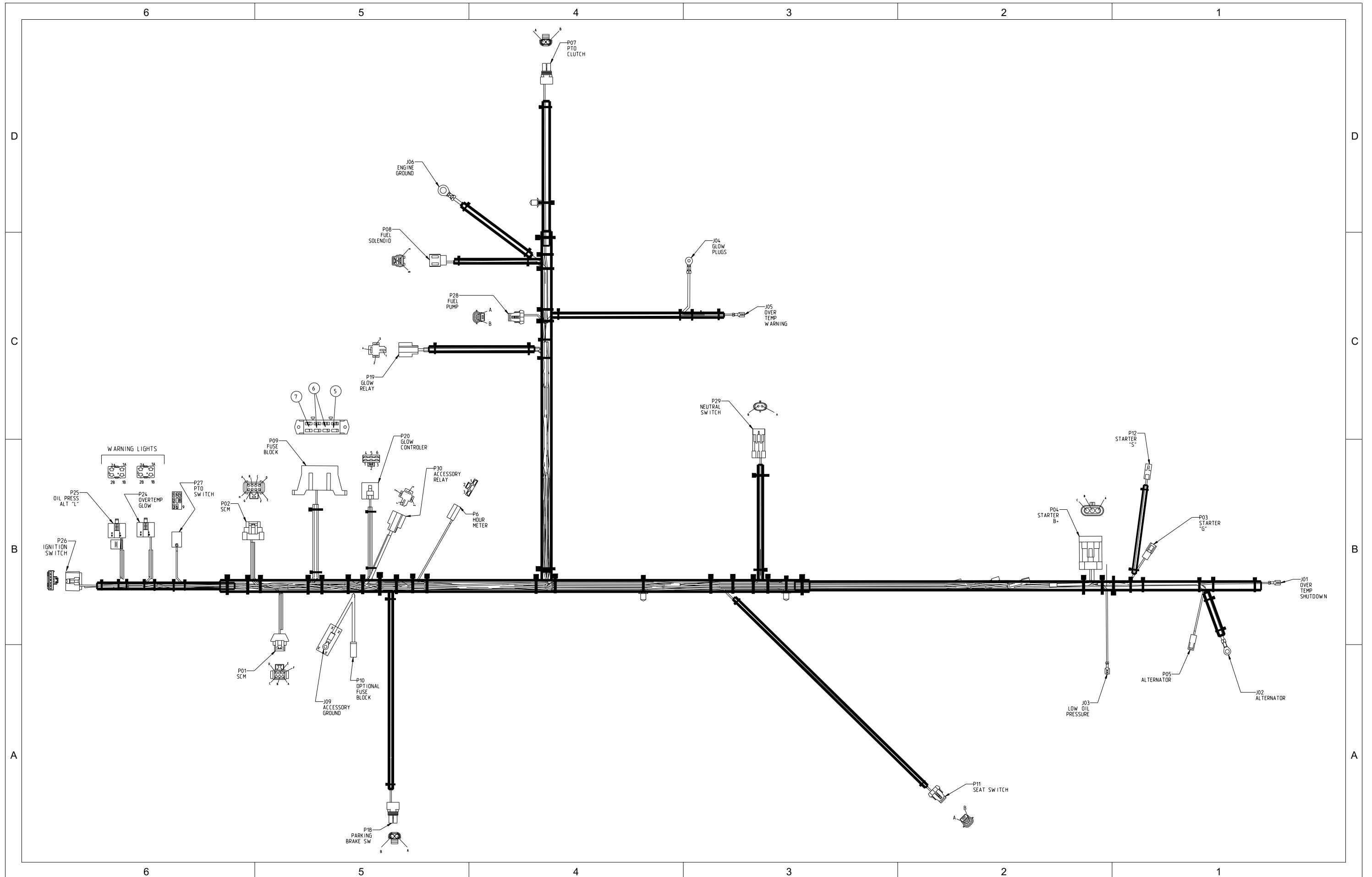


Wire Harness Diagram-Main-3280-D (Machine Serial Number 26000000 to 270000600)

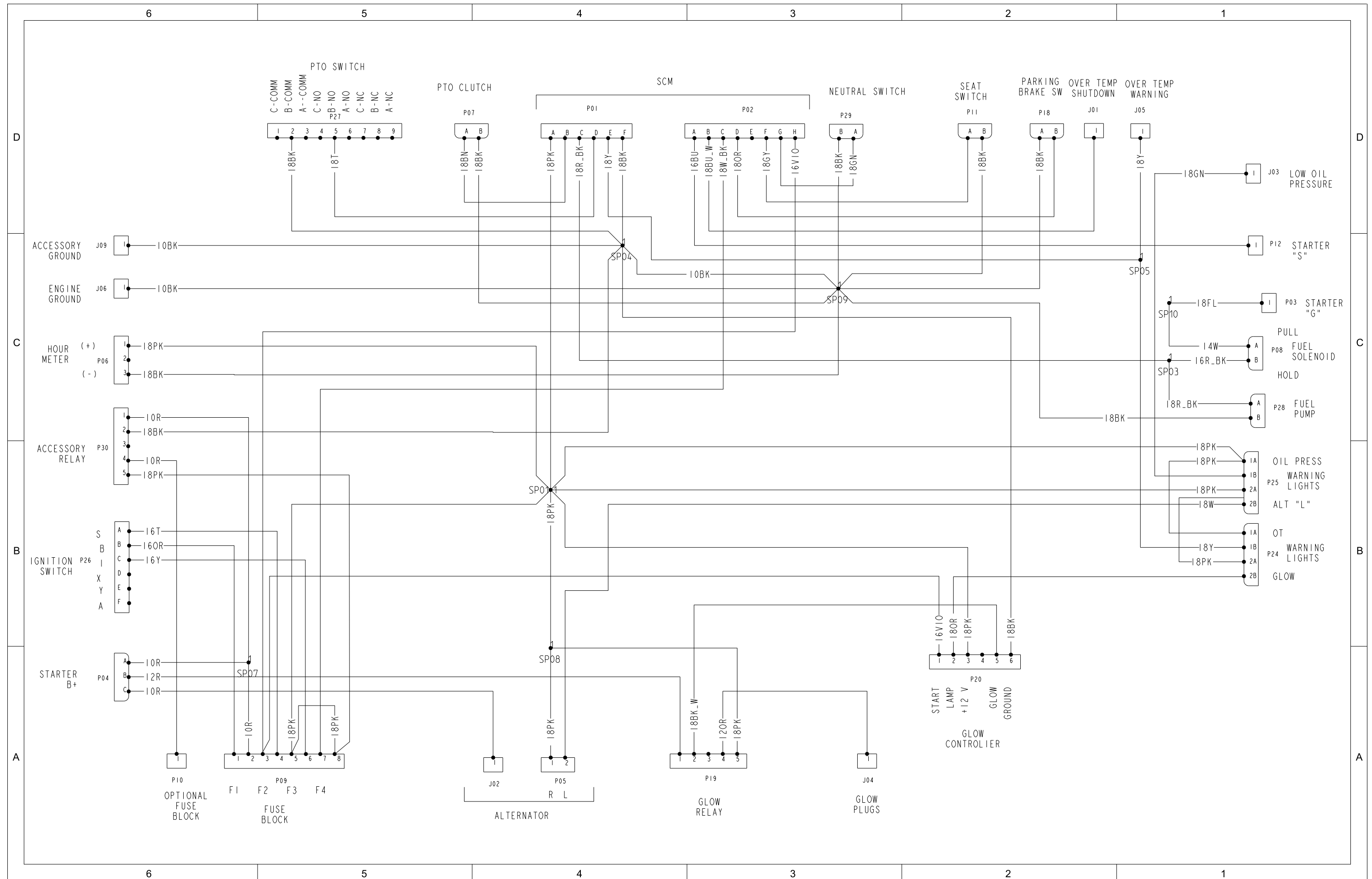


g231008

Wire Harness Drawing-Main-3280-D (Machine Serial Number 270000601 to 311000000)

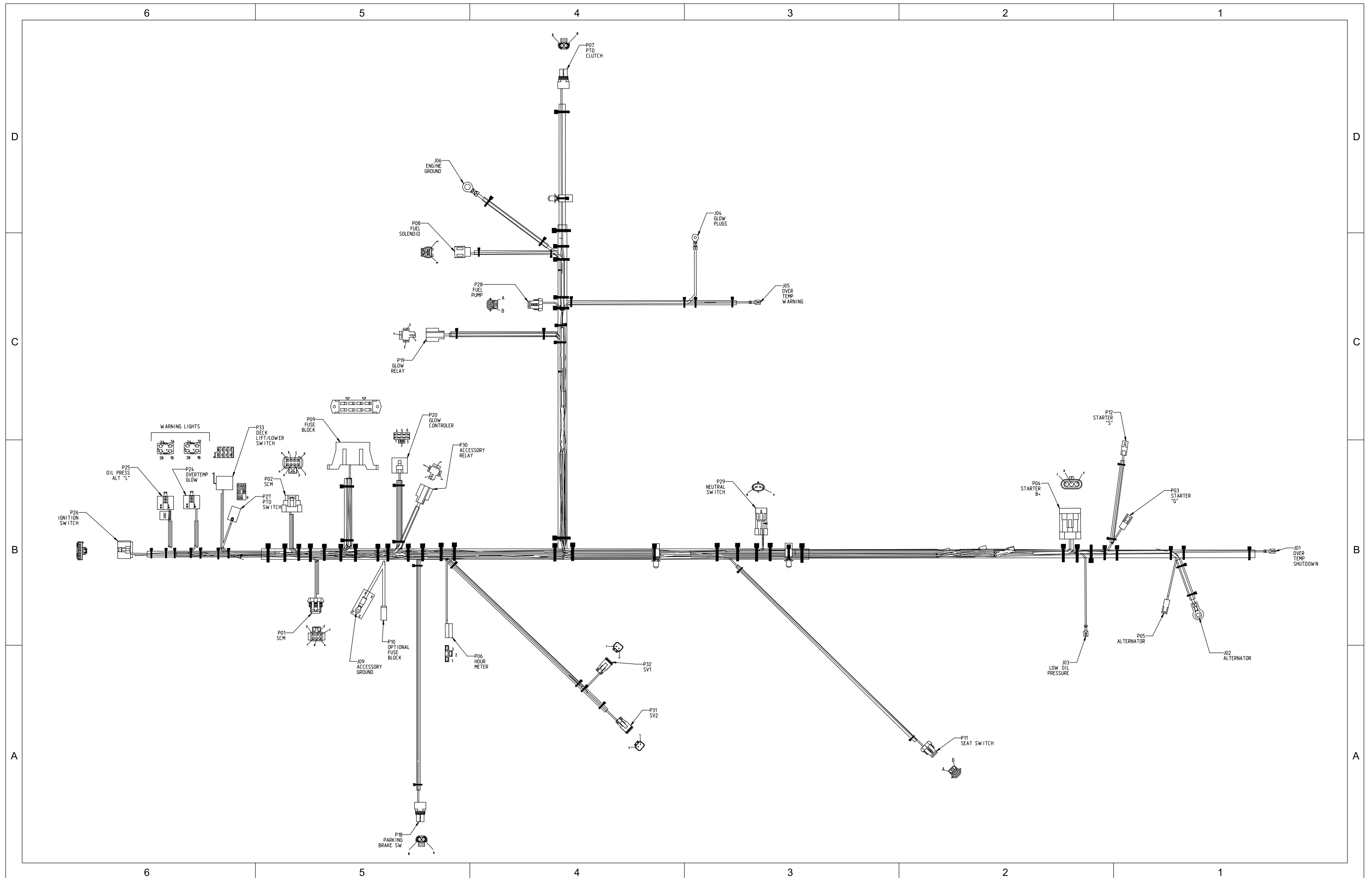


Wire Harness Diagram-Main-3280-D (Machine Serial Number 27000601 to 31100000)

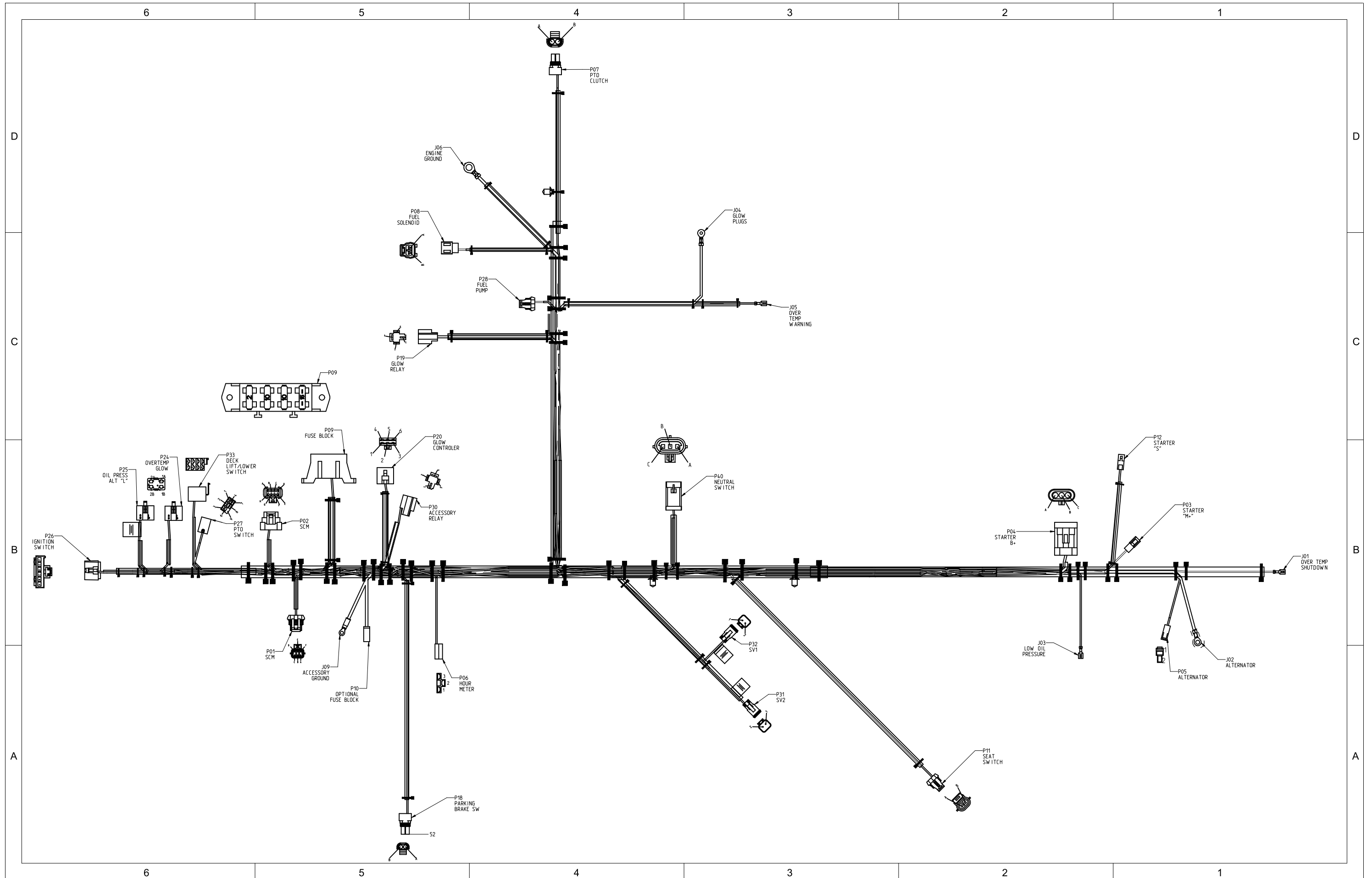


g246497

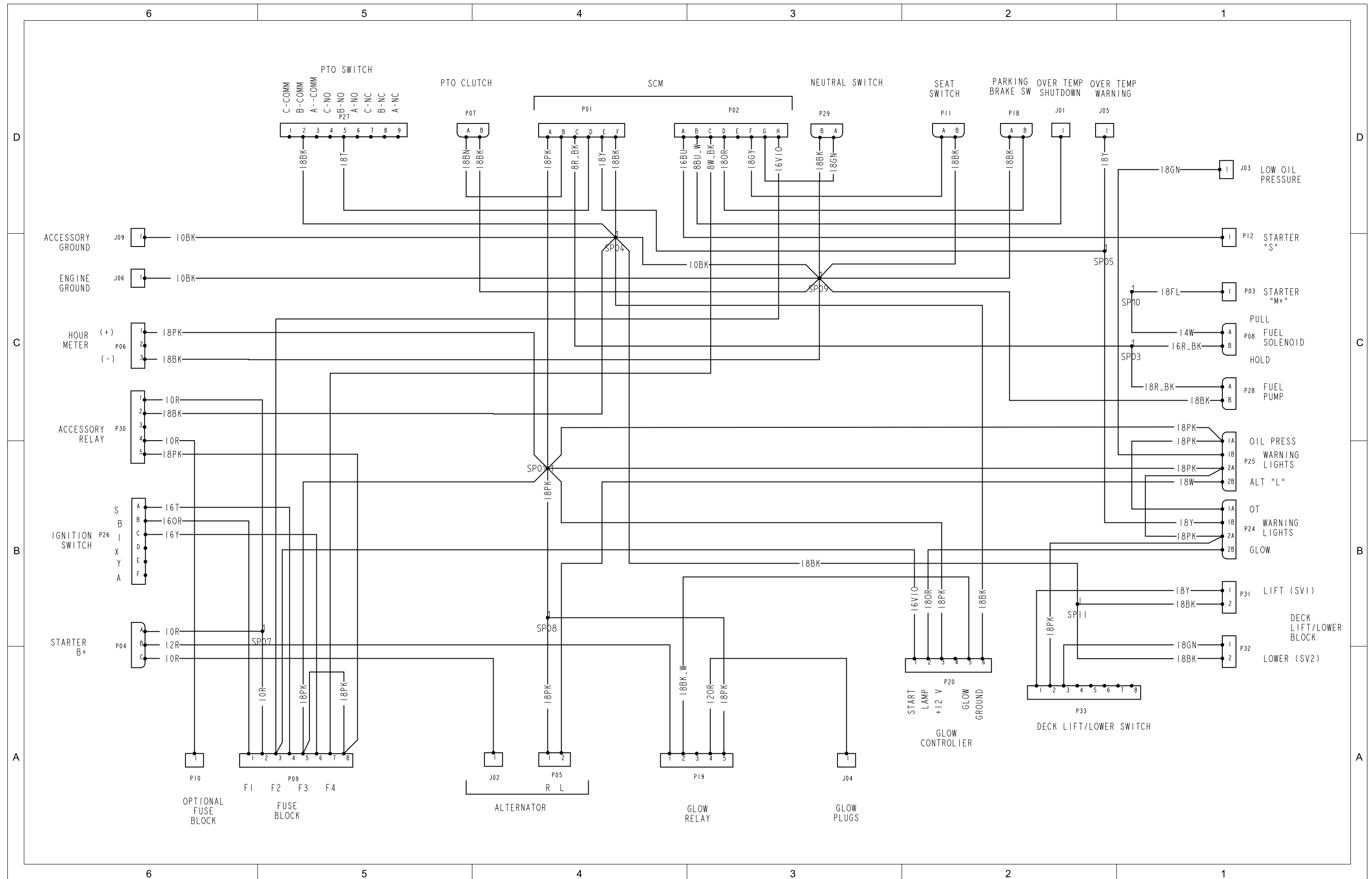
Wire Harness Drawing-Main-3280-D (Machine Serial Number 311000000 to 316000000)



Wire Harness Drawing-Main-3280-D (Machine Serial Number 316000000 to 400000000)

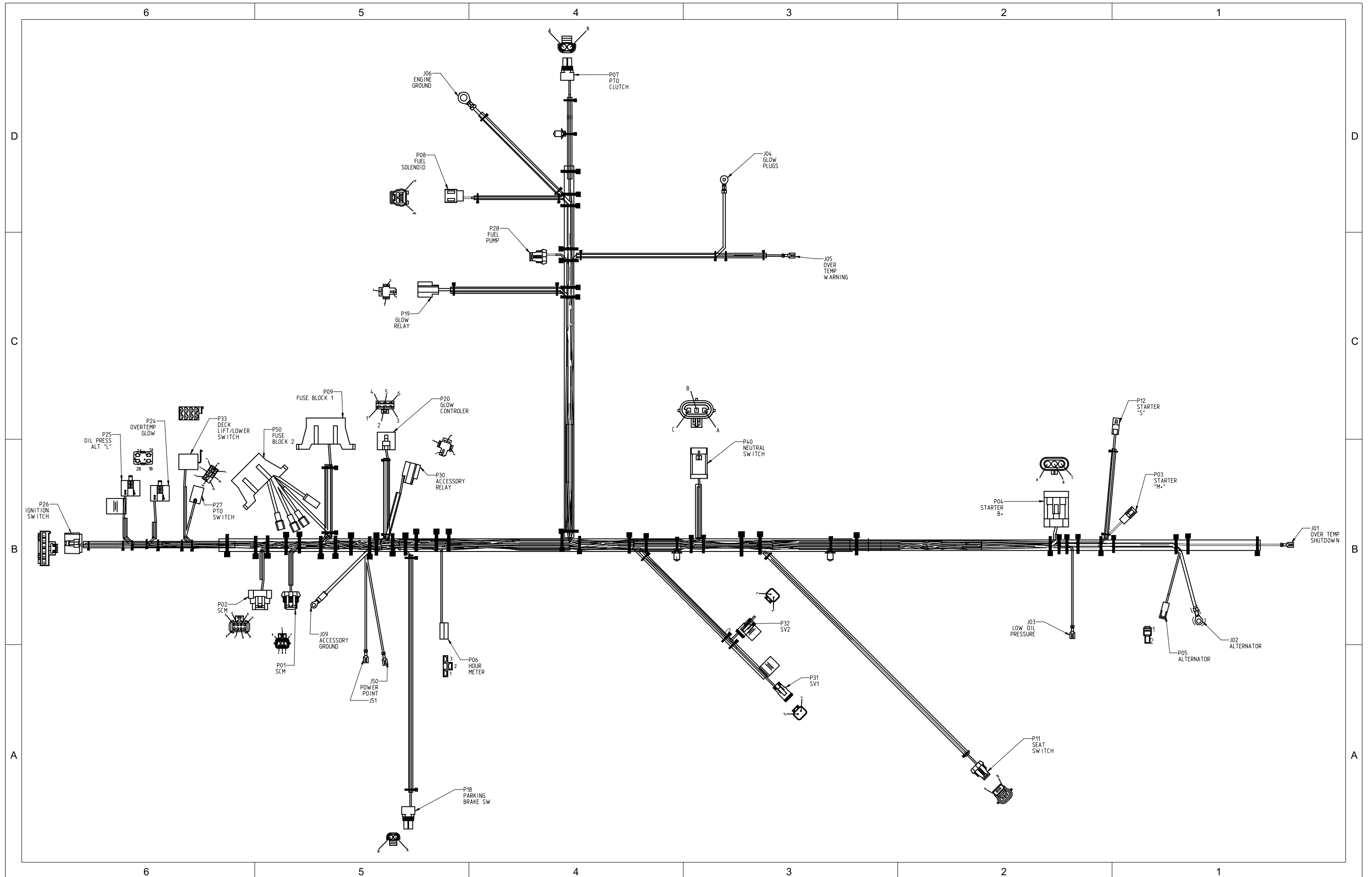


Wire Harness Diagram-Main-3280-D (Machine Serial Number 31600000 to 40000000)

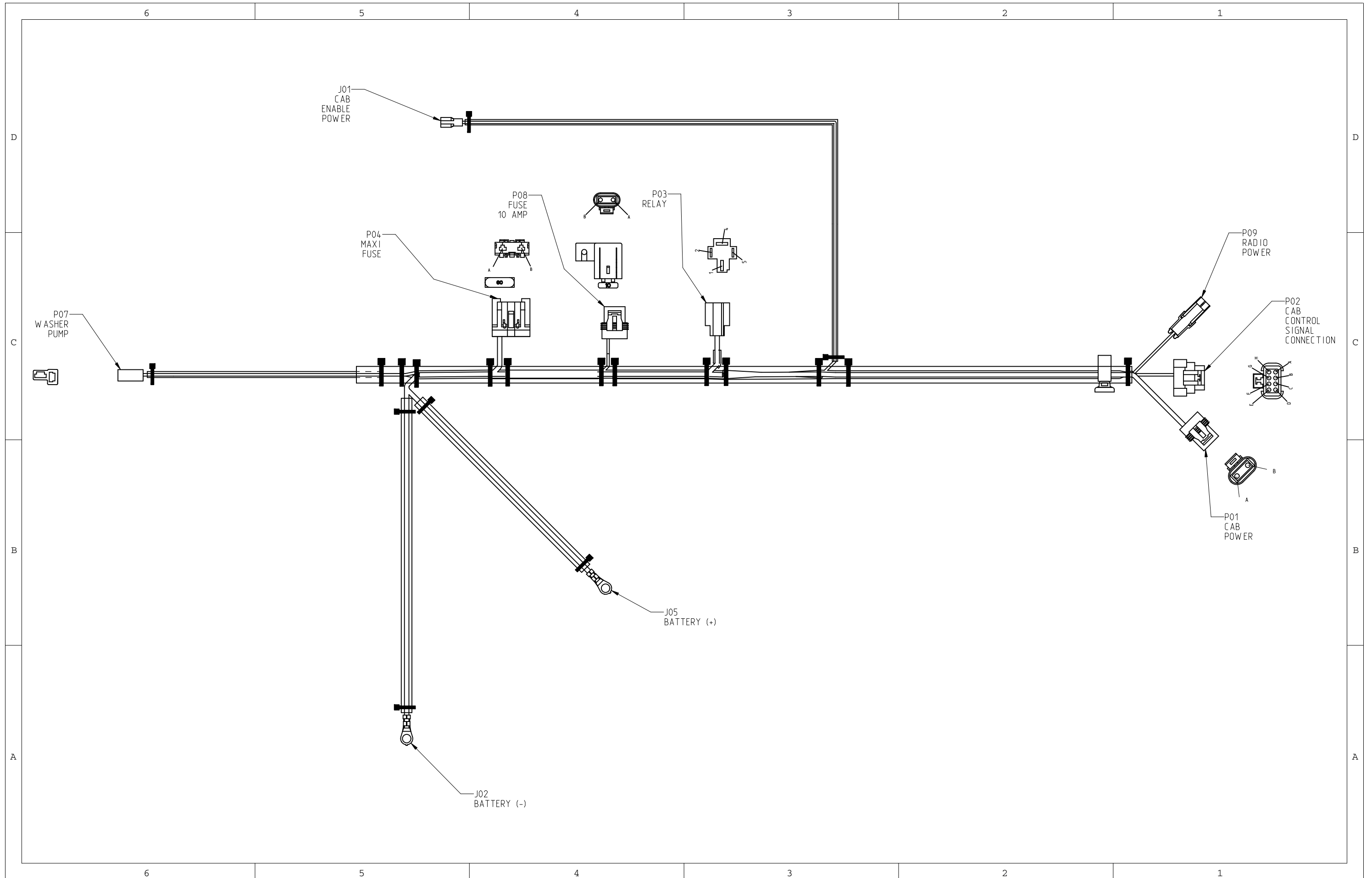


g243938

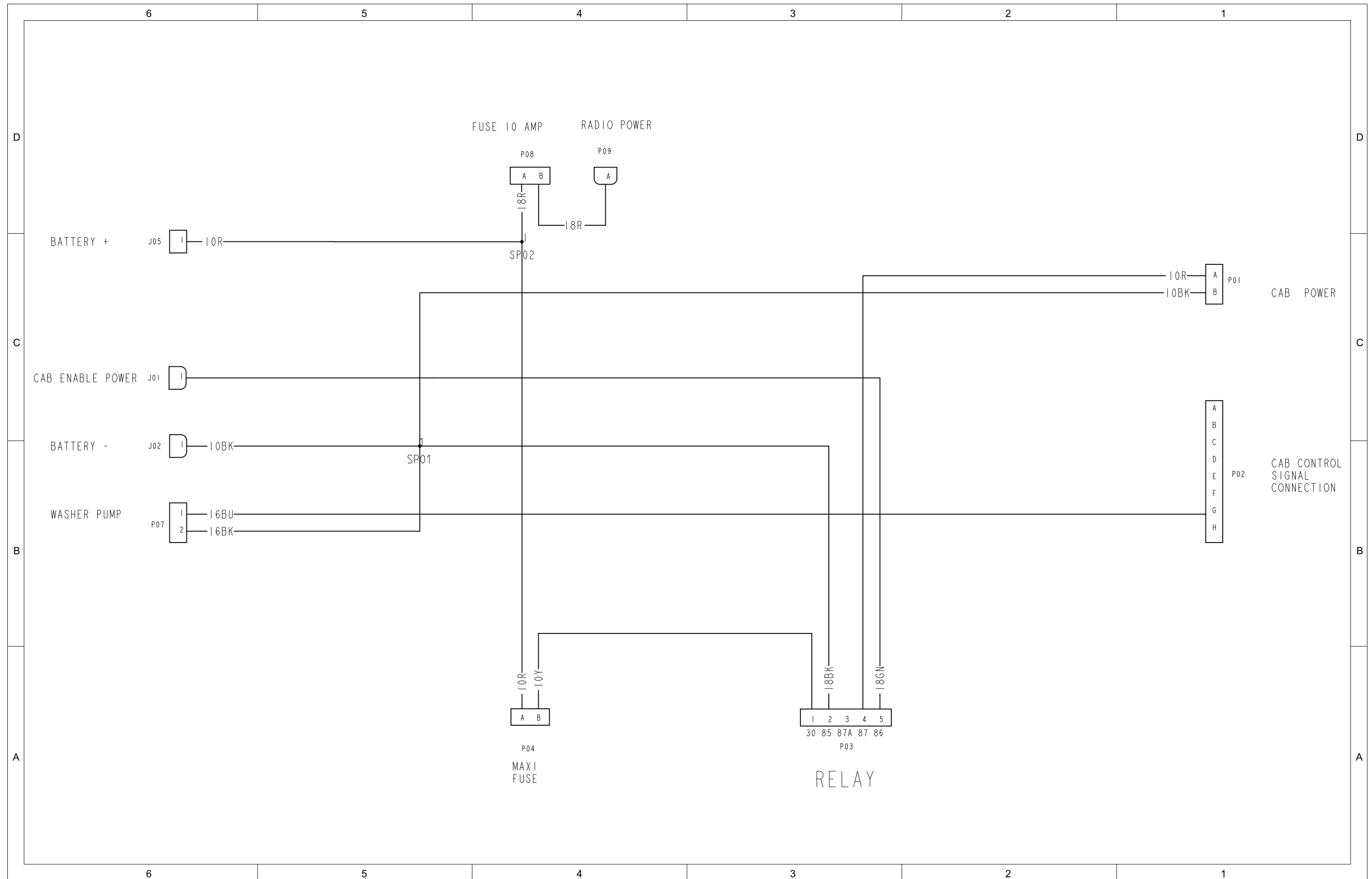
Wire Harness Drawing-Main-3280-D (Machine Serial Number 40000000 and Up)



Wire Harness Drawing-Cab Model 30298 Power

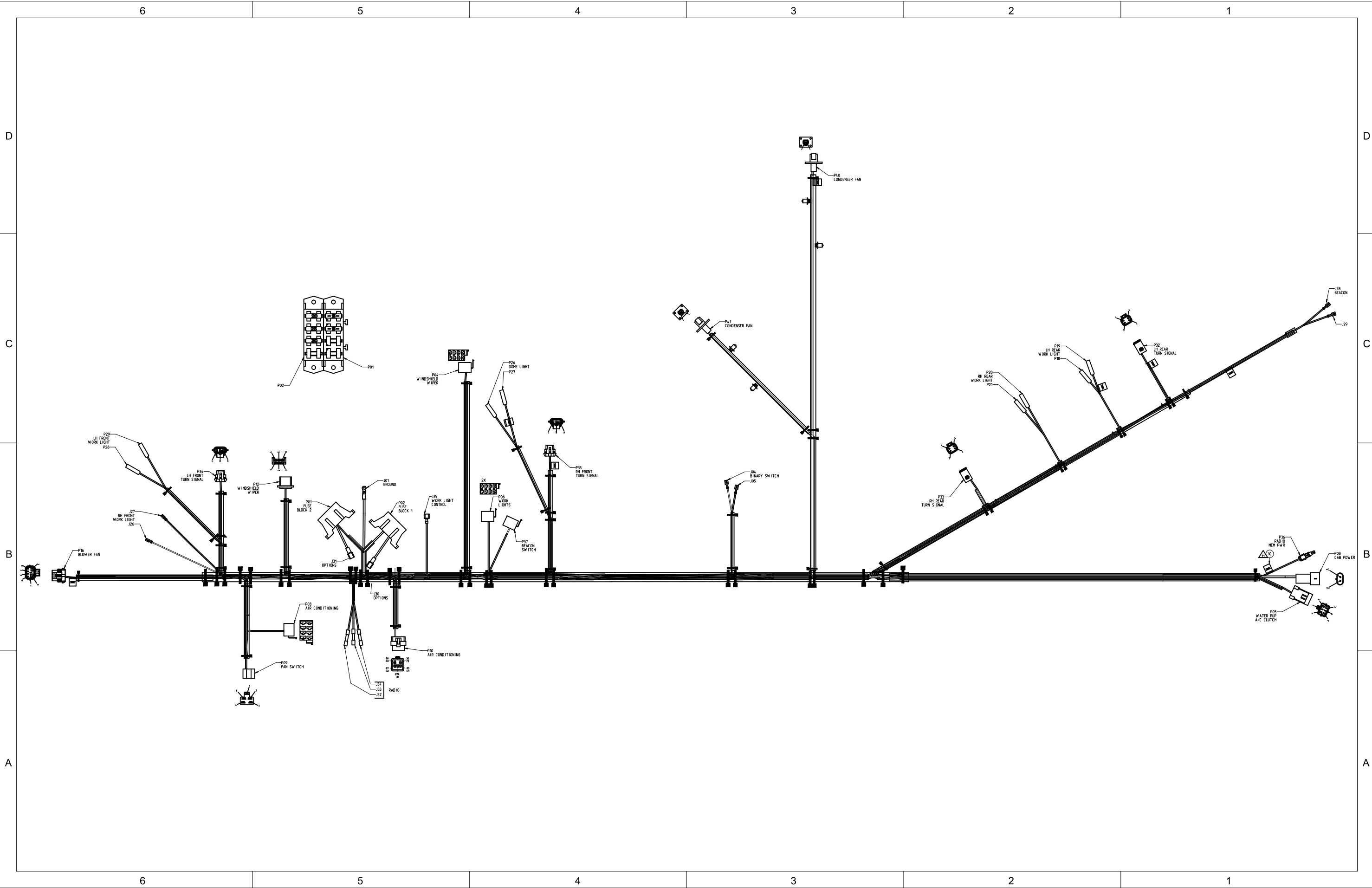


Wire Harness Diagram-Cab Model 30298 Power



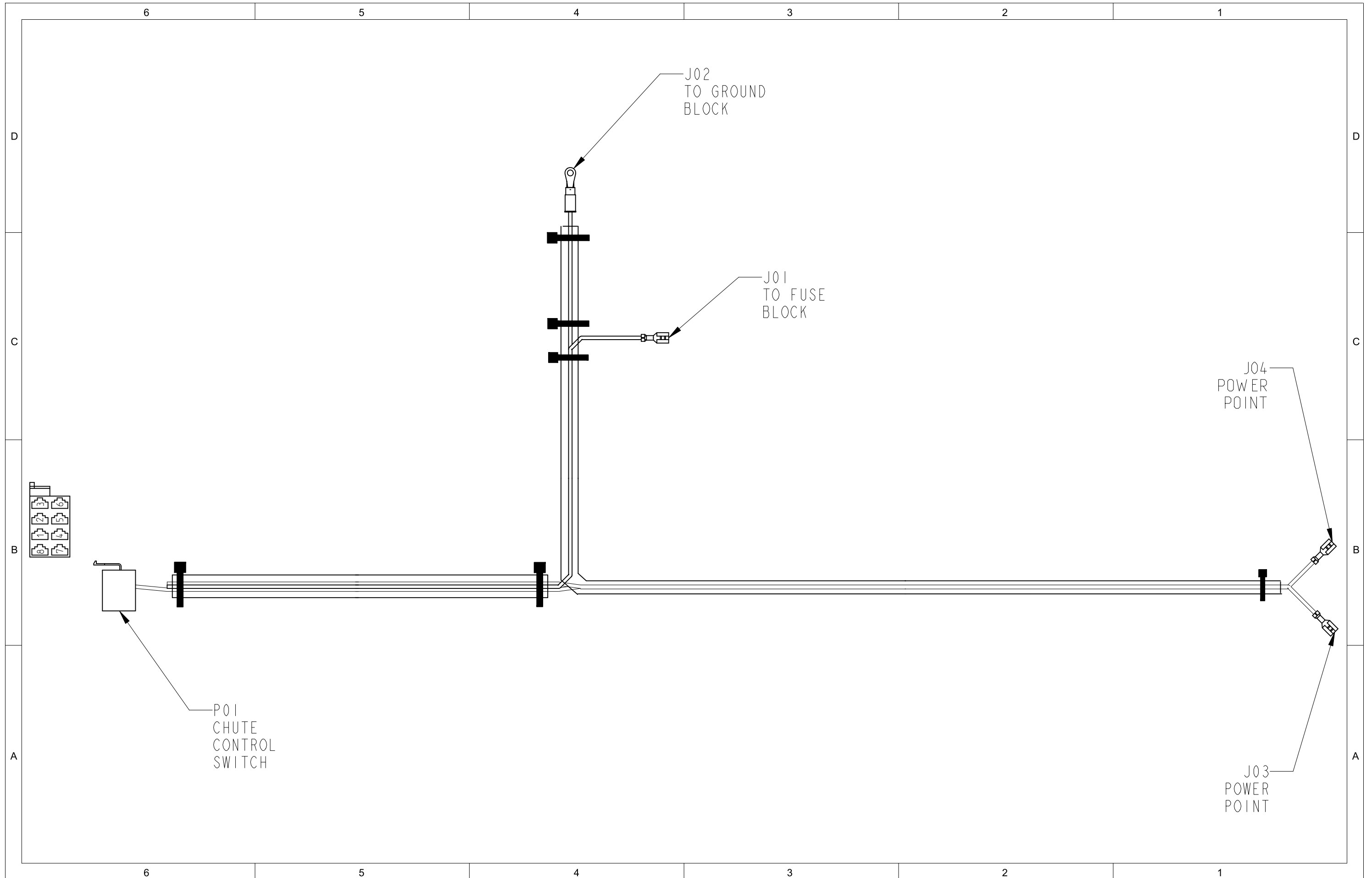
g243942

Wire Harness Drawing-Cab Model 30298 Headliner

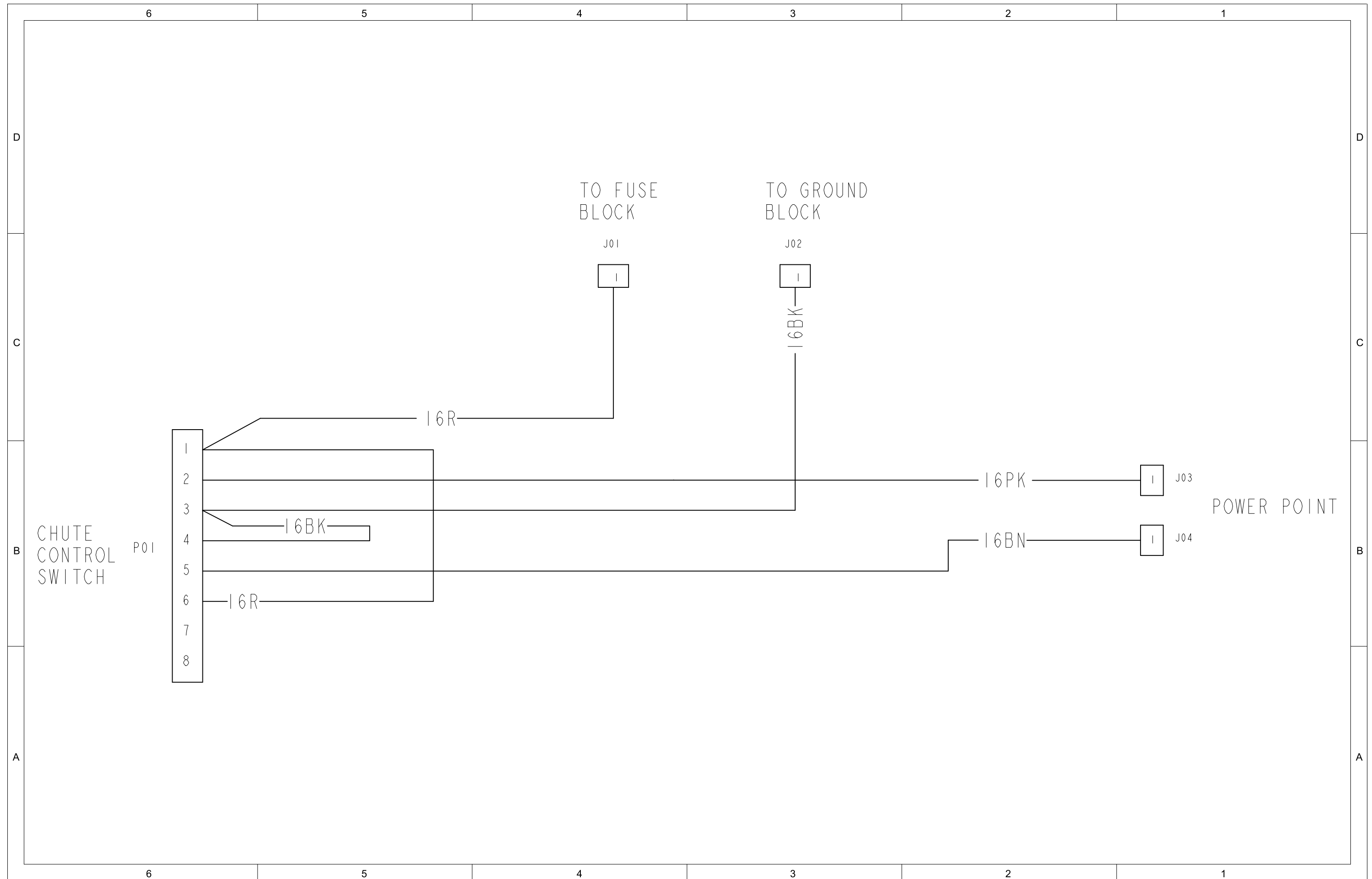


g243429

Wire Harness Drawing-Cab Model 30298 Front Mount Accessory Power Supply

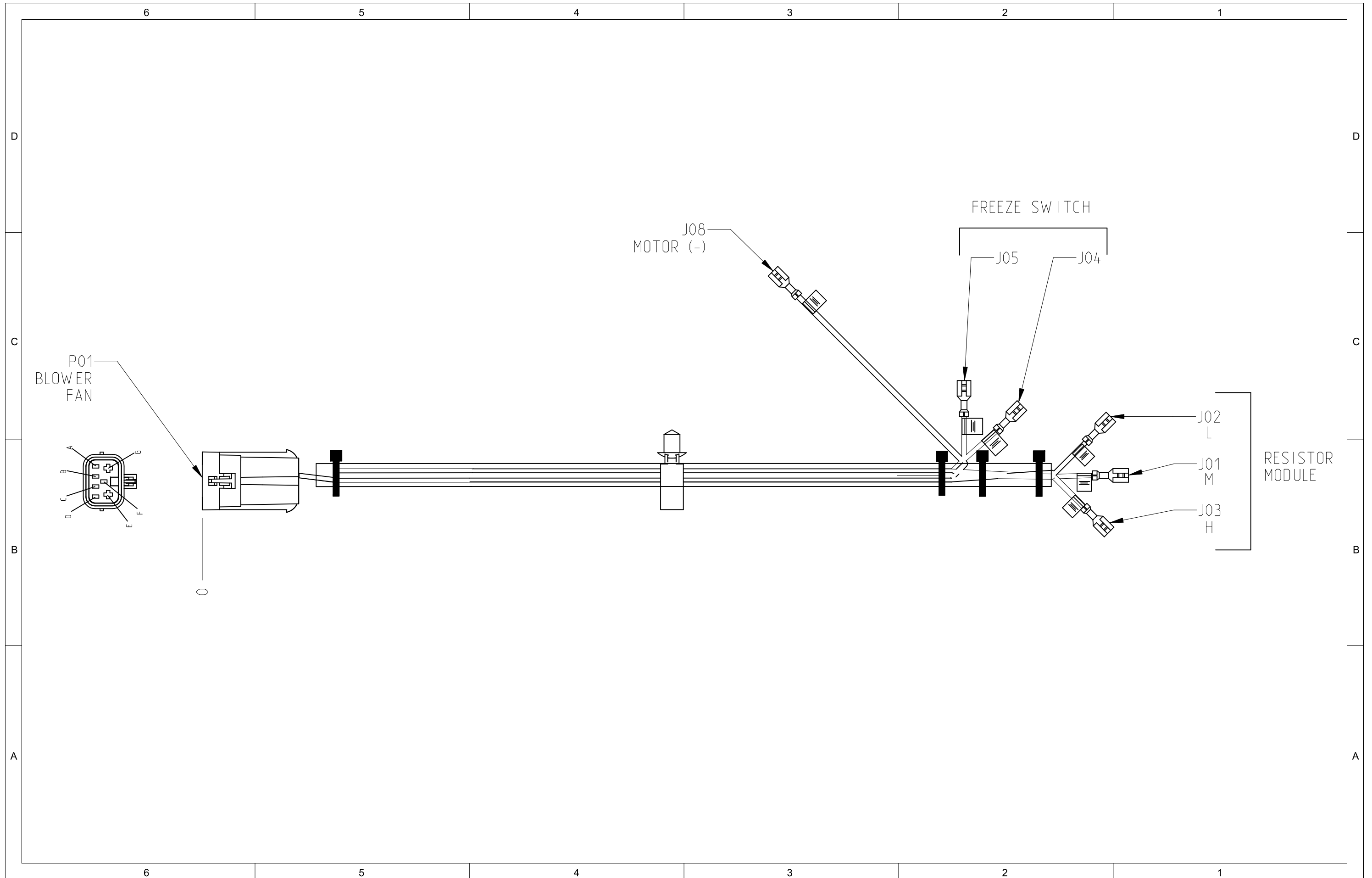


Wire Harness Diagram-Cab Model 30298 Front Mount Accessory Power Supply

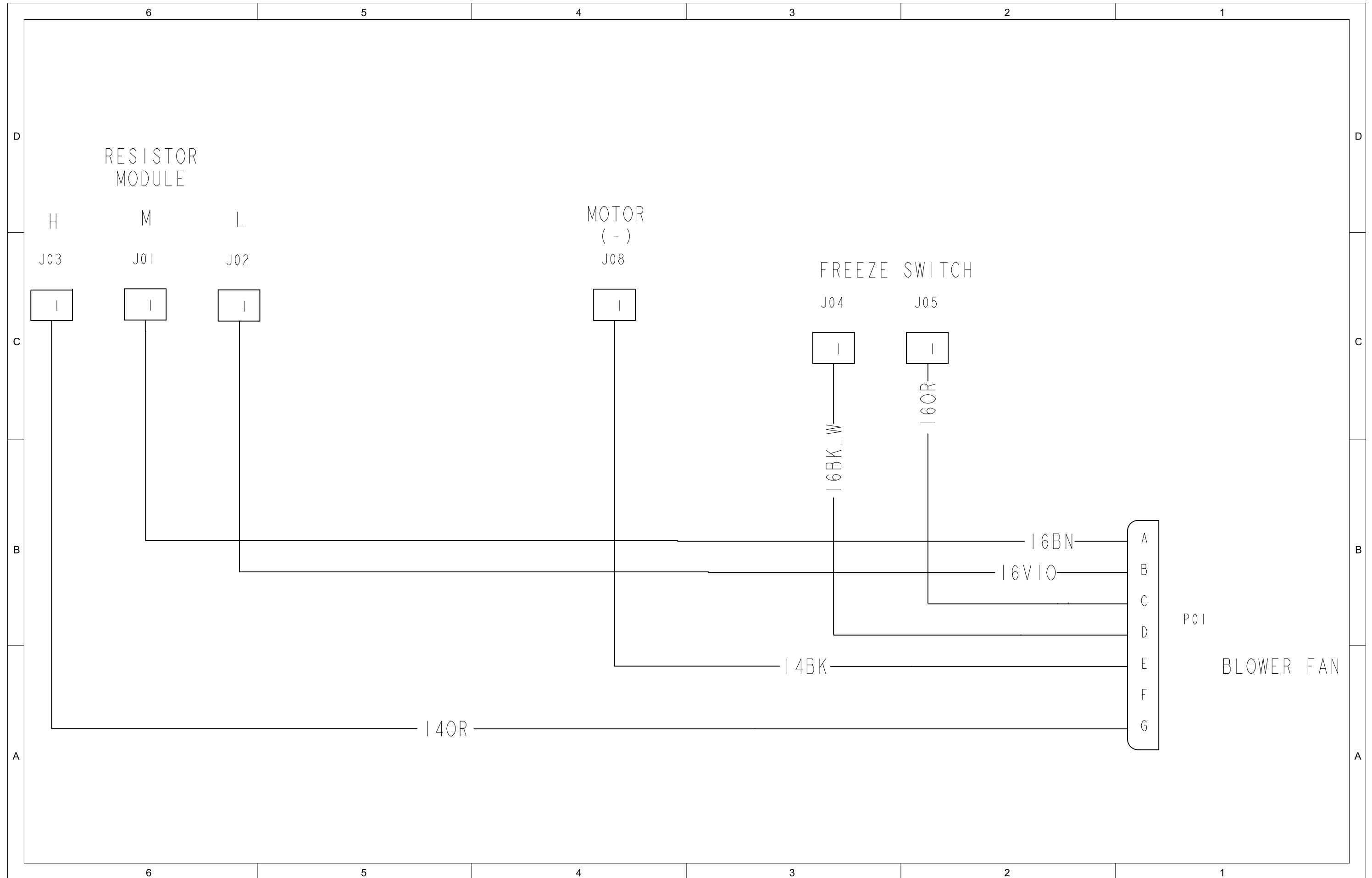


g243940

Wire Harness Drawing-Cab Model 30298 Heat/Air Conditioning Blower

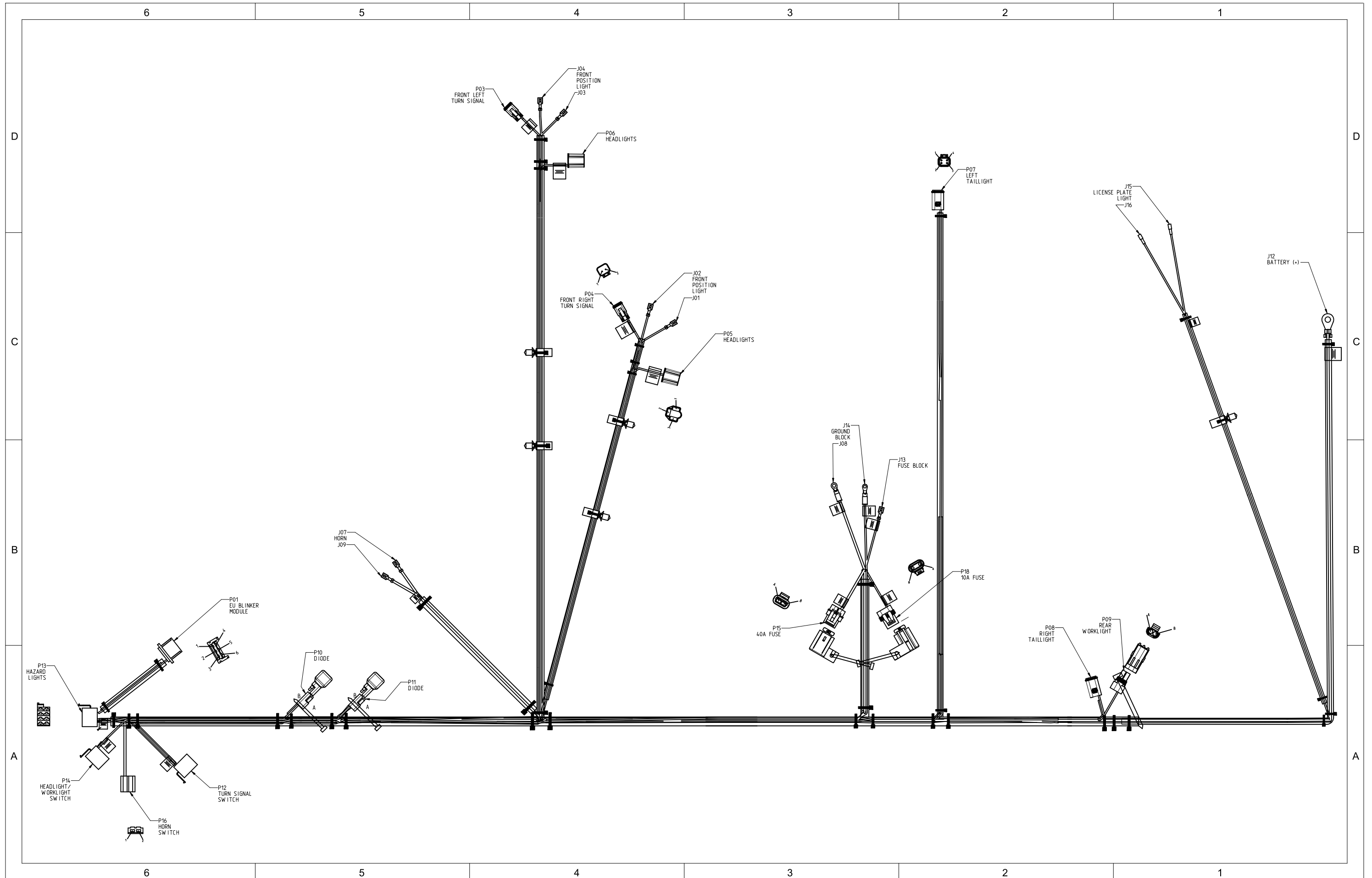


Wire Harness Diagram-Cab Model 30298 Heat/Air Conditioning Blower

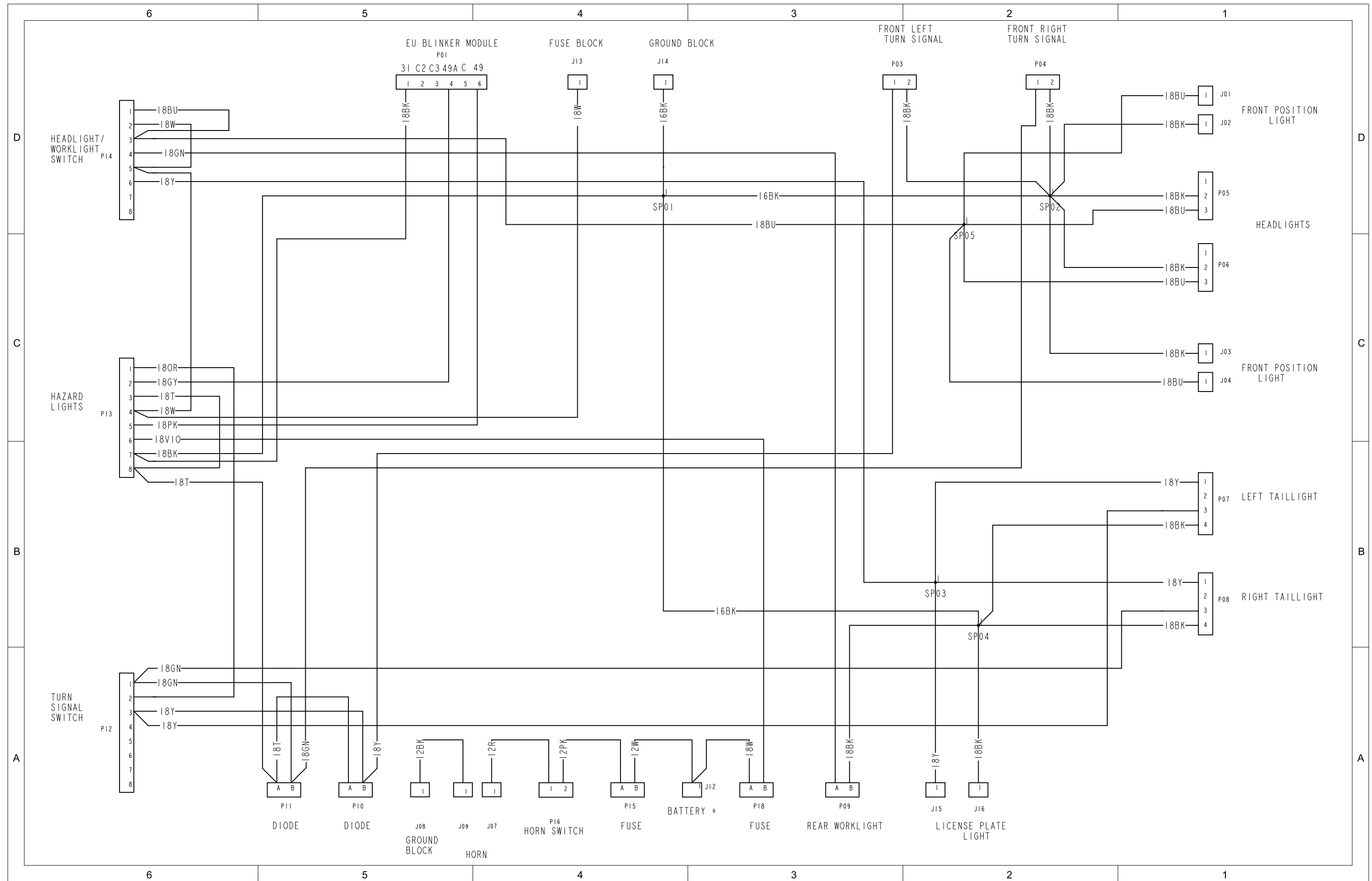


g243428

Wire Harness Drawing-Light Kit Model 30405 (Machines without Cab)

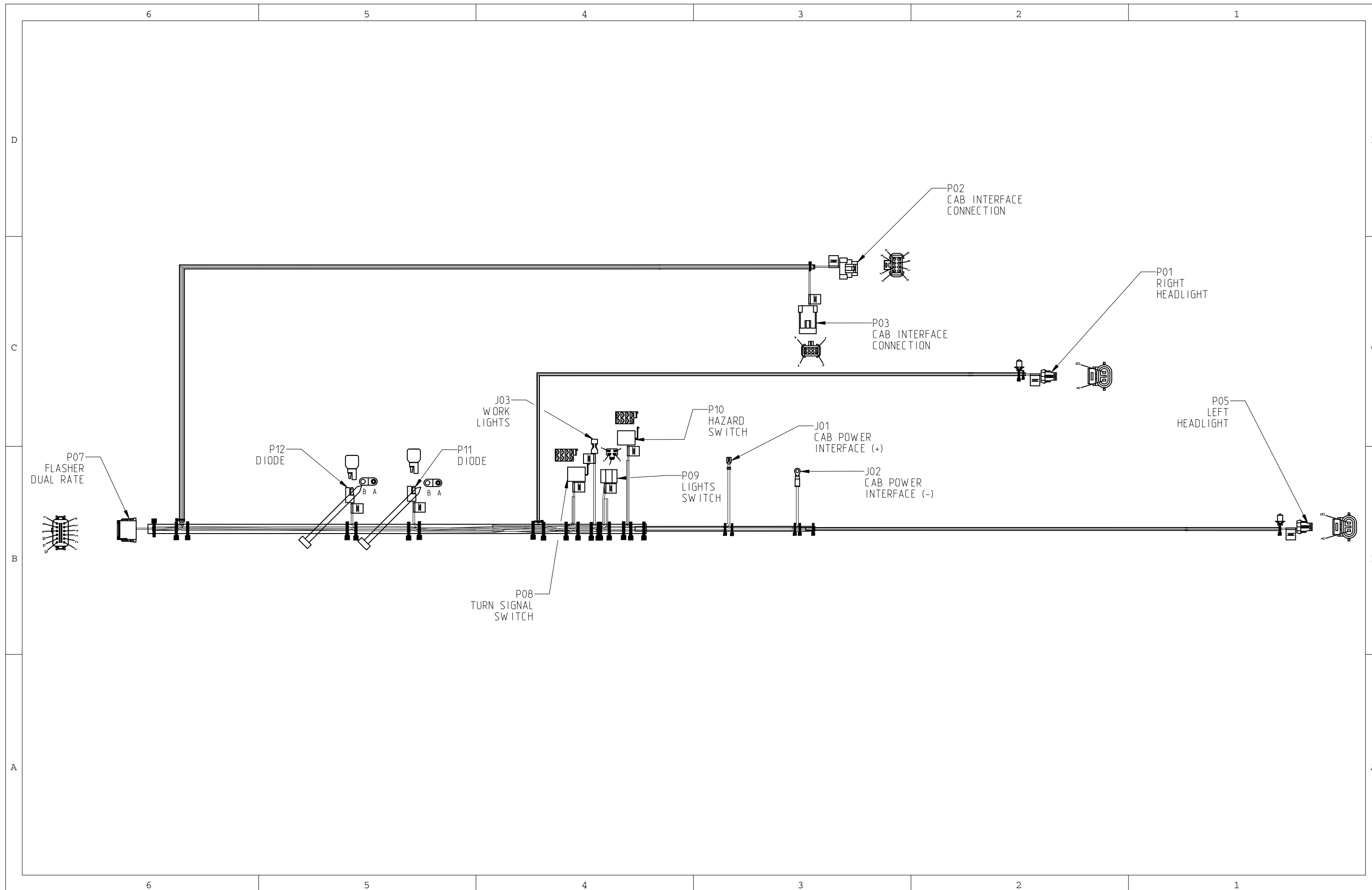


Wire Harness Diagram-Light Kit Model 30405 (Machines without Cab)



g226452

Wire Harness Drawing-North American Light Kit Model 30701 (Machines Serial Number 31500000 and Up)





Count on it.