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TORO®

Count on it.

Service Manual

Groundsmaster® 5900 & 5910

(Models 31698 and 31699)

8111 Lyndale Avenue South
Bloomington, MN 55420

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

Revision History

Revision	Date	Description
–	2016	Initial Issue
A	03/2018	Updated Engine chapter, Electrical chapter and Foldout drawings. Added revision history.
B	10/2019	Updated Hydraulic, Electrical, Chassis and Operator Cab chapters.
C	07/2020	Updated Electrical chapter and Foldout Drawings.
D	04/2021	Updated primary and secondary controller naming.
E	06/2021	Updated Hydraulic chapter and Foldout Drawings.

Reader Comments

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

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NOTES

Preface

The purpose of this publication is to provide the service technician with information for troubleshooting, testing, and repair of major systems and components on the Groundsmaster 5900 and 5910.

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

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

DANGER

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

WARNING

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

CAUTION

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

IMPORTANT

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

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

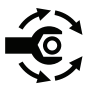
Service Procedure Icons

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

Critical Process

This icon is used to highlight:

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



Critical Torque

This icon is used to highlight an assembly torque requirement that is different than what is recommended in the Standard Torque Tables; refer to Torque Specifications (page 2–7).

Fluid Specifications

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

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

Table of Contents

Additional Reference Materials

Yanmar TNV (Tier 4) Series Service Manual

Yanmar TNV (Tier 4) Series Troubleshooting Manual

Danfoss H1 Closed Circuit Axial Piston Pumps Service Manual

Danfoss H1 Closed Circuit Axial Piston pumps Repair Instructions

Danfoss Steering Unit Type OSPM Service Manual

Eaton Parts And Repair Information: 5 Series Steering Control Units

Sanden SD Compressor Service Guide

Safety

Table of Contents

Safety Instructions

The Groundsmaster 5900 and 5910 are tested and certified by Toro for compliance with existing safety standards and specifications. Although hazard control and accident prevention partially are 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* and the *Operator and Safety Training Videos* found on www.toro.com.

Before Operating the Machine

- Review and understand the contents of the *Operator's Manuals* before starting and operating the machine. Become familiar with the controls and know how to stop the machine and engine quickly. Additional copies of the *Operator's Manuals* are available at www.toro.com.
- Never allow children to operate the machine. Never allow adults to operate the machine without proper instructions.
- Become familiar with the controls and know how to stop the machine and tractor engine quickly.
- Keep all the shields, safety devices, and decals in place. If a shield, safety device, or decal is illegible or damaged, repair or replace it before operating the machine.
- Always wear substantial shoes. Do not operate machine while wearing sandals, tennis shoes or sneakers. Do not wear loose fitting clothing which could get caught in moving parts and cause personal injury.
- Wearing safety glasses, safety shoes, long pants and a helmet is advisable and required by some local safety and insurance regulations.
- Make sure work area is clear of objects which might be picked up and thrown by the attachments.
- Keep everyone, especially children and pets, away from the areas of operation.
- Ensure that the interlock switches are adjusted correctly so the engine cannot be started unless traction pedal is in NEUTRAL and cutting decks are DISENGAGED.
- Since the fuel is highly flammable; handle it carefully.
  - Use an approved fuel container.
  - Do not remove cap from fuel tank when engine is hot or running.
  - Do not smoke while handling fuel.
  - Fill fuel tank outdoors and no higher than to the bottom of filter screen. Do not overfill fuel tank.
  - Wipe up any spilled fuel.

While Operating the Machine

1. Sit on the seat when starting and operating the machine.
2. Before starting the engine:
   A. Apply the parking brake.
   B. Make sure traction pedal is in neutral and the PTO switch is OFF (disengaged).
3. After engine is started, release parking brake and keep foot off traction pedal. Machine must not move. If movement is evident, there may be a problem with traction pedal calibration or the piston (traction) pump that needs to be corrected before using the machine.
4. Do not touch the engine, radiator and muffler or exhaust pipe while engine is running or soon after it has stopped because these areas are hot enough to cause burns.
5. Before getting off the seat:
   A. Ensure that traction pedal is in neutral.
   B. Fully lower and disengage cutting decks. Wait for blades to stop.
   C. Apply the parking brake.
   D. Stop engine and remove key from switch.
6. Toro recommends that anytime the machine is parked (short or long term), the cutting decks should be lowered to the ground. This relieves hydraulic pressure from the deck lift circuit and eliminates the risk of the cutting decks unexpectedly lowering to the ground.
7. Do not park on slopes unless wheels are chocked or blocked.

Maintenance and Service

1. Before servicing or making adjustments, lower decks, stop engine, apply parking brake and remove key from the key switch.
2. Make sure machine is in safe operating condition by keeping all nuts, bolts and screws tight.
3. Never store the machine or fuel container inside where there is an open flame, such as near a water heater or furnace.
4. Make sure all hydraulic connectors are tight and all hydraulic hoses and lines are in good condition before applying pressure to the hydraulic system.
5. Keep body and hands away from pin hole leaks in hydraulic lines that eject high pressure hydraulic fluid. Use cardboard or paper to find hydraulic leaks. Hydraulic fluid escaping under pressure can penetrate skin and cause injury. Fluid accidentally injected into the skin must be surgically removed within a few hours by a doctor familiar with this form of injury or gangrene may result.
6. Before disconnecting or performing any work on the hydraulic system, all pressure in system must be relieved by lowering cutting decks to the ground and stopping engine.
7. If major repairs are ever needed or assistance is desired, contact an Authorized Toro Distributor.
8. To reduce potential fire hazard, keep engine area free of excessive grease, grass, leaves and dirt. Clean protective screen on machine frequently.
9. If engine must be running to perform maintenance or an adjustment, keep hands, feet, clothing and other parts of the body away from cutting decks and other moving parts. Keep bystanders away.
10. To assure safety and accuracy, check maximum engine speed.
11. Shut off the engine before checking or adding oil to the crankcase.
12. Disconnect battery before servicing the machine. Disconnect negative cable first and positive cable last. If battery voltage is required for troubleshooting or test procedures, temporarily connect the battery. Reconnect positive cable first and negative cable last.
13. Battery acid is poisonous and can cause burns. Avoid contact with skin, eyes and clothing. Protect your face, eyes and clothing when working with a battery.
14. Battery gases can explode. Keep cigarettes, sparks and flames away from the battery.
15. At the time of manufacture, the machine conformed to the safety standards for riding mowers. To assure optimum performance and continued safety certification of the machine, use genuine Toro replacement parts and accessories. Replacement parts and accessories made by other manufacturers may result in non-conformance with the safety standards and the warranty may be voided.
16. When changing attachments, tires or performing other service, use correct supports, hoists and jacks. Make sure machine is parked on a solid level surface such as a concrete floor. Prior to raising the machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use appropriate jack stands to support the raised machine. If the machine is not properly supported by jack stands, the machine may move or fall, which may result in personal injury (see Jacking Instructions (page 1–6)).

Maintenance and Service (continued)

17. When welding on machine, disconnect all battery cables to prevent damage to machine electronic equipment. Disconnect negative battery cable first and positive cable last. Also, disconnect wire harness connector from both of the TEC controllers, disconnect and remove the engine ECU and disconnect the terminal connector from the alternator. Attach welder ground cable no more than two (2) feet (0.6 meters) from the welding location.
18. Make sure 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.

Battery-Disconnect Switch

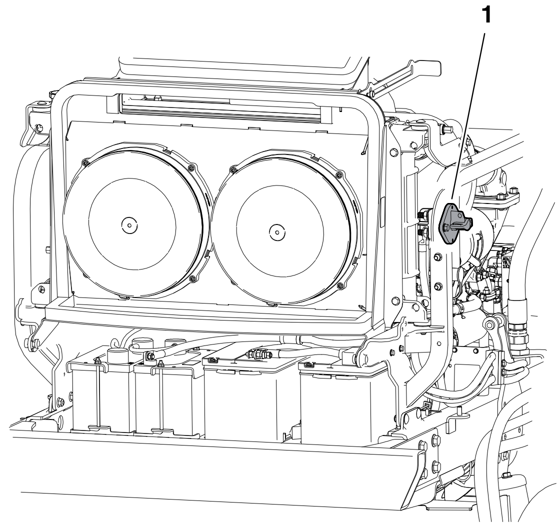


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Figure 1

1. Battery−Disconnect switch

The machine includes a battery−disconnect switch located under the hood in the right rear corner of the engine compartment. Turning the battery disconnect switch to the OFF position opens the 12 Volt and 24 Volt battery ground circuit. The battery disconnect switch should be set to OFF when servicing the machine. The switch can be locked in the OFF position if desired.

⚠ CAUTION ⚠

Do Not turn the battery−disconnect switch to the OFF position while the engine is running. The battery−disconnect switch is not an emergency shutoff. If the battery disconnect switch is set to OFF while the engine is running, the engine will continue to run on the power supplied by the 12 Volt alternator and you may cause damage to electrical components including the Toro Electronic Controllers (TECs).

Jacking Instructions

CAUTION

When changing attachments, tires or performing other service, use correct jacks and supports. Make sure machine is parked on a solid, level surface such as a concrete floor. Prior to raising machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use jack stands to support the raised machine. If the machine is not properly supported by jack stands, the machine may move or fall, which may result in personal injury.

Jacking the Front End (Figure 2)

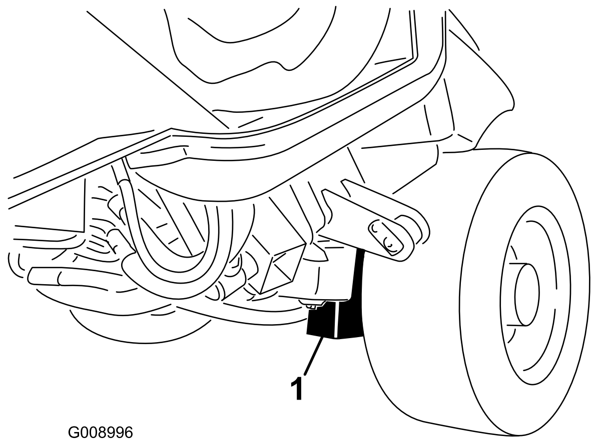

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Figure 2

1. Frame jacking point

1. Set parking brake and chock both rear tires to prevent the machine from moving.
2. Position jack securely under the frame, just to the inside of the front tire. Make sure that the jack does not contact hydraulic lift cylinder. Jack front wheel off the ground.
3. Once the machine is raised, position jack stand under the frame as close to the wheel as possible to support the machine.

Jacking the Rear End (Figure 3)

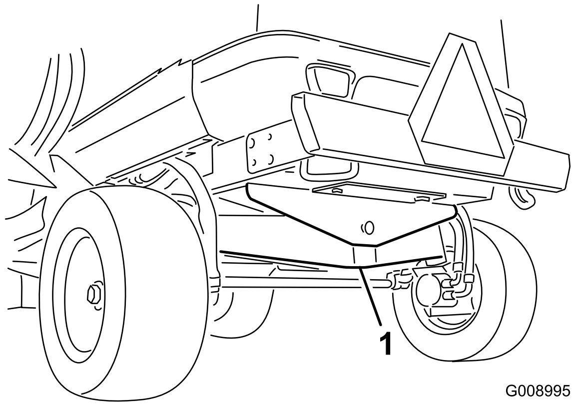

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Figure 3

1. Rear axle jacking point

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1. Set parking brake and chock both front tires to prevent the machine from moving.
2. Place jack securely under the center of rear axle. Jack rear of machine off the ground.
3. Once the machine is raised, use jack stands under the axle 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.

Chapter 2

Specifications and Maintenance

Table of Contents

Specifications

Overall Dimensions

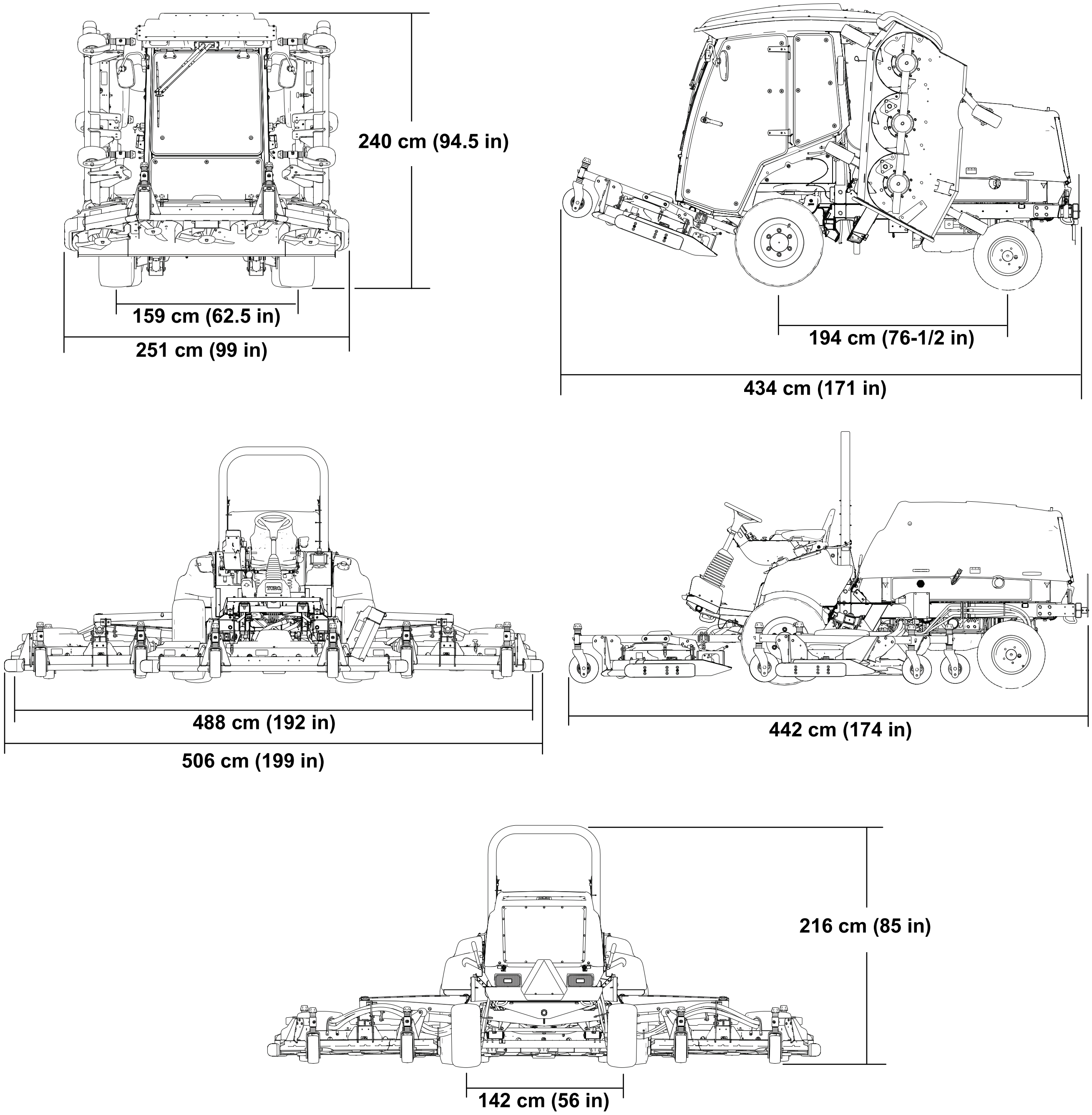

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Figure 4

Engine

Item	Description
Make / Designation	Yanmar Model 4TNV98CT−NTRL: 4−Cycle, 4 Cylinder, Water Cooled, Turbocharged, EPA Tier 4 Diesel Engine
Bore	98 mm (3.858 in)
Stroke	110 mm (4.331 in)
Total Displacement	3319 cc (202.5 in^3)
Firing Order	1 (closest to flywheel end) − 3 − 4 (farthest from flywheel) − 2
Direction of Rotation	Counterclockwise (viewed from flywheel)
Fuel	Diesel or Biodiesel (up to B20) Fuel with Low or Ultra Low Sulfur Content
Fuel Tank Capacity	132.5 liters (35 U.S. gallons)
Fuel Injection Pump	Yanmar Supply Pump
Fuel Injection Type	Common Rail with Direct Injection
Starting Aid	Intake Air Heater
Governor	Electronic All Speed
Low Idle (no load)	1000 RPM (air temperature at or above 4 ºC (40 ºF) 1200 RPM (air temperature below 4 ºC (40 ºF)
High Idle (no load)	CE Mode Disabled = 2530 RPM CE Mode Enabled = 2230 RPM
Engine Oil	API CJ−4 or higher
Engine Oil Viscosity	See *Operator's Manual*
Crankcase Oil Capacity	10.5 liters (11.1 U.S. quarts) with Filter
Oil Pump	Trochoid Type
Coolant Capacity Groundsmaster 5900 Groundsmaster 5910	 12.8 liters (13.5 U.S. quarts) 17 liters (18 U.S. quarts)
Starter	12 VDC, 3.0 KW
Alternator/Regulator	12 VDC, 80 amp
Engine Weight (Dry)	277 kg (611 U.S. lb)

Hydraulic System

Item	Description
Piston (Traction) Pump	Variable Displacement Axial Piston Pump
Maximum Displacement (per revolution)	68 cc (4.15 in³)
System Relief Pressure: Forward	350 bar (5080 PSI)
System Relief Pressure: Reverse	350 bar (5080 PSI)
Charge Pressure	20 bar (290 PSI)
Front Wheel Motors	Dual Speed, Radial Piston Motor
Displacement (per revolution) in Low (Mow) Speed	280.3 cc (17.1 in³)
Displacement (per revolution) in High (Transport) Speed	560.5 cc (34.2 in³)
Rear Wheel Motors	Single Speed, Radial Piston Motor
Displacement (per revolution)	213 cc (13 in³)
Gear Pump	3 Section, Positive Displacement Gear Pump
Front Section Displacement (per revolution)	34.6 cc (2.11 in³)
Middle Section Displacement (per revolution)	34.6 cc (2.11 in³)
Final Section Displacement (per revolution)	16.9 cc (1.03 in³)
Cutting Deck Motors	Gear Motor
Displacement (per revolution)	24.6 cc (1.5 in³)
Relief Pressure (front and left decks)	207 bar (3000 PSI)
Relief Pressure (right deck)	138 bar (2000 PSI)
Steering Valve	Eaton Steering Unit, Series 5
Steering Circuit Relief Pressure	145 bar (2100 PSI)
Lift/Lower Circuit Relief Pressure	103 bar (1500 PSI)
Hydraulic Filters (2 used)	Spin−on Cartridge Type
Hydraulic Reservoir Capacity	71.9 Liters (19 U.S. Gallons)
Hydraulic Reservoir In−line Suction Strainer	100 Mesh (in Reservoir)
Hydraulic Oil	See *Operator's Manual*

Note: The pressure specifications listed above are component settings. When using pressure gauges to measure circuit pressures, values may be different than these specifications. See Testing (page 5–36) section of hydraulic test procedures and expected test results.

Chassis

Item	Description
Tire pressure	
Front tire	29 x 12.00−15, 6 ply @ 220 kPa (32 psi)
Rear tire	23 x 10.50−12, 6 ply @ 207 kPa (30 psi)
Rear wheel toe−in	0 to 3 mm (0.12 in)
Wheel lug nut torque (front and rear)	124 to 146 N·m (92 to 108 ft−lb), front and rear in a crossing pattern
Steering cylinder ball joint slotted nut torque	41 to 61 N·m (30 to 45 ft−lb)
Tie rod ball joint slotted nut torque	41 to 61 N·m (30 to 45 ft−lb)
Front wheel motor mounting screw torque	183 to 224 N·m (135 to 165 ft−lb)
Rear wheel motor mounting screw torque	91 to 112 N·m (67 to 83 ft−lb)

Cutting Decks

MOUNTING:	Cutting decks are supported by lift arms controlled with hydraulic lift cylinders.
CONSTRUCTION:	Deck chambers are welded steel construction reinforced with channels and plates.
HEIGHT−OF−CUT RANGE:	25.4 mm to 152 mm (1 to 6 in) in 12.7 mm (1/2 in) increments. Center deck height−of−cut adjustment is achieved by changing spacers on castor wheels and re−positioning the castor wheel axles in the castor forks. Wing deck adjustment is achieved by changing spacers on castor wheels and re−positioning the castor wheel axles in the castor forks.
CUTTING DECK PITCH:	Cutting deck rake or pitch is the difference in height−of−cut from the front of the blade tip to the back of the blade tip. Use a cutting deck rake of 6.3 to 9.6 mm (0.25 to 0.38 in). A cutting deck pitch larger than 9.6 mm (0.38 in) results in less power required, larger clippings, and a poorer quality of cut. A cutting deck pitch less than 7.9 mm (0.31 in) results in more power required, smaller clippings, and a better quality of cut.
DECK DRIVE:	The closed loop hydraulic system operates hydraulic motor on each cutting deck. The motor drives one spindle directly with remaining deck spindle(s) driven by B section kevlar v−belt(s). Blade spindles are 31.7 mm (1.250 in) shafts supported by greaseable, tapered roller bearings.
CUTTING BLADE:	Cutting blade dimensions are 508 mm (20 in) long, 64 mm (2.500 in) wide and 6.4 mm (0.250 in) thick. Anti−scalp cup installed on each cutting blade. Center deck includes five blades and each wing deck includes three blades.
WIDTH OF CUT:	Front deck provides 2337 mm (92 in) width of cut. Each side deck has 1448 mm (57 in) width of cut. Total width of cut is 4877 mm (192 in).
DISCHARGE:	Clippings are discharged from the rear of the cutting decks.
SUSPENSION SYSTEM:	A fully floating deck suspension with hydraulic counterbalance. Front deck suspended from lift arms and has two castor wheels, two adjustable side skid/bumpers and a front adjustable anti−scalp roller. Wing decks suspended from lift arms and have four castor wheels, two adjustable inner skids and two adjustable side skid/bumpers.
PNEUMATIC CASTOR WHEELS:	All cutting deck castors come with 25.4 cm (10 inch) pneumatic tires standard. Recommended castor wheel tire pressure is 345 kPa (50 psi).

Torque Specifications

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

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

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

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

Calculating the Torque Values When Using a Drive-Adapter Wrench

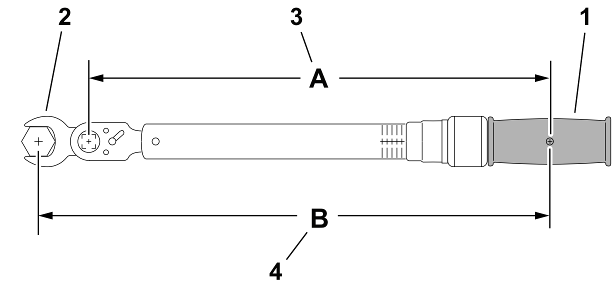


Figure 5

Torque Conversion Factor = A / B

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

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

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

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

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

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

Identifying the Fastener

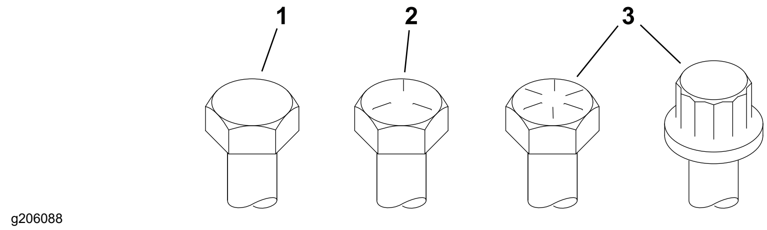


Figure 6
Inch Series Bolts and Screws

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

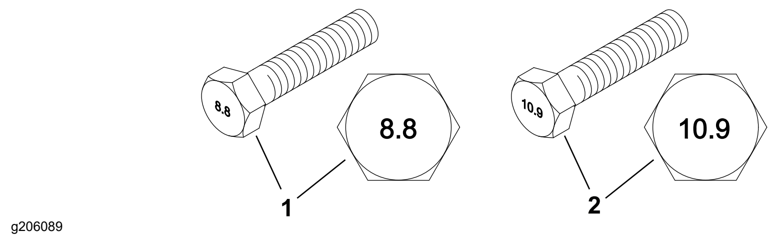


Figure 7
Metric Bolts and Screws

1. Class 8.8
2. Class 10.9

Fasteners with a Locking Feature

IMPORTANT

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

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

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

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

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

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

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

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

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

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

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

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

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

Other Torque Specifications

SAE Grade 8 Steel Set Screws

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

Thread Cutting Screws
(Zinc Plated Steel)

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

Wheel Bolts and Lug Nuts

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

*For steel wheels and non-lubricated fasteners

Thread Cutting Screws
(Zinc Plated Steel)

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

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

Conversion Factors

in-lb X 11.2985 = N·cm

N·cm X 0.08851 = in-lb

ft-lb X 1.3558 = N·m

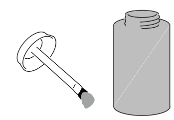
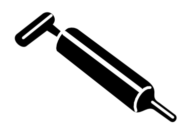
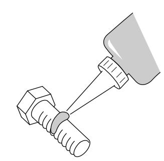
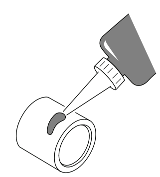
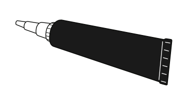
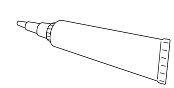
N·m X 0.7376 = ft-lb

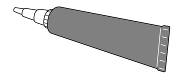
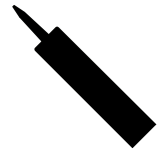
Shop Supplies

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

IMPORTANT

Always follow manufacturers instructions when using or storing shop supplies.

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

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

Special Tools

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

Hydraulic Pressure Testing Kit

K-Line Part No. TOR47009

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

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57 LPM (15 GPM) Hydraulic Tester Kit

K-Line Part No. TOR214678

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

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

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

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

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

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

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

150 LPM (40 GPM) Hydraulic Tester

K-Line Part No. AT40002

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

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

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

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

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

Hydraulic O-Ring Kit

Toro Part No. 117-2727

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

Hydraulic Hose Kit

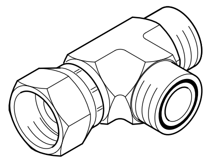
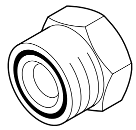
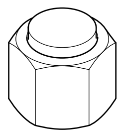
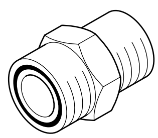
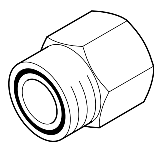
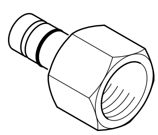
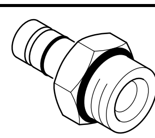
K-Line Part No. TOR6007

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

Hydraulic Test Fitting Kit

K-Line Part No. TOR4079

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

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

High Flow Hydraulic Filter Kit

K-Line Part Number: TOR6011

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

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

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

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

G035050

Measuring Container

K-Line Part Number: TOR4077

Use this container to test hydraulic motor efficiency (motors with case drain lines only). Limit the outlet flow from the motor and measure the leakage from the case drain line to measure the efficiency of a hydraulic motor while the hydraulic system pressurizes the motor.

The table gives the gallons per minute (gpm) conversion for the measured milliliter or ounce motor case drain leakage.

G031767

GPM	mL/15 seconds	oz/15 seconds
0.1	95	3.2
0.2	189	6.4
0.3	284	9.6
0.4	378	12.8
0.5	473	16.0
0.6	568	19.2
0.7	662	22.4
0.8	756	25.6
0.9	852	28.8
1.0	946	32.0

Remote Starter Switch

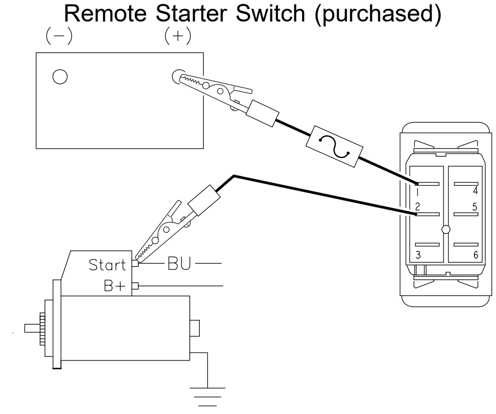
After flushing the hydraulic system or replacing a hydraulic component (e.g. gear pump, piston pump, drive motor), it is necessary to prime the hydraulic pumps. A remote starter switch can be used for this purpose. A remote starter switch can be purchased locally or fabricated as follows.

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

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

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

Remote Starter Switch (purchased)



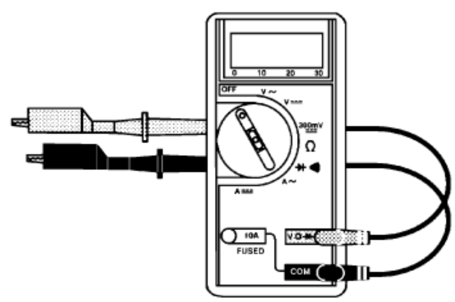
Remote Starter Switch (fabricated)

Multimeter

Obtain this tool locally

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

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



Battery Terminal Protector

Toro Part No. 107-0392

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

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.

Battery Hydrometer

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

Chapter 3

Troubleshooting

Table of Contents

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

Gather Information

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

Evaluate Potential Causes

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

Assess Performance

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

Repair

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

Solution Confirmation

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

General Hydraulic System Problems

The charts that follow contain suggestions that can be used to assist in diagnosing hydraulic system performance issues. The suggestions are not all−inclusive. Also, consider that there may be more than one cause for a machine problem.

Review the hydraulic schematic and information on hydraulic system operation in the Hydraulic Flow Diagrams section of this Chapter. This information will be useful during the hydraulic troubleshooting process.

Refer to the Testing (page 5–36) for precautions and specific hydraulic test procedures.

Problem	Possible Cause
Hydraulic oil leaks from machine.	Fitting(s), hose(s) or tube(s) is (are) loose or damaged. O−ring(s) or seal(s) is (are) missing or damaged.
Hydraulic system operates hot. **Note:** Use InfoCenter Display to determine hydraulic oil temperature.	Engine RPM is too low. Brakes are applied or sticking. Hydraulic reservoir oil level is low. Hydraulic oil is contaminated or the wrong type. Piston pump by-pass valve is open or damaged. Cooling system is not operating properly. Charge pressure is low. Traction circuit pressure is incorrect. Pump(s) or motor(s) are damaged.
Hydraulic oil in reservoir foams.	Hydraulic reservoir oil level is low. Wrong type of oil is in the hydraulic system. Air is leaking into a pump suction line.

Traction Circuit Problems

When troubleshooting traction circuit problems, if a problem exists in both low range (mow) and high range (transport) speeds, consider a faulty component that affects the entire traction circuit (e.g. charge circuit, traction circuit relief valves, piston pump). If the problem exists in low range but not in high range (transport), consider a problem that only exists in mow (e.g. solenoid valve in traction manifold, issue with front wheel motor).

Problem	Possible Cause
Machine operates in one direction only (forward or reverse).	Traction relief valve for non−functioning direction is loose, leaking or damaged. Orifice or screen in piston (traction) pump control assembly is obstructed or damaged. Traction control pedal potentiometer is faulty (fault code should be displayed on InfoCenter Display). Problem with TEC output to piston (traction) pump servo control exists (see Chapter 6: Electrical System (page 6–1)).
Traction operation is sluggish.	Hydraulic reservoir oil level is low (other hydraulic systems are affected as well). Engine speed is low. Traction control pedal assembly is sticking or binding. Traction charge pressure is low. Orifice or screen in piston (traction) pump control assembly is obstructed or damaged. Piston pump servo control valve is damaged. Hydraulic flow for traction charge circuit is low (steering and lift circuits also affected).
Machine travels too far before stopping when the traction pedal is released.	Traction control pedal assembly is binding or out of adjustment. Piston pump servo control valve is damaged. Traction pedal does not return fully to neutral.
Traction power is lost or machine will not operate in either direction.	Hydraulic reservoir oil level is low (Other hydraulic systems are affected as well). Piston (traction) pump by-pass valve is open or damaged. Traction charge pressure is low. Traction circuit pressure is low. Orifice or screen in piston (traction) pump control assembly is obstructed or damaged. Traction control pedal potentiometer is damaged or disconnected (fault code should be displayed on InfoCenter Display). Problem with TEC output to piston (traction) pump servo control exists (see Chapter 6: Electrical System (page 6–1)). Hydraulic flow for traction charge circuit is low (steering and lift circuits also affected).

Problem	Possible Cause
High range traction speed (transport) will not engage.	An electrical problem exists that prevents solenoid valve (SV) operation in traction manifold (see Chapter 6: Electrical System (page 6–1)). Solenoid valve SV in traction manifold is leaking or faulty. PD cartridge valve(s) in traction manifold is (are) leaking, damaged or sticking.
Parking brake cannot be disengaged with engine running.	An electrical problem exists between parking brake control switch and solenoid valve (S10) in steering/deck lift manifold (see Chapter 6: Electrical System (page 6–1)). Solenoid valve (S10) in steering/deck lift manifold is stuck or damaged.

PTO Problems

Problem	Possible Cause
None of the cutting decks will operate.	An electrical problem exists that prevents solenoid valve operation in deck manifolds (see Chapter 6: Electrical System (page 6–1)).
Note: Cutting decks have to be fully lowered and floating, traction speed needs to be in low range (mow), the PTO switch needs to be engaged and the engine coolant temperature needs to be below 102 ºC (215 ºF) in order for decks to operate.	Gear pump internal drive shaft failure. Both gear pump sections for the cutting deck circuits are worn or damaged.
One cutting deck motor does not rotate.	An electrical problem for the affected deck exists (see Chapter 6: Electrical System (page 6–1)). System pressure to the affected deck motor is too low. Woodruff key on affected deck motor is damaged (motor rotates but deck belt and blades do not rotate). Solenoid valve (PRV) in deck manifold for the affected deck is faulty. Cartridge valve (LC1, LC2, SQ) in deck manifold for the affected deck is damaged or sticking. The deck motor for the affected deck is worn or damaged. The gear pump section for the affected deck is worn or damaged.
All cutting deck motors operate slowly.	Engine RPM is low. Cutting deck problem on all decks exists (see Chapter 8: Cutting Decks (page 8–1)). All deck motors are worn or damaged. Both gear pump sections for the cutting deck circuits are worn or damaged.
Cutting deck stops under load.	Relief valve (PRV) in deck manifold for the affected deck is by−passing. Cutting deck problem exists for the affected deck (see Chapter 8: Cutting Decks (page 8–1)). Deck motor for the affected deck is worn or damaged. The gear pump section for the affected deck is worn or damaged.

Lift/Lower Circuit Problems

Problem	Possible Cause
Cutting decks will not raise. **Note:** To raise a cutting deck, the engine must be running. Also, the operator seat has to be occupied or the parking brake must be applied with the traction pedal in neutral. **Note:** When the engine is running below 2000 RPM, only one deck can be raised at a time.	Engine RPM is too low. Hydraulic oil level in reservoir is too low (other hydraulic systems are affected as well). Lift arm pivots are binding. Lift cylinder is damaged. An electrical problem for the affected deck exists (see Chapter 6: Electrical System (page 6–1)). Solenoid valve in steering/deck lift manifold for the affected deck is faulty. Pressure compensator valve (LC) in steering/deck lift manifold is faulty. Final gear pump section for lift circuit is worn or damaged (a worn or damaged final gear pump section will also affect the traction (charge) and steering circuits).
Cutting decks raise, but will not stay up. **Note:** Lift cylinders cannot provide an absolutely perfect seal. A cutting deck will eventually lower if left in the raised position during storage.	Lift circuit hydraulic lines or fittings for the affected deck are leaking. Lift cylinder for the affected deck is worn or damaged. Solenoid valve in steering/deck lift manifold for the affected deck (S4, S6, S9) is leaking or damaged.
Cutting decks will not lower. **Note:** To lower a cutting deck, the seat must be occupied and the traction speed must be in the LOW (mow) position.	An electrical problem for the affected deck exists (see Chapter 6: Electrical System (page 6–1)). Lift arm pivots for the affected deck are binding. Lift cylinder for the affected deck is damaged. Counterbalance pressure is excessive (all cutting decks are affected). Solenoid valve in steering/deck lift manifold for the affected deck is faulty.
Side cutting deck drops too fast.	Excessive debris buildup on the affected cutting deck. Orifice in steering/deck lift manifold for the affected deck (OR3, OR7) is missing or damaged.
Side cutting deck drops too slow.	Orifice in steering/deck lift manifold for the affected deck (OR3, OR7) is plugged or faulty. Lift arm pivots for the affected deck are binding. Lift cylinder for the affected deck is worn or damaged.

Steering Circuit Problems

Problem	Possible Cause
Steering inoperative or sluggish.	Steering components (e.g. tie rods, steering cylinder ends) are worn or binding. Steering cylinder is binding. Oil level in hydraulic reservoir is low (Note: Other hydraulic systems are affected as well). Steering relief valve (RV1) in combination manifold is stuck or damaged. Pressure compensator valve (LC) in steering/deck lift manifold is faulty. One or both of the steering cylinders leak internally. Steering control valve is worn or damaged. Gear pump section is worn or damaged (Note: A worn or damaged gear pump section will also affect the lift/lower, engine cooling fan motor and traction charge circuits).

Starting Problems

CAUTION

Remove all jewelry, especially rings and watches, before doing any electrical troubleshooting or testing. Also, disconnect the battery cables unless the test requires battery voltage.

For effective troubleshooting and repairs, you must have a good understanding of the electrical circuits and components used on this machine (see Appendix A (page A–1)).

If the machine has any interlock switches by−passed, reconnect the switches for proper troubleshooting and safety.

Note: Use the InfoCenter Display when troubleshooting a Groundsmaster 5900 or 5910 electrical problem.

Check the InfoCenter Display for any operator advisories or faults that may appear. Use the InfoCenter Display Diagnostics feature to help identify the problem (see DIAGNOSTICS SCREENS (page 6–22)).

Problem	Possible Cause
All electrical power is dead, including InfoCenter Display.	Battery−Disconnect switch is in the OFF position.
	Batteries are discharged.
	Battery cables are loose or corroded.
	Fuse M2 (60 Amp) is faulty.
	Fuse F−D3 (10 amp) to the key switch is faulty.
	Fuse F−D1 (2 Amp) is faulty.
	Fuse F−D2 (2 Amp) is faulty.
	A faulty ground connection exists on machine.
	Key switch or circuit wiring is faulty.
Starter solenoid clicks, but starter will not crank.	Batteries are discharged.
Note: If the starter solenoid clicks, the problem is not in the interlock circuit.	Battery cables are loose or corroded.
	Ground cable is loose or corroded.
	Wiring at the starter motor is faulty.
	Starter solenoid or starter motor is faulty.

Problem	Possible Cause
Nothing happens when start attempt is made (engine does not crank). InfoCenter display operates with the key switch in the RUN position.	The key switch or circuit wiring is faulty. Traction pedal position sensor or circuit wiring is faulty. The seat switch or circuit wiring is faulty (when trying to start engine in seat). The parking brake switch or circuit wiring is faulty (when trying to start engine out of seat). The start relay or circuit wiring is faulty. The fusible link is loose, corroded or faulty. The starter solenoid or starter motor is faulty. TEC power relay 2 or circuit wiring is faulty. Primary controller fuses (F−D1 or F−B1) are faulty. Yanmar Engine ECU power fuse (25 Amp) is faulty. The engine ECU is malfunctioning (see Yanmar Service Manual and Yanmar Troubleshooting Manual). The primary controller is faulty.
Engine cranks, but does not start.	Engine and/or fuel may be too cold. The glow relay or circuit wiring is faulty. Fuel tank is empty. Electric fuel pump is faulty. Hydraulic load is slowing engine cranking speed. The engine, engine ECU or fuel system is malfunctioning (see Yanmar Service Manual).
Engine cranks, but should not, when the traction pedal is depressed.	Traction pedal position sensor is out of adjustment. Traction pedal position sensor or circuit wiring is faulty.

General Run and Transport Problems

Check the InfoCenter Display for any operator advisories or faults that may appear. Use the InfoCenter Display Diagnostics feature to help identify the problem (see DIAGNOSTICS SCREENS (page 6–22)).

Problem	Possible Cause
Engine continues to run, but should not, when the key switch is turned off.	Key switch or circuit wiring is faulty. The engine, engine ECU or fuel system is malfunctioning (see *Yanmar Service Manual*). The primary controller is faulty.
Engine continues to run without an Operator Advisory, but should not, when the traction pedal is depressed with no operator in the seat.	The seat switch or circuit wiring is faulty. Traction pedal position sensor is out of adjustment. Traction pedal position sensor or circuit wiring is faulty.
Engine stops during operation, but is able to restart.	The operator is lifting off the seat switch while mowing. The seat switch or circuit wiring is faulty. The key switch or circuit wiring is faulty. Machine is being operated on a slope with a low fuel level. The engine, engine ECU or fuel system is malfunctioning (see *Yanmar Service Manual*).
Batteries do not charge.	Wiring to charging circuit component is loose, corroded or damaged (see Appendix A (page A–1)). Alternator belt is loose or damaged. Battery cables are loose or corroded. Alternator is faulty. Battery is faulty.

Cutting Deck (PTO) Operating Problems

Check the InfoCenter Display for any operator advisories or faults that may appear. Use the InfoCenter Display Diagnostics feature to help identify the problem (see DIAGNOSTICS SCREENS (page 6–22)).

Problem	Possible Cause
The cutting decks remain engaged, but should not, with no operator in the seat.	The seat switch or circuit wiring is faulty. A hydraulic problem in the mow circuit exists (see Chapter 5: Hydraulic System (page 5–1)). The secondary TEC is faulty.
Cutting deck runs, but should not, when raised. Decks shut off with PTO switch.	The cutting deck position switch or circuit wiring is faulty. A hydraulic problem in the mow circuit exists (see Chapter 5: Hydraulic System (page 5–1)). The secondary TEC is faulty.
Cutting decks run, but should not, when raised. Decks do not shut off with the PTO switch.	Both the deck position switch or circuit wiring and PTO switch or circuit wiring are faulty. A hydraulic problem in the mow circuit exists (see Chapter 5: Hydraulic System (page 5–1)).
Cutting decks run, but should not, when lowered with PTO switch in the OFF (disengage) position.	Both the cutting deck position switch or circuit wiring and PTO switch or circuit wiring are faulty. A hydraulic problem in the mow circuit exists (see Chapter 5: Hydraulic System (page 5–1)).
Cutting decks run, but should not, when lowered with PTO switch in the OFF (disengage) position.	The PTO switch or circuit wiring is faulty. The secondary TEC is faulty.
One cutting deck does not operate when lowered with the PTO engaged.	Cutting deck manifold solenoid coil PRV or circuit wiring for affected deck is faulty. The cutting deck position switch or circuit wiring is faulty. A hydraulic problem in the mow circuit exists (see Chapter 5: Hydraulic System (page 5–1)).

Problem	Possible Cause
Cutting deck(s) do not operate. Cutting decks are able to raise and lower.	The operator is lifting off the seat switch. The cutting decks are not fully lowered. High temperature of engine coolant or hydraulic oil has disabled the cutting decks. Coolant temperature sender or circuit wiring is faulty. The seat switch or circuit wiring is faulty. The PTO switch or circuit wiring is faulty. The cutting deck position switch or circuit wiring is faulty. The HIGH/LOW range traction speed switch or circuit wiring is faulty. Hydraulic PRV valve solenoid(s) or circuit wiring to the affected deck(s) is faulty. A hydraulic problem in the mow circuit exists (see Chapter 5: Hydraulic System (page 5–1)). The secondary TEC is faulty.

Cutting Deck Lift/Lower Problems

Check the InfoCenter Display for any operator advisories or faults that may appear. Use the InfoCenter Display Diagnostics feature to help identify the problem (see DIAGNOSTICS SCREENS (page 6–22)).

Problem	Possible Cause
None of the cutting decks will lower.	Operator is not fully depressing the seat switch. Traction unit is not in LOW speed (mow) mode. Secondary TEC fuses (F−A2, F−B2, F−C2, F−D2) are faulty. The seat switch or circuit wiring is faulty. The HI/LOW speed switch or circuit wiring is faulty. Lift control manifold solenoid coil S1 or circuit wiring is faulty. A hydraulic problem in the lift/lower circuit exists (see Chapter 5: Hydraulic System (page 5–1)). Secondary TEC is faulty.
None of the cutting units will raise.	Lift control manifold solenoid coil S1 or circuit wiring is faulty. If Operator is in seat: Operator is not fully depressing the seat switch. Seat switch or circuit wiring is faulty. If Operator is not in seat: Parking brake is not set. Parking brake switch or circuit wiring is faulty. Traction pedal is not in neutral. Traction pedal switch or circuit wiring is faulty. A hydraulic problem in the lift/lower circuit exists (see Chapter 5: Hydraulic System (page 5–1)). Secondary TEC is faulty.
Front cutting deck will not raise or lower, but both wing cutting decks will raise and lower.	Front deck raise/lower switch or circuit wiring is faulty. Lift control manifold solenoid coils S5 or S6 or circuit wiring is faulty. A hydraulic problem in the lift/lower circuit exists (see Chapter 5: Hydraulic System (page 5–1)). Secondary TEC is faulty.

Problem	Possible Cause
RH wing cutting deck will not raise or lower, but the front and LH wing cutting decks will raise and lower.	RH deck raise/lower switch or circuit wiring is faulty. Lift control manifold solenoid coils S7, S8 or S9 or circuit wiring is faulty. Combination control manifold solenoid coils S7, S8 or S9 or circuit wiring is faulty. A hydraulic problem in the lift/lower circuit exists (see Chapter 5: Hydraulic System (page 5–1)). Secondary TEC is faulty.
Left side cutting deck will not raise or lower, but the center and right side cutting decks will raise and lower.	LH deck raise/lower switch or circuit wiring is faulty. Lift control manifold solenoid coils S2, S3 or S4 or circuit wiring is faulty. A hydraulic problem in the lift/lower circuit exists (see Chapter 5: Hydraulic System (page 5–1)). Secondary TEC is faulty.

Operator Advisories

Operator advisories are automatically displayed by the InfoCenter when a machine function requires additional action. Typically, an advisory can be eliminated with a change in machine controls by the operator. For example, if the operator attempts to start the engine when the traction pedal is depressed, an advisory is identified on the InfoCenter Display that the traction pedal needs to be in neutral. An advisory will not be logged into any fault log. The following pages explain each advisory in more detail.

Advisory Number	Advisory Description
5, 6, 7, 8, 9	Start Denied
102, 106, 107, 108, 109	PTO Denied
202	Cruise Denied
302, 303, 304	Deck Lower Denied
402	Deck Not Floating (On Engine Start)
502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512	Range High Denied
602, 603, 604	Range Low Denied
804, 805, 806	Traction Disabled
1205, 1206, 1207, 1208, 1209, 1210, 1211	Engine Advisory
1302	Fuel Level
1402	Traction Pedal Not Calibrated
1602, 1603, 1604, 1605	Deck Raise Denied

Note: If “Unknown Cause” appears as an advisory description, a controller software issue may exist. If you are unable to clear this type of advisory, contact your Authorized Toro Distributor.

Advisories are available for the following functions:

TO START

The TO START advisory identifies that the engine starter will not engage after the key switch is turned to the START position.

#5 DISENGAGE PTO:	The PTO switch is in the engaged position and must be disengaged before starter will operate.
#6 MOVE TRACTION PEDAL TO NEUTRAL:	The traction pedal position sensor is not in the neutral position.
#7 MUST BE SEATED OR SET PARKING BRAKE:	Operator needs to be in seat or parking brake switch needs to be in the engaged position before starter will operate.
#8 DISENGAGE DECK SWITCH:	One of the three (3) deck raise/lower switches is in the raise or lower position and must be set to the middle (neutral) position before starter will operate.
#9 TURN KEY SWITCH OFF THEN ON:	Power to the control system must be recycled before starter will operate.

TO ENGAGE PTO

The TO ENGAGE PTO advisory identifies that the PTO will not engage when the PTO switch is pulled out.

#102 MUST BE IN LOW RANGE:	Machine is set to high range traction speed and needs to be in low range traction speed before PTO will engage.
#106 OPERATOR MUST BE SEATED:	Operator needs to be in seat to engage PTO.
#107 LOWER DECKS:	No cutting decks are fully lowered. At least one deck must be fully lowered before the PTO will engage.
#108 LET ENGINE COOL:	Engine coolant temperature must be less than 102 ºC (216 ºF) before PTO will engage.
#109 REQUIRES SERVICE:	CAN communication between the two (2) Toro Electronic Controllers (TEC) must be reestablished before the PTO will engage.

TO SET CRUISE CONTROL

The TO SET CRUISE CONTROL advisory identifies that the cruise control will not engage when the cruise control switch is pressed.

#202 INCREASE GROUND SPEED:	Forward ground speed must be increased before cruise control can be engaged.

TO LOWER DECK

The TO LOWER DECK advisory identifies that the cutting deck will not lower when a lower deck switch is pressed. The deck switch must be recycled after the advisory condition has been corrected.

#302 SET MACHINE TO LOW SPEED RANGE:	Machine is set to high speed range and needs to be in low speed range before decks will lower.
#303 OPERATOR MUST BE SEATED:	Operator needs to be in seat before cutting decks will lower.
#304 REQUIRES SERVICE:	The secondary Toro Electronic Controller is inoperable due to CAN communication issues or an internal controller fault.

TO FLOAT DECK

The TO FLOAT DECK advisory identifies that the cutting decks are not in float mode.

#402 LOWER DECKS:	Press deck lower switch(es) to fully lower the decks and engage the float position.

TO SET HIGH RANGE

The TO SET HIGH RANGE traction speed advisory identifies that high range traction speed will not engage when the High/Low range traction speed switch is pressed.

#502 LIFT LEFT DECK:	Left cutting deck must be raised or raised higher before high speed range can be engaged.
#503 LIFT CENTER DECK:	Center (front) cutting deck must be raised or raised higher before high speed range can be engaged.
#504 LIFT RIGHT DECK:	Right cutting deck must be raised or raised higher before high speed range can be engaged.
#505 LIFT LEFT DECK FULLY:	Left cutting deck is Floating and needs to be raised before high speed range can be engaged.
#506 LIFT CENTER DECK FULLY:	Center (front) cutting deck is floating and needs to be raised before high speed range can be engaged.
#507 LIFT RIGHT DECK FULLY:	Right cutting deck is floating and needs to be raised before high speed range can be engaged.
#508 DISENGAGE PTO:	PTO switch is in the engage position and must be set to disengage before high speed range can be engaged.
#509 DISENGAGE CRUISE:	Cruise control is engaged and must be shut off before high speed range can be engaged.
#510 REDUCE GROUND SPEED:	Ground speed needs to be less than 2 MPH in order to engage high speed range.
#511 REQUIRES SERVICE:	CAN communication between the two (2) Toro Electronic Controllers (TEC) must be reestablished before high speed range can be engaged.
#512 LET HYDRAULIC OIL WARM UP:	The hydraulic oil temperature must be above 4 ºC (40 ºF) before high speed range can be engaged.

TO SET LOW RANGE

The TO SET LOW RANGE advisory identifies that low range traction speed will not engage when the High/Low range traction speed switch is pressed.

#602 DISENGAGE CRUISE:	Cruise control is engaged and needs to be disengaged in order to engage low speed range.
#603 REDUCE GROUND SPEED:	Ground speed needs to be less than 2 MPH in order to engage low speed range.
#604 REQUIRES SERVICE:	CAN communication between the two (2) Toro Electronic Controllers (TEC) must be reestablished before low speed range can be engaged.

FOR TRACTION

The FOR TRACTION advisory identifies that the traction drive will not engage when the traction pedal is pressed.

#806 OPERATOR MUST BE SEATED:	Operator needs to be in seat to engage traction.
#804 RELEASE PARKING BRAKE:	Parking brake is applied and needs to be released before traction drive will engage.
#805 MOVE TRACTION PEDAL TO NEUTRAL:	The traction pedal needs to be in the neutral position before engaging forward or reverse operation.

ENGINE

The ENGINE advisory identifies conditions that may reduce engine performance.

#1205 30 SECOND STARTER TIME OUT:	Engine starter has been disabled after being engaged (cranking) for 30 seconds. Recycle key switch.
#1206 CHECK AIR FILTER:	A high vacuum condition exists in the air cleaner body indicating the air filter element may require replacement.
#1207 SERVICE DUE X HOURS:	This message will appear twenty (20) hours before scheduled service is due. The message will reappear at two (2) engine hour increments until the service timer is reset.
#1208 PAST DUE X HOURS:	This message will appear when the scheduled service timer has expired. This message will appear at two (2) engine hour increments until the service timer is reset.
#1209 REGENERATION REQUIRED WITHIN 30 MINUTES:	Due to a high pressure differential in the diesel particulate filter (DPF), the engine ECU has requested a stationary regeneration be performed. This is a serious condition and should be addressed in a timely matter.
#1210 LET ENGINE COOL:	The engine coolant temperature has exceeded 105 ºC (221 ºF). The maximum engine RPM will be reduced by the engine ECU until the coolant temperature is lowered. The engine will not be shut off by the engine ECU due to a high temperature condition.

FUEL LEVEL

The FUEL LEVEL advisory identifies that the fuel remaining in the tank is low.

#1302 LOW ADD FUEL:	Less than 5 gallons of fuel remain in the fuel tank.

TRACTION PEDAL

The TRACTION PEDAL advisory identifies an inaccurate or inconsistent signal from the traction pedal position sensor.

#1402 CALIBRATE:	The traction pedal position sensor needs to be calibrated (see Traction Pedal Position Sensor Calibration (page 6–51)).

TO RAISE DECK

The TO RAISE DECK advisory identifies that the cutting deck will not raise when a raise deck switch is pressed.

#1602 OPERATOR MUST BE SEATED:	Operator needs to be in seat before cutting decks will raise.
#1603 SET PARKING BRAKE:	If the operator is not in the seat, the parking brake switch needs to be in the engaged position and the traction pedal needs to be in neutral before cutting decks will raise.
#1604 RETURN TRACTION PEDAL TO NEUTRAL:	If the operator is not in the seat, the traction pedal needs to be in the neutral position and the parking brake must be engaged before cutting decks will raise.
#1605 REQUIRES SERVICE:	The secondary Toro Electronic Controller is inoperable due to CAN communication issues or an internal controller fault.

Using the InfoCenter Display for Troubleshooting

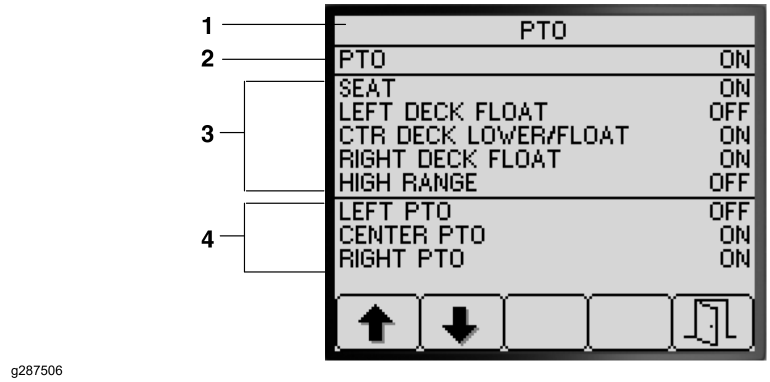


Figure 8

1. Machine function
2. Input
3. Qualifiers
4. Outputs

The Diagnostics − Input/Output screens of the InfoCenter display can be very helpful when troubleshooting machine operation issues (see DIAGNOSTICS SCREENS (page 6–22)). Some of the electrical components and the circuit wiring involved in various machine operations can be evaluated using the Input/Output screens prior to testing each component individually. The Input/Output screens show the current state of the inputs, qualifiers and the outputs required to allow the operation to proceed (Figure 8).

CAUTION

It may be necessary to start and run the engine, raise and lower the cutting units, or otherwise operate the machine during the troubleshooting process. Make sure the machine is in a well ventilated area and keep away from cutting units and moving parts while troubleshooting to prevent personal injury.

If a machine operation is malfunctioning, the following procedure can help identify the component or circuit wiring causing the malfunction.

1. Park machine on a level surface, lower cutting decks if possible and stop engine.
2. Set the key switch to the RUN position and navigate to the InfoCenter Diagnostic − Input/Output Screen for the desired machine function. For this example, the PTO operation has been selected.
3. Manually operate the input or qualifier component. The component state on the InfoCenter display should alternate ON and OFF as the component is switched open and closed. If ON and OFF do not alternate during component operation, the component or its circuit wiring is faulty and should be tested (see Testing (page 5–36)).

When the correct inputs and qualifiers are received by the controllers, the outputs identified on the Input/Output screen should show as ON. If the inputs and qualifiers are properly positioned and the output remains OFF, a problem with controller power (circuit wiring or fuse) may exist, or the Toro Electronic Controller (TEC) or TEC software may require reloading or replacement. Contact your Authorized Toro Distributor for assistance.

A faulty output component will not be identified by the Input/ Output screen. If all inputs, qualifiers and outputs are correct for the machine operation selected, yet the operation does not function as it should, the output component may be faulty. In this example, the controller output is occurring but the faulty component is preventing the operation from functioning. Test the specific output and output wiring (see Testing (page 5–36)).

PTO operation example:

- Test the PTO switch (input) and the seat switch (qualifier). If ON and OFF do not alternate when the switch is moved OPEN and CLOSED, the switch or the circuit wiring for the switch is faulty and should be tested (see Testing (page 5–36)).
- The qualifiers Left Deck Float, CTR Deck Lower/ Float, Right Deck Float and High Range are solenoids that must be energized before the operation can proceed. The solenoids are energized by controller outputs, and therefore cannot be tested using the InfoCenter procedure. Test the specific output and output wiring (see Testing (page 5–36)).

Machine Faults

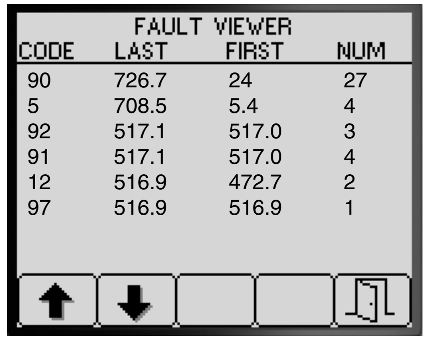


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Figure 9

Machine faults are generated by the Toro Electronic Controllers (TEC) to identify an electrical system malfunction (fault) that occurs during machine operation. When an machine fault occurs, an audible alarm will sound and the InfoCenter will display information about the fault logged. Machine faults can be viewed via the InfoCenter Diagnostic Screen Fault Viewer (Figure 9). See DIAGNOSTICS SCREENS (page 6–22) for additional information.

The Yanmar Engine Control Unit (ECU) can also generate electrical faults. The faults generated by the ECU are specific to the engine (see Engine Faults (page 3–27) for additional information).

Machine faults 1 through 4 are specific to the traction pedal position sensor. For traction pedal position sensor problems:

1. Use the InfoCenter Display to check the different traction pedal position sensor positions (see DIAGNOSTICS SCREENS (page 6–22)).
2. Recalibrate the traction pedal position sensor (see Traction Pedal Position Sensor Calibration (page 6–51)).
3. Test the traction pedal position sensor and its circuit wiring (see Testing (page 5–36)).

Fault code 5 is specific to the primary TEC output signals being sent to the traction (piston) pump forward and reverse solenoids. This fault may indicate an internal problem with the primary TEC requiring replacement and reprograming. Contact an Authorized Toro Distributor for assistance.

Machine faults 6 through 40 identify problems with inputs (e.g. sensors and switches) to the TEC controllers. For input problems:

1. Use the InfoCenter Display to check the different switch positions (see DIAGNOSTICS SCREENS (page 6–22)).
2. Test the specific component and its circuit wiring (see Testing (page 5–36)).

Machine faults 81 through 100 identify general machine faults that require specific corrective action as suggested in the following table:

Fault Code	Fault Description	Service Suggestions
1	Pedal Sensor Voltage Out of Range.	Test traction pedal position sensor supply power from TEC.
		Test traction pedal position sensor and circuit wiring.
		Replace traction pedal position sensor.
2	Pedal Sensor Analog and Digital Signals Conflict.	Replace traction pedal position sensor.

Fault Code	Fault Description	Service Suggestions
3	Pedal Sensor Neutral Switch Issue (receiving Fwd/Neutral/Rev inputs simultaneously).	Replace traction pedal position sensor.
5	Traction Current Validation Failure.	Test the traction (piston) pump forward and reverse solenoid coils and circuit wiring.
		Replace the primary TEC (contact an Authorized Toro Distributor for assistance).
6	Forward Traction Circuit Failure.	Test the traction (piston) pump forward and reverse solenoid coils and circuit wiring.
		Replace the primary TEC (contact an Authorized Toro Distributor for assistance).
7	Reverse Traction Circuit Failure.	Test the traction (piston) pump forward and reverse solenoid coils and circuit wiring.
		Replace the primary TEC (contact an Authorized Toro Distributor for assistance).
11	Hydraulic Temp Sensor Out of Range (open or short).	Test hydraulic temp sensor and circuit wiring.
12	Fuel Level Gage Out of Range (open or short).	Test fuel level sender and circuit wiring.
13	Key Switch Issue (receiving Start input without Run input).	Test key switch and circuit wiring.
14	Cruise Control Switch Issue (receiving Cruise Engage input without Cruise Enable input).	Test cruise control switch and circuit wiring.
15	Turn Signal Switch Issue (receiving Right and Left inputs simultaneously).	Test turn signal switch and circuit wiring.
16	Left Deck Raise/Lower Switch Issue (receiving Raise and Lower inputs simultaneously).	Test left deck raise/lower switch and circuit wiring.
17	Center Deck Raise/Lower Switch Issue (receiving Raise and Lower inputs simultaneously).	Test center deck raise/lower switch and circuit wiring.
18	Right Deck Raise/Lower Switch Issue (receiving Raise and Lower inputs simultaneously).	Test right deck raise/lower switch and circuit wiring.
19	Range High/Low Switch Issue (receiving High and Low inputs simultaneously).	Test high/low range switch and circuit wiring.
81	Key Start Timeout (key switch in Start position for more than 30 seconds). **Note:** This fault pertains to the key (ignition) switch only. Issues with the start relay or starter solenoid will generate an Engine Fault as these items are controlled by the Yanmar engine ECU (see Engine Faults (page 3–27)).	Recycle key (ignition) switch.
		Test key (ignition) switch and circuit wiring.

Fault Code	Fault Description	Service Suggestions
82	Charging Too High (12 Volt system).	Use InfoCenter Display to check 12V system voltage.
		Test engine alternator (see Yanmar Service Manual).
84	Internal TEC Fault − Master.	Replace the primary TEC and reprogram system software (contact an Authorized Toro Distributor for assistance).
85	Internal TEC Fault − Secondary.	Replace the primary TEC and reprogram system software (contact an Authorized Toro Distributor for assistance).
86	Master Contention Fault (two primary controllers on CAN bus).	Reprogram system software (contact your Authorized Toro Distributor for assistance).
87	Secondary Contention Fault (two secondary controllers on CAN bus).	Reprogram system software (contact your Authorized Toro Distributor for assistance).
88	Software Version Incompatibility (secondary controller and/or InfoCenter Display software is incompatible with currently loaded primary controller software).	Reprogram system software (contact your Authorized Toro Distributor for assistance).
89	Machine Number(s) Unknown (primary controller not recognizing model and/or serial number entered).	Enter correct machine model and serial numbers (contact an Authorized Toro Distributor for assistance).
90	Communication Fault (primary controller unable to establish communication with one or more of the remaining devices on the machine network in 2.5 seconds).	Test CAN termination resistor and circuit wiring.
		Test CAN connectors and circuit wiring at primary controller, secondary controller, InfoCenter display and Yanmar engine controller.
91	Master Fuse Failure (primary controller output fuses).	Test 7.5 amp fuses F−A1, F−B1, F−C1 and circuit wiring.
92	Secondary Fuse Failure (secondary controller output fuses).	Test 7.5 amp fuses F−A2, F−B2, F−C2 and circuit wiring.
93	Main Power Relay Failure − Master (no voltage present at primary controller PWR 2 or 3).	Test 7.5 amp fuses F−B1, F−C1 and circuit wiring.
		Test TEC power relay 2 and circuit wiring.
94	Main Power Relay Failure − Secondary (no voltage present at primary controller PWR 4 or secondary controller PWR 2, 3 or 4).	Test 7.5 amp fuses F−A1, F−A2, F−B2, F−C2 and circuit wiring.
		Test TEC power relay 1 and circuit wiring.
95	eFAN RAD Fault (one or both radiator fans overloaded or fan controller internal fault).	Clear obstructions from radiator and/or radiator fans.
		Test radiator fans and circuit wiring.
96	eFAN HOC Fault (one or both hydraulic oil cooler fans overloaded or fan controller internal fault).	Clear obstructions from oil cooler and/or oil cooler fans.
		Test oil cooler fans and circuit wiring.
97	24V Bus Voltage Out of Range (less than 19 Volts or more than 30 Volts).	Use InfoCenter Display to check 24V system voltage.
		Test 24V alternator and circuit wiring.

Fault Code	Fault Description	Service Suggestions
98	L Deck PTO Fault.	Test left deck manifold PRV solenoid and circuit wiring.
		Replace the secondary TEC (contact an Authorized Toro Distributor for assistance).
99	C Deck PTO Fault.	Test center deck manifold PRV solenoid and circuit wiring.
		Replace the secondary TEC (contact an Authorized Toro Distributor for assistance).
100	R Deck PTO Fault.	Test right deck manifold PRV solenoid and circuit wiring.
		Replace the secondary TEC (contact an Authorized Toro Distributor for assistance).
123	Internal software fault 3.	A software fault exists within the primary TEC. Contact an authorized Toro Distributor.
124	Internal software fault 4.	A software fault exists within the primary TEC. Contact an authorized Toro Distributor.
125	Internal software fault 5.	A software fault exists within the primary TEC. Contact an authorized Toro Distributor.
126	Internal software fault 6.	A software fault exists within the primary TEC. Contact an authorized Toro Distributor.

Engine Faults

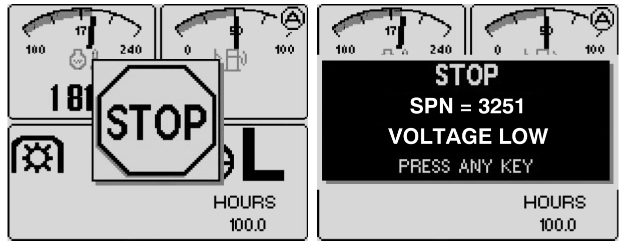

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Figure 10

Engine faults are generated by the by the Yanmar engine Electronic Control Unit (ECU) to identify an electrical system malfunction (fault) pertaining to the engine during operation. When an engine fault occurs, an audible alarm will sound and the InfoCenter will display information about the fault. Depending on the severity of the fault, a STOP icon may display as well (Figure 10).

The Toro Electronic Controllers (TECs) can also generate electrical faults. The faults generated by the TECs are specific to the machine (see Machine Faults (page 3–23) for additional information).

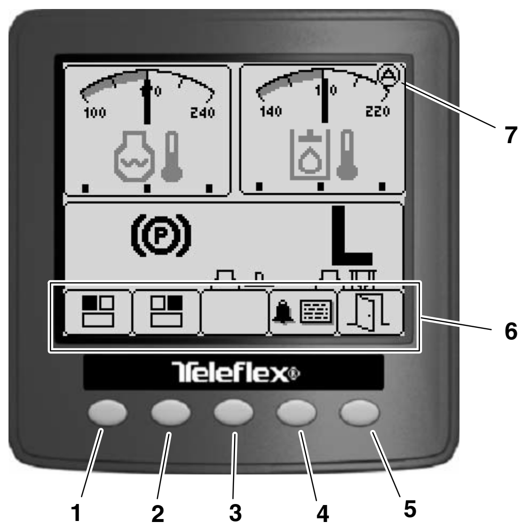

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Figure 11

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Navigation pane
7. Fault active icon

If an engine fault occurs:

1. Press any key to remove the fault information panel from Operator Information Screen. The audible alarm will continue to sound.
2. To recognize the fault, view additional information about the fault or silence the audible alarm, press button 4 from the Operator's Information Screen (Figure 11).

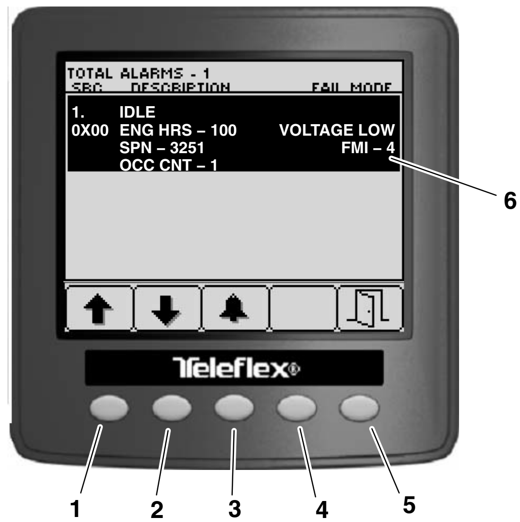

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Figure 12

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Engine fault description

3. The fault description will be displayed on the Info- Center (Figure 12). Press button 3 to silence the audible alarm. Press buttons 1 and 2 to scroll through the list of active engine faults.
4. If a STOP fault is displayed on the InfoCenter, the operator should cease operation of the machine and the engine as quickly and as safely as possible to reduce damage to the engine.
5. If a CHECK ENGINE fault is displayed on the Info- Center, the operator should take the machine for service as soon as possible.
6. Return to the previous screen by pressing button 5.

An icon will appear in the upper left corner of the Operator's Information screen as long as an engine fault is active (Figure 11). In order to clear the displayed fault, the engine problem has to be resolved. See the Yanmar Engine Troubleshooting and Yanmar Service Manual for additional information.

Note: Engine faults that are no longer active are stored in the Yanmar Engine Electronic Control unit (ECU) and can only be viewed by using the Yanmar SMARTASSIST−Direct diagnostic software.

Factors That Can Affect Quality of Cut and Clipping Dispersion

Note: Cutting decks have to be fully lowered and floating, traction speed needs to be in low range (mow), the PTO switch needs to be engaged and the engine coolant temperature needs to be below 102 ºC (215 ºF) in order for decks to operate.

There are a number of factors that can contribute to unsatisfactory quality of cut, some of which may be turf conditions. Turf conditions such as excessive thatch, uneven ground conditions, “sponginess” or attempting to cut off too much grass height may not always be overcome by adjusting the machine.

Remember that the “effective” or actual height−of−cut depends on cutting unit weight, tire pressures, hydraulic counterbalance settings and turf conditions. Effective height−of−cut will be different than the bench set height−of−cut.

Factor	Possible Problem/Correction
Maximum governed engine speed	Make sure that throttle control is placed in the maximum RPM position when mowing. Check maximum governed engine speed (see Chapter 4: Yanmar Diesel Engine (page 4–1)).
Blade speed	All deck blades should rotate at the same speed. See Chapter 5: Hydraulic System (page 5–1).
Tire pressure	Check air pressure of all machine tires including cutting deck castor tires and adjust as necessary.
Blade condition	Sharpen blades if their cutting edges are dull or nicked. Inspect blade sail for wear or damage. Replace blade if needed.
Mower housing condition	Make sure that cutting chambers are in good condition. Keep underside of deck clean. Debris buildup will reduce cutting performance and clipping dispersion.
Height−of−cut	Make sure all deck height−of−cut adjustments (including castor wheel, front deck roller, and skid mounting locations) are the same. Adjust deck (see *Operator’s Manual*).
Cutting unit pitch	All cutting decks should be tipped slightly forward for optimal performance. Adjust the front and side cutting deck pitch as specified in the *Operator’s Manual*.
Front winglet deck level to front center deck	The blades of the front winglet decks should be level to the blades of the front center deck. Level the front winglet decks as specified in the *Operator’s Manual*.
Cutting deck alignment and ground following	Check lift arms and cutting deck pivot pins for wear, damage or binding. Ensure all deck lift arm pivots are lubricated and move easily to allow counterbalance to function correctly.
Roller and castor wheel condition	All rollers and caster wheels should rotate freely. Replace bearings if worn or damaged.
Grass conditions	Mow when grass is dry. Remove only 25.4 mm (1 in) or 1/3 of the grass blade when cutting.
Ground speed	Mowing too fast can reduce cutting performance. If stragglers are present, reduce ground speed or let ”SmartPower” feature control ground speed.

Yanmar Diesel Engine

Table of Contents

Additional Reference Materials

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

General Information

This Chapter gives information about specifications and repair of the Yanmar diesel engine used in the Groundsmaster 5900/5910.

General maintenance procedures are described in your Traction Unit Operator's Manual. Information on engine troubleshooting, testing, disassembly and assembly is identified in the Yanmar Service Manual and Yanmar Troubleshooting Manual.

Most repairs and adjustments require tools which are commonly available in many service shops. Special tools are described in the Yanmar Service Manual. The use of some specialized test equipment is explained. However, the cost of the test equipment and the specialized nature of some repairs may dictate that the work be done at a Yanmar engine repair facility.

Service and repair parts for Yanmar engines are supplied through your Authorized Toro Distributor. If no parts list is available, be prepared to provide your distributor with the Toro model and serial number of your machine.

Operator's Manuals

The Traction Unit *Operator's Manual* and *Yanmar Engine Operator's Manuals* provide information regarding the operation, general maintenance and maintenance intervals for your Groundsmaster machine. Refer to these publications for additional information when servicing the machine.

Yanmar Service and Troubleshooting Manuals

The engine that powers your Groundsmaster machine is a Yanmar model 4TNV98CT (Tier 4). Both the Yanmar Service Manual and the Yanmar Troubleshooting Manual are available for this engine. Make sure that the correct engine manuals are used when servicing the engine on your Groundsmaster.

Stopping the Engine

IMPORTANT

Before stopping the engine after mowing or full load operation, cool the turbo-charger by allowing the engine to run at low idle speed for five (5) minutes. Failure to do so may lead to turbo-charger trouble.

Engine Electronic Control Unit (ECU)

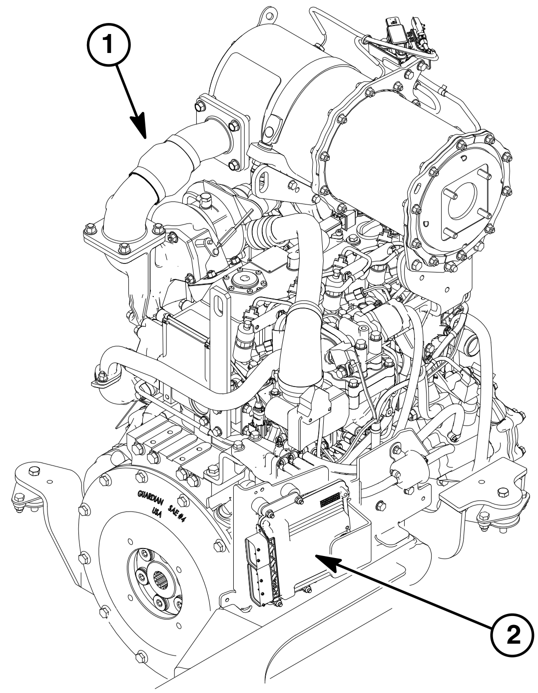

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Figure 13

1. Engine
2. Engine ECU

The Yanmar engine that powers your Groundsmaster uses an Electronic Control Unit (ECU) for engine management and also to communicate with the Toro Electronic Controller (TEC) and the operator InfoCenter display on the machine. All wire harness electrical connectors should be plugged into the ECU before the machine key switch is moved from the OFF position to either the ON or START position.

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

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

IMPORTANT

Do not plug or unplug the engine ECU for a period of thirty (30) seconds after the machine key switch is turned OFF. The ECU may remain energized even though the key switch is OFF.

Engine Electronic Control Unit (ECU) (continued)

If the engine ECU is to be disconnected for any reason, make sure that the key switch is in the OFF position with the key removed before disconnecting the engine ECU. Also, to prevent possible ECU damage when welding on the machine, disconnect the engine ECU from the machine before welding.

The engine ECU is mounted to the machine using four (4) rubber isolator mounts. The mounts isolate the ECU from the machine electrically, and reduce machine vibration to the ECU. Make sure the ECU isolator mounts remain soft and unbroken. Replace isolator mounts as necessary.

Yanmar Engine

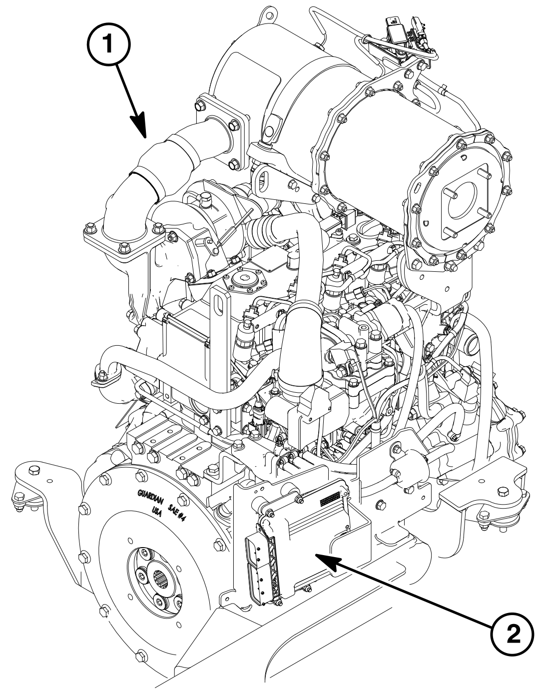

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Figure 14

1. Engine
2. Engine ECU

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

During the operation of the engine, if conditions warrant, the engine ECU may generate an engine fault. Use the machine InfoCenter to identify the engine fault; refer to the Yanmar Troubleshooting Manual, or contact an Authorized Toro Distributor for assistance.

Diesel Particulate Filter

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

Regeneration

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

Note: The user interface and InfoCenter displays for DPF regeneration changed with machine software **122−0310J**. Use the InfoCenter About screen to verify the software installed on the machine.

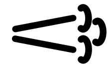
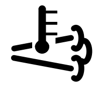
- **For machines with software 122−0310A thru H:** Complete DPF regeneration instructions can be found in the updated traction unit Operator's Manual for the specific machine. Visit www.toro.com to download the updated traction unit Operator's Manual for the machine.
- **For machines with software 122−0310J and up:** Complete DPF regeneration instructions can be found in the traction unit Operator's Manual. Visit www.toro.com to download the traction unit *Operator's Manual* with the correct DPF regeneration instructions for the machine.

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

Type	Conditions	Description
Passive	Occurs during normal operation of the machine at high engine speed or high engine load.	The DPF processes high heat exhaust gasses, oxidizing harmful emissions and incinerating soot to ash. The InfoCenter does not display an icon during passive regeneration.

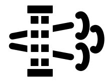
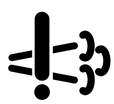
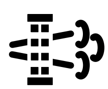
Regeneration (continued)

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

Assist	Occurs because of prolonged operation at low engine speed, low engine load, or when the engine ECU detects the soot filter is becoming obstructed.	The engine ECU adjusts the intake throttle to raise the exhaust temperature.  **For software 122−0310A thru H only:** the InfoCenter displays the assist regeneration icon.
Reset	Occurs every 100 hours of engine operation. Occurs after an assist regeneration if the engine ECU determines the assist regeneration did not sufficiently reduce the soot level. **Note:** Reset regeneration may be temporarily delayed if high exhaust temperatures would create an unsafe condition (the machine is operating indoors or outdoors around trees, brush, tall grass, or other temperature-sensitive plants or materials). Refer to Setting the Inhibit Regen in the traction unit *Operator’s Manual* for additional information.	TThe engine ECU adjusts the exhaust intake throttle and the injector timing to raise the exhaust temperature.  **For all software revisions:** the InfoCenter displays the high exhaust temperature icon.

Regeneration (continued)

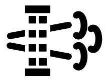
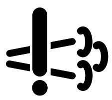
Types of regeneration that are performed manually (while the machine is stationary)

Type	Conditions	Description
Parked	Occurs when exhaust back pressure in the DPF increases due to continued soot buildup. May be caused by prolonged operation at low engine speed, low engine load, or the use of incorrect fuel or engine oil. May occur if the InfoCenter is set to inhibit regen (preventing a Reset Regeneration) and machine operation is continued. Can be initiated when prompted by the engine ECU or after a minimum of 50 hours of engine operation. **For software 122−0310J and up:** if a parked regeneration is ignored, the machine mow function (PTO) will be disabled approximately 2 hours after the first notification.	Manually initiate a parked regeneration as soon as possible. A parked regeneration requires 30 to 60 minutes and should not be started with less than 1/4 tank of fuel. The machine must remain stationary (cannot be operated) during the entire parked regeneration process. The engine ECU adjusts the exhaust intake throttle to raise the exhaust temperature.  **For all software revisions:** the InfoCenter displays advisory #188 and/or the stationary regeneration icon .
Recovery	Occurs when exhaust back pressure in the DPF increases due to soot buildup reaching a critical level. Can only be initiated when prompted by the engine ECU. **For software 122−0310J and up:** the machine mow function (PTO) will be disabled at first notification.	Manually initiate a recovery regeneration as soon as possible. A recovery regeneration will take approximately 3 hours and should not be started with less than 1/2 tank of fuel. The machine must remain stationary (cannot be operated) during the entire recovery regeneration process. Use the InfoCenter About screen to verify the software installed on the machine. • **Machines with software 122−0310A thru H:** Recovery regeneration must be initiated by an Authorized Toro Distributor service technician using Yanmar SMARTASSIST-Direct. • **Machines with software 122−0310J and up:** Recovery regeneration can be initiated from the machine InfoCenter.  **For software 122−0310A thru H only:** the InfoCenter displays the recovery regeneration icon.  **For software 122−0310J and up:** the InfoCenter displays advisory #190 and/or the stationary regeneration icon. **Note:** Verify the model and serial number of the engine installed in the machine. 4TNV98CTNTRL engines below serial number 16420 cannot run a recovery regeneration without first reprogramming the engine ECU. Contact an Authorized Toro Distributor for assistance.

Soot Accumulation

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

Soot Accumulation Engine Faults

Fault Level	Regeneration Icon	Fault Code	Engine Power Rating	Recommended Action
Level 1: Engine Warning		ENGINE REGENERATION REQUIRED WITHIN 30 MINUTES. 1209 PRESS ANY KEY	De-rated to 85%	Perform a parked regeneration as soon as possible.
Level 2: Engine Warning		ENGINE REGENERATION REQUIRED WITHIN 30 MINUTES. 1209 PRESS ANY KEY	De-rated to 50%	Perform a recovery regeneration as soon as possible.

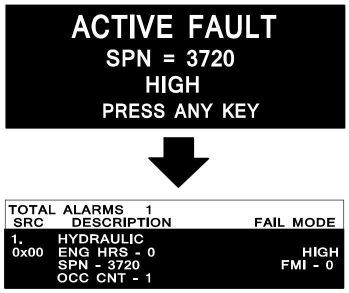
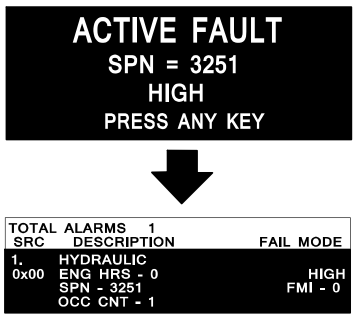
Ash Accumulation

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

Ash Accumulation Advisories and Engine Faults

Fault Level	Fault Code	Engine Power Rating	Engine Speed Reduction	Recommended Action
System Advisory (machine software 122−0310A thru H only)	ENGINE REGENERATION REQUIRED WITHIN 30 MINUTES. 1209 PRESS ANY KEY	100%	None	Plan to service the DPF in the future.
Level 1: Engine Warning	ACTIVE FAULT SPN = 3720 HIGH PRESS ANY KEY ↓ TOTAL ALARMS 1 SRC DESCRIPTION FAIL MODE 1. HYDRAULIC 0x00 ENG HRS - 0 HIGH SPN - 3720 FMI - 0 OCC CNT - 1	De-rated to 85%	None	Service DPF.

Ash Accumulation Advisories and Engine Faults (continued)

Fault Level	Fault Code	Engine Power Rating	Engine Speed Reduction	Recommended Action
Level 2: Engine Warning		De-rated to 50%	None	Service DPF.
Level 3: Engine Warning		De-rated to 50%	Maximum torque +200 rpm	Service DPF.

Service and Repairs

Air Filter

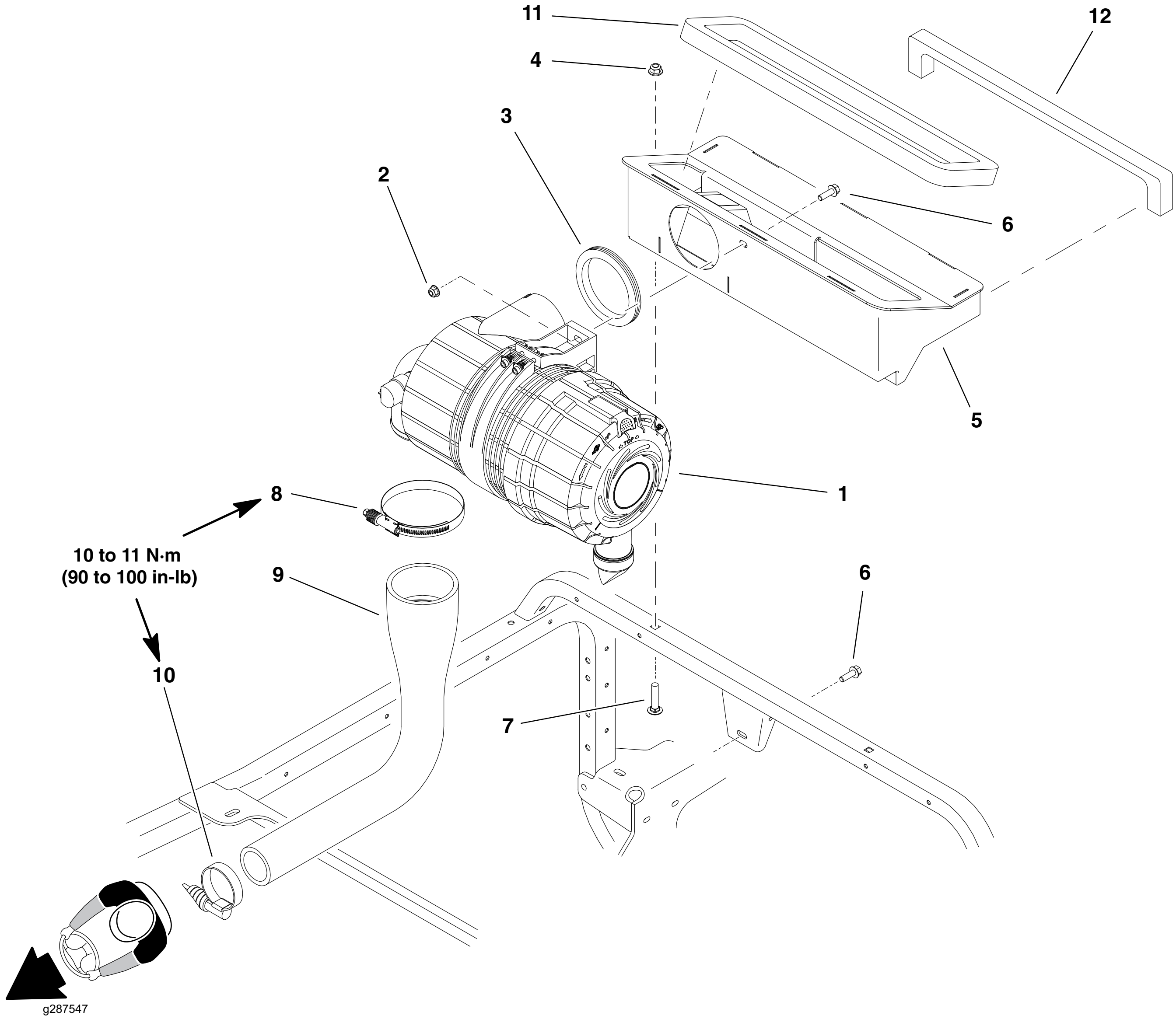


Figure 15

1.	Air filter assembly	5.	Air box	9.	Intake tube
2.	Flange nut (2)	6.	Flange head screw (2)	10.	Hose clamp
3.	Grommet	7.	Carriage screw (2)	11.	Foam seal
4.	Flange nut (2)	8.	Hose clamp	12.	Foam seal

Air Filter Removal

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the key switch.
2. Raise the hood to allow access to engine.
3. Remove air filter components as needed (Figure 15).

   Note: See Air Filter Service Indicator (page 6–108) testing information.
4. Inspect intake tube, clamps and foam seals for evidence of wear or damage. Replace components as needed.

Air Filter Installation

IMPORTANT

Any leaks in the air filter system will cause serious engine damage. Make sure that all air filter components are in good condition and are properly secured during installation.

1. Assemble air filter system (Figure 15):

   A. Verify that tabs in air filter mounting bands mesh fully with slots in air filter body.

   B. Tighten intake tube hose clamps from **10 to 112 N·m (90 to 100 in−lb)**.

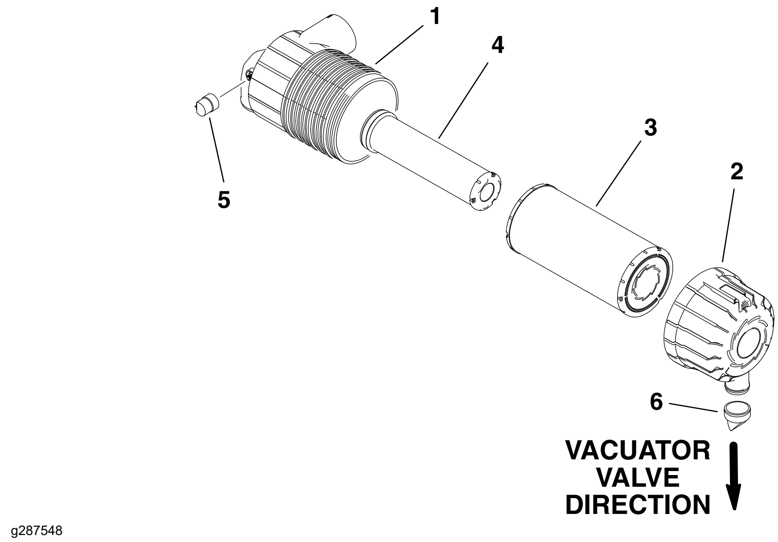


Figure 16

1.	Air filter housing	4.	Safety filter
2.	Cover	5.	Service indicator
3.	Filter element	6.	Vacuator valve

   C. Make sure that air filter vacuator valve is pointed down after assembly (Figure 16).

   D. If service indicator (Figure 16 item 5) was removed from air filter housing, apply thread sealant to adapter threads before installing indicator to housing. Tighten indicator from **1.5 to 1.9 N·m (13 to 17 in−lb)**.

2. Lower hood and check that hood makes a continuous seal around air box foam seals. Replace foam seals if necessary.

3. Lower and secure hood.

Exhaust System

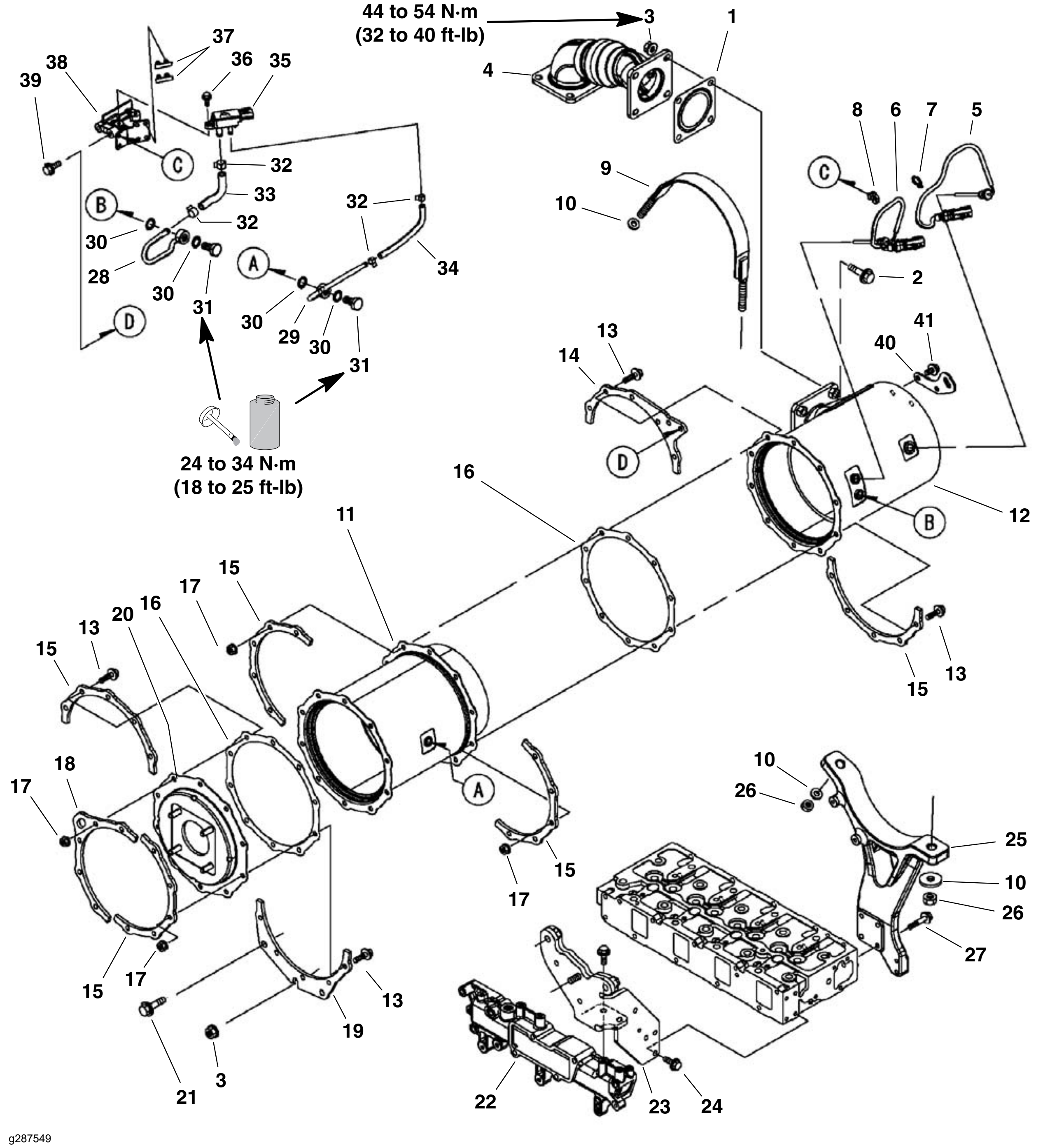


Figure 17

Figure 17 (continued)

1. Exhaust gasket
2. Flange head screw (4)
3. Flange nut (5)
4. Exhaust elbow
5. DOC temp sensor (inlet)
6. DOC temp sensor (outlet)
7. Band
8. Band clip
9. Band
10. Flat washer (3)
11. DPF assembly
12. DOC assembly
13. Flange head screw (20)
14. DPF stiffener
15. DPF stiffener (5)
16. DPF gasket (2)
17. Lock nut (20)
18. DPF stiffener w/lifting lug
19. DPF stiffener
20. Outlet flange
21. Flange head screw (2)
22. Intake manifold
23. Mount
24. Flange head screw (5)
25. Mount
26. Lock nut (2)
27. Flange head screw (4)
28. Exhaust pressure pipe (DPF inlet)
29. Exhaust pressure pipe (DPF outlet)
30. Sensor gasket (4)
31. Banjo bolt (2)
32. Hose clip (4)
33. Exhaust pressure hose (DPF inlet)
34. Exhaust pressure hose (DPF outlet)
35. Pressure sensor
36. Flange head screw (2)
37. Connector clip (2)
38. Sensor bracket
39. Flange head screw (2)
40. Lifting lug
41. Flange head screw (2)

Groundsmaster 5900/5910 models that are powered by a diesel engine that complies with EPA Tier 4 emission regulations are equipped with an exhaust system that includes a diesel oxidation catalyst (DOC) and a diesel particulate filter (DPF). These exhaust components require service or component replacement at intervals identified in your *Operator's Manual*. Additionally, the exhaust assembly uses two (2) temperature sensors and a pressure differential sensor which are used as inputs for the engine ECU to monitor the operation of the exhaust system.

The diesel particulate filter (DPF) is cleaned periodically through a regenerative process that is controlled by the engine ECU (see the Engine Electronic Control Unit (ECU) (page 4–3)). The InfoCenter display will identify the status of DPF regeneration. At recommended intervals, DPF reconditioning is necessary which will require exhaust system disassembly, DPF removal and DPF reconditioning by a company that has the necessary equipment. Once the DPF has gone through the reconditioning process, it can be re−installed in the exhaust system. Contact your Toro Distributor for information on reconditioning the DPF.

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

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

Exhaust System Removal

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

⚠ CAUTION ⚠

The engine and exhaust system may be hot. To avoid possible burns, allow the engine and exhaust system to cool before working on the exhaust system.

Exhaust System Removal (continued)

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the key switch.
2. Raise the hood and remove side panel from left side of machine to gain access to exhaust system. Allow engine and exhaust to cool before doing any disassembly of exhaust system components.

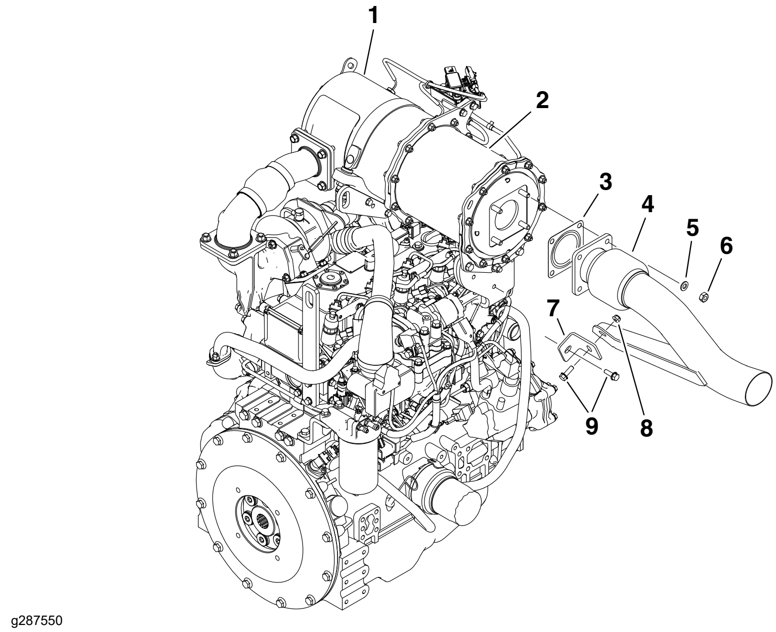


Figure 18

1.	DOC assembly	6.	Lock nut (4)
2.	DPF assembly	7.	Support bracket
3.	Exhaust gasket	8.	Flange nut
4.	Exhaust pipe	9.	Flange head screw (2)
5.	Flat washer (4)		

3. Remove exhaust system components from the engine as necessary (Figure 17 and Figure 18). Discard all gaskets removed.
4. If exhaust opening is to be left open for any length of time, cover opening to prevent any material from falling into opening.

Exhaust System Installation

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

1. Remove any cover or plug that were placed during removal to prevent contamination entry.
2. Make sure to install new gaskets in place of all gaskets that were removed. Do not use any type of gasket sealant on gasket or flange surfaces.
3. Assemble all removed exhaust system components (Figure 17 and Figure 18).

   A. If exhaust temperature sensors (Figure 17 items 5 and 6) were removed, tighten sensors from **25 to 40 N·m (19 to 29 ft–lb)**.

   B. If exhaust pressure pipes (Figure 17 items 28 and 29) were removed, replace sensor gaskets (item 30) on both sides of the pressure pipe fitting. Tighten banjo bolts from **45 to 55 N·m (33 to 40 ft–lb)**.

Exhaust System Installation (continued)

C. If DPF stiffeners (Figure 17 items 14, 15, 18 and 19) were loosened or removed, tighten fasteners that secure stiffeners before tightening fasteners that secure exhaust system to DPF mounts.

D. Position new exhaust gasket and exhaust pipe to engine and secure with four (4) flat washers and hex nuts.

E. Position support bracket flat against the engine and the exhaust pipe and secure with flange head screws and flange nut.

4. Install and secure side panel to left side of machine.
5. Lower and secure hood.

Fuel System

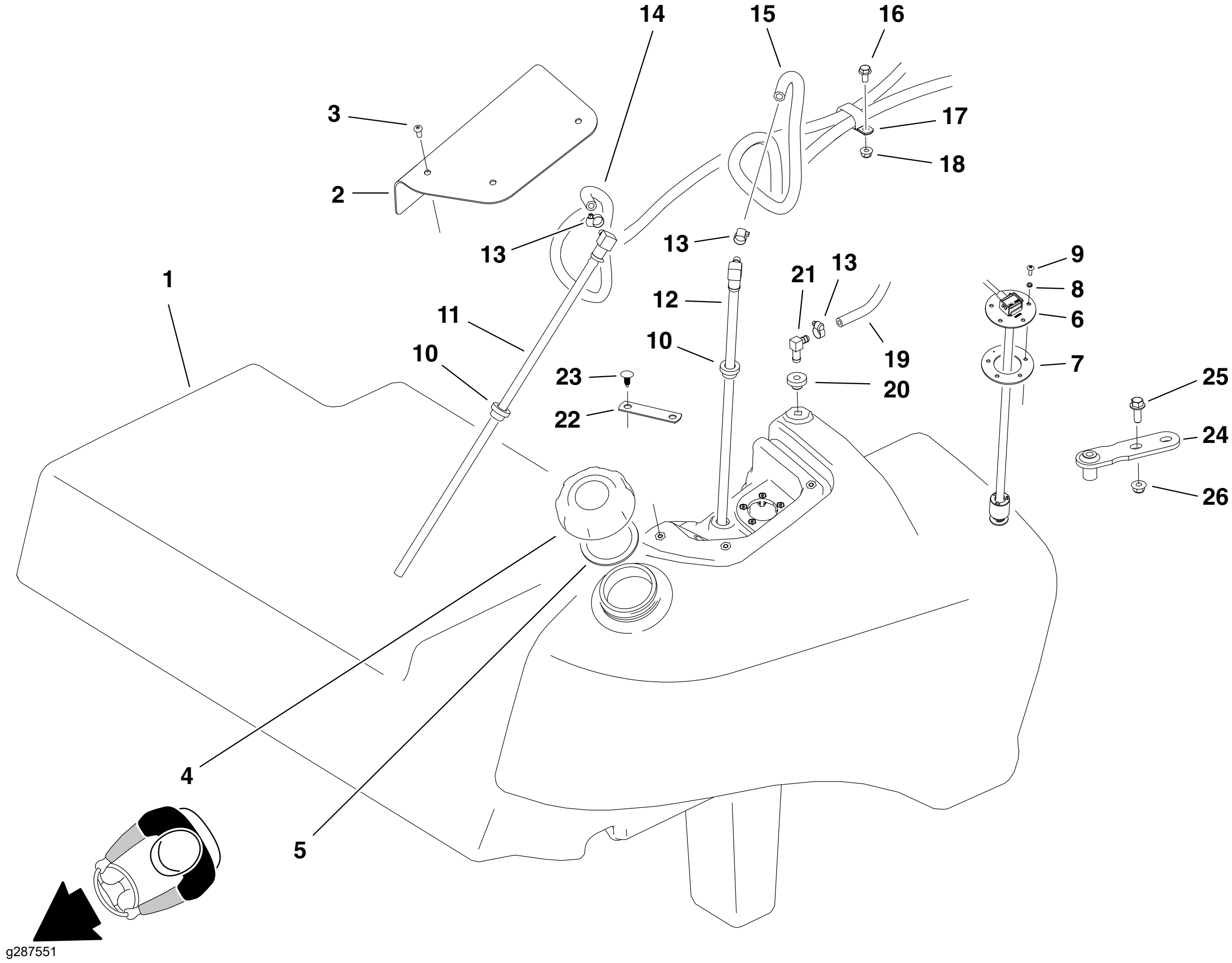


Figure 19

1. Fuel tank
2. Fitting cover
3. Screw (3)
4. Cap
5. Gasket
6. Fuel sender
7. Gasket
8. Lock washer (5)
9. Screw (5)
10. Bushing (2)
11. Standpipe − return
12. Standpipe − supply
13. Clamp (3)
14. Fuel hose − return from filter
15. Fuel hose − supply to separator
16. Flange head screw
17. Clamp
18. Flange nut
19. Fuel hose − to vent tube
20. Bushing
21. Elbow fitting − vent
22. Clamp (2)
23. Panel fastener (4)
24. Tank hold down
25. Flange head screw (2)
26. Flange nut (2)

DANGER

Because diesel fuel 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 diesel fuel before starting the engine. Store fuel in a clean, safety−approved container and keep cap in place. Use diesel fuel as an engine fuel only; not for any other purpose.

Drain and Clean Fuel Tank

Drain and clean the fuel tank periodically as recommended in the *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 diesel fuel. Make sure tank is free of contaminates and debris.

Check Fuel Lines and Connections

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

Prime 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 filter/water separator, replacing a fuel hose). To prime the fuel system, make sure that the fuel tank has fuel in it. Then, turn the ignition key to the ON position for 10 to 15 seconds which allows the fuel pump to prime the fuel system. DO NOT use the engine starter motor to crank the engine in order to prime the fuel system.

Fuel Tank Removal

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the key switch.
2. Remove the front left wheel from the machine (see Wheels (page 7–3)).
3. Use a fuel transfer pump to remove fuel from the fuel tank and into a suitable container.
4. Using Figure 19 as a guide, remove three (3) socket head screws that secure fitting cover (item 2) to fuel tank. Remove fitting cover.
5. Disconnect the fuel sender from the machine wire harness.

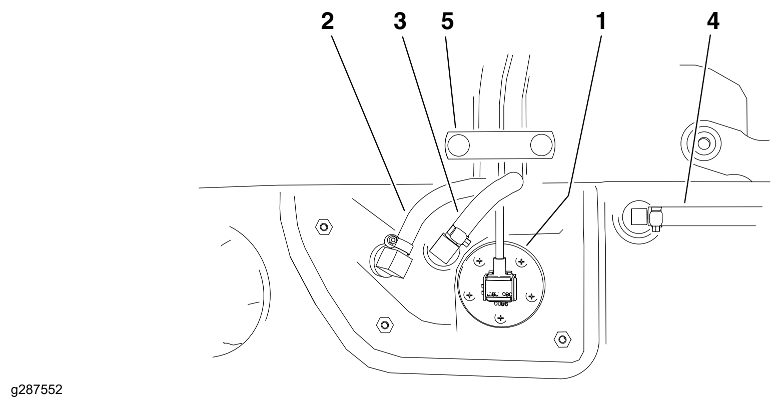


Figure 20

1.	Fuel sender	4.	Vent hose
2.	Fuel return hose	5.	Clamp (2)
3.	Fuel supply hose		

6. Label fuel hoses to assure proper assembly. Disconnect fuel hoses from the fuel supply standpipe, the fuel return standpipe and the tank vent elbow fitting in top of tank (Figure 20).
7. Route fuel lines from under clamps (item 22) that secure supply and return fuel lines to tank If necessary, remove plugs and clamps from top of tank.
8. Remove two (2) flange head screws and lock nuts that secure tank hold down (item 24) to frame. Remove tank hold down.

Fuel Tank Removal (continued)

9. Slide the fuel tank out from the left side of the machine.

   Note: See Fuel Sender (page 6–109) testing information.

10. If necessary, remove standpipes, vent elbow, bushings and fuel sender from fuel tank.

Fuel Tank Installation

1. If removed, install standpipes, vent elbow, bushings and fuel sender into fuel tank (Figure 19).
2. Slide the fuel tank in from the left side of the machine.
3. Position tank hold down (item 24) to fuel tank and machine frame. Secure hold down with two (2) flange head screws and lock nuts.
4. Route fuel supply and return hoses under clamps in top of tank.
5. Using labels placed during tank removal, correctly connect fuel hoses to the fuel supply standpipe, fuel return standpipe and the fuel tank vent elbow fitting. Secure hoses with hose clamps.
6. Connect the fuel sender to the machine wire harness.
7. Position fitting cover to fuel tank and secure with three (3) socket head screws.
8. Install the front left wheel to the machine (see Wheels (page 7–3)).
9. Add fuel to the tank and prime the fuel system (see Prime the Fuel System (page 4–18)). Check the fuel system for leaks before returning the machine to service.

Fuel Lines, Filters and Fuel Pump Removal

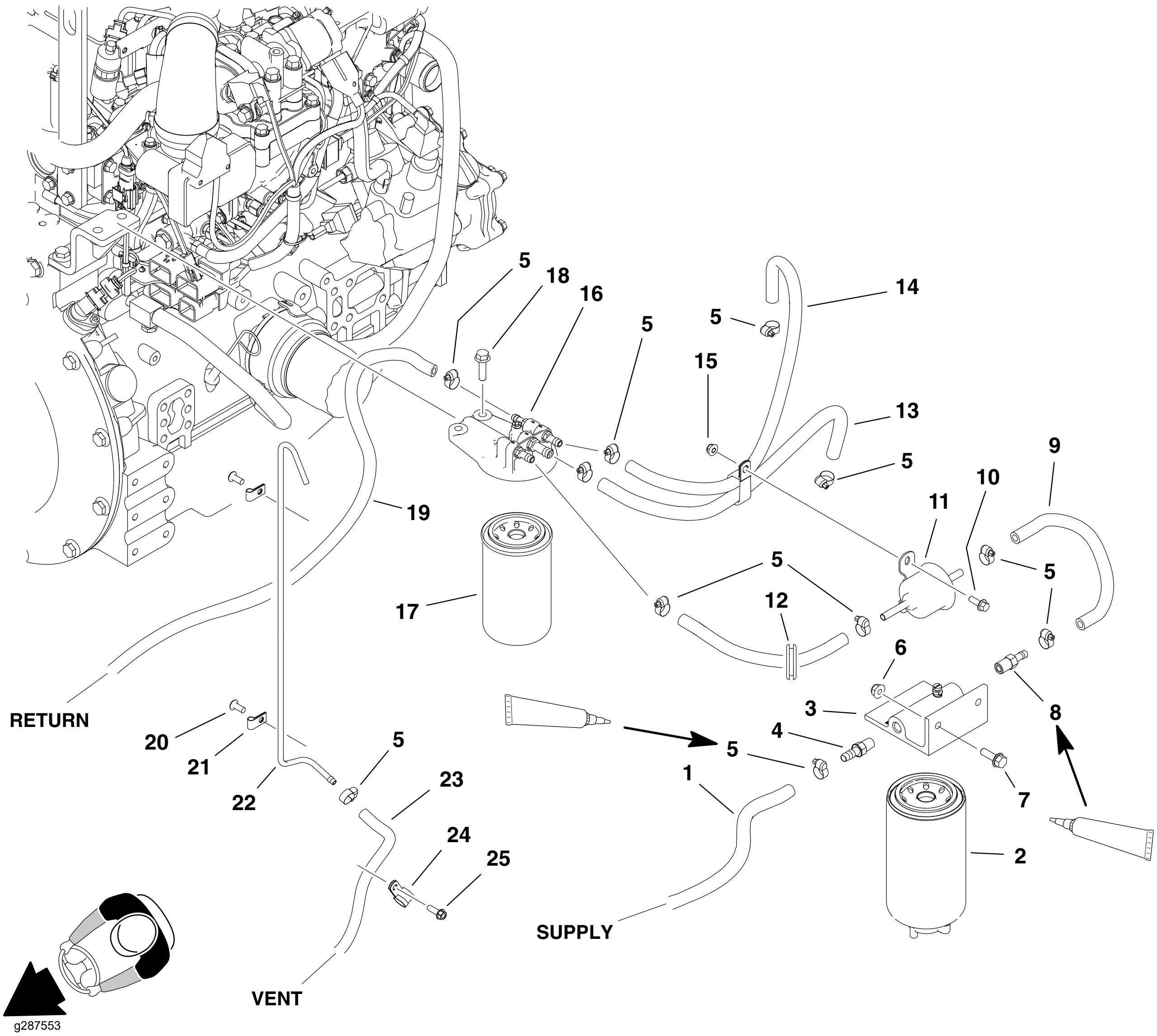


Figure 21

1. Fuel hose − supply from tank
2. Fuel/water separator element
3. Fuel/water separator head
4. Straight barb fitting
5. Hose clamp (11)
6. Flange nut (2)
7. Flange head screw (2)
8. Straight barb fitting
9. Fuel hose − fuel/water separator to pump
10. Flange head screw (2)
11. Fuel pump
12. Grommet
13. Fuel hose − filter to injection pump
14. Fuel hose − Y junction to filter
15. Flange nut (2)
16. Fuel filter head
17. Fuel filter element
18. Flange head screw (2)
19. Fuel hose − return to tank
20. Rivet (2)
21. Clip (2)
22. Vent tube (attached to R.O.P.S.)
23. Fuel hose − vent from tank
24. Clamp
25. Flange head screw

---

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the key switch.
2. Raise the hood and remove side panel from left side of machine to gain access to fuel lines, filters and fuel pump. Allow engine and exhaust to cool before doing any disassembly of fuel system components.
3. Label fuel hoses to assure proper assembly (Figure 21).

Fuel Lines, Filters and Fuel Pump Removal (continued)

4. Remove fuel system components from the engine as necessary.

   Note: See Fuel Pump (page 6–111) testing information.

See machine *Operator's Manual* for fuel/water separator and fuel filter service information.

Fuel Lines, Filters and Fuel Pump Installation

1. Install removed system components (Figure 21).
2. If barb fittings were removed from fuel/water separator head, apply thread sealant to fittings prior to installation.
3. Add fuel to the tank and prime the fuel system (see Prime the Fuel System (page 4–18)). Check fuel system for leaks before returning the machine to service.
4. Install and secure side panel to left side of machine.
5. Lower and secure hood.

Radiator

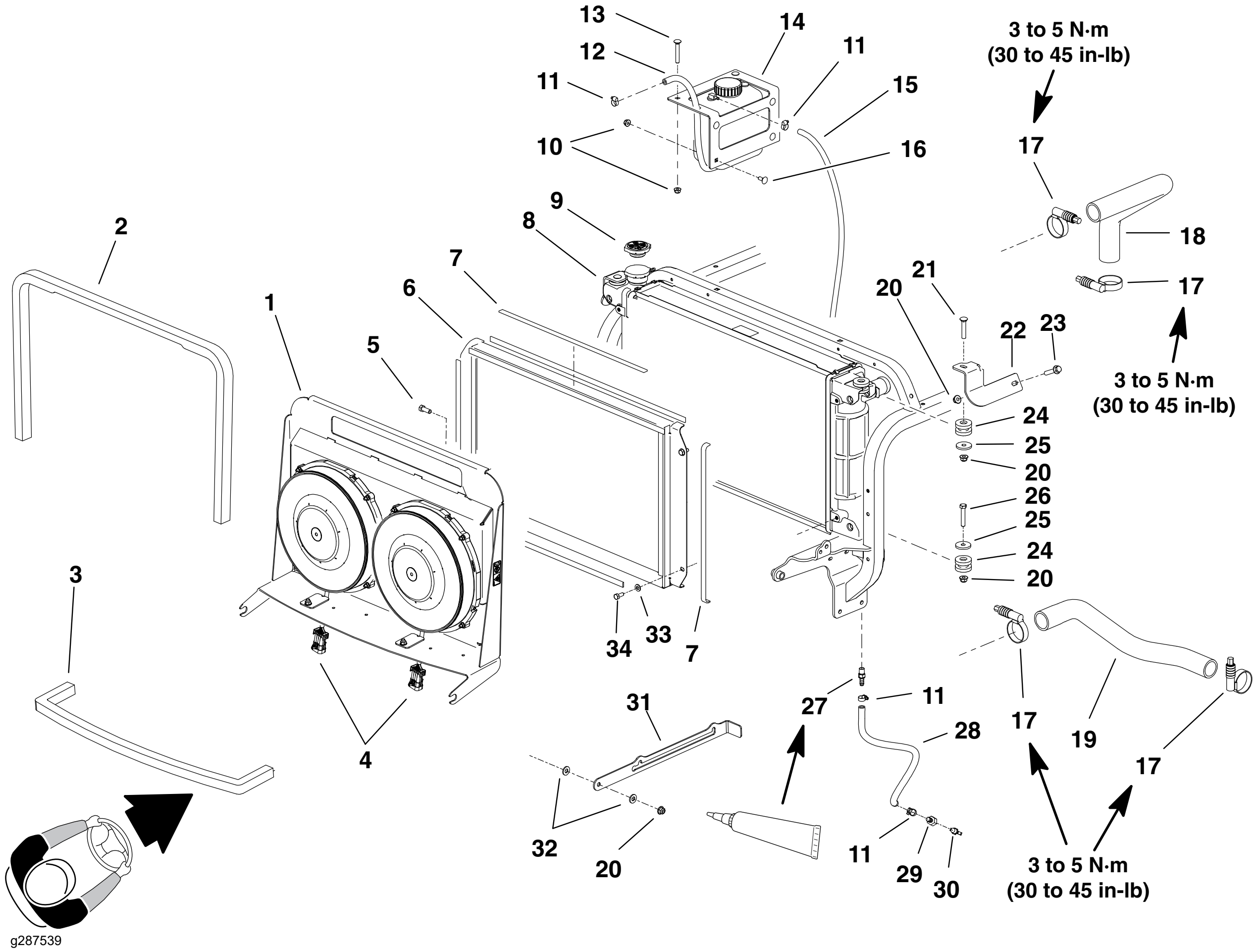


Figure 22

1.	Fan shroud assembly	13.	Screw − carriage (2)	25.	Washer (4)
2.	Foam seal	14.	Coolant reservoir	26.	Cap screw (2)
3.	Foam seal	15.	Hose − reservoir overflow	27.	Straight barb fitting
4.	Cooling fan electrical connector (2)	16.	Screw − carriage (4)	28.	Hose − radiator drain
5.	Flange head screw (8)	17.	Hose clamp (4)	29.	Female barb fitting
6.	Radiator seal plate	18.	Upper radiator hose	30.	Drain valve
7.	Foam seal (6)	19.	Lower radiator hose	31.	Fan shroud prop
8.	Radiator assembly	20.	Flange nut (7)	32.	Friction washer (2)
9.	Radiator cap	21.	Carriage screw (2)	33.	Flat washer (4)
10.	Flange nut (6)	22.	Upper radiator bracket (2)	34.	Cap screw (4)
11.	Hose clamp (5)	23.	Flange head screw (2)		
12.	Hose − coolant reservoir	24.	Rubber isolator mount (4)		

Radiator Removal

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the key switch.
2. Remove hood (see Hood Removal (Figure 322) (page 7–48)).
3. Remove the air box and air filter assembly (see Air Filter Removal (page 4–11)).
4. Disconnect radiator cooling fans from electrical harness (Figure 22).

Radiator Removal (continued)

5. Remove the lock nut, friction washers and cap screw (item 5) securing the fan shroud prop to the fan shroud and remove the fan shroud prop (Figure 23).
6. Tilt fan shroud assembly toward the rear of the machine and lift the fan shroud assembly from machine (Figure 23).

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.

7. Drain radiator into a suitable container using the radiator drain. The radiator drain is located inside the right frame rail near the rear wheel.
8. Loosen hose clamps and disconnect upper and lower coolant hoses (Figure 22 item 20 and 21) from the radiator.
9. Disconnect coolant reservoir hose (item 14) from the radiator.
10. Remove two (2) flange nuts and flange head screws (item 25) securing upper radiator mounting brackets to the cooler mount frame.
11. Remove two (2) flange nuts, washers and cap screws (item 28) securing lower corners of radiator to cooler mount frame.
12. Tilt radiator toward rear of machine and carefully lift the radiator from the machine.
13. Plug all radiator and hose openings to prevent contamination.
14. Inspect all four (4) rubber isolator mounts (item 26) on radiator. Replace isolator mounts if worn or damaged.
15. Inspect all foam seals and replace if worn or damaged.
16. Disassemble radiator assembly as needed.

Radiator Installation

1. Assemble radiator as needed. If removed, apply thread sealant to coolant reservoir fitting and drain hose fitting (Figure 22).
2. Remove plugs from radiator and hoses placed during the removal procedure.
3. Carefully lower radiator assembly into the machine.
4. Secure lower corners of radiator to cooler mount frame with caps screws (item 28), washers and flange nuts.
5. Secure upper radiator mounting brackets to cooler mount frame with flange nuts and flange head screws (item 25).
6. Connect upper and lower coolant hoses to the radiator. Orient hose clamps as shown (Figure 22) and tighten hose clamps from **3 to 5 N·m (30 to 45 in−lb)**.
7. Connect coolant reservoir hose (item 14) to the radiator and secure with hose clamp.

Radiator Installation (continued)

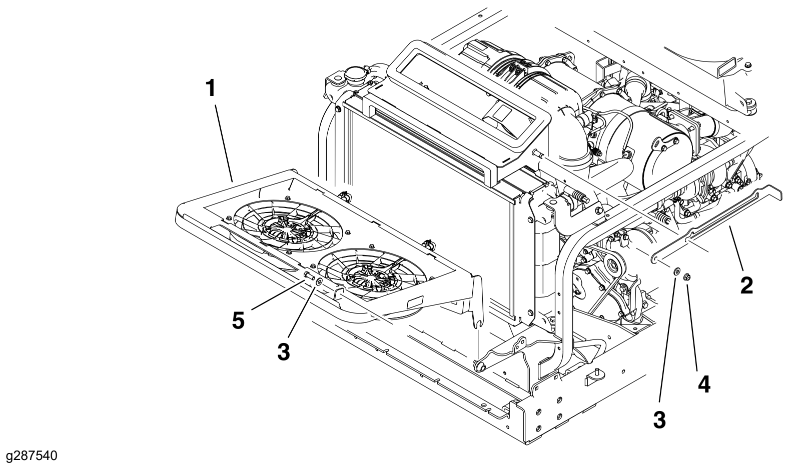


Figure 23

1. Fan shroud assembly
2. Fan shroud prop
3. Friction washer (2)
4. Lock nut
5. Cap screw

8. Install the fan shroud assembly and fan shroud prop (Figure 23). Connect the radiator cooling fans to the machine wire harness. Ensure that the fan shroud assembly seals around the radiator when fan shroud prop is latched. Adjust upper radiator mounting brackets forward or rearward for proper seal if necessary.
9. Install air box and air filter assembly (see Air Filter Installation (page 4–12)).
10. Make sure radiator drain is closed. Fill radiator with coolant (see machine *Operator's Manual*).
11. Run engine and check for any coolant leaks. Check and adjust coolant level as necessary (see machine *Operator's Manual*).
12. Install hood (see Hood Installation (Figure 322) (page 7–48)).

Engine

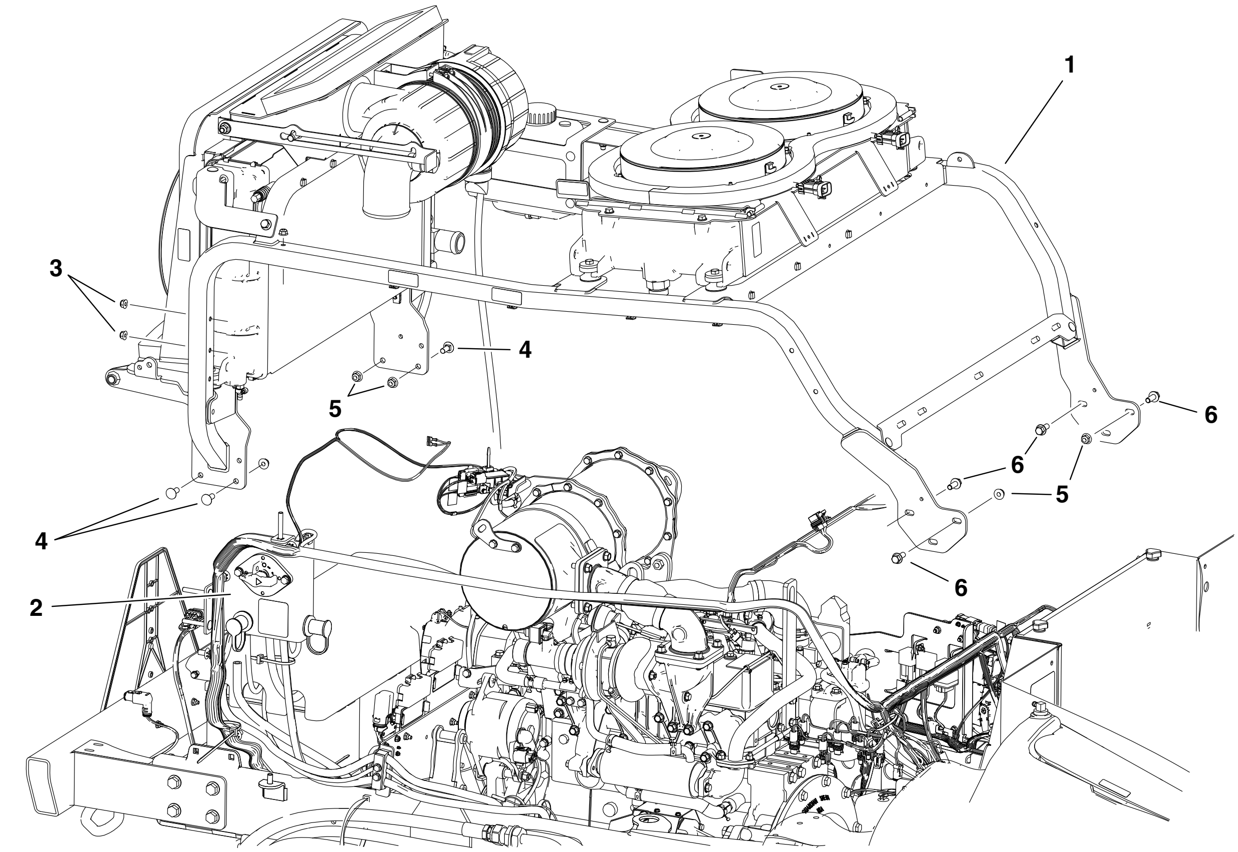


Figure 24

1.	Cooler frame assembly	3.	Flange not (3)	5.	Flange nut (6)
2.	Battery−disconnect switch bracket	4.	Carriage screw (4)	6.	Cap screw (6)

Engine Removal

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the key switch.

CAUTION

The engine, exhaust pipe, radiator and oil cooler may be hot. To avoid possible burns, allow the machine to cool before working on or near these components.

2. Turn the battery−disconnect switch to the OFF position and disconnect the battery positive (+) cables at the batteries of the 12 Volt and 24 Volt systems.
3. If engine is to be disassembled, drain oil from engine.
4. Remove hood (see Hood Removal (Figure 322) (page 7–48)).
5. Drain radiator into a suitable container using the radiator drain. The radiator drain is located inside the right frame rail near the rear wheel.
6. Loosen hose clamps and disconnect upper and lower coolant hoses from the radiator.
7. Loosen hose clamp and disconnect the air intake hose from the engine.

Engine Removal (continued)

8. To prevent contamination of hydraulic system, thoroughly clean exterior of oil cooler, fittings and hydraulic hoses prior to disconnecting hydraulic hoses.
9. Disconnect hydraulic hoses from the oil cooler and install caps or plugs on fittings and hoses.
10. Remove the cooler frame assembly with the radiator and fan assembly, oil cooler and fan assembly, air filter and plenum assembly, coolant reservoir and windshield washer reservoir attached (Figure 24):
    A. Record the location of cable ties, clamps and clips used to secure the electrical harness to the cooler frame.
    B. Disconnect the windshield washer reservoir pump from the wire harness (GM 5910 only).
    C. Disconnect two (2) oil cooler fans from the wire harness.
    D. Disconnect air filter service indicator from the wire harness.
    E. Disconnect two (2) radiator fans from the wire harness.
    F. Disconnect two (2) radiator fans from the wire harness.
    G. Support the cooler frame assemble from overhead and remove the fasteners securing the cooler frame to the machine. Lift the cooler frame assembly from the machine.
11. Record the location of cable ties, clamps and clips used to secure the electrical harness to the engine and prepare the engine for removal:
    A. Disconnect the diesel particulate filter (DPF) from the wire harness.
    B. Disconnect the alternator from the wire harness and the positive (+) cable.

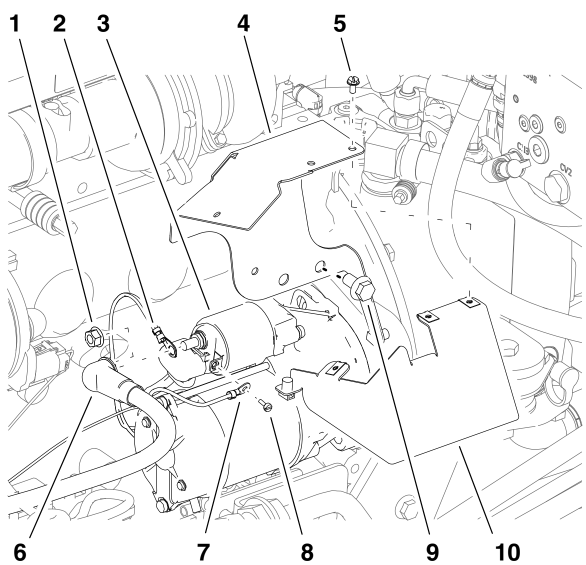


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Figure 25

1.	Lock nut	6.	Positive battery cable
2.	Fusible link	7.	Wire harness
3.	Starter solenoid	8.	Cap screw
4.	Heat shield	9.	Flange head screw (2)
5.	Flange head screw (3)	10.	Heat shield

    C. Remove the heat shields from around the starter motor and disconnect the positive (+) battery cable, fusible link and wire harness (Figure 25).

D. Remove the cable clamp securing the ground wires to the right rear engine mount bracket and remove bolt securing ground wires to engine block (below starter motor).

E. Disconnect the glow plugs from the wire harness (near the fuel/water separator).

F. Disconnect the oil pressure switch from the wire harness (near the fuel/water separator).

G. Disconnect four (4) wire harness connections at the Yanmar engine wire harness (near the fuel/water separator).

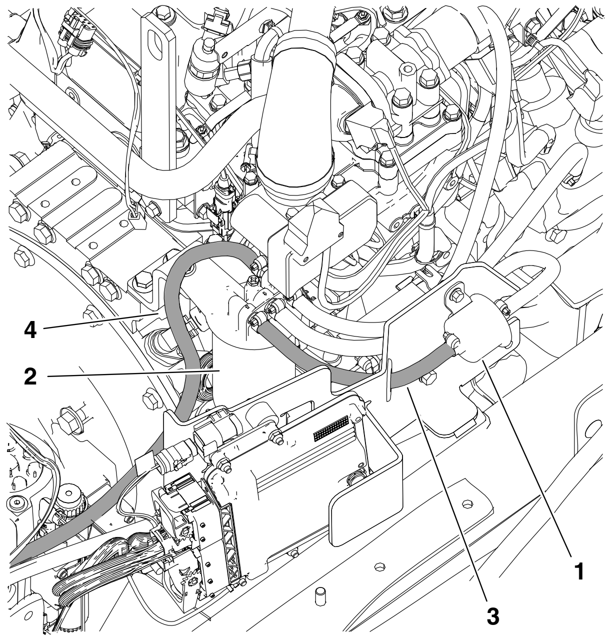

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Figure 26

1. Fuel pump
2. Fuel filter
3. Fuel supply hose
4. Fuel return hose

H. Loosen the hose clamps and disconnect the fuel supply line (from the fuel pump) and the fuel return hose at the fuel filter (Figure 26). Cap and plug fuel hoses and fuel filter fittings to prevent contamination.

12. Loosen the cap screw securing the 24 Volt alternator/ air conditioning compressor drive belt tensioner to the frame and remove the drive belt (see 24 Volt Alternator/Air Conditioning Compressor Drive Belt (page 6–147)).

IMPORTANT

To prevent compressor oil from filling the compressor cylinders, keep compressor in the same orientation as the installed position. Support compressor to make sure it will not fall during engine removal.

13. On Groundsmaster 5910 machines, remove air conditioning compressor from bracket (see Air Conditioning Compressor (page 9–6)). Position compressor away from engine taking care to not damage compressor or hoses.

14. Remove the piston (traction) pump assembly from the machine (see Piston (Traction) Pump (page 5–94)).

Engine Removal (continued)

CAUTION

Make sure that hoist or lift used to remove engine can properly support engine. Engine assembly without hydraulic pumps weighs approximately 295 kg (650 lb).

15. Connect suitable hoist or lift to the front and rear lift tabs on engine. Do not allow the lift chains or straps to contact the DPF.

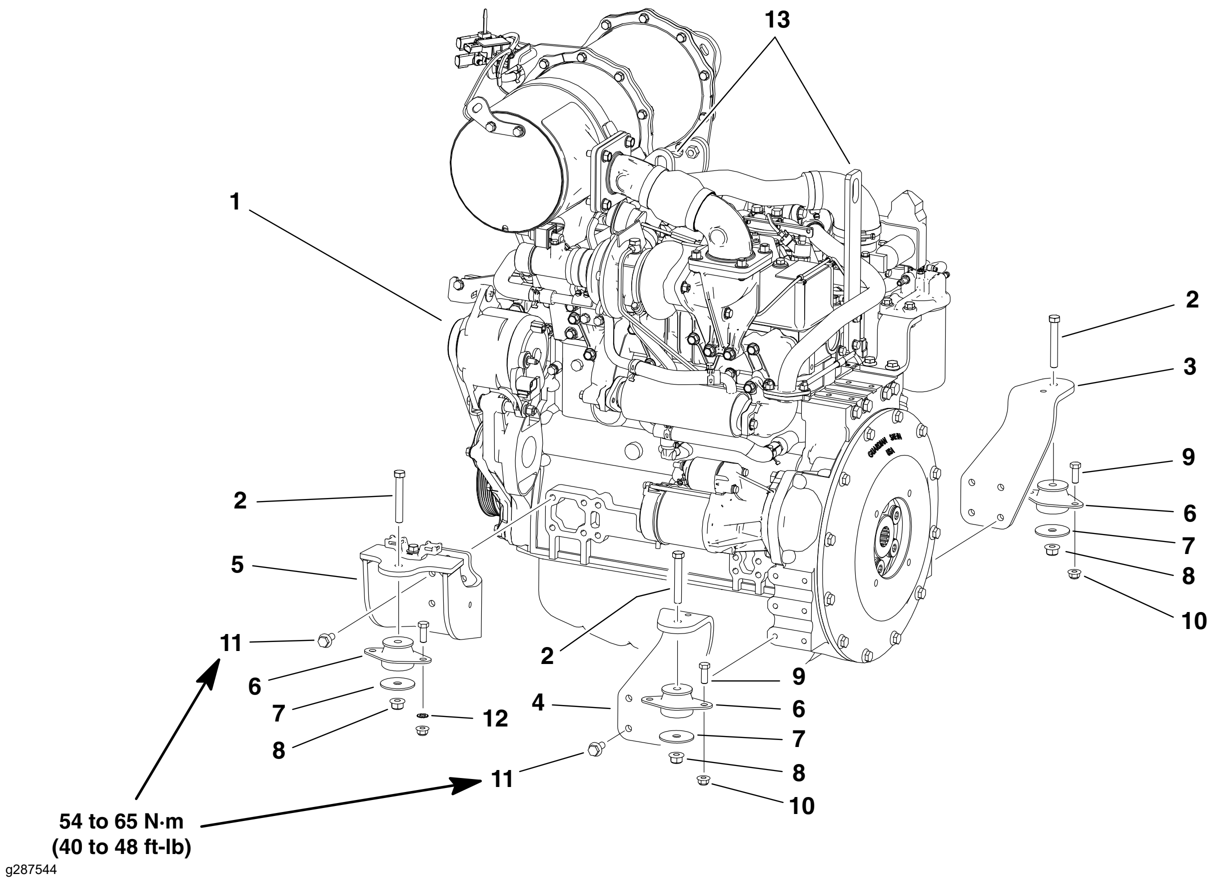

Figure 27

1. Engine assembly	6. Engine isolator mounts (4)	11. Cap screw (16)
2. Cap screw (4)	7. Snubbing washer (4)	12. External tooth lock washer (for ground cable)
3. LH front engine mount bracket	8. Lock nut (4)	13. Engine lifting lugs
4. RH front engine mount bracket	9. Cap screw (8)	
5. RH rear engine mount bracket	10. Lock nut (8)	

16. Remove lock nuts, snubbing washers and cap screws securing the engine isolator mounts to the engine brackets (Figure 27).

CAUTION

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

Engine Removal (continued)

IMPORTANT

Make sure to not damage the engine, fuel lines, hydraulic lines, electrical harness or other machine components while removing the engine.

17. Carefully raise engine from the machine.
18. If necessary, remove engine mount brackets from the engine.
19. If necessary, remove engine isolator mounts from frame. Note ground connection at right rear isolator mount.
20. Cover or plug all engine openings to prevent contaminants from entering engine.

Engine Installation

1. If removed, install engine isolator mounts to frame.
2. If removed, install engine mount brackets to engine and tighten cap screws from **54 to 65 N·m (40 to 48 ft−lb)**.
3. Make sure that all parts removed from the engine during maintenance or rebuilding are correctly installed to the engine.
4. Remove all covers and plugs from engine openings that were placed during engine removal.

CAUTION

Make sure that hoist or lift used to install engine can properly support engine. Engine weighs approximately 295 kg (650 lb).

5. Connect suitable hoist or lift to the front and rear lift tabs on engine. Do not allow the lift chains or straps to contact the DPF.

CAUTION

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

IMPORTANT

Make sure not to damage the engine, fuel and hydraulic lines, electrical harness or other parts while installing the engine.

6. Slowly lower engine into the machine.
7. Install the piston (traction) pump (see Piston (Traction) Pump (page 5–94)).
8. Align engine mount brackets to the engine isolator mounts and secure with cap screws, snubbing washers and lock nuts (Figure 27).
9. On Groundsmaster 5910 machines, install air conditioning compressor (see Air Conditioning Compressor (page 9–6)).

Engine Installation (continued)

10. Install the 24 Volt alternator/air conditioning compressor drive belt (see 24 Volt Alternator/Air Conditioning Compressor Drive Belt (page 6–147)).
11. Connect the supply and return fuel hoses to the fuel pump (Figure 26). Secure the clamp supporting the fuel hoses to the fuel pump mounting screw.
12. Connect wires and/or electrical connections to the engine assembly at the following locations:
    A. Four (4) connections at Yanmar engine harness
    B. Oil pressure switch
    C. Glow plugs
    D. Electric starter
    E. Alternator
    F. Diesel Particulate Filter (DPF)
13. Install cooler frame assembly to machine frame. Tighten rear cooler frame mounting fasteners first, followed by front fasteners.
14. Install the battery−disconnect switch bracket and connect wires and/or electrical connections to the cooler frame assembly at the following locations:
    A. Radiator fans (2)
    B. Air filter service indicator
    C. Oil cooler fans (2)
    D. Windshield washer reservoir pump (GM 5910 only)
15. Install air intake hose. Tighten hose clamps from **10 to 11 N·m (90 to 100 in−lb)**.
16. Install upper and lower coolant hoses. Tighten hose clamps from **3 to 5 N·m (30 to 45 in−lb)**. Close radiator drain and fill radiator and reservoir with coolant (see machine *Operator's Manual*).
17. Replace all cable ties, clamps and clips removed during disassembly and secure electrical harness. Check position of electrical harnesses, fuel lines and hydraulic hoses for proper clearance with rotating, high temperature and moving components.
18. Install hood (see Hood and Lower Shrouds (page 7–47)).
19. Check and adjust engine oil as needed.
20. Check and adjust hydraulic oil as needed.
21. Turn the batter−disconnect switch to the ON position.
22. Run engine and check for any leaks.
23. Operate hydraulic controls to properly fill hydraulic system (see Charge Hydraulic System (page 5–79)).
24. Install hood to machine (see Hood and Lower Shrouds (page 7–47)).

Pump Adapter Plate (Coupler)

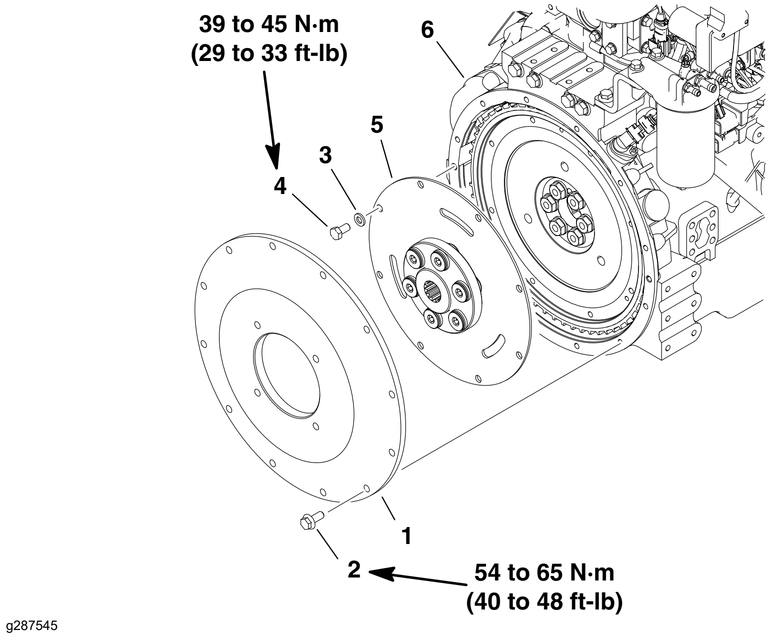

Figure 28

1. Flywheel cover
2. Washer head screw (12)
3. Hardened washer (8)
4. Cap screw (8)
5. Spring coupler
6. Engine

Removal

Note: The hydraulic pump assembly needs to be removed from engine before coupler can be removed.

1. If engine is in machine, remove hydraulic pump assembly (see Piston (Traction) Pump (page 5–94)).
2. Remove flywheel cover and spring coupler from engine (Figure 28).

Installation

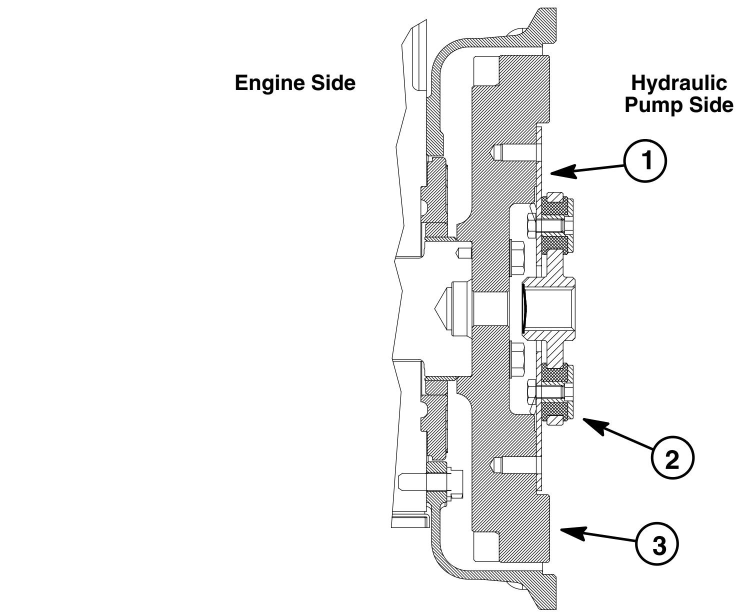

Figure 29

1. Coupler
2. Coupler hub
3. Engine flywheel

1. Position spring coupler to engine flywheel and align mounting holes (Figure 28). Make sure that coupling hub is toward pump (away from engine flywheel) (Figure 29).
2. Apply medium strength thread locker to threads of cap screws (item 4). Secure coupling to engine flywheel with eight (8) cap screws and hardened washers. Tighten cap screws in a crossing pattern from **39 to 45 N·m (29 to 33 ft−lb)**.
3. Position flywheel cover to engine. Secure flywheel cover to engine with twelve (12) washer head screws (item 2). Tighten cap screws in a crossing pattern from **54 to 65 N·m (40 to 48 ft−lb)**.
4. If engine is in machine, install hydraulic pump assembly (see Piston (Traction) Pump (page 5–94)).

Hydraulic System

Table of Contents

Additional Reference Materials

Danfoss H1 Closed Circuit Axial Piston Pumps Service Manual

Danfoss H1 Closed Circuit Axial Piston pumps Repair Instructions

Danfoss Steering Unit Type OSPM Service Manual

Eaton Parts And Repair Information: 5 Series Steering Control Units

General Information

Operator's Manual

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

Relieving Hydraulic System Pressure

Before disconnecting or performing any work on the hydraulic system, all pressure in the hydraulic system must be relieved. Park machine on a level surface, lower cutting decks fully, disengage PTO and stop engine. Remove key from key switch.

System pressure in mow circuit is relieved when the cutting decks are disengaged.

To relieve hydraulic pressure in steering circuit with engine not running, rotate steering wheel in both directions.

To relieve hydraulic pressure in lift circuit, make sure that engine is not running and have operator seat occupied. Turn key switch to RUN, depress each of the deck lift switches to the deck lower position and then release switch. Return key switch to the OFF position after all lift switches have been depressed.

To relieve hydraulic pressure in traction circuit, turn key switch to ON (engine not running) and depress traction pedal to both forward and reverse directions. Turn key switch to OFF after relieving traction circuit pressure.

After all hydraulic system pressures have been relieved, remove key from key switch.

Towing Traction Unit

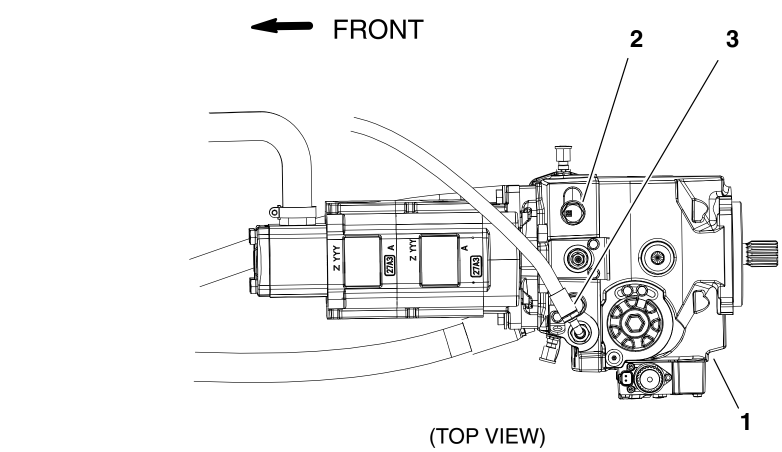

Figure 30

1. Piston pump
2. Forward relief valve
3. Reverse relief valve

IMPORTANT

If towing limits are exceeded, severe damage to the piston (traction) pump may occur.

Towing Traction Unit (continued)

If it becomes necessary to tow or push the machine, move machine in a forward direction at a speed below 2 mph (3.2 kph), and for a very short distance. If the machine needs to be moved more than a short distance, machine should be transported on a trailer.

The piston (traction) pump high pressure relief valves include a high pressure relief valve, charge check valve and a bypass valve. Both forward and reverse high pressure relief valves need to be loosened three (3) revolutions to engage the bypass function and allow the machine to be moved (Figure 30). To prevent leakage from relief valves, do not loosen them more than three (3) revolutions. Also, manually release the automatic parking brake using the bypass valve and plunger located on the right side of the operator seat. Refer to your *Operator's Manual* for additional towing instructions.

IMPORTANT

Do not loosen relief valves when engine is running.

Before returning machine to service, tighten both of the relief valves until seated. Then, torque relief valves to **70 N·m (52 ft−lb)**. The parking brake automatically resets when the engine is started.

Traction Circuit Component Failure

The traction circuit on Groundsmaster 5900 and 5910 machines is a closed loop system that includes the piston (traction) pump and four (4) wheel motors. If a component in the traction circuit should fail, debris and contamination from the failed component will circulate throughout the traction circuit. This contamination can damage other components in the circuit so it must be removed to prevent additional component failure.

The recommended method of removing traction circuit contamination would be to temporarily install the Toro high flow hydraulic filter (see Special Tools (page 2–15)) into the traction circuit. This filter should be used when connecting hydraulic test gauges in order to test traction circuit components or after replacing a failed traction circuit component (e.g. traction (piston) pump or wheel motor). The filter will ensure that contaminates are removed from the closed loop and thus, do not cause additional component damage.

IMPORTANT

To prevent damage to the high flow hydraulic filter during use on a Groundsmaster 5900 or 5910, keep engine speed below 2200 RPM. Higher engine speeds may allow excessive hydraulic flow to the filter.

Once the Toro high flow hydraulic filter kit has been placed in the circuit, raise and support the machine with all wheels off the ground (see Jacking Instructions (page 1–6)). Then, operate the traction circuit to allow oil flow throughout the circuit. The filter will remove contamination from the traction circuit during operation. Because the Toro high flow filter is bidirectional, the traction circuit can be operated in both the forward and reverse direction. The filter should be removed from the machine after contamination has been removed from the traction circuit. See Filtering Closed−Loop Traction Circuit (page 5–81) for additional information on using the Toro high flow hydraulic filter.

The alternative to using the Toro high flow hydraulic filter kit after a traction circuit component failure would be to disassemble, drain and thoroughly clean all components, hydraulic tubes and hydraulic hoses in the traction circuit. If any debris remains in the traction circuit and the machine is operated, the debris can cause additional circuit component failure.

Hydraulic Hoses

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

- Hydraulic hoses should not be hard, cracked, cut, abraded, charred, leaking, or otherwise damaged.
- Hydraulic hoses should not be kinked, crushed, flattened, or twisted.
- Hydraulic hose covers should not be blistered, soft, degraded, or loose.
- Hydraulic hose fittings should not be cracked, damaged, or badly corroded.

WARNING

Release all pressure in the hydraulic system before performing any work on the hydraulic system:

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

When you replace a hydraulic hose, ensure that the hose is straight (not twisted) before you tighten the fittings. Observe the imprint (layline) on the hose to do this. Using two wrenches, hold the hose straight with one wrench and tighten the hose swivel nut onto the fitting with the other wrench; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–7).

Note: If the hose has an elbow at one 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 the Toro Basics Series Training Book *Hydraulic Hose Servicing* (Part No. 94813SL).

Installing Hydraulic Hoses and Tubes (O-Ring Face Seal)

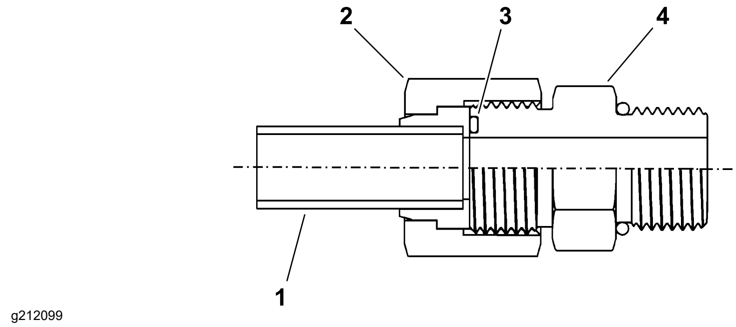

Figure 31

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

1. Ensure that all the threads, the sealing surfaces of the hose/tube, and the fitting are free of burrs, nicks, scratches, or unwanted material.
2. To help prevent a hydraulic leak, replace the face seal O-ring when you open the connection. Ensure that the O-ring is installed and correctly seated in the groove of the fitting. Lightly lubricate the O-ring with clean hydraulic fluid.
3. Align the hose/tube against the body of the fitting so that the flat face of the hose/tube sleeve fully touches the O-ring in the fitting (Figure 31).
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 5–8). 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 2–8).

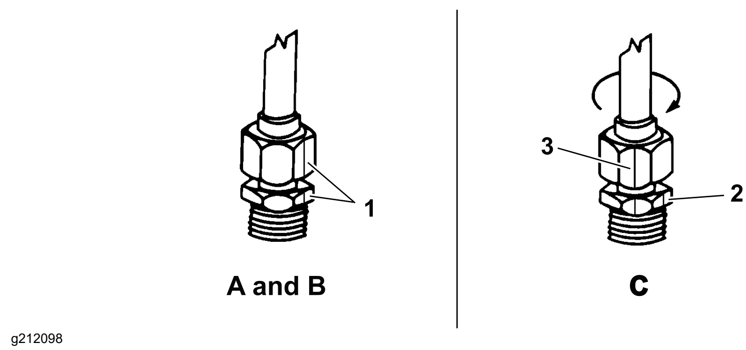

Figure 32

1. Mark swivel nut and fitting body
2. Initial position
3. Final position

Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (continued)

Hose/Tube Installation Torque Table

Fitting Dash Size	Hose/Tube Side Thread Size (inch)—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

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.

   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 (item 1 in Figure 32). If connecting a hose, hold the hose in alignment with a wrench to prevent the hose from turning.

   C. Use a wrench to tighten the nut to the correct Flats From Wrench Resistance (compare items 2 and 3 in Figure 32).

Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings)

Installing a Non-Adjustable Fitting

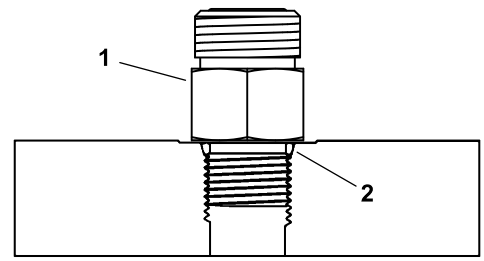

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Figure 33

1. Fitting
2. O-ring

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

IMPORTANT

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

4. Install the fitting into the port, then use a torque wrench and socket to tighten the fitting to the recommended torque value within the specified range of torque values; refer to the Fitting Installation Torque Table (page 5–11).

   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 2–8).

5. If a torque wrench is not available or if space at the port prevents the use of a torque wrench, use the Flats From Finger Tight (FFFT) procedure given below:

   A. Install the fitting into the port and tighten the fitting down full length until finger-tight.

   B. If the port material is steel, tighten the fitting to the listed value; refer to the Flats From Finger Tight (FFFT) Table (page 5–11).

   C. If the port material is aluminum, tighten the fitting to 60% of the listed value; refer to the Flats From Finger Tight (FFFT) Table (page 5–11).

Installing an Adjustable Fitting

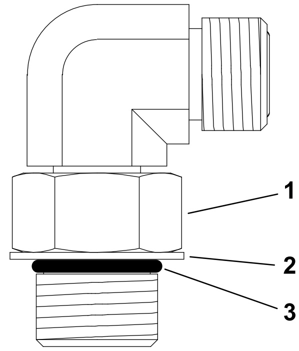

Figure 34

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

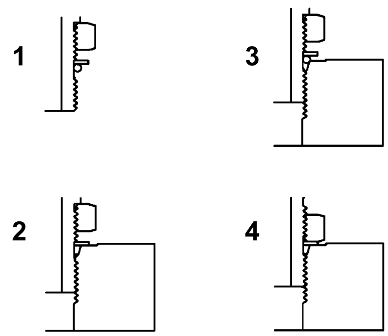

Figure 35

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

1. Ensure that all the threads, the sealing surfaces of fitting, and the component port are free of burrs, nicks, scratches, or unwanted material.
2. To help prevent a hydraulic leak, replace the O-ring when you open the connection.
3. Lightly lubricate the O-ring with clean hydraulic fluid. Ensure that the threads of the fitting are clean with no lubricant applied.
4. Turn back the lock nut 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 35).
5. Install the adjustable fitting into the port by hand until the washer contacts the face of the port (Step 2 in Figure 35).
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 35). Do not rotate the adjustable fitting more than 1 turn counterclockwise.

IMPORTANT

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

Installing an Adjustable Fitting (continued)

7. Tighten the fitting lock nut (Step 4 in Figure 35):

   A. Hold the fitting in the correct alignment with a wrench and use a torque wrench and tighten the lock nut to the recommended torque value within the specified range of torque values; refer to the Fitting Installation Torque Table (page 5–11). This tightening procedure requires a drive-adapter wrench (e.g., crowfoot wrench); refer to Calculating the Torque Values When Using a Drive-Adapter Wrench (page 2–8).

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

   C. If the port material is steel, tighten the fitting to the listed Flats From Finger Tight (FFFT) value; refer to the Flats From Finger Tight (FFFT) Table (page 5–11).

   D. If the port material is aluminum, tighten the fitting to 60% of the listed FFFT value; refer to the Flats From Finger Tight (FFFT) Table (page 5–11).

Fitting Installation Torque Table

Fitting Dash Size	Fitting Port Side Thread Size (inch)—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)

Flats From Finger Tight (FFFT) 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 Schematic

The hydraulic schematic for Groundsmaster 5900 and 5910 machines is located in A Hydraulic Schematic (page A–5).

Hydraulic Flow Diagrams

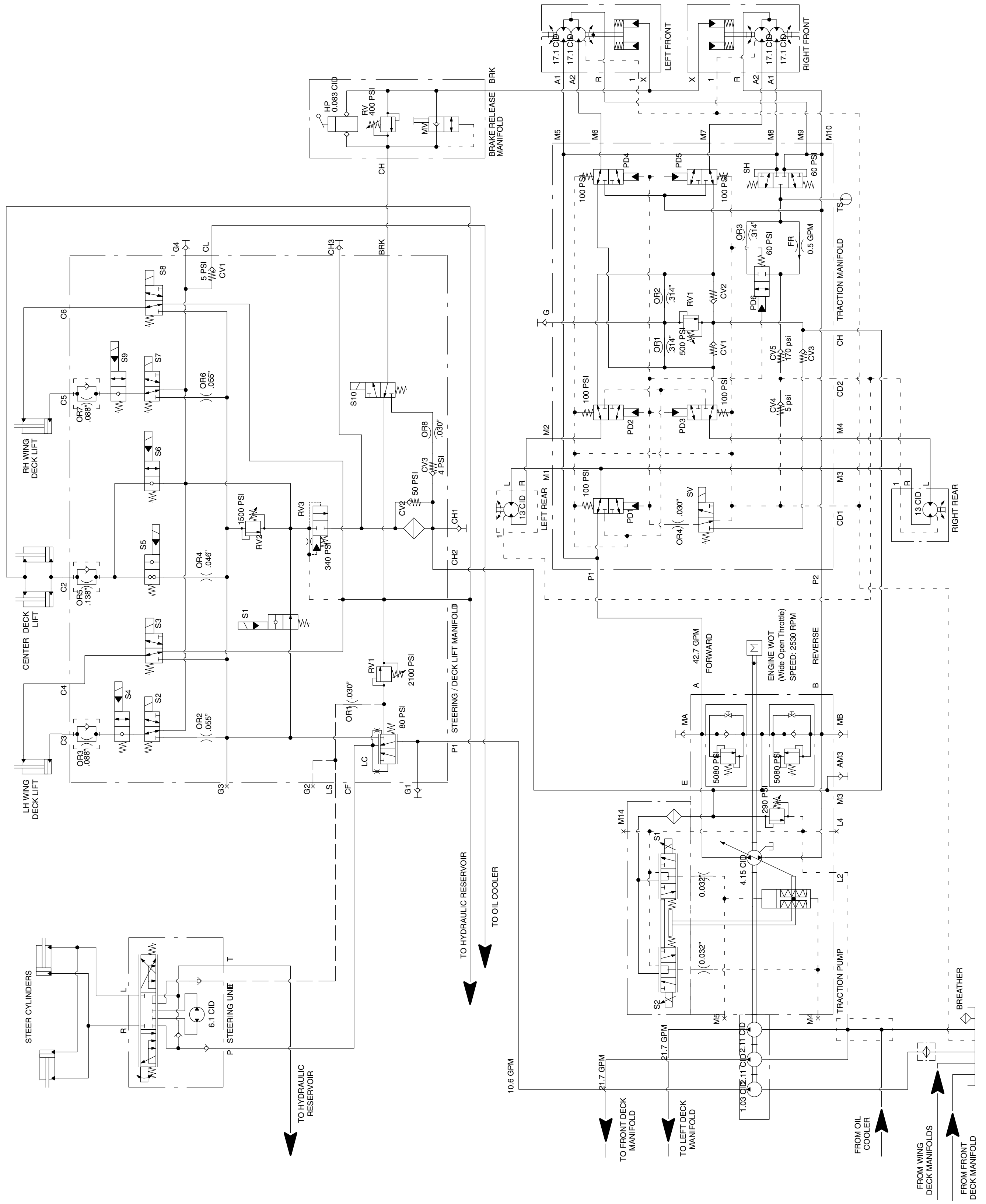

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Figure 36

Traction Circuit Schematic

Traction Circuit Operation

A variable displacement, bi−directional piston pump is directly coupled to the engine flywheel to provide hydraulic flow for the traction circuit. The piston pump swash plate movement is controlled by a pump mounted electrical displacement control. Pushing the traction pedal rotates a potentiometer that provides an input to the machine master Toro Electronic Controller (TEC). The controller in turn sends a corresponding PWM (Pulse Width Modulation) output signal to the piston pump displacement control to rotate the pump swash plate accordingly to control the pump's output and direction. When the traction pedal is pushed in the forward direction, solenoid S1 on the displacement control is energized. Solenoid S1 is the upper solenoid on the pump control assembly. Solenoid S2 is energized when the traction pedal is pushed in the reverse direction.

The traction circuit provides operation in either low range traction speed (mow/four wheel drive) or high range traction speed (transport/two wheel drive). Solenoid valve (SV) in the traction manifold is energized by the secondary TEC controller when the high range traction speed (transport) is selected.

Front and rear wheel motors are fixed displacement, high torque, low speed radial piston motors. Front motors are 2−speed design and rear motors are single speed. The oil from the piston pump is directed to the front and rear wheel motors through the traction manifold.

Operating pressure on the high pressure side of the closed loop traction circuit is determined by the amount of load developed at the wheel motors. As the load increases, circuit pressure can increase to relief valve settings (350 bar (5080 PSI) in both forward and reverse). If pressure exceeds the relief setting, oil flows through the unseated relief valve to the low pressure side of the closed loop traction circuit.

Note: The piston (traction) pump high pressure relief valves include the high pressure relief valve, a charge circuit check valve and a bypass valve to allow the machine to be towed a limited distance.

Traction circuit pressure (forward and reverse) can be measured at test fittings attached to the sides of the piston pump. The forward traction port is on the right side of the pump and the reverse traction port is on the left side.

The Smart Power™ feature prevents the engine from slowing down in heavy load conditions (e.g. cutting tall grass) by automatically decreasing the traction speed if necessary. With a reduced traction speed, the cutting blades can continue to be at optimum speed.

Traction pump flow is directed to the rear wheel motors and the opposite front wheel motors to maximize traction. To reduce tire scuffing when turning, traction system pressure is equalized in the traction manifold with an orifice and a relief valve. Check valves in the traction manifold prevent circuit cavitation if the front wheel motors should lose traction.

To further enhance traction control, the cutting deck lift/lower circuit is equipped with a counterbalance system. Counterbalance is achieved by applying a constant pressure to the lift cylinders to lift the cutting decks slightly. This action causes some of the cutting deck weight to be transferred to the traction unit to improve traction. A pre−set counterbalance valve (RV3) located in the steering/deck lift manifold controls the amount of counterbalance pressure in the lift circuit. The pressure setting can be modified for snow or blower attachments.

The traction pump and wheel motors use a small amount of hydraulic fluid for internal lubrication. Fluid is designed to leak across the pump and motor parts and into the component case drain. This leakage results in the loss of hydraulic fluid from the closed loop traction circuit that must be replaced. The traction charge circuit is designed to replace this traction circuit leakage.

Traction Circuit Operation (continued)

The final gear pump section supplies oil to the steering, cutting deck lift and traction charge circuits. This gear pump section provides a constant supply of charge oil to the traction circuit to make up for oil that is lost to internal leakage in the traction pump and wheel motors. Charge pump flow is directed through the charge oil filter attached to the steering/deck lift manifold before entering the piston pump. A bypass valve is located in the manifold to allow charge oil flow to the closed traction loop if the filter becomes plugged.

Traction charge pressure is limited to 20 bar (290 PSI) by a relief valve located in the piston pump. Charge pressure going into the pump can be measured at the pressure test port (CH1) located on the steering/deck lift manifold. Measured pressure should be approximately 26 bar (380 psi) with 150F oil. Charge pressure inside the pump can be measured at the pressure port (AM3) located on the LH side.

The traction manifold includes a shuttle valve (SH) for cooling of the closed loop traction circuit. The shuttle valve spool is shifted by traction pressure and allows hydraulic fluid to bleed off for cooling of the closed loop traction circuit. The charge system replenishes oil that is bled from the traction circuit due to shuttle valve operation.

The front wheel motors include an internal, multi−disc parking brake system. The parking brake is automatically applied by internal motor spring pressure when the engine is not running or charge pressure drops below 12 bar (174 psi). The brake is released when the engine is running, charge pressure is above 12 bar (174 psi) and the parking brake rocker switch is in the disengaged position.

Traction Circuit: Low Range Traction Speed (Mow)

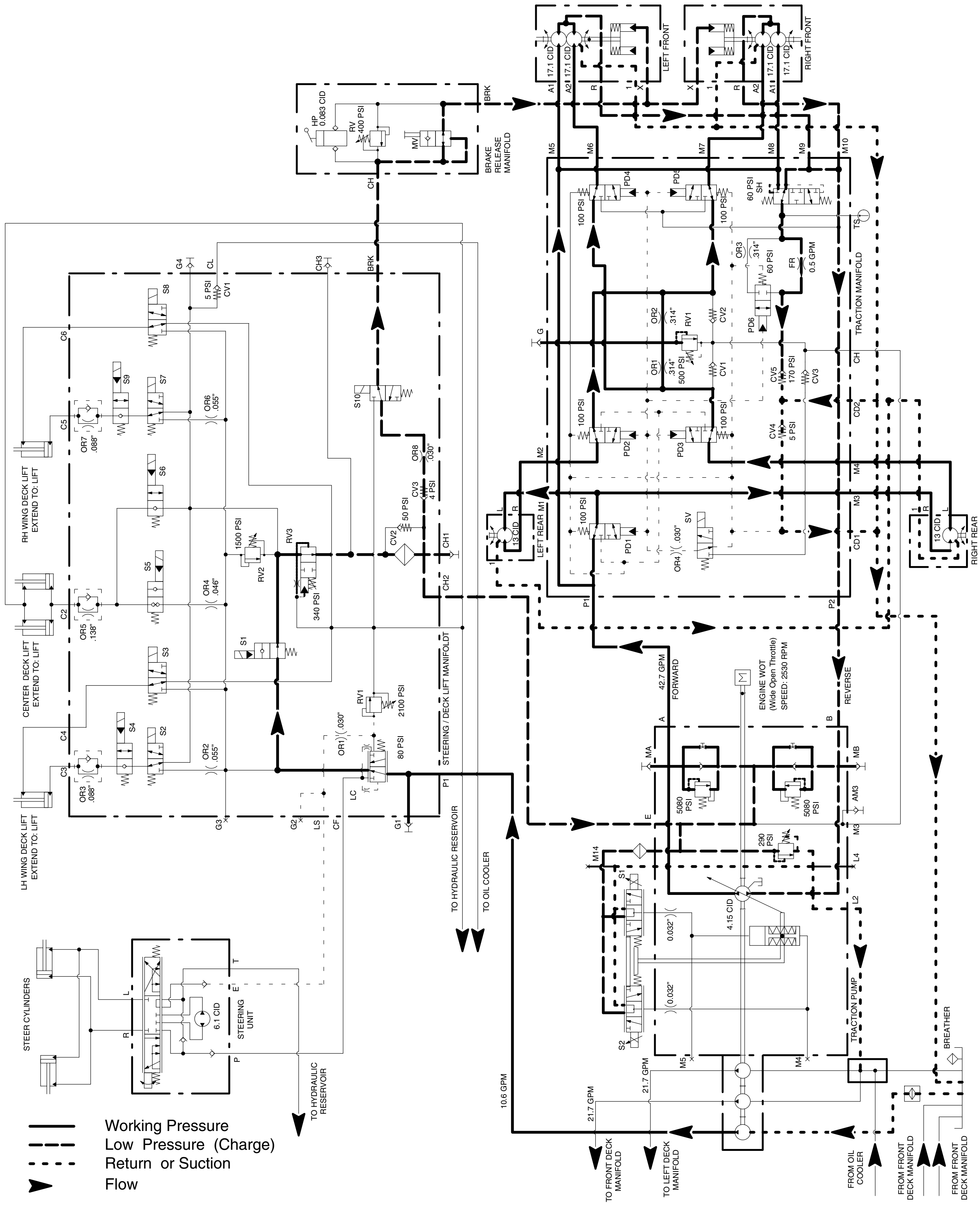

Figure 37

Traction Circuit: Low Range Traction Speed (Forward Shown)

Note: See Traction Circuit Operation (page 5–14) for a description of general function of the traction circuit.

With the low range traction speed (mow) selected and the traction pedal in the neutral position, the swash plate in the piston pump is not rotated so there is no oil flow from the pump and no machine traction movement.

Forward Direction

With the low range traction speed (mow) selected and the traction pedal pushed in the forward direction, oil from the piston pump is routed out port A to traction manifold port P1. Pump flow is then routed in parallel to half the displacement of the front wheel motors through ports A1 and to the rear wheel motors through unshifted traction manifold valve PD1. The flow that goes through the rear motors is then routed to the opposite front motor through ports A2 of the front motors (left rear to right front through unshifted PD2 and PD5, right rear to left front through unshifted PD3 and PD4). Oil flow through the rear and front motors keeps all wheel motors at their maximum displacement to allow a lower traction speed along with CrossTrax™ 4WD operation for enhanced traction while mowing.

Oil from the front motors exits the motors through port R and re−enters the traction manifold through ports M9 and M10. This return oil is routed to the shuttle valve (SH) that is shifted by front wheel traction pressure. When in low speed range, the traction manifold flow regulator (FR) allows approximately 1.9 LPM (0.5 GPM) of hydraulic fluid to bleed off for cooling of the closed loop traction circuit when the shuttle valve (SH) is shifted. By limiting the amount of oil that is removed from the traction circuit, the chance of a front tire losing traction can be reduced. Return oil that is not bled from the traction circuit is returned to the piston pump through traction manifold port P2 and piston pump port B.

If a rear motor loses traction, pressure increases in the serial line because too much flow is being sent to the opposite front motor. This lowers the torque available to the tire trying to spin so that overall machine traction is maintained. If a front tire loses traction, pressure increases in the low side of the traction loop reducing the pressure differential across the front motor and increasing pressure drop across the rear motors. This allows the rear motors to provide more traction effort.

The traction manifold includes several components designed to enhance low speed traction performance. Steering orifices in the manifold serial line (OR1 and OR2) prevent tire scuffing when turning. The serial line relief valve (RV1) prevents tire scuffing and also increases rear motor life. Check valves CV1 and CV2 prevent circuit cavitation if either of the front wheel motors lose traction.

Reverse Direction

The traction circuit operates essentially the same in reverse low range as it does in the forward direction. However, the flow through the circuit is reversed. Oil flow from piston pump port B is directed to traction manifold port P2. Pump flow is then routed in parallel to both halves of the front wheel motors through port R of the motors. Flow exits the motor sections through motor ports A1 and A2. Flow from motor port A1 returns to the piston pump through the traction manifold P1 port and then is routed back to pump port A. Return flow from the front wheel motor A2 port is routed to the opposite rear wheel motor (right front to left rear through unshifted PD5 and PD2, left front to right rear through unshifted PD4 and PD3). Flow from the rear motors returns through unshifted traction manifold valve PD1, manifold port P1 and to piston pump port A. Oil flow in reverse keeps all wheel motors at their maximum displacement to allow a lower traction speed along with CrossTrax™ 4WD operation for enhanced traction.

Operation of the traction manifold shuttle valve (SH), steering orifices (OR1 and OR2), relief valve (RV1) and check valves (CV1 and CV2) is the same in reverse low speed as it is in the forward direction.

Traction Circuit: High Range Traction Speed (Transport)

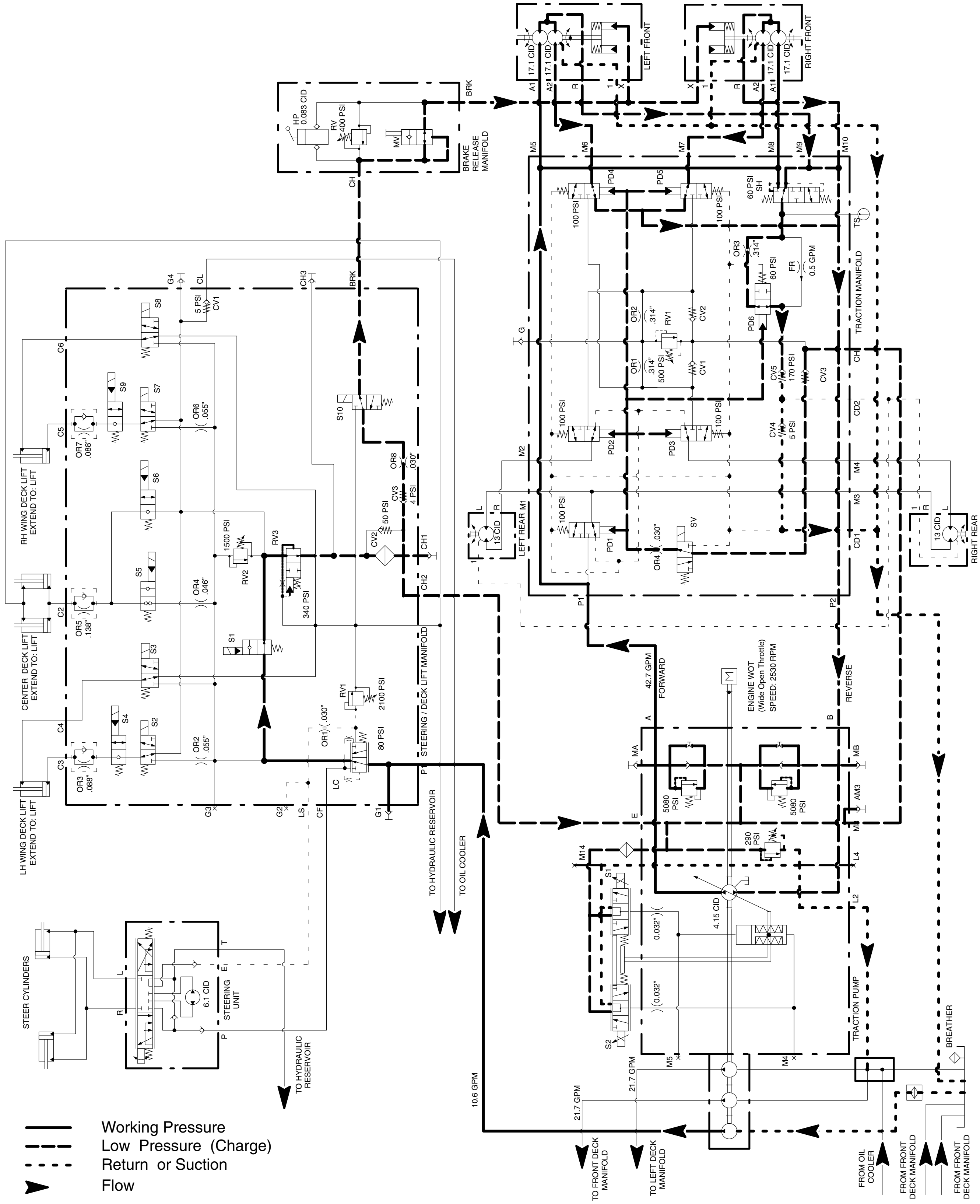

Figure 38

Traction Circuit: High Range Traction Speed (Forward Shown)

Note: See Traction Circuit Operation (page 5–14) for a description of general function of the traction circuit.

When the high range traction speed (transport) is selected, solenoid valve (SV) in the traction manifold is energized by the secondary Toro electronic controller. The shifted solenoid valve (SV) spool directs charge pressure in the traction manifold to shift all six (6) pressure differential valves (PD1, PD2, PD3, PD4, PD5 and PD6) in the manifold.

When the machine is in the high speed range, traction manifold steering orifices (OR1 and OR2), relief valve (RV1) and check valves CV1 and CV2 have no function.

With the high range traction speed (transport) selected and the traction pedal in the neutral position, the swash plate in the piston pump is not rotated so there is no oil flow from the pump and no machine traction movement.

Forward Direction

With the high range traction speed selected and the traction pedal pushed in the forward direction, oil from the piston pump is routed out pump port A and then to traction manifold port P1. The shifted PD1 valve in the traction manifold prevents piston pump hydraulic flow from reaching the rear wheel motors. With flow blocked to the rear wheel motors, all piston pump flow is directed to the front wheel motors when in the high speed range.

Total piston pump flow is routed in parallel to half the displacement of the front wheel motors through ports A1 of the motors to drive the front motors at transport speed. Higher machine transport speed is possible due to all of the pump flow being routed to one section of each of the front wheel motors.

The shifted PD1, PD2 and PD3 valves in the traction manifold allow the rear wheel motors to remain filled with hydraulic oil while they free−wheel in high speed range. When in high speed, case pressure in the rear wheel motors keeps the motor pistons retracted to reduce rolling resistance of the rear wheels.

Oil from the front motors exits the motors through port R and re−enters the traction manifold through ports M9 and M10. This return oil is routed to the shuttle valve (SH) that is shifted by front wheel traction pressure. When in high speed range, approximately 18.6 LPM (4.8 GPM) of hydraulic fluid is released from the closed loop traction circuit through the shifted shuttle valve (SH) and shifted PD6. This release of oil from the traction circuit loop is also necessary to keep the rear wheel motor pistons retracted when in the high (transport) speed range. Return oil that is not bled from the traction circuit is returned to the piston pump through traction manifold port P2 and piston pump port B.

The shifted PD4 and PD5 valves in the traction manifold recirculate return oil from the driven front wheel motors to the second section of the front motors through ports A2 of the motors. This recirculated flow provides cooling and lubrication of the front wheel motors when in transport speed range.

Reverse Direction

The traction circuit operates essentially the same in reverse high range traction speed as it does in the forward direction. However, the flow through the circuit is reversed. Oil flow from piston pump port B is directed to traction manifold port P2. Pump flow is then routed in parallel to both halves of the front wheel motors through port R of both motors. Flow exits the motor sections through motor ports A1 and A2. Flow from motor port A1 returns through the traction manifold, out the P1 port and then is routed back to piston pump port A. Return flow from the front wheel motor A2 port is returned under pressure back to the incoming pump flow (right front through shifted PD5, left front through shifted PD4).

Operation of the traction manifold shuttle valve (SH) is the same in reverse low speed as it is in the forward direction.

Raise Cutting Deck

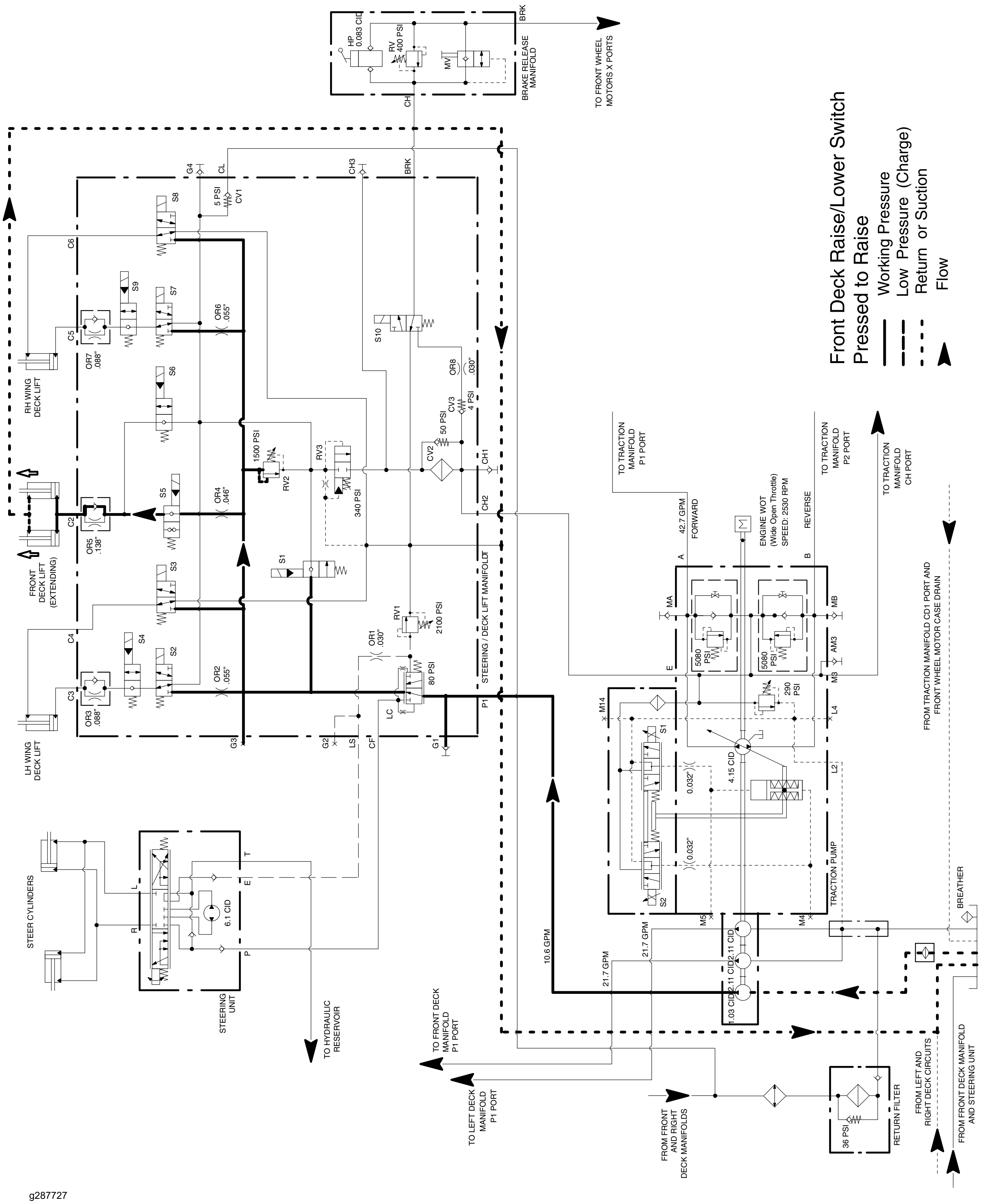

Figure 39

Raise Cutting Deck

A three (3) section gear pump is coupled to the piston (traction) pump. The gear pump section furthest from the piston pump supplies hydraulic flow to the steering, cutting deck lift and traction charge circuits. Hydraulic flow from the final pump section is directed to the appropriate circuits by a pressure compensator valve located in the steering/deck lift manifold.

An adjustable counterbalance valve (RV3) in the steering/ deck lift control manifold maintains back pressure on the deck lift cylinders to allow some of the cutting deck weight to be transferred to the traction unit to improve traction. A relief valve (RV2) located in the steering/deck lift manifold limits lift/lower circuit pressure to 103 bar (1500 PSI).

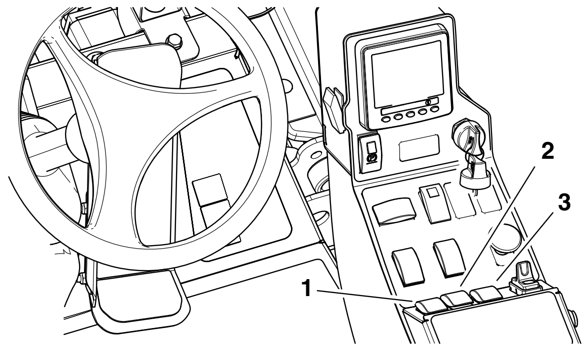

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Figure 40

1. Left deck raise/lower switch
2. Front deck raise/lower switch
3. Right deck raise/lower switch

Each of the cutting decks (front, right and left) can be raised independently with the use of three (3) deck raise/lower switches on the armrest console (Figure 40). Pressing the rear of a switch provides an input for the secondary Toro Electronic Controller (TEC) to raise a cutting deck. The controller provides electrical outputs to solenoids in the steering/deck lift manifold to allow appropriate valve shift to cause a cutting deck to raise.

When the cutting decks are in a stationary position, all solenoids in the steering/deck lift manifold are de−energized. In this position, the flow from the final gear pump section is by−passed through solenoid valve (S1), the counterbalance valve (RV3), the charge oil filter and then is routed to the traction charge circuit.

Note: To raise a cutting deck, the engine must be running. Also, the operator seat has to be occupied or the parking brake must be applied with the traction pedal in neutral.

Front Deck Raise

To raise the front deck, the rear of the center console switch is depressed. The switch acts as an input to the secondary TEC which provides an electrical output to solenoid valves S1 and S5 in the steering/deck lift manifold. The energized solenoid valves shift to allow a passage for circuit oil flow to the barrel end of the front deck lift cylinders. Shifted S1 prevents oil flow from returning directly to the traction charge circuit. Shifted S5 allows an oil path through orifice OR4 (to control raising speed), the check valve at OR5 and to the barrel end of the lift cylinders to extend the lift cylinders and raise the front deck. Oil from the extending cylinders returns to the hydraulic reservoir.

When the deck switch is released, the manifold solenoids are de−energized and the front deck lift cylinders and front deck are held in position.

Right Wing Deck Raise

To raise the right wing deck, the rear of the right console switch is pushed to act as an input to the secondary TEC. The controller provides an electrical output to solenoid valves S1 and S7 in the steering/deck lift manifold. The energized solenoid valves shift to allow a passage for circuit oil flow to the barrel end of the right deck lift cylinder. Shifted S1 prevents oil flow from returning directly to the traction charge circuit. Shifted S7 allows an oil path through orifice OR6 (to control raising speed), the check valve at S9 (de−energized), the check valve at OR7 and to the barrel end of the lift cylinder to extend the lift cylinder and raise the right wing deck. Oil from the extending cylinder is directed through S8 (de−energized) and returns to the hydraulic reservoir.

When the deck switch is released, the manifold solenoids are de−energized and the lift cylinder and right wing deck are held in position.

Left Wing Deck Raise

To raise the left wing deck, the rear of the left console switch is pushed to act as an input to the secondary TEC. The controller provides an electrical output to solenoid valves S1 and S2 in the steering/deck lift manifold. The energized solenoid valves shift to allow a passage for circuit oil flow to the barrel end of the left deck lift cylinder. Shifted S1 prevents oil flow from returning directly to the traction charge circuit. Shifted S2 allows an oil path through orifice OR2 (to control raising speed), the check valve at S4 (de−energized), the check valve at OR3 and to the barrel end of the lift cylinder to extend the lift cylinder and raise the left wing deck. Oil from the extending cylinder is directed through S3 (de−energized) and returns to the hydraulic reservoir.

When the deck switch is released, the manifold solenoids are de−energized and the lift cylinder and left wing deck are held in position.

Lower Cutting Deck

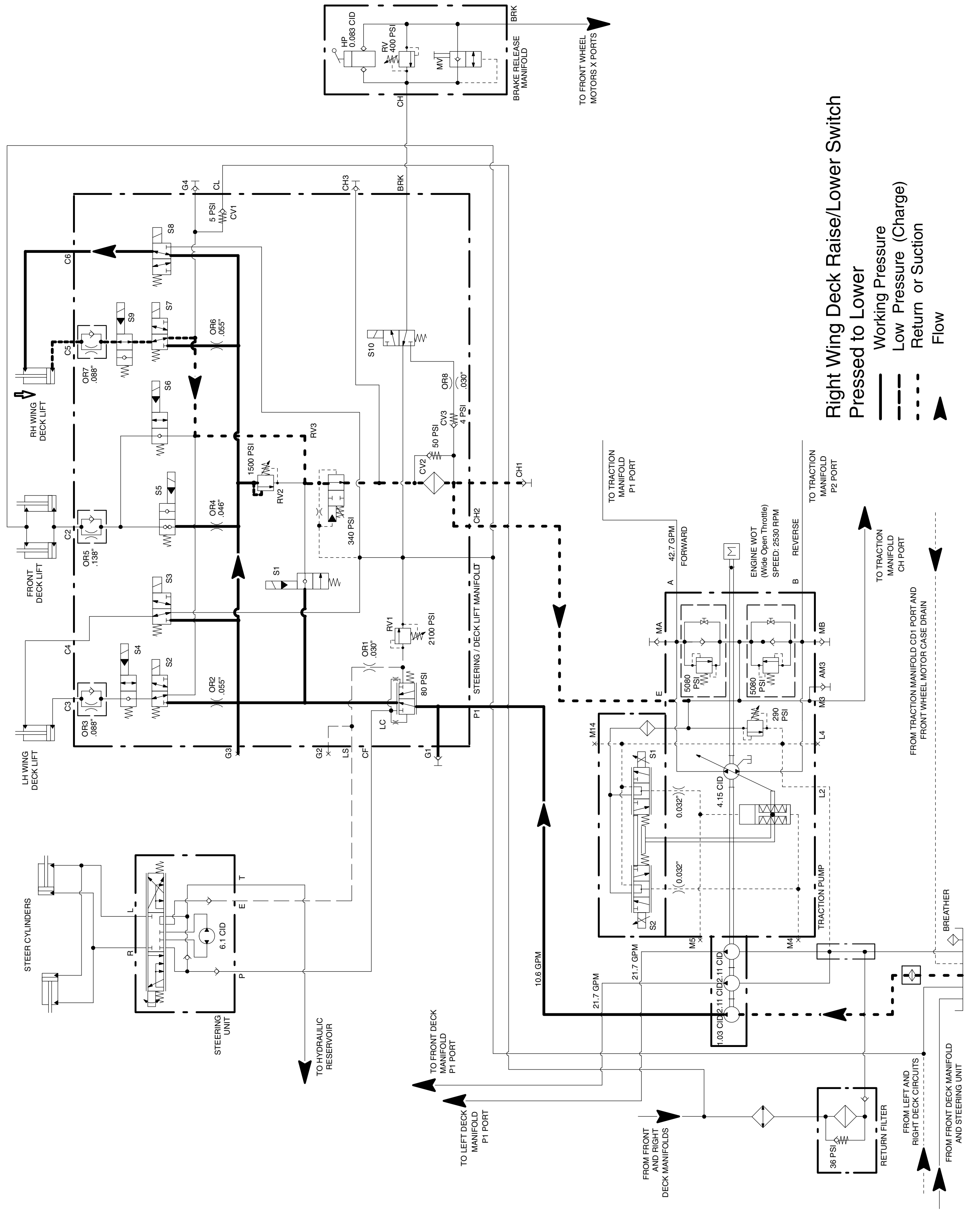

Figure 41

Lower Cutting Deck

A three (3) section gear pump is coupled to the piston (traction) pump. The gear pump section furthest from the piston pump supplies hydraulic flow to the steering, cutting deck lift and traction charge circuits. Hydraulic flow from the final pump section is directed to the appropriate circuits by a pressure compensator valve located in the steering/deck lift control manifold.

An adjustable counterbalance valve (RV3) in the steering/ deck lift control manifold maintains back pressure on the deck lift cylinders to allow some of the cutting deck weight to be transferred to the traction unit to improve traction. A relief valve (RV2) located in the steering/deck lift control manifold limits lift/lower circuit pressure to 103 bar (1500 PSI).

Each of the cutting decks (front, right and left) can be lowered independently with the use of three (3) deck lift/lower switches on the armrest console (Figure 40). Pressing the front of a switch provides an input for the secondary Toro Electronic Controller (TEC) to lower a cutting deck. The controller provides electrical outputs to solenoids in the steering/deck lift control manifold to allow appropriate valve shift to cause a cutting deck to lower.

When the cutting decks are in a stationary position, all solenoids in the steering/deck lift control manifold are de−energized. In this position, the flow from the final gear pump section is by−passed through solenoid valve (S1), the counterbalance valve (RV3), the charge oil filter and then is routed to the traction charge circuit.

Note: To lower a cutting deck, the traction speed needs to be in low range (mow) and the operator seat must be occupied.

Front Cutting Deck Lower

To lower the front cutting deck, the front of the center console switch is depressed. The switch acts as an input to the secondary TEC which provides an electrical output to solenoid valve S6 in the steering/deck lift control manifold. Energized solenoid valve S6 shifts to allow a passage for oil flow from the barrel end of the front deck lift cylinders. The weight of the cutting deck causes the front deck lift cylinders to retract and lower the front cutting deck.

When the deck switch is released, the control manifold solenoid is de−energized and the lift cylinders and front cutting deck are held in position.

Right Cutting Deck Lower

To lower the right wing deck, the front of the right console switch is depressed to act as an input to the secondary TEC. The controller provides an electrical output to solenoid valves S1, S8 and S9 in the steering/deck lift control manifold. The energized solenoid valves shift to allow a passage for circuit oil flow to the rod end of the right wing deck lift cylinder. Shifted S1 prevents oil flow from returning directly to the traction charge circuit. Shifted S8 allows an oil path to the shaft end of the lift cylinder to retract the lift cylinder and lower the right wing deck. Oil from the retracting cylinder flows through orifice OR7 to control the drop speed of the cutting deck. Flow is then directed through the shifted S9, counterbalance valve (RV3) and then is routed to the traction charge circuit.

When the deck switch is released, the control manifold solenoids are de−energized and the lift cylinder and right wing deck are held in position.

Left Cutting Deck Lower

To lower the left wing deck, the front of the left console switch is depressed to act as an input to the secondary TEC. The controller provides an electrical output to solenoid valves S1, S3 and S4 in the steering/deck lift control manifold. The energized solenoid valves shift to allow a passage for circuit oil flow to the rod end of the left wing deck lift cylinder. Shifted S1 prevents oil flow from returning directly to the traction charge circuit. Shifted S3 allows an oil path to the shaft end of the lift cylinder to retract the lift cylinder and lower the left wing deck. Oil from the retracting cylinder flows through orifice OR3 to control the drop speed of the cutting deck. Flow is then directed through the shifted S4, counterbalance valve (RV3) and then is routed to the traction charge circuit.

When the deck switch is released, the control manifold solenoids are de−energized and the lift cylinder and left wing deck are held in position.

Cutting Deck Float

Cutting deck float allows the fully lowered cutting decks to follow ground surface contours. Lift control manifold solenoid valves S4 (left deck), S6 (front deck) and S9 (right deck) are energized when the decks are fully lowered. These energized solenoids provide an oil passage to and from the lift cylinders to allow cylinder and cutting deck movement while mowing. Counterbalance pressure will affect deck float operation.

Note: If a deck is already fully lowered when the key switch is moved from OFF to RUN, the deck will not be in float until the deck lift/lower switch is momentarily pressed to lower.

PTO Mow Circuit

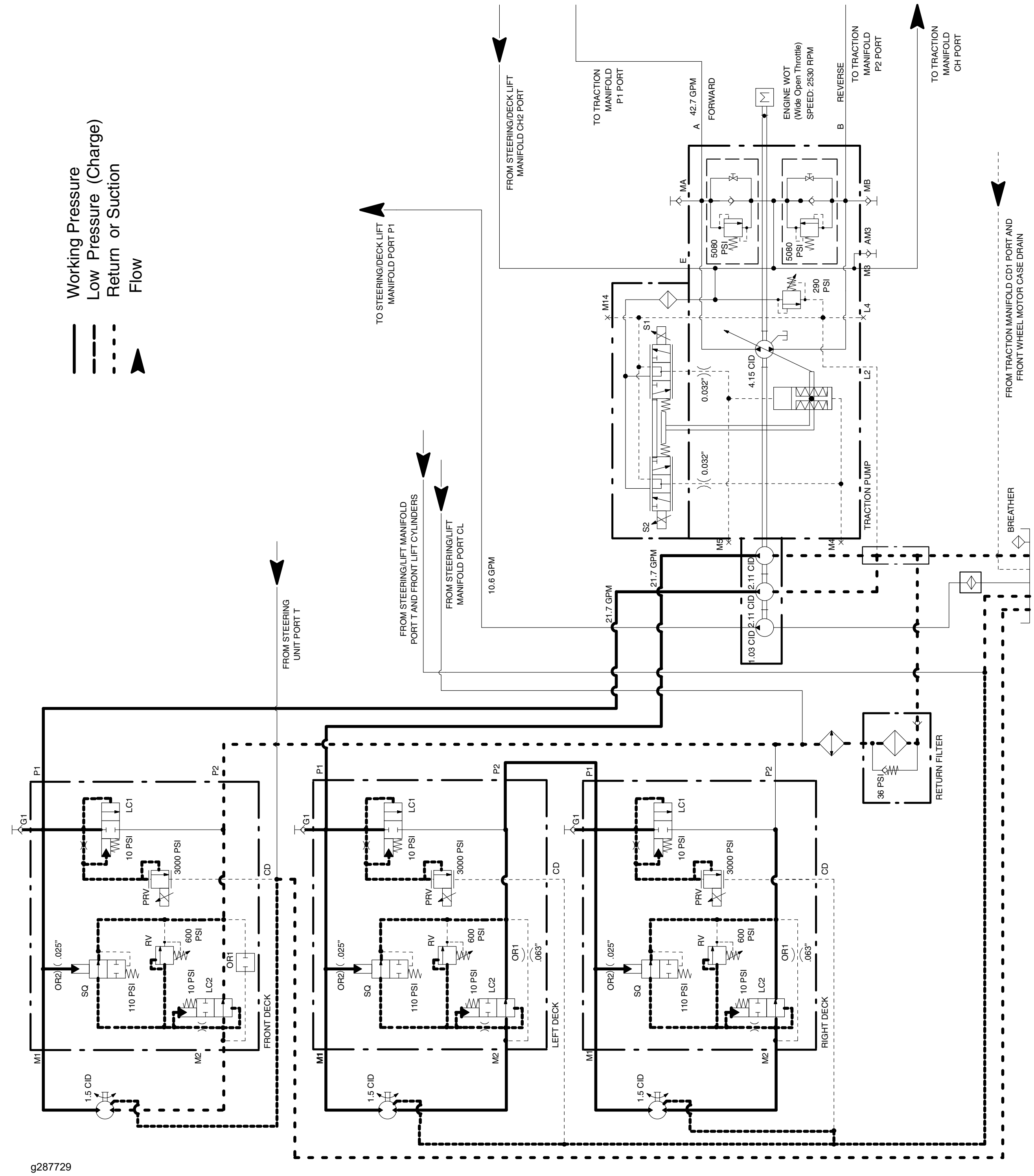

Figure 42

PTO Mow Circuit (All Deck Motors Rotating)

A three (3) section gear pump is coupled to the piston (traction) pump. Hydraulic flow for the PTO mow circuit is supplied by two (2) sections of the gear pump. The gear pump section closest to the piston pump supplies hydraulic flow in series to the right and left decks, while the middle gear pump section supplies the front deck.

Each of the three (3) cutting decks is controlled by a hydraulic control manifold equipped with a proportional relief valve (PRV), logic valves (LC1) and (LC2), a sequence valve (SQ) and a brake relief cartridge (RV). The proportional relief valve is a solenoid operated valve that also functions as the circuit relief valve when the valve is energized by the secondary Toro Electronic Controller (TEC). Mow circuit pressure can be measured at port (G1) of the hydraulic manifold for each cutting deck.

Note: To engage the mow circuit, the operator must be in the operator seat, the traction speed must be in the LOW speed (mow) position, the PTO switch must be ON and the cutting deck(s) must be fully lowered.

PTO Not Engaged

When the PTO switch is OFF or if the deck is raised with the PTO switch ON, the PTO manifold proportional relief valve (PRV) is not energized by the secondary TEC which allows a small amount of hydraulic flow through the valve. As this hydraulic flow returns to the hydraulic reservoir, a circuit pressure increase shifts logic valve LC1. The pump flow is routed through shifted LC1 and out manifold port P2 bypassing the cutting unit motor. Sequence valve (SQ), pilot direction valve (PD) and relief valve (RV) remain in the unshifted position to prevent any flow to or from the deck motor which keeps the motor and cutting blades from rotating.

Return flow from the front and right deck control manifolds is routed through the oil cooler, oil filter and then to the gear pump input. Return flow from the left deck control manifold provides supply for the right deck.

PTO Engaged

When the PTO switch is turned ON and the decks are lowered, the PTO manifold proportional relief valve (PRV) is energized by the secondary TEC. This shifted solenoid valve prevents any flow through the valve which allows the logic valve LC1 to be in its neutral position directing circuit flow toward the cutting deck motor. Gear pump flow entering the manifold is routed out manifold port M1 and to the cutting deck motor. As circuit pressure increases, the sequence valve (SQ) and then the logic valve (LC2) shift to allow the motor and cutting blades to rotate and to provide a return path for circuit flow. The return flow from the deck motor re−enters manifold port M2, is routed through shifted logic valve (LC2) and out manifold port P2. Return flow from the front and right deck control manifolds is routed through the oil cooler, oil filter and then to the gear pump input. Return flow from the left deck control manifold provides supply for the right deck. Flow for the deck motor continues as long as proportional relief valve (PRV) is energized.

Deck motor case drain leakage returns directly to the hydraulic reservoir.

PTO Circuit Relief

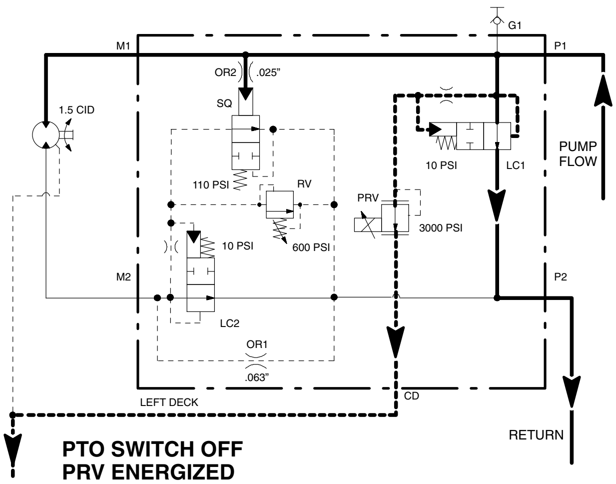

Figure 43

Maximum mow circuit pressure is limited for each deck by the proportional relief valve (PRV) in the hydraulic control manifold. The front and left deck relief valves are set at 207 bar (3000 PSI) and the right deck relief valve is set at 138 bar (2000 PSI).

Proportional relief valve (PRV) and logic cartridge (LC1) work together as a circuit relief. When increased circuit resistance is met or if a cutting blade should strike an object, the pressure increase is felt at the relief valve (PRV). If the pressure should exceed the relief valve (PRV) setting, the relief valve (PRV) will open, creating a small amount of hydraulic flow to return to tank through a manifold sensing line. This flow causes a pressure increase that shifts logic cartridge (LC1) and diverts circuit flow away from the deck motor to manifold port P2 (Figure 43). When circuit pressure lowers, relief valve (PRV) closes which returns logic cartridge LC1 back to its neutral position allowing circuit flow to return to the deck motor.

PTO Mow Circuit Cutting Deck Blade Braking

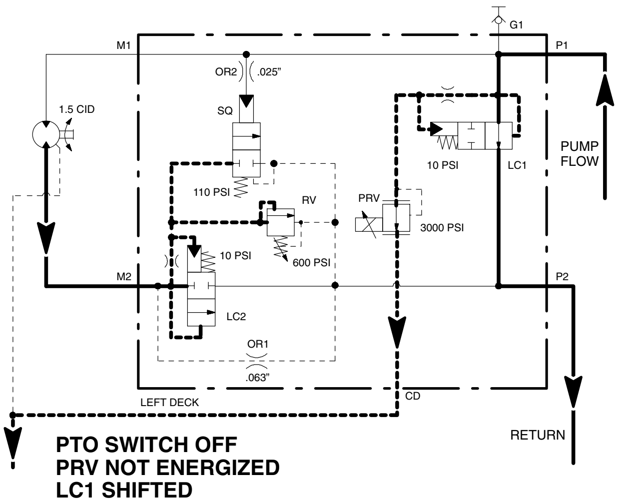

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Figure 44

When the operator turns the PTO switch OFF or if a deck is raised with the PTO switch ON, deck manifold proportional relief valve (PRV) is de−energized causing logic cartridge (LC1) to shift (refer to PTO Mow Circuit (page 5–28)). This shifted cartridge allows oil return out manifold port P2. As circuit pressure decreases, SQ and LC2 are both shifted to their neutral positions, preventing return flow from the deck motor and slowing the deck cutting blades (Figure 44).

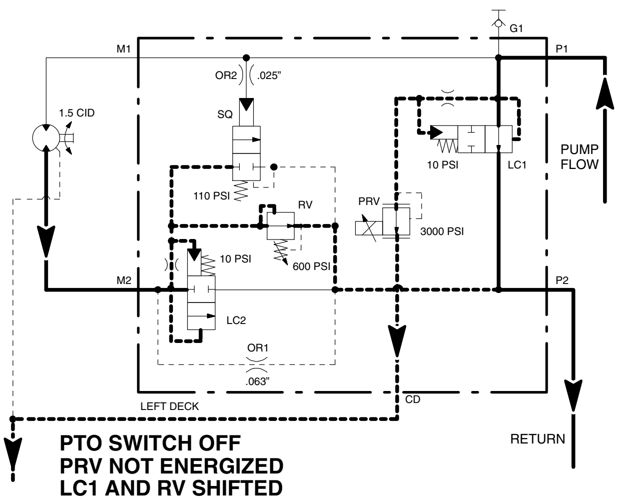

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Figure 45

PTO Mow Circuit Cutting Deck Blade Braking (continued)

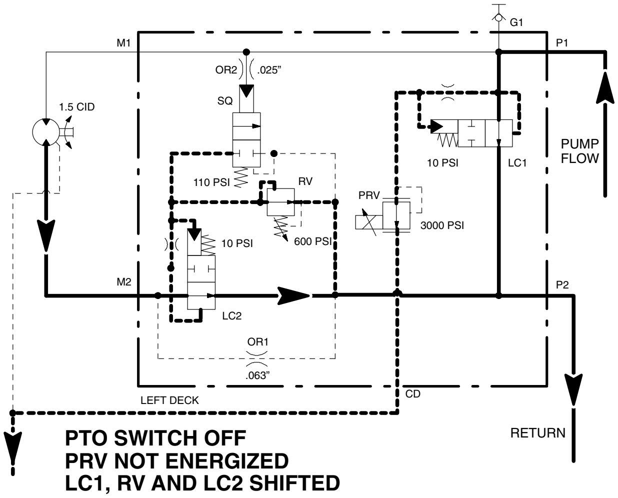

Figure 46

The inertia of the rotating cutting blades, however, effectively turns the deck motor into a pump causing an increase in pressure as the flow from the motor comes up against the closed logic cartridge (LC2). When this pressure builds to approximately 41 bar (600 PSI), relief valve (RV) opens which allows a small amount of hydraulic flow to return to tank through a manifold sensing line (Figure 45). This flow causes a pressure increase that shifts logic cartridge LC2 to once again allow oil flow from the motor (Figure 46). When return pressure drops below 41 bar (600 PSI), relief valve (RV) reseats and causes LC2 to close again blocking return flow from the deck motor to further slow the cutting blades. This action of the brake relief valve opening and the logic cartridge shifting occurs several times in a very short time frame as the blades finally come to a stop. Once the blades have stopped, logic cartridge LC2 remains in the unshifted position to keep the deck motor from rotating.

Steering Circuit

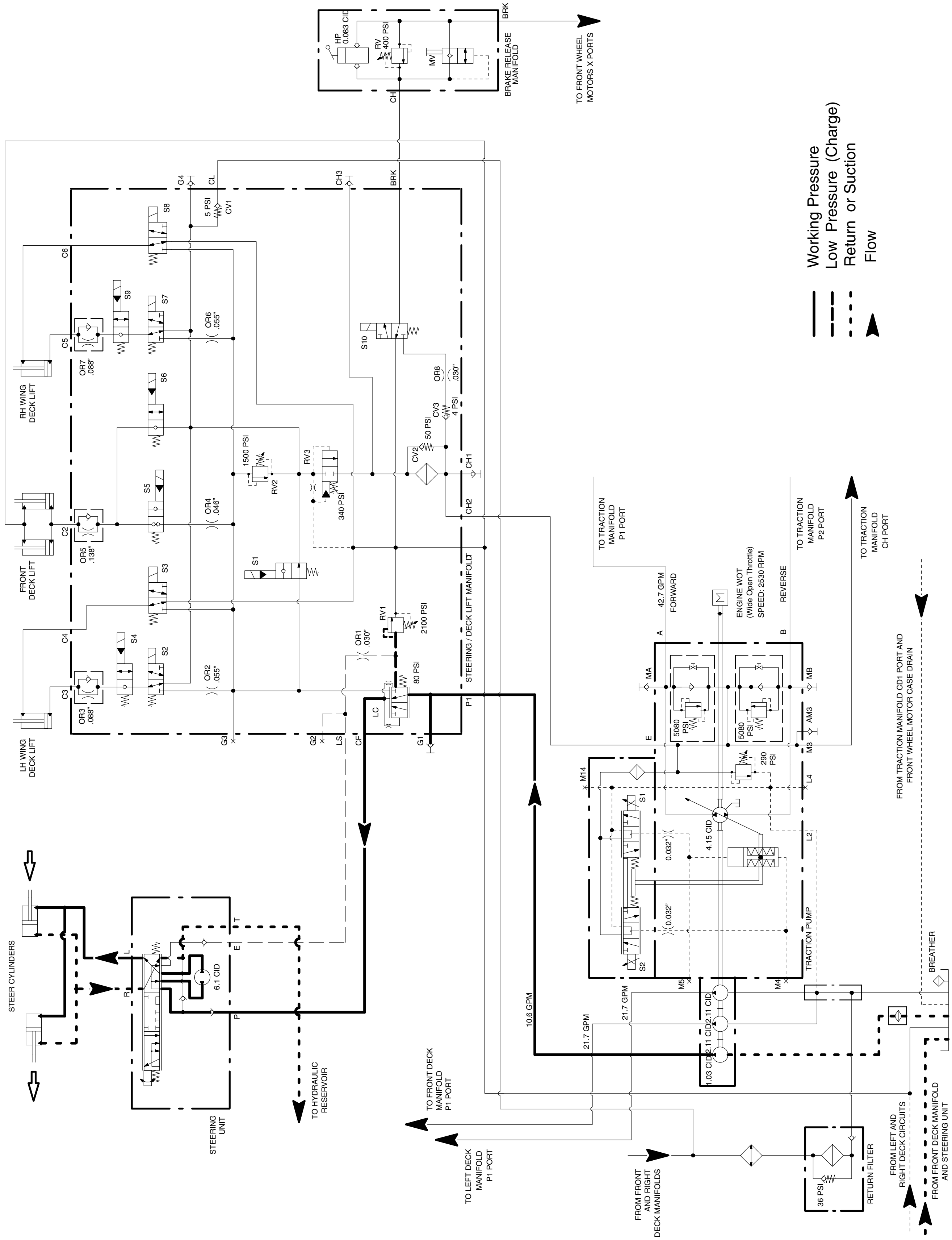

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Figure 47

Steering Circuit (Left Turn Shown)

A three (3) section gear pump is coupled to the piston (traction) pump. The gear pump section furthest from the piston pump supplies hydraulic flow to the steering, cutting deck lift and traction charge circuits. Hydraulic flow from the final pump section is directed to the appropriate circuits by a pressure compensator valve located in the steering/deck lift control manifold.

The steering control valve is a closed center, load sensing valve. The steering control valve senses the oil flow that is needed for steering and the pressure compensator valve (LC) in the steering/deck lift control manifold will supply the correct amount of oil. Gear pump oil flow that is not used for the steering circuit is available for the traction charge and deck lift circuits.

When the steering wheel is in the neutral, at rest position and the engine is running, hydraulic oil from the final gear pump section enters the steering/deck lift control manifold port P1, flows through the pressure compensator valve (LC) and is routed to the steering control valve where it dead heads at the control valve spool. Oil is also sent to both ends of the (LC) spool. On one end of the spool, oil is directed to both the steering relief valve (RV1) and also to the OR1 orifice and out the manifold LS port to the steering control valve. This flow provides steering load sensing that is directed through a small passage in the steering control valve spool and sleeve before returning to the hydraulic reservoir. As long as this load sense flow is returning to the reservoir due to no steering input, the pressure compensator valve (LC) spool is shifted to direct pump section flow to the traction charge and deck lift circuits.

Left Turn

When a left turn is made with the engine running, the turning of the steering wheel positions the steering unit spool valve so that the load sense flow is blocked off. Without load sense flow, pressures on the ends of manifold pressure compensator valve (LC) start to equalize causing (LC) to move toward its neutral position which allows the needed oil to the steering control valve for turning. Oil is routed out manifold port CF, into steering valve port P, through the steering control spool, is drawn through the rotary meter section and out the L port to the steering cylinders. The rotary meter ensures that the oil flow to the cylinders is proportional to the amount of the turning on the steering wheel. Fluid leaving the cylinders flows back through steering valve R port, the spool valve, out the T port and is then returned to the hydraulic reservoir.

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

Right Turn

When a right turn is made with the engine running, the turning of the steering wheel positions the steering unit spool valve so that the load sense flow is blocked off. Without load sense flow, pressures on the ends of manifold pressure compensator valve (LC) start to equalize causing (LC) to move toward its neutral position which allows the needed oil to the steering control valve for turning. Oil is routed out manifold port CF, into steering valve port P, through the steering control spool, is drawn through the rotary meter section and out the R port to the steering cylinders. The rotary meter ensures that the oil flow to the cylinders is proportional to the amount of the turning on the steering wheel. Fluid leaving the cylinders flows back through the steering valve L port, the spool valve, out the T port and is then returned to the hydraulic reservoir.

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

Steering Relief Operation

When the steering cylinders reach the end of their stroke or if a rear wheel should encounter an obstruction (e.g. a curb) while steering, the pressure in the steering circuit will rise. Relief valve (RV1) in the steering/deck lift manifold senses this pressure increase. When steering circuit pressure builds to approximately 145 bar (2100 PSI), relief valve (RV1) opens and allows hydraulic flow to return to the hydraulic reservoir. This action causes the spool of pressure compensator valve (LC) to shift and send oil away from the steering circuit and to the deck lift and traction charge circuits. Relief valve (RV1) controls the action of pressure compensator valve (LC) and allows the valve to divert only enough oil flow to the steering circuit to maintain relief pressure.

Testing

The most effective method for isolating problems in the hydraulic system is by using hydraulic test equipment such as pressure gauges and flow meters in the circuits during various operational checks (see Special Tools (page 2–15)).

Before Performing Hydraulic Tests

IMPORTANT

All obvious areas such as oil supply, filter, binding linkages, loose fasteners or improper adjustments must be checked before assuming that a hydraulic component is the source of the problem.

Precautions for Hydraulic Testing

CAUTION

Failure to use gauges with recommended pressure (bar/PSI) rating as listed in test procedures could result in damage to the gauge and possible personal injury from leaking hot oil.

CAUTION

All testing should be performed by two (2) people. One person should be in the seat to operate the machine and the other should read and record test results.

CAUTION

Before opening the hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure (page 5–3).

WARNING

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

Precautions for Hydraulic Testing (continued)

WARNING

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved and all rotating machine parts must be stopped. Stop engine; lower or support attachments.

---

1. Clean machine thoroughly before disconnecting or disassembling any hydraulic components. Always keep in mind the need for cleanliness when working on hydraulic equipment. Contamination will cause excessive wear of hydraulic components.
2. Put metal caps or plugs on all hydraulic lines left open or exposed during testing or removal of components.
3. The engine must be in good operating condition. Use a phototac when performing a hydraulic test. Engine speed can affect the accuracy of the tester readings.
4. The inlet and the outlet hoses for tester with pressure and flow capabilities must be properly connected and not reversed to prevent damage to the hydraulic tester or components.
5. When using hydraulic tester with pressure and flow capabilities, open tester load valve completely before starting the engine to minimize the possibility of damaging components.
6. Install hose fittings finger tight and far enough to make sure that they are not cross−threaded before tightening them with a wrench.
7. Position tester hoses to prevent rotating machine parts from contacting and damaging the hoses or tester.
8. Check oil level in the hydraulic reservoir. After connecting test equipment, make sure tank is full.
9. Check control linkages for improper adjustment, binding or broken parts.
10. After installing test gauges, run engine at low speed and check for any hydraulic oil leaks.
11. All hydraulic tests should be made with the hydraulic oil at normal operating temperature (54 to 66 ºC (130 to 150 ºF)).
12. Before returning machine to use, make sure that hydraulic reservoir has correct fluid level. Also, check for hydraulic leaks after test equipment has been removed from hydraulic system.

Which Hydraulic Tests Are Necessary?

Before beginning any hydraulic test, identify if the problem is related to the traction circuit, PTO (mow) circuit, deck lift or steering circuit. Once the faulty system has been identified, perform tests that relate to that circuit.

1. If a traction circuit problem exists, consider performing one or more of the following tests: Traction Circuit Charge Pressure, Traction Circuit Relief Pressure, Counterbalance Pressure and/or Piston (Traction) Pump Flow Tests.
2. If a PTO (mow) circuit problem exists, consider performing one or more of the following tests: Cutting Deck Circuit Pressure, Cutting Deck Circuit Relief Pressure, Cutting Deck Motor Case Drain Leakage and/or Gear Pump Flow Tests.

Which Hydraulic Tests Are Necessary? (continued)

3. If a lift circuit problem exists, consider performing one or more of the following tests: Lift/Lower Circuit Relief Pressure, Counterbalance Pressure and/or Gear Pump Flow Tests.
4. If a steering circuit problem exists, consider performing one or more of the following tests: Steering Circuit Relief Pressure, Steering Cylinder Internal Leakage and/or Gear Pump Flow Tests.

Traction Circuit Charge Pressure Test (Using Pressure Gauge)

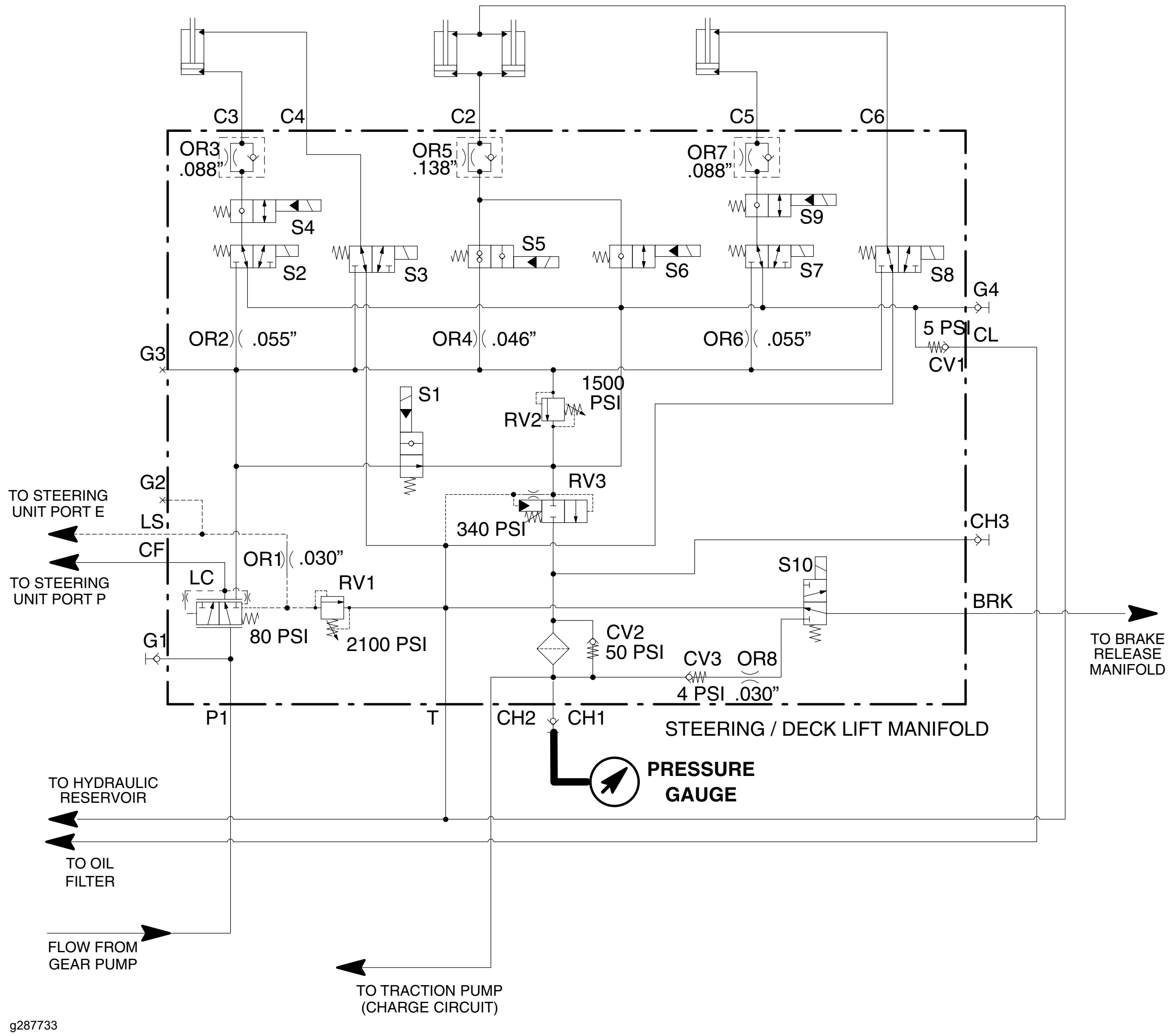

Figure 48

The traction circuit charge pressure test should be performed to make sure that the traction charge circuit is functioning correctly. After determining charge pressure with machine stationary, monitoring charge pressure while driving the machine can determine if problems exist with traction circuit components.

CAUTION

Prevent personal injury and/or damage to equipment. Read all WARNINGS, CAUTIONS and Precautions for Hydraulic Testing at the beginning of this section.

Procedure for Traction Circuit Charge Pressure Test

1. Park machine on a level surface, lower cutting decks fully, disengage PTO and stop engine. Remove key from key switch.
2. Make sure that hydraulic tank is full.
3. Raise hood to allow access to steering/deck lift manifold that is secured to right side frame rail.

Procedure for Traction Circuit Charge Pressure Test (continued)

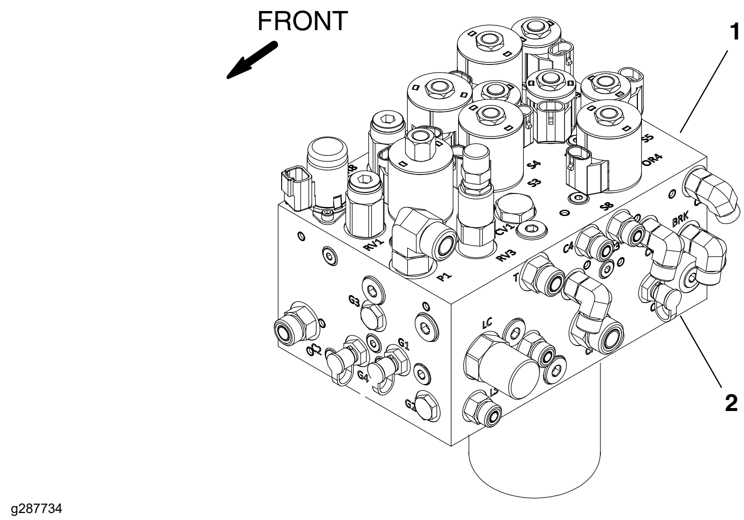

Figure 49

1. Steering/lift manifold
2. Port CH1 test fitting

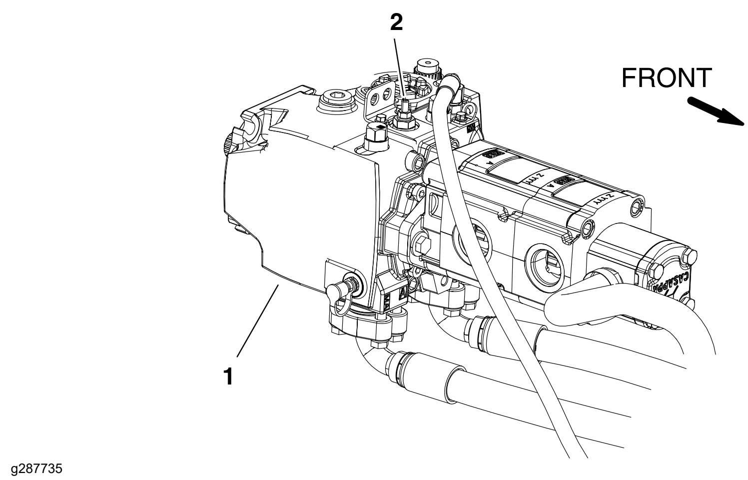

Figure 50

1. Piston pump
2. Charge relief valve

4. Connect a 70 Bar (1000 PSI) pressure gauge with hydraulic hose attached to test fitting on steering/deck lift manifold port CH1 (Figure 49). Route gauge hose to allow operator to view the gauge.
5. After installing pressure gauge, start engine and run at low idle speed. Check for hydraulic leakage at tester connections and correct before proceeding with test.
6. Make sure hydraulic oil is at normal operating temperature (54 to 66 ºC (130 to 150 ºF)) by operating the machine for approximately ten (10) minutes.
7. Operate the engine at high idle speed (2530 RPM) with no load on the hydraulic system.

   GAUGE READING TO BE: 25 to 27 bar (370 to 390 PSI)
8. Stop engine and record test results.

Procedure for Traction Circuit Charge Pressure Test (continued)

9. If there is no pressure, or pressure is low, check the following items:

   A. Restriction in gear pump intake line or reservoir strainer.

   B. Inspect charge pressure relief valve located in the piston pump and adjust if necessary (see Sauer− Danfoss H1 Closed Circuit Axial Piston Pumps Service Manual). Keep in mind that operating the machine with an elevated charge pressure can reduce swash−plate response time.

   C. Consider that a forward or reverse relief valve in the piston pump is leaking or damaged.

   D. Leakage in the steering/deck lift manifold will affect charge circuit pressure. Consider that damaged cartridge seals in this manifold will cause low charge circuit pressure in addition to affecting normal operation of steering and/or deck lift/lower circuits.

   E. If necessary, check for internal damage or worn parts in the final gear pump section which supplies the charge circuit with hydraulic flow. A worn or damaged final gear pump section will also affect cutting deck lift/lower and steering operation.

10. Next, with the pressure gauge still connected to the charge pressure test port, take a gauge reading while operating the machine in forward and reverse. Start the engine, release parking brake and run engine at high idle speed (2530 RPM). Push the traction pedal forward while monitoring the pressure gauge. Repeat for reverse direction. Stop engine and record test results.

11. If charge pressure meets specifications under no load conditions (step 6 above), but consistently drops more than 15% when under traction load (step 9 above), the piston (traction) pump and/or wheel motor(s) should be suspected of wear and inefficiency. When the pump and/or wheel motor(s) are worn or damaged, the charge circuit is not able to keep up with internal leakage in traction circuit components.

12. When charge pressure testing is complete, disconnect pressure gauge from manifold test fitting. Lower and secure hood.

Traction Circuit Relief Pressure Test (Using Pressure Gauge)

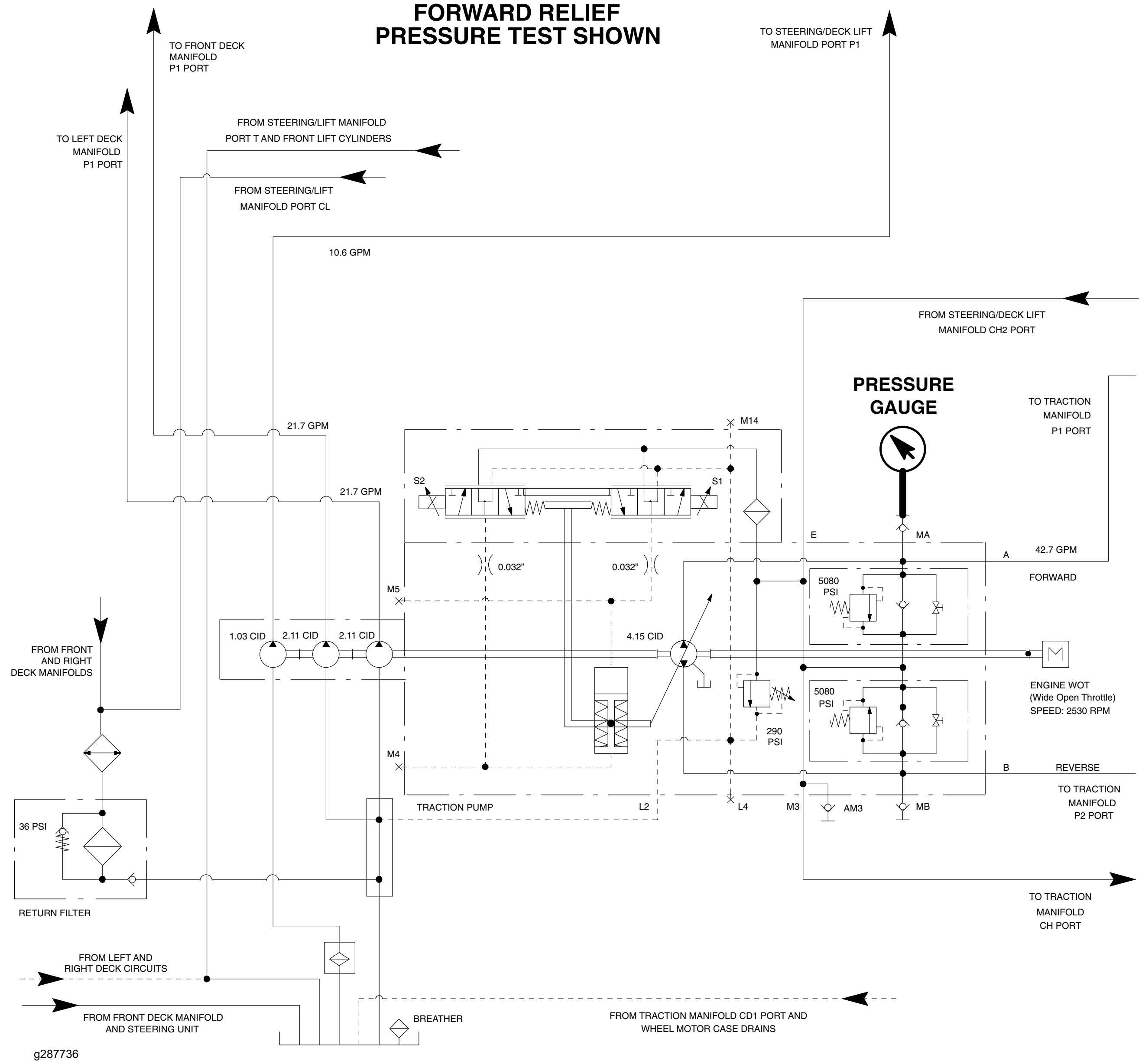

Figure 51

The traction circuit relief pressure test should be performed to make sure that forward and reverse traction circuit relief pressures are correct.

CAUTION

Prevent personal injury and/or damage to equipment. Read all WARNINGS, CAUTIONS and Precautions for Hydraulic Testing at the beginning of this section.

Procedure for Traction Circuit Relief Pressure Test

1. Make sure hydraulic oil is at normal operating temperature (54 to 66 ºC (130 to 150 ºF)) by operating the machine for approximately ten (10) minutes. Make sure the hydraulic tank is full.

CAUTION

Perform Traction Circuit Relief Pressure Test in an open area, away from people and obstructions.

2. Drive machine to an open area, fully raise cutting decks, engage parking brake and turn the engine off.

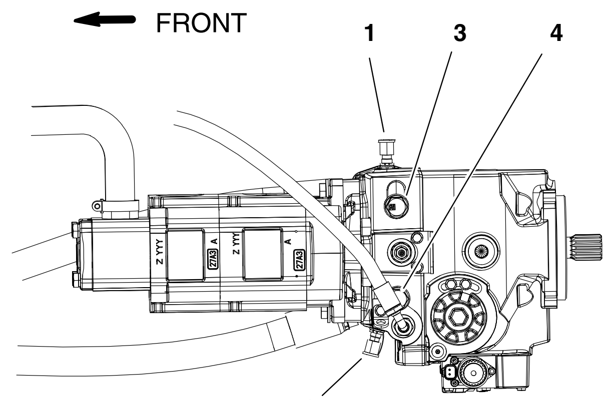

Figure 52

1. Forward test port (MA)
2. Reverse test port (MB)
3. Forward relief valve
4. Reverse relief valve

3. Connect a 700 Bar (10,000 PSI) pressure gauge with hydraulic hose attached to traction circuit test port for function to be checked (Figure 52). Route gauge hose to allow operator to view the gauge.
4. After installing pressure gauge, start engine and run at low idle speed. Check for hydraulic leakage at tester connections and correct before proceeding with test.
5. Sit on seat and operate the engine at high idle speed (2530 RPM). Make sure that machine is in the high range traction speed (transport).
6. Drive machine so front tires are wedged against an immovable object (e.g. a curb) to prevent wheel rotation in the direction to be tested. An alternative would be to position the machine on an inclined surface to allow a high traction load in the direction to be tested.
7. Slowly depress the traction pedal in the appropriate direction (forward or reverse). While pushing traction pedal, look at pressure reading on gauge. As the traction relief valve lifts, the gauge needle will stop momentarily.

   GAUGE READING TO BE:

   402 to 411 bar (5825 to 5965 PSI) in forward (MA port)

   397 to 407 bar (5760 to 5910 PSI) in reverse (MB port)
8. Release traction pedal and stop engine. Record test results.

Procedure for Traction Circuit Relief Pressure Test (continued)

9. If traction relief pressure is low, make sure that bypass (tow) valves in traction pump are fully seated. Then, inspect traction pump relief valves (Figure 52). Clean or replace valves as necessary. These cartridge type valves are factory set and are not adjustable. If relief valves are in good condition, piston (traction) pump or wheel motors should be suspected of wear and inefficiency.

   Note: Forward and reverse relief valves are identical. Relief valves can be switched in piston (traction) pump to help in identifying a faulty relief valve.

10. When relief pressure testing is complete, disconnect pressure gauge from test port.

Counterbalance Pressure Test (Using Pressure Gauge)

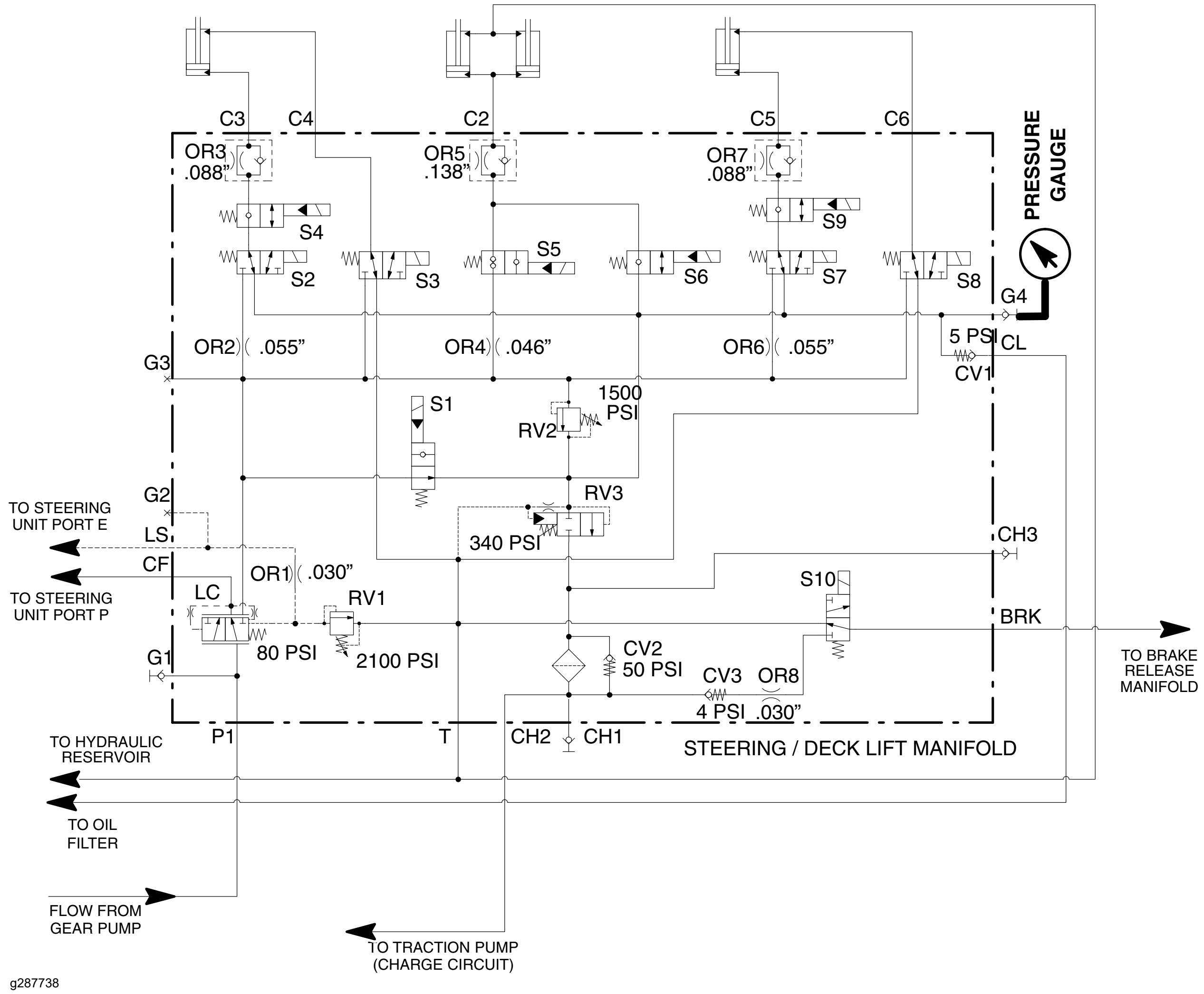

Figure 53

The counterbalance pressure test will determine if cutting deck counterbalance pressure is correct.

CAUTION

Prevent personal injury and/or damage to equipment. Read all WARNINGS, CAUTIONS and Precautions for Hydraulic Testing at the beginning of this section.

Procedure for Counterbalance Pressure Test

1. Make sure hydraulic oil is at normal operating temperature (54 to 66 ºC (130 to 150 ºF)) by operating the machine for approximately ten (10) minutes. Make sure the hydraulic tank is full.
2. Park machine on a level surface, lower cutting decks fully, disengage PTO, engage parking brake and stop engine. Remove key from key switch.
3. Raise hood to allow access to steering/deck lift manifold that is secured to right side frame rail.

Procedure for Counterbalance Pressure Test (continued)

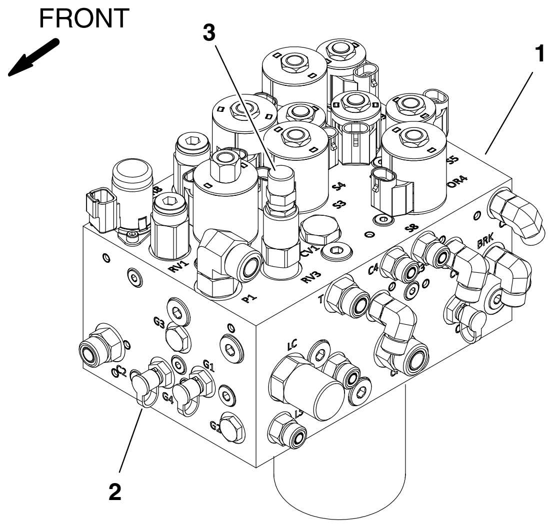

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Figure 54

1. Steering/lift manifold
2. Test fitting (port G4)
3. Counterbalance valve

4. Connect a 70 Bar (1000 PSI) pressure gauge to test fitting in port G4 on steering/deck lift control manifold (Figure 54).
5. After installing pressure gauge, start engine and run at low idle speed. Check for hydraulic leakage at tester connections and correct before proceeding with test.
6. Operate the engine at high idle speed (2530 RPM) with no load on the system. Do not engage the cutting decks.

   GAUGE READING TO BE: 21 to 29 bar (305 to 425 PSI).

7. Stop engine and record test results.

   Note: If hydraulic oil is not at normal operating temperature or if traction charge relief pressure is high, counterbalance pressure will be higher than normal.

8. If necessary, adjust the counterbalance valve (RV3) so that counterbalance pressure is correct (see Adjust Manifold Relief Valves (page 5–72)). The counterbalance valve (RV3) is located on the top of the steering/deck lift manifold (Figure 54).
9. When counterbalance testing is complete, disconnect pressure gauge from test fitting. Lower and secure hood.

Piston (Traction) Pump Flow Test (Using Tester with Pressure Gauge & 40 GPM Flow Meter)

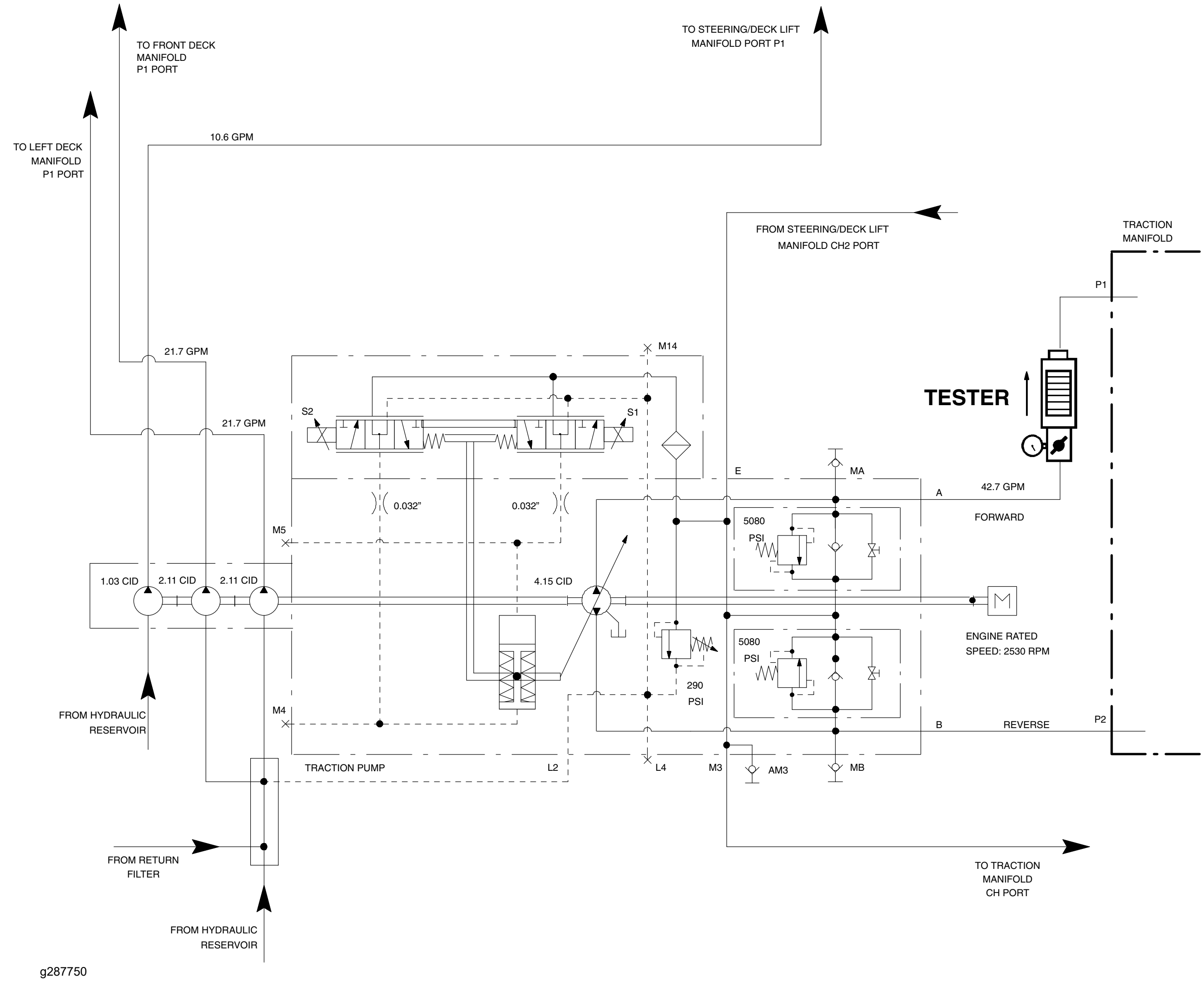

Figure 55

The piston (traction) pump flow test measures piston pump output (flow) in high range (transport). During this test, pump load is created at the flow meter using the adjustable load valve on the tester.

IMPORTANT

At normal engine high idle speed, traction circuit flow for the Groundsmaster 5900/5910 exceeds 150 LPM (40 GPM). For this test, use 40 GPM Hydraulic Tester #AT40002 (pressure and flow) and Hydraulic Hose Kit (see Special Tools (page 2–15)) and make sure that engine speed is adjusted as described in the following test procedure. If engine is run at normal high idle speed while testing, hydraulic tester damage will likely occur.

Note: Two people will be required to complete the following test procedure.

Note: Before performing piston pump flow test, make sure that traction speed limit is set to 100% in forward transport mode using the InfoCenter settings menu.

CAUTION

Prevent personal injury and/or damage to equipment. Read all WARNINGS, CAUTIONS and Precautions for Hydraulic Testing at the beginning of this section.

Procedure for Piston (Traction) Pump Flow Test

1. Park machine on a level surface, raise and lock the cutting decks, disengage PTO, engage parking brake and stop engine. Remove key from key switch. Make sure hydraulic oil is at normal operating temperature (54 to 66 ºC (130 to 150 ºF)).

CAUTION

All wheels will be off the ground and rotating during this test. Make sure machine is supported so it will not move and accidentally fall to prevent injuring anyone near the machine.

2. Raise and support machine so all wheels are off the ground (see Jacking Instructions (page 1–6)).

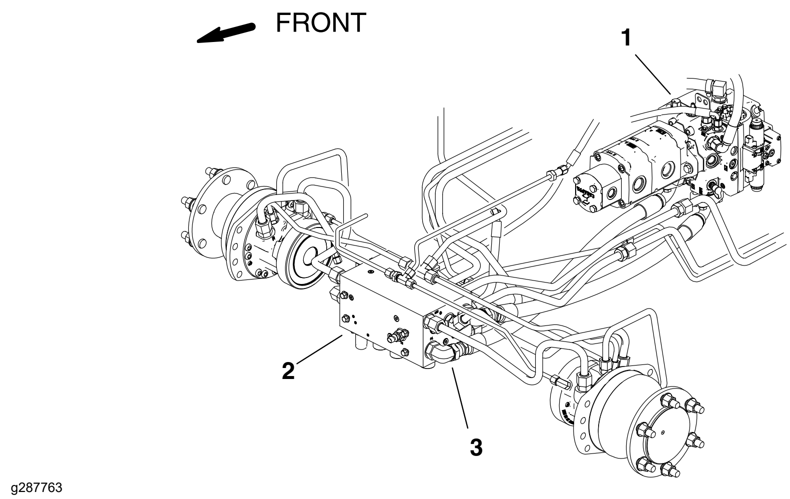

Figure 56

1. Piston pump
2. Traction manifold
3. Manifold P1 port

3. Thoroughly clean junction of hydraulic hose from piston pump A port and 90º fitting in the P1 port on side of traction manifold which is attached to the bottom of the front axle frame (Figure 56). Disconnect hose from 90º fitting.

IMPORTANT

When tester is installed, make sure that the oil flow indicator arrow on the flow gauge is showing that oil will flow from the disconnected hydraulic hose, through the tester and into the traction manifold fitting.

Procedure for Piston (Traction) Pump Flow Test (continued)

4. Install 40 GPM tester (flow and pressure) in series between disconnected hose and manifold fitting to allow flow from piston (traction) pump to tester. Use hydraulic hose kit (see Special Tools (page 2–15)) to connect tester to machine. Make sure that fitting and hose connections are properly tightened. Also, make sure the flow control valve on tester is fully open.
5. After installing tester, start engine and run at low idle speed. Check for hydraulic leakage at tester connections and correct before proceeding with test.
6. Slowly increase engine speed while using the Info- Center Display to adjust engine speed to 2200 RPM (NOT normal high idle speed).
7. With engine running at 2200 RPM, disengage the parking brake, select high range (transport) operation and slowly push traction pedal to fully forward position. Keep pedal fully depressed in the fully forward position.
8. Have second person watch pressure gauge on tester carefully while slowly closing the flow control valve until 69 bar (1000 PSI) is obtained. Verify with the InfoCenter display that the engine speed is still 2200 RPM.

   Note: If engine speed drops during testing, pump flow will decrease and flow test results will be inaccurate.
9. Observe flow gauge. Flow indication should be approximately 142 LPM (37.5 GPM).
10. Once piston pump flow is identified, release traction pedal to the neutral position, open flow control valve on tester, lower engine speed to low idle and shut off engine. Record test results.
11. If flow is less than 127 LPM (33.6 GPM), consider the following:
    A. The traction pedal is not calibrated correctly (see Traction Pedal Position Sensor Calibration (page 6–51)).
    B. The piston pump swash plate is not being rotated fully (e.g. traction speed is not set to 100%).
    C. The forward traction relief valve is leaking or faulty.
    D. The piston pump needs to be repaired or replaced as necessary.
12. Make necessary repairs before performing any additional traction circuit tests.
13. When testing is complete, disconnect tester from manifold fitting and machine hydraulic hose. Reconnect hose to manifold fitting. Lower machine to ground.
14. Make sure that the hydraulic tank is full before returning machine to operation.

Cutting Deck Circuit Pressure Test (Using Pressure Gauge)

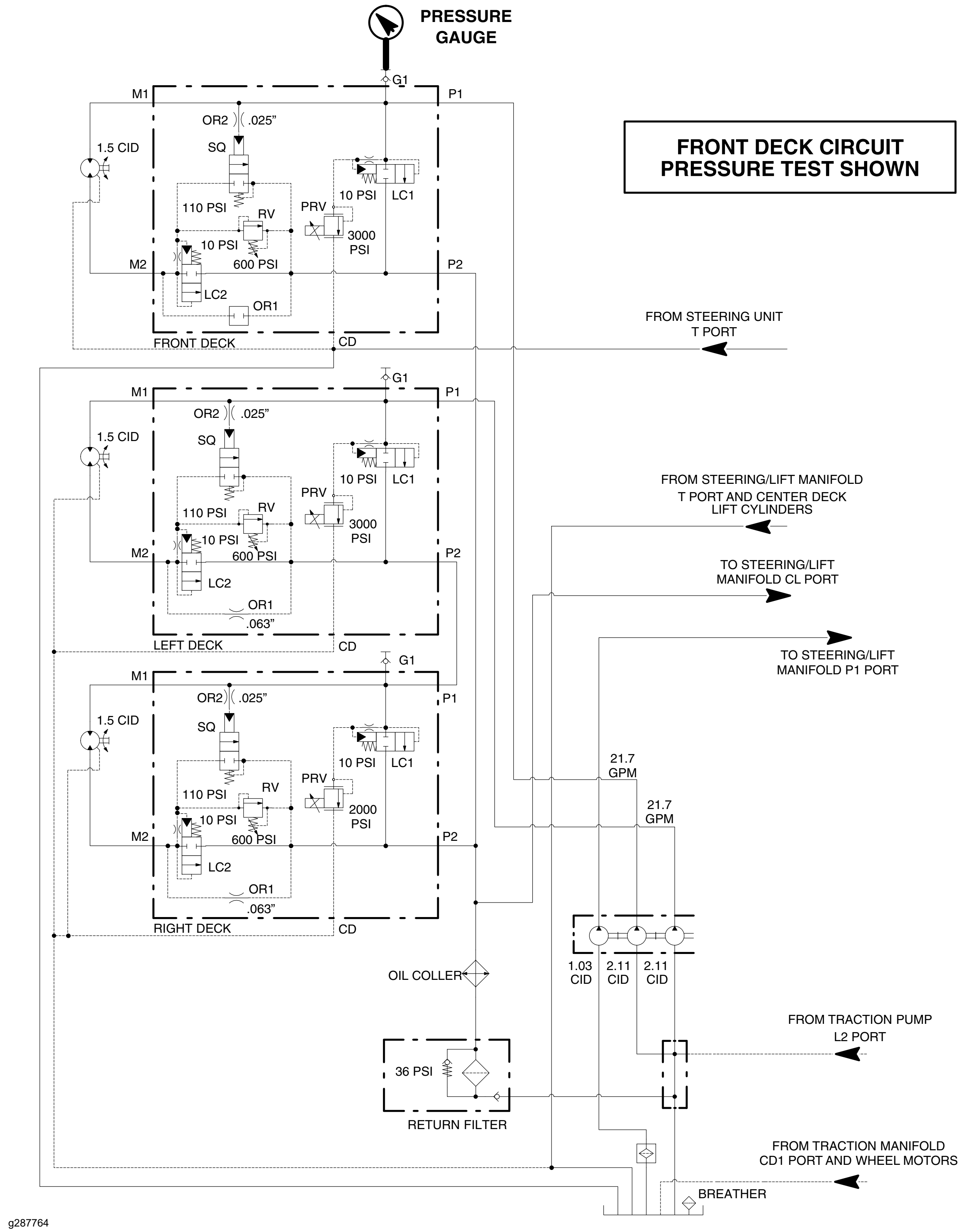

Figure 57

The cutting deck circuit pressure test should be performed to make sure that the cutting deck circuit pressures are correct.

CAUTION

Prevent personal injury and/or damage to equipment. Read all WARNINGS, CAUTIONS and Precautions for Hydraulic Testing at the beginning of this section.

Procedure for Cutting Deck Circuit Pressure Test

1. Make sure hydraulic oil is at normal operating temperature (54 to 66 ºC (130 to 150 ºF)) by operating the machine for approximately ten (10) minutes. Make sure the hydraulic tank is full.
2. Park machine on a level surface, lower cutting decks fully, disengage PTO, engage parking brake and stop engine. Remove key from key switch.

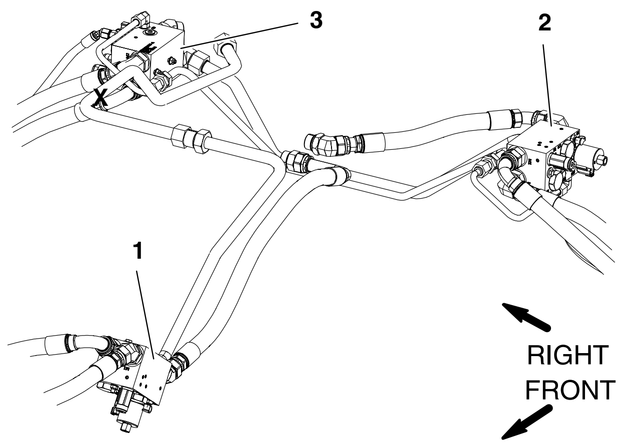

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Figure 58

1. Front deck manifold
2. LH deck manifold
3. RH deck manifold

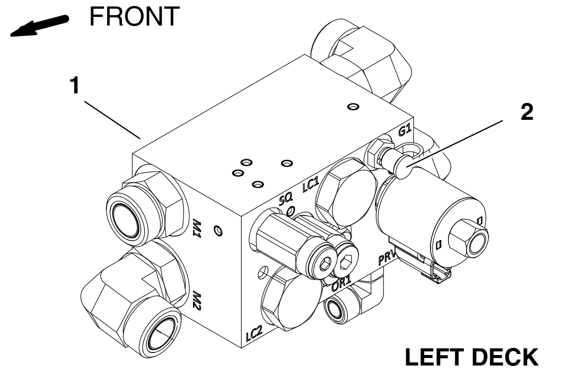

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Figure 59

1. Left deck manifold
2. Test fitting (port G1)

3. Locate deck manifold for the cutting deck to be tested (Figure 58).
4. Install 350 Bar (5000 PSI) pressure gauge with hydraulic hose attached to deck manifold test fitting in port G1 for the deck to be tested. Port G1 is next to solenoid valve PRV on the manifold. The left deck manifold is shown in Figure 59 as an example. Route gauge hose to allow operator to view the gauge.

Procedure for Cutting Deck Circuit Pressure Test (continued)

5. After installing pressure gauge, start engine and run at low idle speed. Check for hydraulic leakage at tester connections and correct before proceeding with test.

CAUTION

Keep away from cutting decks during test to prevent personal injury from the cutting blades.

6. Sit on seat and operate the engine at high idle speed (2530 RPM). Release parking brake and engage the cutting decks.
7. Watch pressure gauge carefully while mowing with the machine.
8. Cutting deck circuit pressure for front and left decks should be from 69 to 224 bar (1000 to 3250 PSI). Pressure for the right deck should be from 69 to 148 bar (1000 to 2150 PSI). Cutting deck circuit pressures will vary depending on mowing conditions.
9. Disengage cutting decks and shut off engine. Record test results.
10. When testing is completed, disconnect pressure gauge with hose from manifold test port.
11. Repeat test for other cutting decks if necessary.
12. Make sure that the hydraulic tank is full before returning machine to operation.

Cutting Deck Circuit Relief Pressure Test (Using Tester with Pressure Gauge and 40 GPM Flow Meter)

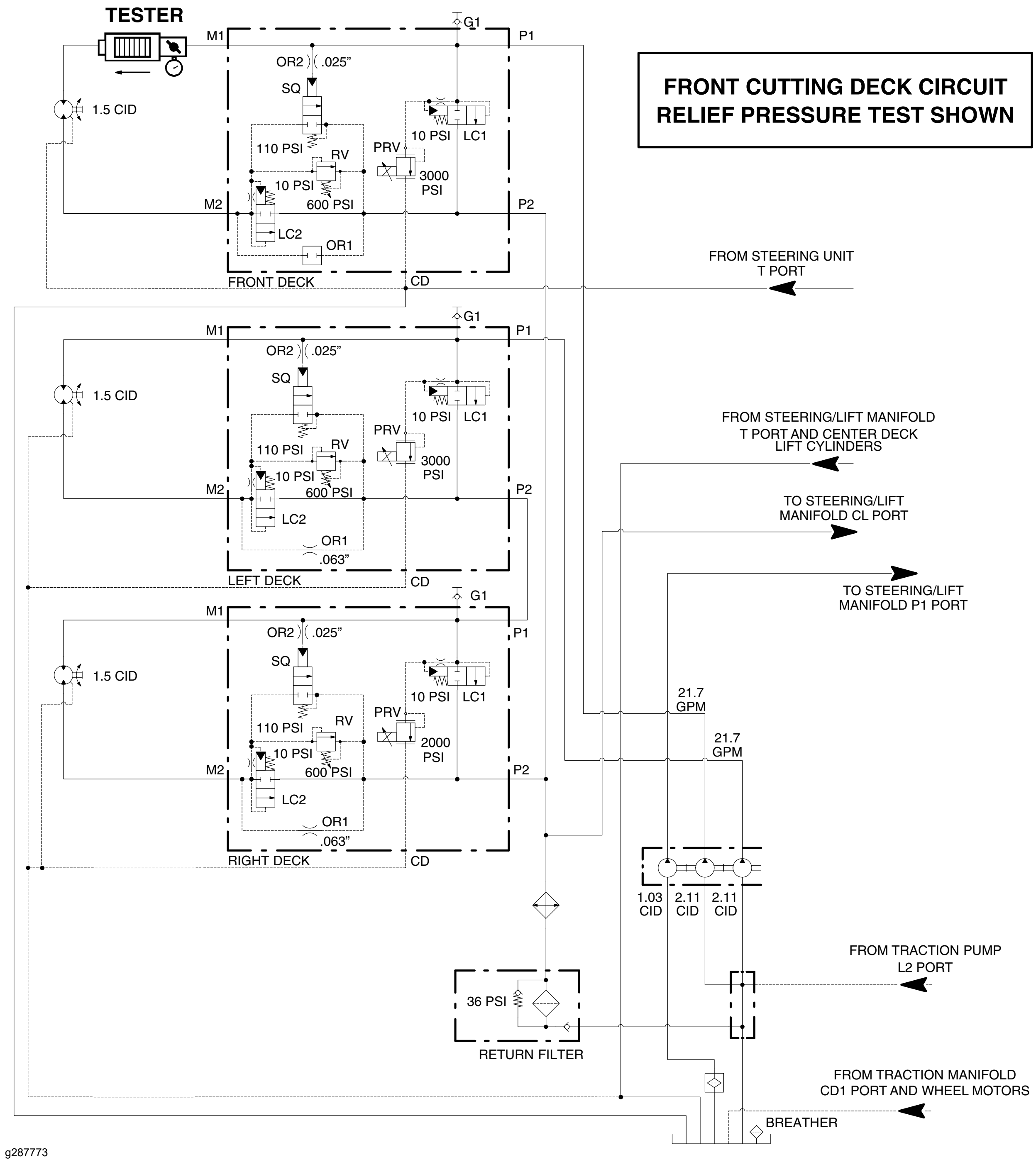

Figure 60

The cutting deck circuit relief pressure test should be performed to make sure that the deck circuit relief pressures are correct.

IMPORTANT

To prevent hydraulic tester damage, use 40 GPM Hydraulic Tester #AT40002 (pressure and flow) and Hydraulic Hose Kit for this test (see Special Tools (page 2–15)).

CAUTION

Prevent personal injury and/or damage to equipment. Read all WARNINGS, CAUTIONS and Precautions for Hydraulic Testing at the beginning of this section.

Procedure for Cutting Deck Circuit Relief Pressure Test

1. Make sure hydraulic oil is at normal operating temperature (54 to 66 ºC (130 to 150 ºF)) by operating the machine for approximately ten (10) minutes. Make sure the hydraulic tank is full.
2. Park machine on a level surface, lower cutting decks fully, disengage PTO, engage parking brake and stop engine. Remove key from key switch.

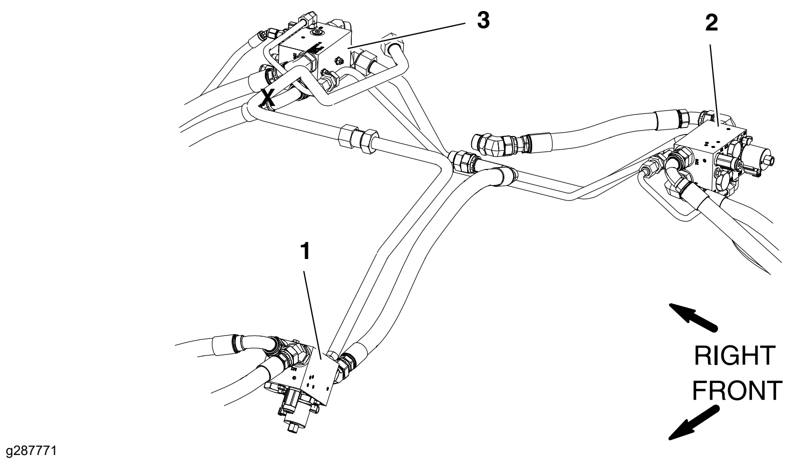

Figure 61

1. Front deck manifold
2. LH deck manifold
3. RH deck manifold

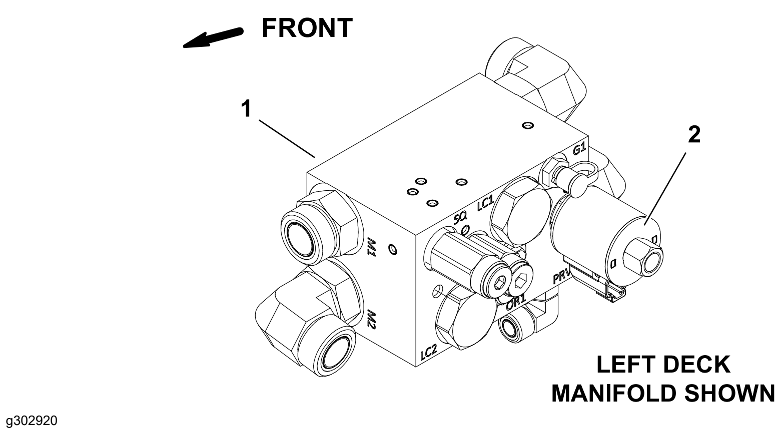

Figure 62

1. Left deck manifold
2. PRV valve

3. Locate deck manifold for the cutting deck to be tested Figure 61). Disconnect hydraulic hose from fitting in deck manifold port M1.

Procedure for Cutting Deck Circuit Relief Pressure Test (continued)

IMPORTANT

Make sure that the oil flow indicator arrow on the flow gauge is showing that the oil will flow from the manifold, through the tester and into the disconnected hydraulic hose.

4. Install 40 GPM tester (flow and pressure) in series between the deck manifold port M1 and the disconnected hose. Make sure the flow control valve on tester is fully open.

CAUTION

Cutting deck blades will rotate when cutting decks are lowered with PTO switch in ON position. Keep away from cutting decks during test to prevent personal injury from rotating blades. Do not stand in front of the machine.

5. After installing hydraulic tester, start engine and run at low idle speed. Check for hydraulic leakage at tester connections and correct before proceeding with test.
6. Increase engine speed to high idle speed (2530 RPM). Release the parking brake and engage the cutting decks.
7. Watch tester pressure gauge carefully while slowly closing the tester flow control valve to fully closed.
8. As the cutting deck circuit relief valve lifts, system pressure should be approximately:

   203 to 224 bar (2950 to 3250 PSI) for the center and left decks.

   127 to 148 bar (1850 to 2150 PSI) for the right deck.
9. After identifying relief valve pressure, fully open tester flow control valve, disengage cutting decks and decrease engine speed to low idle. Shut off engine and record test results.
10. If relief pressure is incorrect, remove PRV valve on deck manifold and clean or replace valve (see Traction Control Manifold Service (page 5–112)). After PRV valve service, perform relief pressure test again and if pressure is still low, check for restriction in gear pump inlet line. The first gear pump section (for front deck circuit) and/or the second gear pump section (for side deck circuits) could also be suspected of wear, damage or inefficiency (see Procedure for Gear Pump Flow Test (page 5–68)).
11. When relief pressure testing is complete, disconnect tester from deck manifold fitting and hydraulic hose. Reconnect hydraulic hose that was disconnected for test procedure.
12. Repeat test for other cutting deck circuits if necessary.
13. When testing is complete, make sure that the hydraulic tank is full before returning machine to operation.

Cutting Deck Motor Case Drain Leakage Test (Using Tester with Pressure Gauge & 40 GPM Flow Meter)

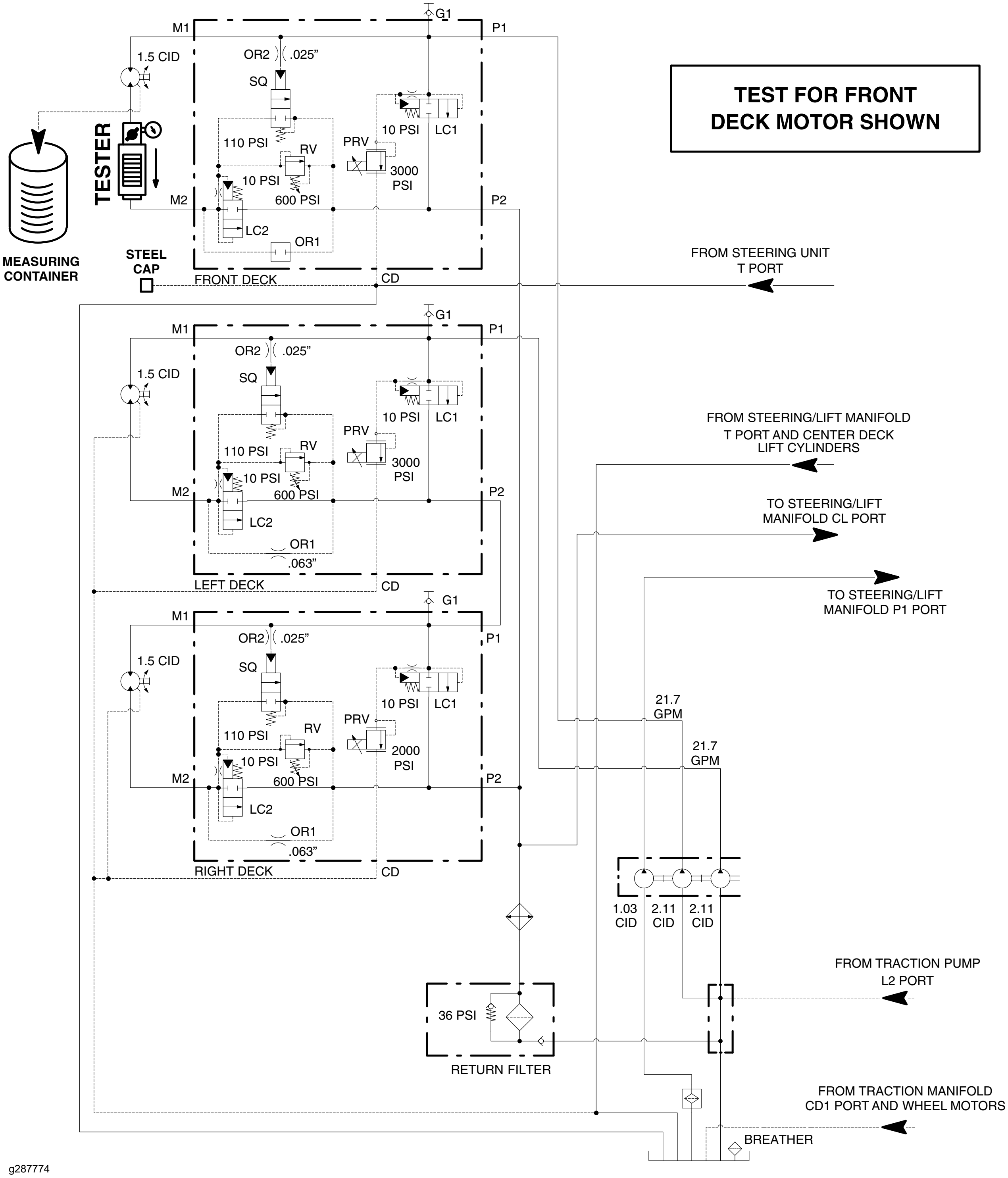

Figure 63

Note: Over a period of time, a deck motor can wear internally. A worn motor may bypass oil to its case drain causing the motor to be less efficient. Eventually, enough oil loss will cause the deck motor to stall under heavy cutting conditions. Continued operation with a worn, inefficient motor can generate excessive heat, cause damage to seals and other components in the hydraulic system and affect quality of cut.

Note: One method to find a failing or malfunctioning deck motor is to have a second person observe the machine while mowing in dense turf. A bad motor will run slower, produce fewer clippings and may cause a different appearance on the turf.

IMPORTANT

To prevent hydraulic tester damage, use 40 GPM Hydraulic Tester #AT40002 (pressure and flow) and Hose Kit for this test (see Special Tools (page 2–15)).

Note: Two people will be required to complete the following test procedure.

CAUTION

Prevent personal injury and/or damage to equipment. Read all WARNINGS, CAUTIONS and Precautions for Hydraulic Testing at the beginning of this section.

Procedure for Deck Motor Case Drain Leakage Test

1. Park machine on a level surface, lower cutting decks fully, disengage PTO, engage parking brake and stop engine. Remove key from key switch. Make sure the hydraulic reservoir is full.

   Note: The side deck motors are connected in series. To isolate a faulty side deck motor, both motors in the circuit may have to be tested by starting with the left deck motor (refer to A Hydraulic Schematic (page A–5)).

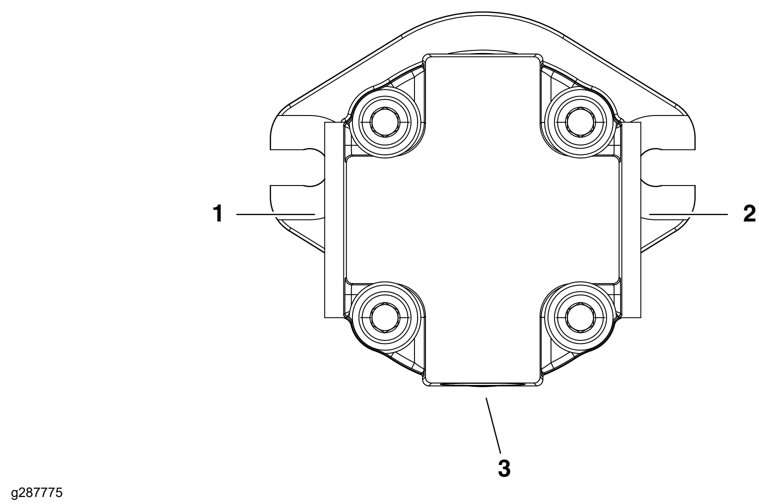

Figure 64

1. Flow − in
2. Flow return − out
3. Case drain

2. Disconnect hydraulic return hose from the deck motor to be tested (Figure 64).

IMPORTANT

Make sure that the oil flow indicator arrow on the flow gauge is showing that the oil will flow from the motor, through the tester and into the disconnected hydraulic hose.

Procedure for Deck Motor Case Drain Leakage Test (continued)

3. Install 40 GPM tester (flow and pressure) in series with the deck motor and the disconnected return hose. Make sure the flow control valve on tester is fully open.
4. Start engine and run at low idle speed. Check for hydraulic leaks at tester connections and make corrections if necessary before proceeding with test.
5. Increase engine speed and make sure hydraulic oil is at normal operating temperature (54 to 66 ºC (130 to 150 ºF)) by operating the machine for approximately ten (10) minutes. Stop engine and remove key from key switch.
6. Chock the wheels so that the machine will not move during testing.
7. For the deck motor to be tested, disconnect the motor case drain hose (small diameter hose) where it connects to the front PTO manifold tee fitting or hydraulic tube at the side PTO manifold (not at the motor). Put a steel cap on the open tee fitting or tube connection; leave the case drain hose open.

CAUTION

Cutting deck blades will rotate when lowered with PTO switch in ON position. Keep away from cutting decks during test to prevent personal injury from rotating blades. Do not stand in front of the machine during test.

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8. Sit on seat, start the engine and increase engine speed to high idle speed (2530 RPM). Engage cutting decks. Do not depress the traction pedal during testing procedure.
9. While watching tester pressure gauge, have a second person slowly close flow control valve on tester until a pressure of 83 bar (1200 PSI) is obtained.

   Note: Use a graduated container, special tool TOR4077, to measure case drain leakage.

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Figure 65

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10. Have the second person measure flow from the open case drain hose for fifteen (15) seconds, then disengage the cutting decks, open flow control valve on tester and stop the engine. Record test results.

    TEST RESULTS: Case drain leakage should be less than 672 ml (23 ounces) of hydraulic fluid in fifteen (15) seconds.
11. If case drain flow is more than 672 ml (23 ounces), the deck motor is worn or damaged and should be repaired or replaced.

Procedure for Deck Motor Case Drain Leakage Test (continued)

12. When testing is complete, disconnect tester from motor and hydraulic hose. Reconnect return hose to the deck motor. Remove cap from the PTO manifold tee fitting or hydraulic tube and reconnect case drain hose.
13. Repeat test for additional deck motors if required.
14. When testing is complete, make sure that the hydraulic tank is full before returning machine to operation.

GPM	Milliliters in 15 sec.	Ounces in 15 sec.
0.1	95	3.2
0.2	189	6.4
0.3	284	9.6
0.4	378	12.8
0.5	473	16.0
0.6	568	19.2
0.7	662	22.4
0.8	756	25.6
0.9	852	28.8
1.0	946	32.0

Lift/Lower Circuit Relief Pressure Test (Using Pressure Gauge)

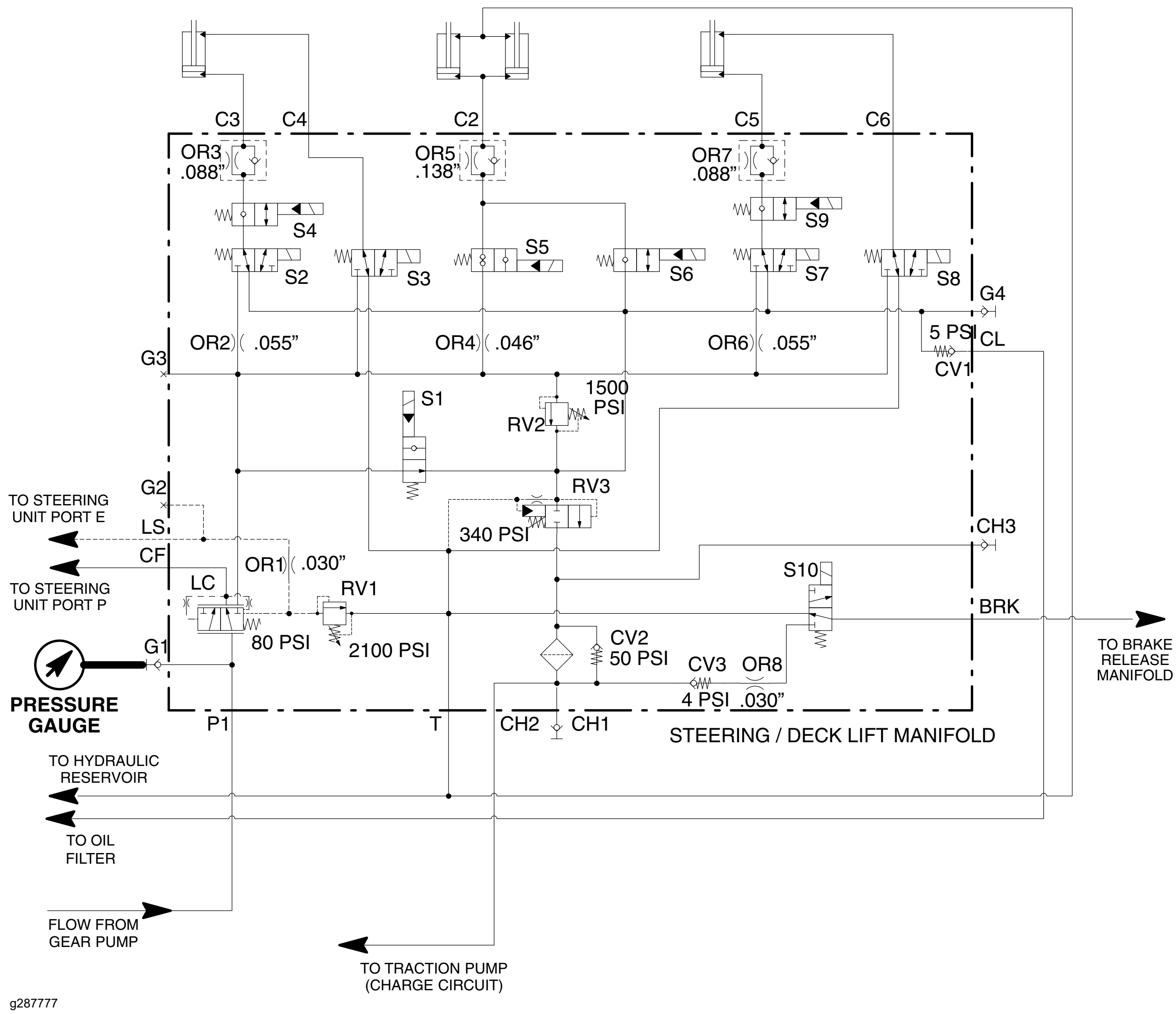

Figure 66

The lift/lower circuit relief valve pressure test should be performed to make sure that the lift circuit relief pressure is correct.

CAUTION

Prevent personal injury and/or damage to equipment. Read all WARNINGS, CAUTIONS and Precautions for Hydraulic Testing at the beginning of this section.

Procedure for Lift/Lower Circuit Relief Pressure Test

1. Make sure hydraulic oil is at normal operating temperature (54 to 66 ºC (130 to 150 ºF)) by operating the machine for approximately ten (10) minutes.
2. Park machine on a level surface, lower cutting decks fully, disengage PTO and stop engine. Remove key from key switch.
3. Make sure the hydraulic tank is full.
4. Raise hood to allow access to steering/deck lift manifold that is secured to right side frame rail.

Procedure for Lift/Lower Circuit Relief Pressure Test (continued)

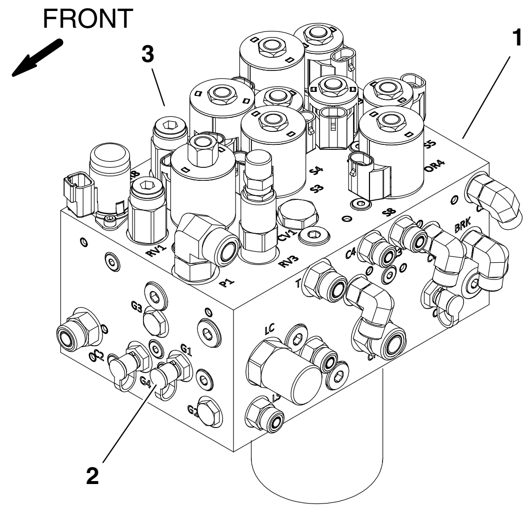

Figure 67

1. Steering/lift manifold
2. Test fitting (port G1)
3. Relief valve RV2

5. Connect a 350 Bar (5000 PSI) pressure gauge with hydraulic hose attached to test fitting in port G1 on steering/ deck lift manifold (Figure 67). Route gauge hose to allow operator to view the gauge.
6. After installing pressure gauge, start engine and run at idle speed. Check for hydraulic leakage and correct before proceeding with test.
7. Sit on the seat and operate the engine at full speed (2530 RPM).
8. While sitting on the seat, press and hold one of the deck lift switches to fully raise a cutting deck. Momentarily hold the switch with the deck fully raised while watching the pressure gauge.
9. As the lift/lower relief valve (RV2) lifts, system pressure should be approximately:

   GAUGE READING TO BE: 114 to 145 bar (1650 to 2100 PSI)
10. After relief pressure is identified, release lift switch, stop engine and record test results.

IMPORTANT

Lift/Lower circuit relief pressure is affected by both counterbalance pressure adjustment and spring pressure of the LC valve in the steering/deck lift manifold. If lift/lower circuit relief pressure is incorrect, consider that counterbalance pressure or an issue with the LC valve is affecting lift/lower circuit relief pressure.

Note: Do not remove relief valve (RV2) from the hydraulic manifold for adjustment.

11. If lift/lower relief pressure is too high, adjust the relief valve (RV2) in the steering/deck lift manifold so that relief pressure is correct (see Adjust Manifold Relief Valves (page 5–72)). The relief valve (RV2) is located on the top of the steering/ deck lift manifold (Figure 67).

Procedure for Lift/Lower Circuit Relief Pressure Test (continued)

12. If lift/lower relief pressure is too low, check for restriction in gear pump inlet line or reservoir strainer. Also, check the lift cylinder for internal leakage. If cylinder is not leaking, adjust the relief valve (RV2) so that relief pressure is correct (see Adjust Manifold Relief Valves (page 5–72)). The relief valve (RV2) is located on the top of the steering/deck lift manifold (Figure 67). If relief pressure remains too low after adjustment, the final gear pump section or lift cylinder(s) should be suspected of wear, damage or inefficiency.
13. When testing is complete, disconnect pressure gauge from test fitting. Lower and secure hood.

Steering Circuit Relief Pressure Test (Using Pressure Gauge)

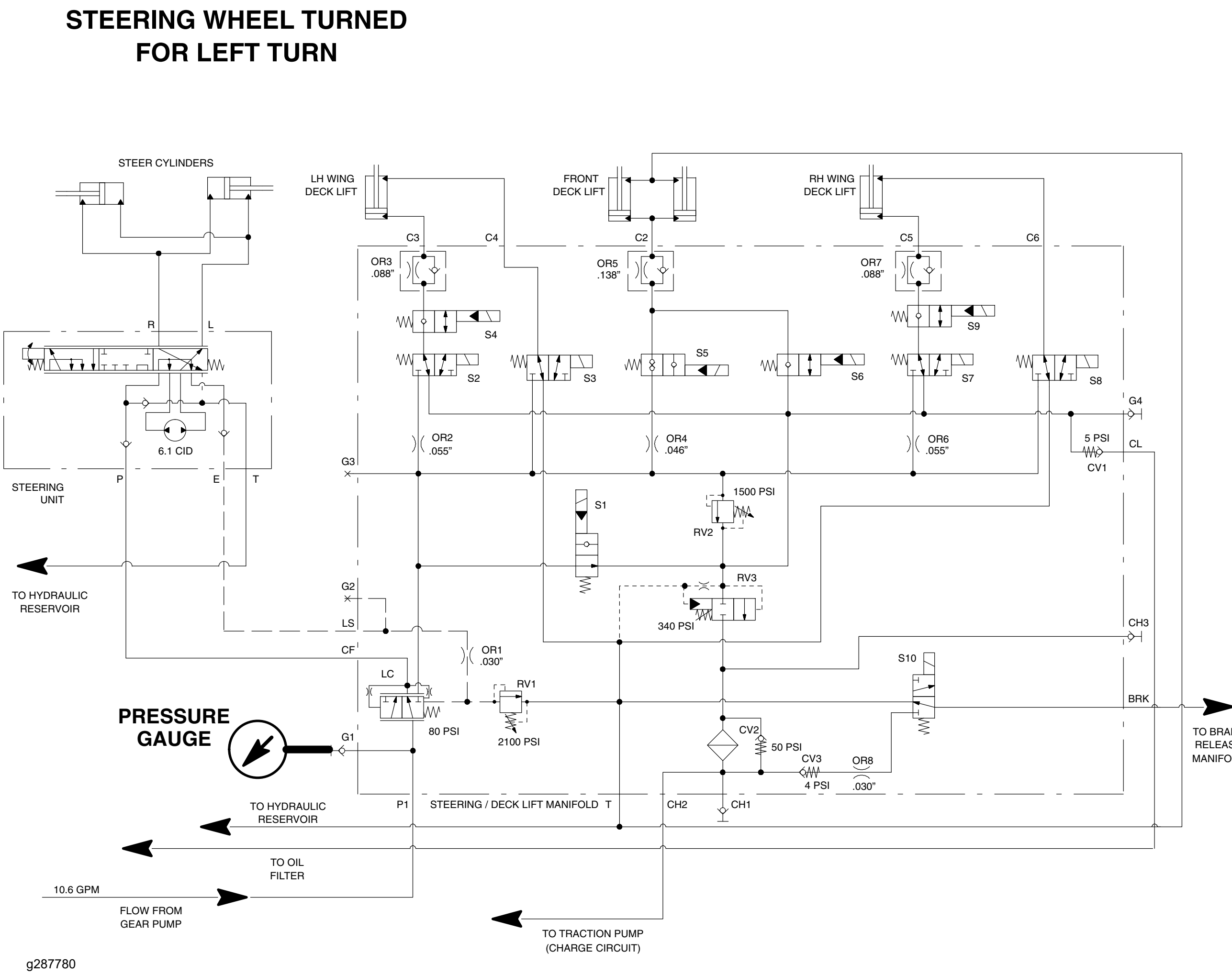

Figure 68

The steering circuit relief valve pressure test should be performed to make sure that the steering circuit relief pressure is correct.

CAUTION

Prevent personal injury and/or damage to equipment. Read all WARNINGS, CAUTIONS and Precautions for Hydraulic Testing at the beginning of this section.

Procedure for Steering Circuit Relief Pressure Test

1. Make sure hydraulic oil is at normal operating temperature (54 to 66 ºC (130 to 150 ºF)) by operating the machine for approximately ten (10) minutes.
2. Park machine on a level surface, lower cutting decks fully, disengage PTO, engage parking brake and stop engine. Remove key from key switch.
3. Make sure the hydraulic tank is full.
4. Raise hood to allow access to steering/deck lift manifold that is secured to right side frame rail.

Procedure for Steering Circuit Relief Pressure Test (continued)

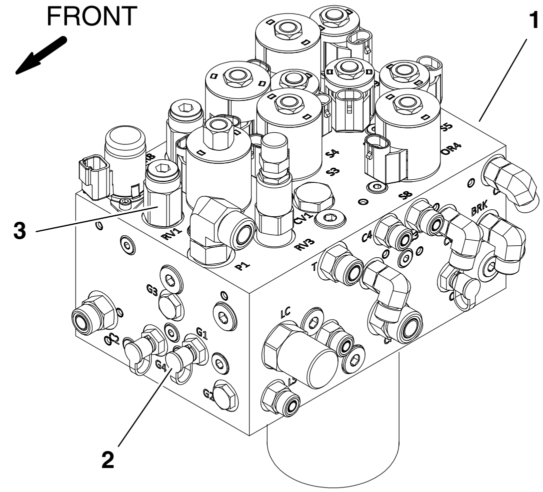

Figure 69

1. Steering/lift manifold
2. Test fitting (port G1)
3. Relief valve RV1

5. Connect a 350 Bar (5000 PSI) pressure gauge with hydraulic hose attached to test fitting in port G1 on steering/ deck lift manifold (Figure 69). Route gauge hose to allow operator to view the gauge.
6. After installing pressure gauge, start engine and run at idle speed. Check for hydraulic leakage at test connection and correct before proceeding with test.
7. Operate the engine at high idle speed (2530 RPM).

IMPORTANT

Hold 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 steering components.

8. Turn steering wheel all the way in one direction and momentarily hold the steering wheel against resistance.

   GAUGE READING TO BE: 151 to 155 bar (2200 to 2250 PSI).

9. Release steering wheel, stop engine and record test results.

   Note: If steering relief pressure is incorrect and lift/lower problems also exist, the final gear pump section should be suspected of wear and inefficiency. If steering wheel continues to turn at end of cylinder travel (with lower than normal effort), the steering cylinders or steering control valve should be suspected of wear or damage.

10. If relief pressure specification is not met, adjust relief valve (RV1) in steering/deck lift manifold (Figure 69) so that relief pressure is correct (see Adjust Manifold Relief Valves (page 5–72)).
11. When testing is complete, disconnect pressure gauge from manifold test fitting. Lower and secure hood.

Steering Cylinder Internal Leakage Test

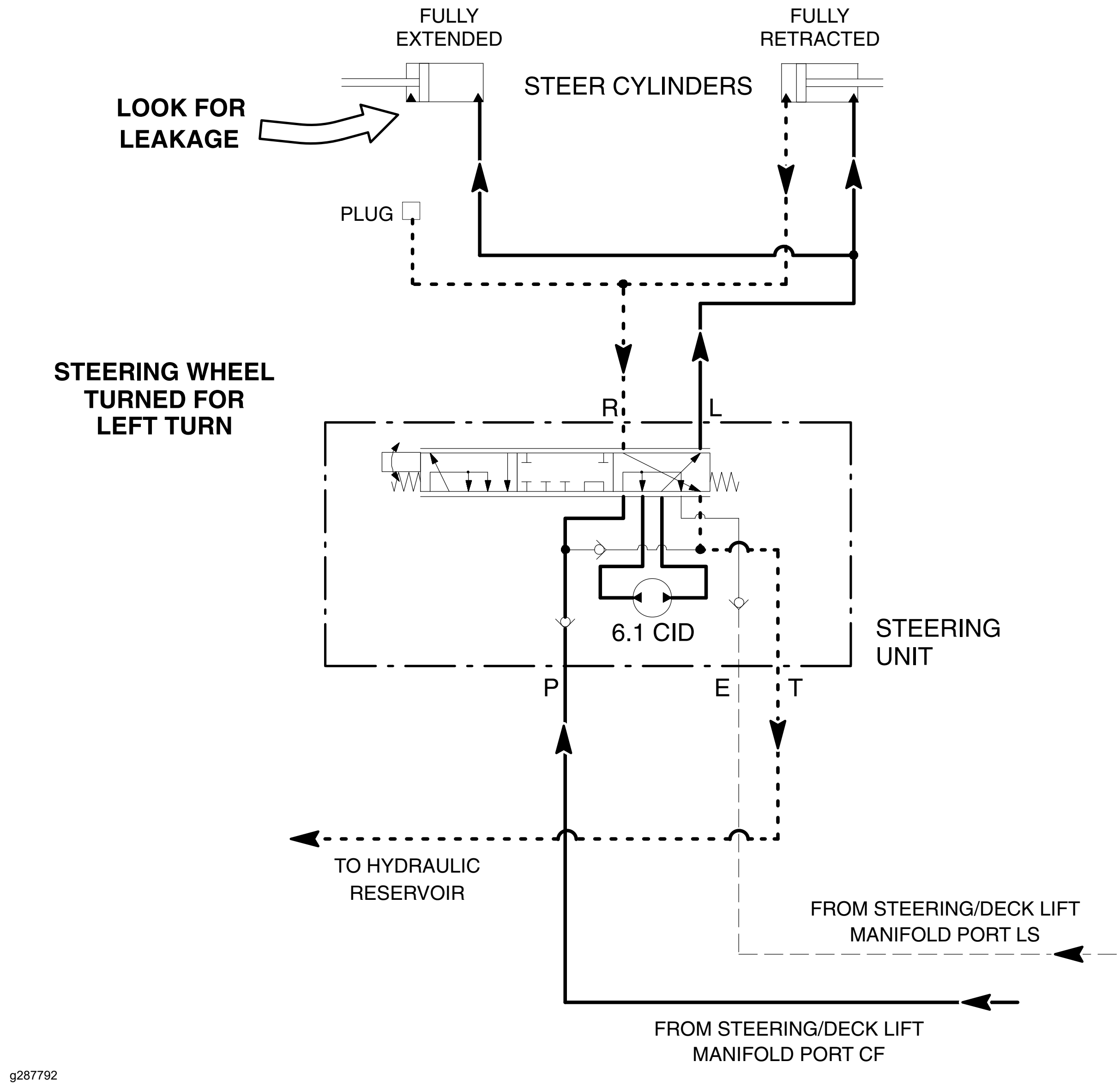

Figure 70

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

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

CAUTION

Prevent personal injury and/or damage to equipment. Read all WARNINGS, CAUTIONS and Precautions for Hydraulic Testing at the beginning of this section.

Procedure for Steering Cylinder Internal Leakage Test

1. Make sure hydraulic oil is at normal operating temperature (54 to 66 ºC (130 to 150 ºF)).
2. Park machine on a level surface, lower cutting decks fully, disengage PTO, engage parking brake and stop engine. Remove key from key switch.
3. Turn the steering wheel so the steering cylinder rod of the cylinder to be tested is fully extended.
4. Thoroughly clean the area around the hydraulic hose at the rod end of the steering cylinder to be tested.

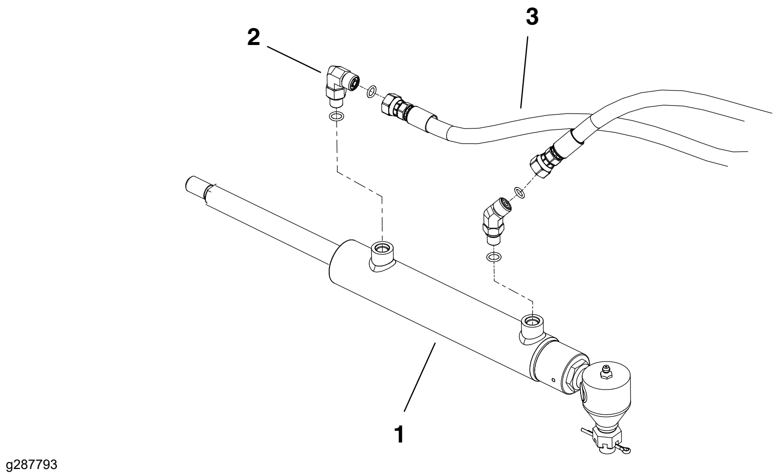

Figure 71

1. Steering cylinder
2. Rod end fitting
3. Hydraulic hose

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5. Place a drain pan under the steering cylinder being tested. Remove hydraulic hose from the fitting on the rod end of the steering cylinder to be tested. Install a steel plug in the disconnected hose.
6. Remove all hydraulic oil from drain pan. Make sure that empty drain pan remains under the open fitting of the steering cylinder.
7. With the engine off, turn the steering wheel in the same direction needed to extend the cylinder. Observe the open fitting on the extended steering cylinder as the steering wheel is turned. If oil comes out of the fitting while turning the steering wheel, the steering cylinder has internal leakage and must be repaired or replaced (see Steering Cylinder Service (page 5–141)). Check drain pan for any evidence of oil that would indicate cylinder leakage.
8. After testing is completed, remove plug from the hydraulic hose. Connect hose to the steering cylinder fitting.
9. Repeat steering cylinder internal leakage test for other steering cylinder if necessary.
10. If a steering problem exists and the steering cylinders tested acceptably, the steering control valve requires service (see Steering Control Valve Service (For machines serial number below 40345000) (page 5–137)).
11. After testing is completed, check oil level in hydraulic reservoir and adjust if needed.

Gear Pump (PTO, Steering, Deck Lift/Lower and Traction Charge Circuits) Flow Test (Using Tester with Pressure Gauges and Flow Meter)

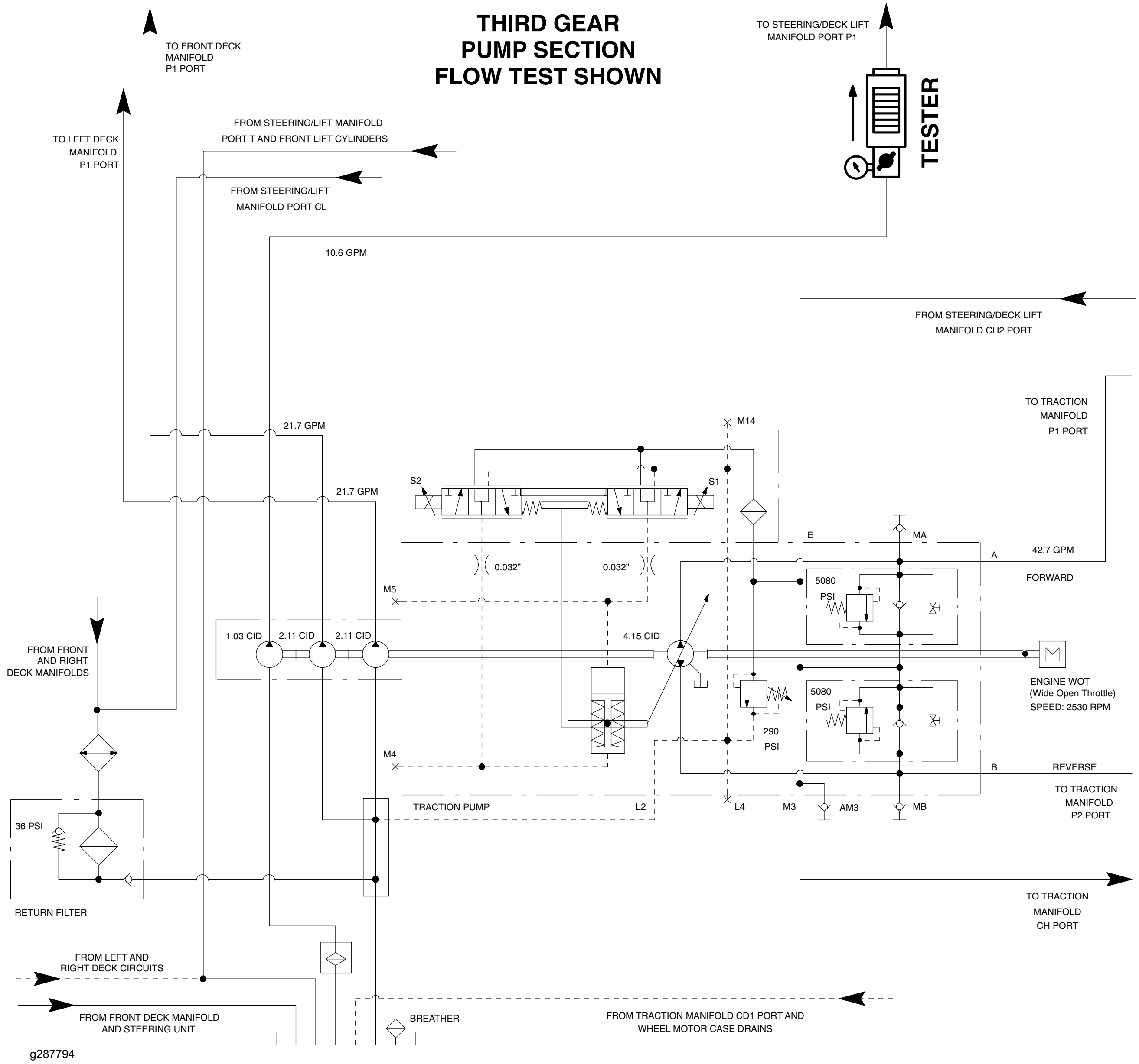

Figure 72

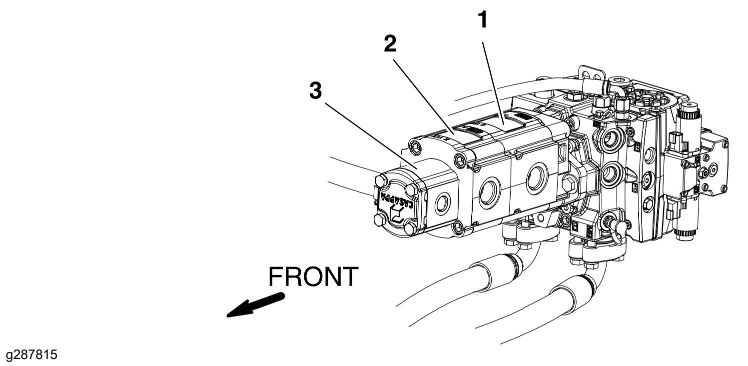

Figure 73

1. First gear pump section (side decks)
2. 2^{nd} gear pump section (front deck)
3. 3^{rd} gear pump section (steering, lift/lower, charge)

The gear pump flow test should be performed to make sure that the mow, steering, cutting deck lift/lower and traction charge circuits have adequate hydraulic flow. Gear pump sections are illustrated in Figure 73. The first gear pump section provides hydraulic flow for both wing cutting decks. The second gear pump section provides hydraulic flow for the front cutting deck. The third gear pump section provides hydraulic flow for the steering, deck lift/lower and traction charge circuits.

Note: Over a period of time, the gears and wear plates in the gear pump can wear. A worn pump will by pass oil and make the pump less efficient. Eventually, enough oil loss will occur to cause circuit problems (e.g. cutting deck motors stalling under heavy cutting conditions, lift or steering problems). Continued operation with a worn, inefficient gear pump can generate excessive heat and cause damage to the seals and other components in the hydraulic system.

CAUTION

Prevent personal injury and/or damage to equipment. Read all WARNINGS, CAUTIONS and Precautions for Hydraulic Testing at the beginning of this section.

Procedure for Gear Pump Flow Test

1. Park machine on a level surface, lower cutting decks fully, disengage PTO and stop engine. Remove key from key switch.

Procedure for Gear Pump Flow Test (continued)

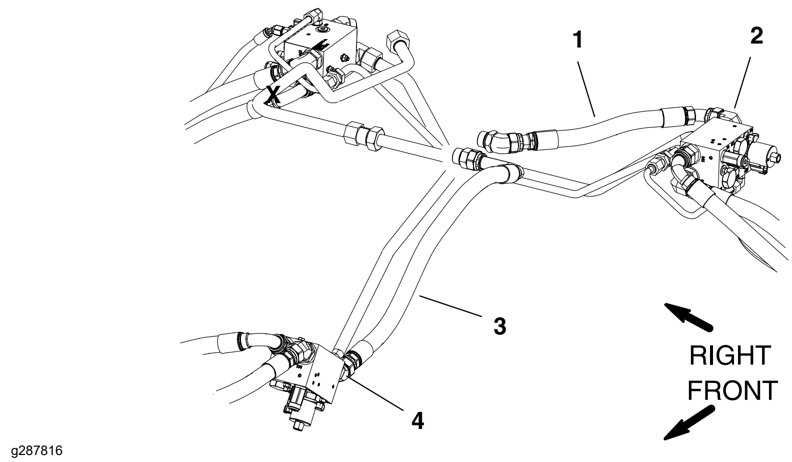

Figure 74

1. 1st pump section hose
2. Left deck manifold P1
3. 2nd pump section hose
4. Front deck manifold P1

2. Determine which gear pump section is to be tested. Thoroughly clean and then disconnect hydraulic hose from appropriate manifold fitting for gear pump section that is to be tested:

   A. For 1st gear pump section (side deck flow), disconnect hydraulic hose from fitting in left deck manifold port P1 (Figure 74).

   B. For 2nd gear pump section (front deck flow), disconnect hydraulic hose from fitting in front deck manifold port P1 (Figure 74).

   C. For 3rd gear pump section (steering, lift/lower and traction charge circuits), raise hood and disconnect hydraulic hose from fitting in steering/deck lift manifold port P1 (Figure 75).

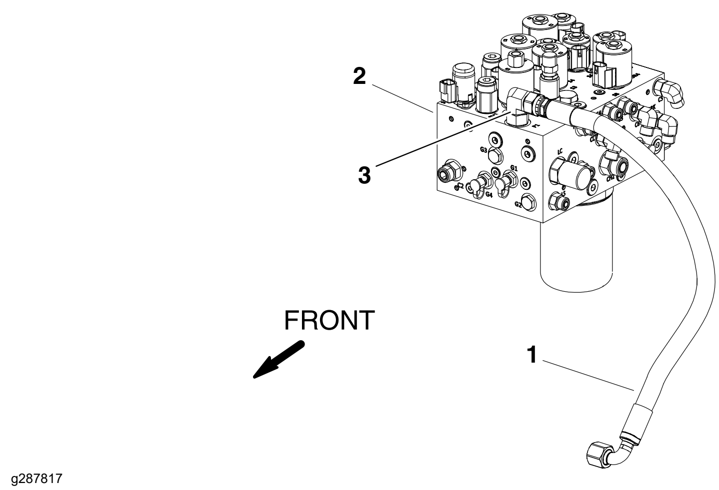

Figure 75

1. 3rd pump section hose
2. Steering/lift manifold
3. Manifold P1 port

IMPORTANT

To prevent hydraulic tester damage, use 40 GPM Hydraulic Tester #AT40002 (pressure and flow) and Hose Kit for this test (see Special Tools (page 2–15)).

IMPORTANT

Make sure that the oil flow indicator arrow on the flow gauge is showing that the oil will flow from the hydraulic hose from the pump, through the tester and into the manifold fitting.

3. Install 40 GPM tester (flow and pressure) in series with the disconnected hose and hydraulic fitting in manifold.
4. Make sure the flow control valve on tester is fully open.
5. Start engine and increase engine speed to high idle speed (2530 RPM). Do not engage the cutting decks. Check for hydraulic leakage at test connection and correct before proceeding with test.
6. Make sure hydraulic oil is at normal operating temperature (54 to 66 ºC (130 to 150 ºF)) by operating the machine for approximately ten (10) minutes. Make sure the hydraulic reservoir is full.

IMPORTANT

Do not fully restrict oil flow through tester. In this test, the flow tester is positioned before the circuit relief valve. Pump damage can occur if the oil flow is fully restricted.

7. Watch pressure gauge carefully while slowly closing the flow control valve until 69 bar (1000 PSI) is obtained. Verify with the InfoCenter display that the engine is still running at the correct high idle speed (2530 RPM).

   Note: If engine speed drops during testing, pump flow will decrease and flow test results will be inaccurate.

8. Normal flow indication for the three (3) gear pump sections is listed in below table:

PUMP SECTION	NORMAL FLOW	MINIMUM FLOW
FIRST SECTION	83 LPM (22 GPM)	74 LPM (19.6 GPM)
SECOND SECTION	83 LPM (22 GPM)	74 LPM (19.6 GPM)
THIRD SECTION	40 LPM (10.6 GPM)	36 LPM (9.5 GPM)

9. Once the gear pump section flow has been determined, open tester flow control valve and stop engine. Record test results.

Procedure for Gear Pump Flow Test (continued)

10. If a pressure of 69 bar (1000 PSI) cannot be obtained or flow was less than the minimum flow listed in above table, check for restriction in the pump inlet line. If inlet line is not restricted, consider that the tested gear pump section is worn or damaged.
11. After testing is completed, disconnect tester from hydraulic hose and fitting in manifold. Reconnect hose to the manifold fitting (see Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–7)).
12. If hood was opened, lower and secure hood. Make sure that hydraulic reservoir is full before returning machine to operation.

Adjustments

Adjust Manifold Relief Valves

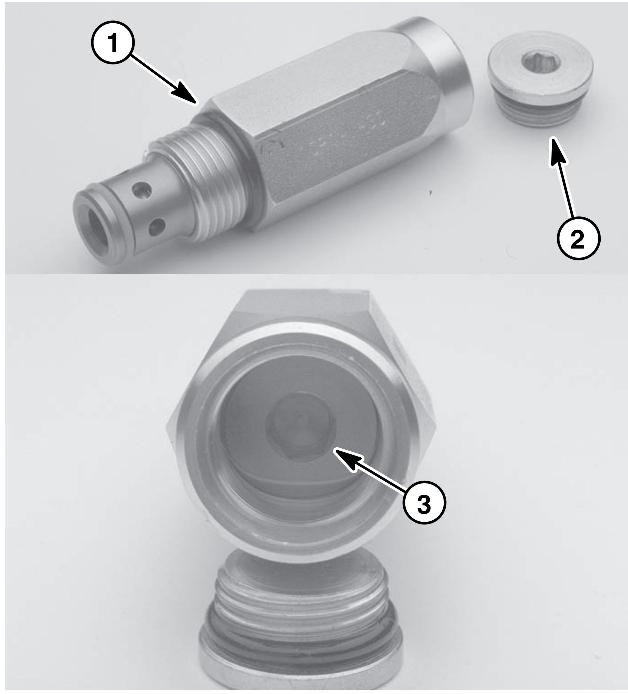

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Figure 76

1. Relief valve
2. Valve cap
3. Adjustment socket

The steering/deck lift manifold includes adjustable pressure relief valves. An adjustment may be required to these valves if testing determines that the circuit pressure setting is incorrect (see Testing (page 5–36)). Use the following process if a valve adjustment is required.

Note: Do not remove the valve from the hydraulic manifold for adjustment.

1. Park machine on a level surface, lower cutting decks fully, disengage PTO and stop engine. Remove key from key switch.
2. Locate relief valve on steering/deck lift manifold.
3. Remove cap on relief valve with an allen wrench.
4. To increase pressure setting, turn the adjustment socket on the valve in a clockwise direction. A 1/8 turn on the socket will make a measurable change in pressure.
5. To decrease pressure setting, turn the adjustment socket on the valve in a counterclockwise direction. A 1/8 turn on the socket will make a measurable change in pressure.
6. Install cap on valve.
7. Recheck relief valve pressure using correct test procedure and readjust if needed.

Service and Repairs

General Precautions for Removing and Installing Hydraulic System Components

Before Repair or Replacement of Components

1. Before removing any parts from the hydraulic system, park machine on a level surface, lower cutting decks fully, disengage PTO and stop engine. Remove key from the key switch.
2. Read and be familiar with all procedure steps before starting to remove, repair, replace or install hydraulic system components.
3. Clean machine before disconnecting, removing or disassembling any hydraulic components. Make sure hydraulic components, hoses connections and fittings are cleaned thoroughly. Always keep in mind the need for cleanliness when working on hydraulic equipment.

CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. Controls must be operated with the key switch in RUN and the engine OFF. Make sure all electrically operated control valves are actuated. Return key switch to OFF after pressure has been relieved. Remove key from the key switch.

4. Put caps or plugs on any hydraulic lines, hydraulic fittings or components left open or exposed to prevent hydraulic system contamination.
5. Put labels on disconnected hydraulic lines and hoses for proper installation after repairs are completed.
6. Note the position of hydraulic fittings (especially elbow fittings) on hydraulic components before removal. Mark parts if necessary to make sure they will be aligned properly when reinstalling hydraulic hoses and tubes.

After Repair or Replacement of Components

1. Check oil level in the hydraulic reservoir and add correct oil if necessary. Drain and refill hydraulic system reservoir and change oil filter if component failure was severe or system is contaminated (see Flush Hydraulic System (page 5–77)).

IMPORTANT

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

2. Lubricate O−rings and seals with clean hydraulic oil before installing hydraulic components.
3. Make sure all caps or plugs are removed from hydraulic tubes, hydraulic fittings and components before reconnecting.
4. Use proper tightening methods when installing hydraulic hoses and fittings (see Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–7)).
5. After repairs, check control linkages or cables for proper adjustment, binding or broken parts.

After Repair or Replacement of Components (continued)

6. If piston (traction) pump, front wheel motors or rear axle motor was removed from machine for service, fill housing through case drain with new hydraulic oil before starting engine. This will ensure that internal components have adequate lubrication during initial operation.
7. After disconnecting or replacing any hydraulic components, operate machine functions slowly until air is out of system (see Charge Hydraulic System (page 5–79)).
8. Check for hydraulic oil leaks. Shut off engine and correct leaks if necessary. Check oil level in hydraulic reservoir and add correct oil if necessary.

Check Hydraulic Lines and Hoses

⚠ WARNING ⚠

Keep body and hands away from pin hole leaks or nozzles that eject hydraulic fluid under high pressure. Use paper or cardboard, not hands, to search for leaks. Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and cause serious injury. If fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury. Gangrene may result from such an injury.

IMPORTANT

Check hydraulic lines and hoses daily for leaks, kinked lines, loose mounting supports, wear, loose fittings or deterioration. Make all necessary repairs before operating the machine.

Priming Hydraulic Pumps

Whenever the hydraulic system is flushed, the hydraulic system is charged or hydraulic components are installed, it is important to properly prime the hydraulic pumps. Hydraulic pump priming ensures that the gear pump and piston (traction) pump have adequate oil during initial start−up and running. The pumps can be primed by using a remote starter switch (see Special Tools (page 2–15)) to crank engine which allows the pumps to prime.

Use the following procedure to prime the hydraulic pumps:

1. Make sure that key switch is in the OFF position and key is removed from switch.
2. Check hydraulic reservoir oil level and adjust if necessary.

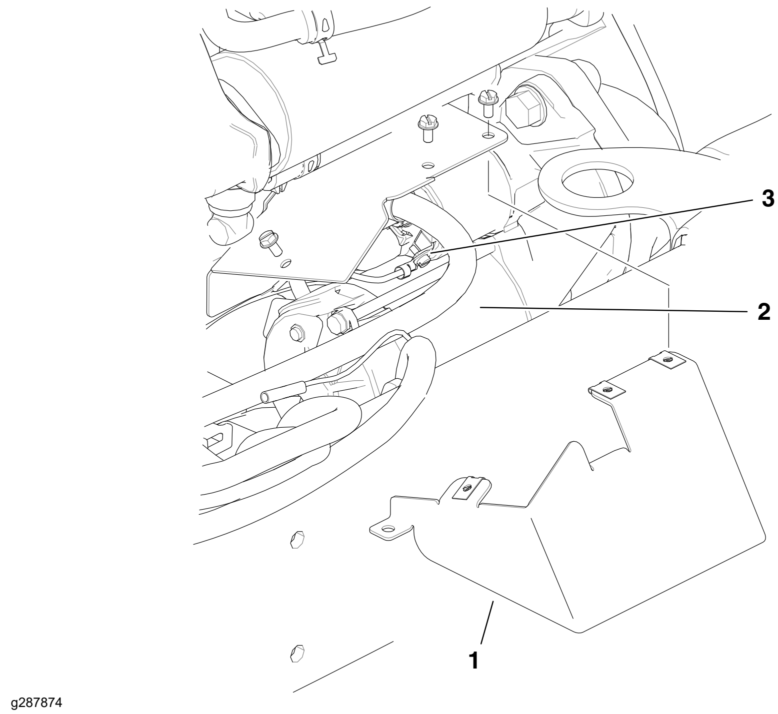

Figure 77

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

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3. Remove the shield over the starter motor to access the terminals on the back of the starter motor.

   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.

4. Connect remote starter switch electrical leads to the starter motor solenoid B+ terminal and the positive jumper post near the battery−disconnect switch.
5. Engage remote starter switch and crank starter for thirty (15) seconds to prime hydraulic pumps. Wait thirty (30) seconds to allow the starter motor and starter solenoid to cool. Repeat cranking procedure a second time.
6. Disconnect remote starter switch leads from starter motor solenoid terminal and positive jumper post.

Flush Hydraulic System

IMPORTANT

Flush the hydraulic system any time there is a severe component failure or the system is contaminated. Contaminated oil may appear milky or black or may contain metal particles.

IMPORTANT

If a component failure occurred in the closed loop traction circuit (e.g. piston pump or wheel motor), filtering the traction circuit is recommended. See Filtering Closed−Loop Traction Circuit (page 5–81).

1. Park machine on a level surface, lower cutting decks fully, disengage PTO and stop engine. Remove key from the key switch.

⚠ WARNING ⚠

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. See Relieving Hydraulic System Pressure (page 5–3).

IMPORTANT

Make sure to clean around any hydraulic connections that will be disconnected for draining.

2. Remove drain plug from the hydraulic reservoir and drain reservoir into a suitable container.
3. Remove suction screen from reservoir and clean thoroughly.
4. Drain hydraulic system. Drain all hoses, tubes and components while the system is warm.
5. Change and replace both hydraulic oil filters.

IMPORTANT

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

6. Inspect and clean hydraulic reservoir (see Hydraulic Reservoir (page 5–83)).
7. Connect all hydraulic hoses, lines and components that were disconnected while draining system.

IMPORTANT

When filling hydraulic reservoir, use only hydraulic fluids specified in *Operator's Manual*. Other fluids could cause system damage.

Flush Hydraulic System (continued)

8. Fill hydraulic reservoir with new hydraulic fluid.
9. Prime hydraulic pumps (see Priming Hydraulic Pumps (page 5–76)).
10. Charge the hydraulic system (see Charge Hydraulic System (page 5–79)).
11. Check condition of hydraulic oil. If the new fluid shows any signs of contamination, repeat steps 1 through 11 again until oil is clean.
12. Assume normal operation and follow recommended maintenance intervals.

Charge Hydraulic System

Note: When initially starting the hydraulic system with new or rebuilt components such as motors, pumps or lift cylinders, it is important that the hydraulic system be charged properly. Air must be purged from the system to reduce the chance of component damage.

IMPORTANT

Change hydraulic oil filters whenever hydraulic components are repaired or replaced.

1. Park machine on a level surface, lower cutting decks fully, disengage PTO and stop engine. Remove key from the key switch.
2. Make sure all hydraulic connections, lines and components are secured tightly.
3. If hydraulic component failure was severe or the hydraulic system is contaminated, flush and refill hydraulic system and hydraulic reservoir (see Flush Hydraulic System (page 5–77)).

IMPORTANT

When filling hydraulic reservoir, use only hydraulic fluids specified in *Operator's Manual*. Other fluids could cause system damage.

4. Make sure hydraulic reservoir is full. Add correct hydraulic oil to reservoir if necessary.
5. Prime hydraulic pumps (see Priming Hydraulic Pumps (page 5–76)).

WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 (page 1–1).

6. Raise machine so that all wheels are off the ground and place appropriate jack stands under the frame to support the machine.
7. Safely clamp or lock the front left and rear right wheels to prevent them from rotating.

IMPORTANT

During initial operation, check hydraulic reservoir oil level frequently. Add oil as necessary to keep reservoir at FULL level.

8. Make sure traction pedal and lift switches are in neutral. Start engine and run at low idle speed. The gear pump should pick up oil and fill the hydraulic system. If there is no indication of fill in thirty (30) seconds, stop the engine and determine the cause.

Charge Hydraulic System (continued)

9. After the hydraulic system starts to show signs of fill, actuate a lift switch until the lift cylinder rod moves in and out several times. If the lift cylinder does not move after ten (10) to fifteen (15) seconds, or if the pump emits abnormal sounds, shut the engine off immediately and determine cause or problem. Inspect for the following:
   A. Loose filter or suction lines.
   B. Blocked suction line.
   C. Faulty charge relief valve.
   D. Faulty gear pump.
10. Once the lift cylinder does move in ten (10) to fifteen (15) seconds, proceed to next step.
11. Set the traction speed range to LOW. With the engine at low idle speed, move the traction pedal to about 1/2 forward speed and hold for 30 seconds. Both unlocked wheels should turn in the forward direction smoothly.

    Note: If the wheels rotate in the wrong direction, stop engine and check for proper hydraulic hose and electrical connections at traction pump and motors. Correct as needed.
12. Move the traction pedal to about 1/2 reverse speed and hold for 30 seconds. Both unlocked wheels should turn in the reverse direction smoothly.
13. Remove the wheel clamps or locks from the machine.
14. Safely clamp or lock the front right and rear left wheels to prevent them from rotating.
15. Repeat step 11 and 12.
16. Remove the wheel clamps or locks from the machine.
17. Set the traction speed range to HIGH. With the engine at low idle speed, move the traction pedal to about 1/2 forward speed and hold for 30 seconds. Both front wheels should turn in the forward direction smoothly. The rear wheels should not rotate.

    Note: If the rear wheels rotate, solenoid valve SV or pressure differential valve PD1 in the traction manifold may not be shifting.
18. Move the traction pedal to about 1/2 reverse speed and hold for 30 seconds. Both front wheels should turn in the reverse direction smoothly. The rear wheels should not rotate.
19. Check operation of the traction system interlock switches (see Check Operation of Interlock Switches (page 6–45)).
20. If the piston (traction) pump or a traction motor was replaced or rebuilt, run the machine so all wheels turn slowly for ten (10) minutes.
21. Stop the engine and set the key switch to the OFF position. Remove the jack stands and lower the machine to the ground.
22. Check hydraulic reservoir and fill if necessary. Check hydraulic components for leaks and tighten any loose connections.
23. Operate machine by gradually increasing its work load to full over a ten (10) minute period.

Filtering Closed−Loop Traction Circuit

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

1. Park machine on a level surface, lower cutting decks fully, disengage PTO and stop engine. Remove key from key switch.
2. Raise and support machine so all wheels are off the ground (see Jacking Instructions (page 1–6)).

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

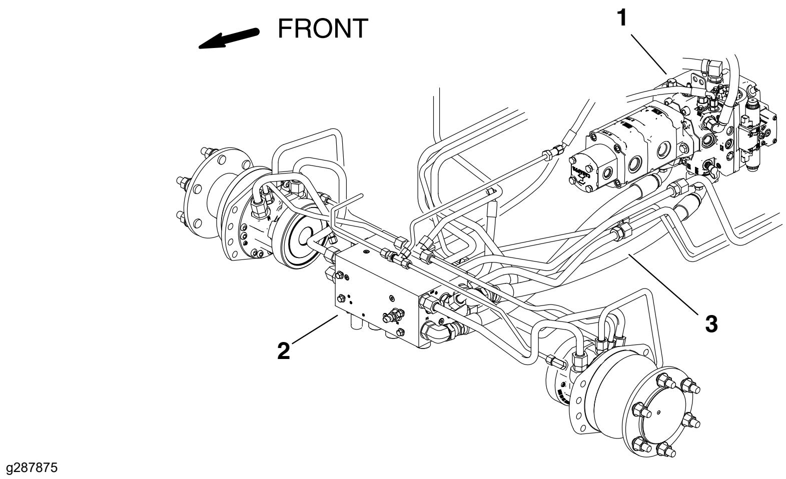

Figure 78

1. Piston pump
2. Traction manifold
3. Hose to P2 fitting

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3. Thoroughly clean junction of hydraulic hose from piston pump and elbow fitting in the P2 port on side of traction manifold which is attached to the bottom of the front axle frame (Figure 78). Disconnect hose from elbow fitting.
4. Connect Toro high flow hydraulic filter in series between manifold fitting and disconnected hose. Use hydraulic hose kit (see Special Tools (page 2–15)) to connect filter to machine. Make sure that hose connections are properly tightened.
5. After installing high flow filter to machine, check and fill hydraulic reservoir with new hydraulic oil as required (see *Operator's Manual*).
6. Start engine and run at low idle speed. Check for any hydraulic leakage from filter and hose connections. Correct any leaks before proceeding.

CAUTION

All wheels will be off the ground and rotating during this procedure. Make sure machine is well supported so it will not move and accidentally fall to prevent injuring anyone around machine.

Filtering Closed−Loop Traction Circuit (continued)

IMPORTANT

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

7. With 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 traction circuit engaged in forward for five (5) minutes while gradually increasing both forward pressure on traction pedal and engine speed until engine is running at 2000 RPM. Monitor filter indicator to make sure that green color is showing during operation.

IMPORTANT

If 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 flow is reversed when using a filter that is not bi−directional, debris from the filter will re−enter the traction circuit.

8. With engine running at 2000 RPM, alternately move traction pedal from forward to reverse. While monitoring filter indicator, continue this process for an additional five (5) minutes.
9. Shut engine off and remove key from key switch.
10. Remove high flow hydraulic filter and hydraulic hose kit from machine. Connect hydraulic hose to hydraulic tube. Make sure to properly tighten hose (see Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–7)).
11. Lower machine to ground.
12. Check oil level in hydraulic reservoir and add correct oil if necessary.

Hydraulic Reservoir

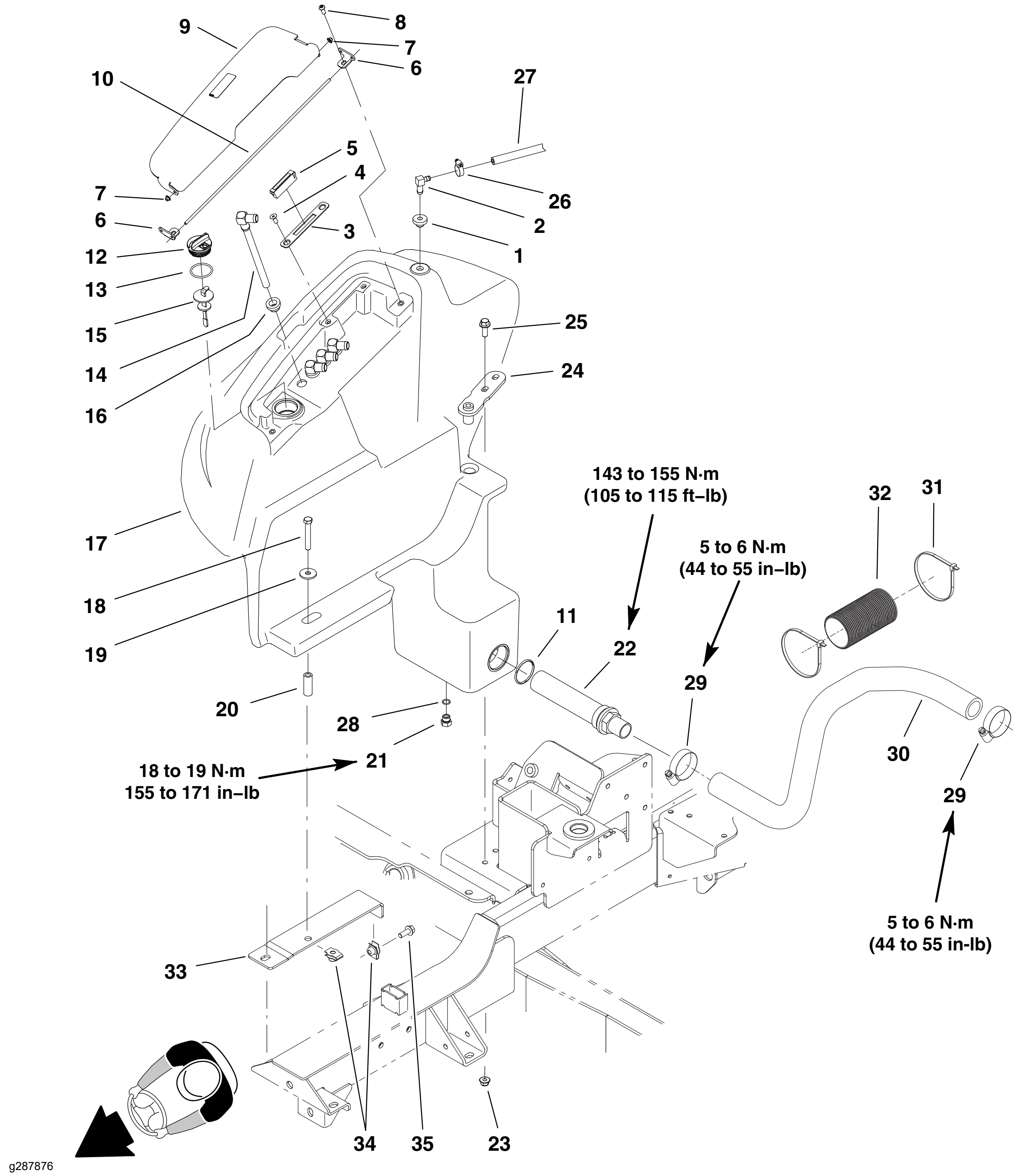

Figure 79

1.	Bushing	13.	O–ring	25.	Flange head screw
2.	Elbow fitting	14.	Stand pipe (4)	26.	Hose clamp
3.	Latch plate	15.	Dipstick	27.	Hose
4.	Socket head screw (2)	16.	Bushing (4)	28.	O–ring
5.	Magnetic catch	17.	Hydraulic reservoir	29.	Hose clamp
6.	Hinge bracket (2)	18.	Cap screw	30.	Suction hose
7.	Push nut (2)	19.	Washer	31.	Cable tie (2)
8.	Socket head screw (2)	20.	Spacer	32.	Hose guard
9.	Tank cover	21.	Drain plug	33.	Tank support
10.	Rod	22.	Tank strainer	34.	Tinnerman nut (2)
11.	O–ring	23.	Flange nut (2)	35.	Flange head screw
12.	Reservoir cap	24.	Reservoir hold down		

Hydraulic Reservoir Removal (Figure 79)

1. Park machine on a level surface, lower cutting decks fully, disengage PTO and stop engine. Remove key from key switch.
2. Read the General Precautions for Removing and Installing Hydraulic System Components (page 5–73).
3. To prevent contamination of hydraulic system during hydraulic reservoir removal, thoroughly clean exterior of reservoir, fittings and hoses.

IMPORTANT

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

4. Remove drain plug from the hydraulic reservoir and drain reservoir into a suitable container.
5. To allow access to reservoir hold down and fasteners, loosen fuel tank and slide it toward left side of machine (see Fuel System (page 4–17)).
6. Remove reservoir hold down (item 24) and cap screw, flat washer and spacer at front of reservoir (item 18).

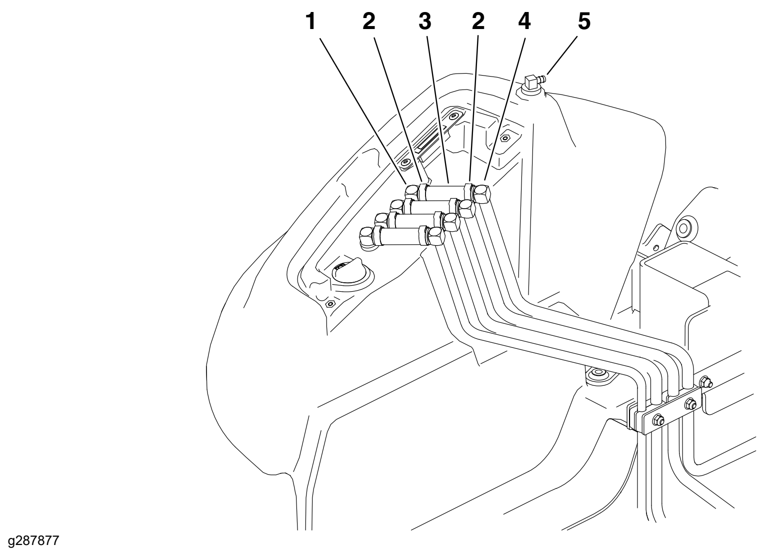

Figure 80

1. Stand pipe
2. Hose clamp
3. Hose
4. Hydraulic tube
5. Vent fitting

7. To ease assembly, label all hydraulic hoses to identify their correct position on the reservoir.

   Note: Original production clamps used to secure four (4) hoses to stand pipes and hydraulic tubes are crimp type clamps and will need to be cut in order to remove hoses (Figure 80). Traditional worm type clamps can be used as replacements.

8. Disconnect hydraulic hoses from stand pipes, vent fitting and suction strainer. Put caps or plugs on fittings and hoses to prevent contamination.
9. Remove hydraulic reservoir.

Inspection

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

Hydraulic Reservoir Installation (Figure 79)

1. Install reservoir:
   A. Position reservoir in frame and install hold down bracket and cap screws. Install spacer, flat washer and cap screw at front of reservoir.
   B. Tighten drain plug (item 21) from **18 to 19 N·m (155 to 171 in−lb)**.
   C. Tighten suction strainer (item 22) from **143 to 155 N·m (105 to 115 ft−lb)**.
2. Remove caps or plugs placed during removal to prevent contamination.
3. Using tags placed during reservoir removal, properly connect hydraulic hoses to stand pipes, vent fitting and suction strainer, and secure with hose clamps.
4. If hose guard (item 32) was removed, install guard with split orientated up and secure with two (2) cable ties.
5. Slide fuel tank to proper location on machine and secure in place (see Fuel System (page 4–17)).
6. Fill reservoir with new hydraulic fluid and check for leaks before returning machine to service.

Gear Pump

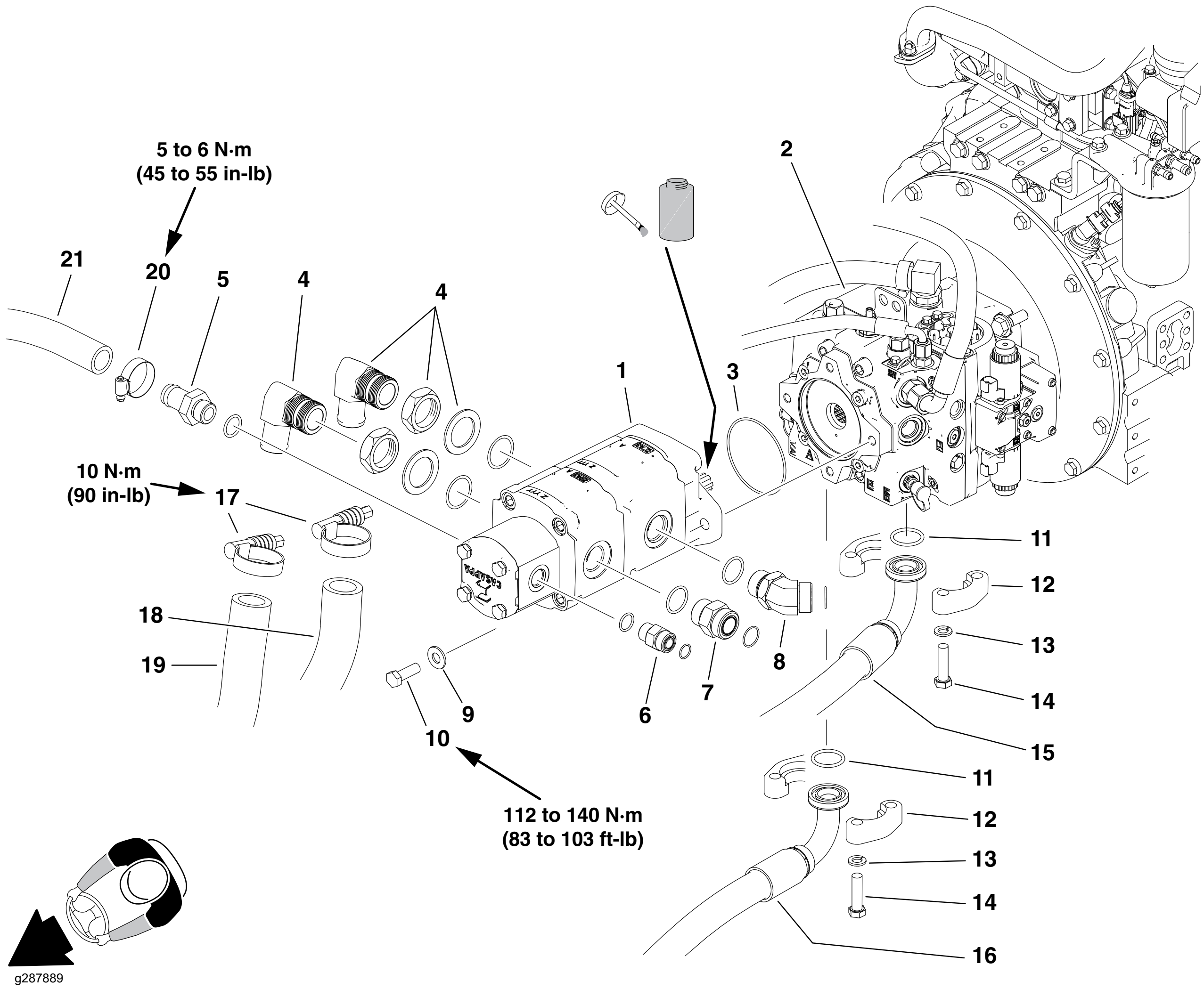

Figure 81

1.	Gear pump	8.	45 Elbow fitting	15.	Hydraulic hose assembly
2.	Piston pump	9.	Flat washer (2)	16.	Hydraulic hose assembly
3.	O−ring	10.	Cap screw (2)	17.	Hose clamp (2)
4.	90 Elbow barb fitting (2)	11.	O−ring (2)	18.	Suction hose
5.	Straight barb fitting	12.	Mounting flange (4)	19.	Suction hose
6.	Straight fitting	13.	Lock washer (8)	20.	Hose clamp
7.	Straight fitting	14.	Cap screw (8)	21.	Suction hose

Gear Pump Removal (Figure 81)

1. Park machine on a level surface, lower cutting decks fully, disengage PTO and stop engine. Remove key from key switch.
2. Open hood to gain access to gear pump. Remove side shrouds for improved overhead access to pump if desired (see Hood and Lower Shrouds (page 7–47)).
3. Remove drain plug from the hydraulic reservoir and drain reservoir into a suitable container.
4. Read the General Precautions for Removing and Installing Hydraulic System Components (page 5–73).

Gear Pump Removal (Figure 81) (continued)

5. To prevent contamination of hydraulic system during pump removal, thoroughly clean exterior of pump and fittings.
6. Label all hydraulic hose connections for assembly purposes.
7. Disconnect all hydraulic lines from gear pump and two (2) hydraulic hoses from bottom of piston pump (items 15 and 16). Put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper reassembly.

CAUTION

Make sure gear pump is properly supported before removing the pump mounting screws. Gear pump assembly weighs approximately 30 kg (68 lb).

8. Support gear pump assembly to prevent it from falling.
9. Remove two (2) cap screws and flat washers that secure gear pump to piston pump. Remove gear pump from machine.
10. Locate and discard O−ring between gear pump and piston pump (item 3).
11. If hydraulic fittings are to be removed from gear pump, mark fitting orientation to allow correct assembly. Remove fittings from pump and discard O−rings.

Gear Pump Installation (Figure 81)

1. If fittings were removed from gear pump, lubricate and place new O−rings onto fittings. Install fittings into pump openings using marks made during the removal process to properly orientate fittings. Tighten fittings (see Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–7)).
2. Apply clean petroleum jelly or light grease to new O−ring (item 3) and position O−ring in piston pump.
3. Apply anti seize lubricant to splines of gear pump shaft and position gear pump to piston pump. Align gear pump input shaft splines with piston pump coupler and slide gear pump input shaft into piston pump coupler. Secure gear pump to piston pump with two (2) flat washers and cap screws. Tighten screws from **112 to 140 N·m (83 to 103 ft−lb)**.
4. Remove caps or plugs from hydraulic lines and fittings. Install hydraulic lines to gear pump (see Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–7)). Tighten 1 in. hose clamp from **5 to 6 N·m (45 to 55 in−lb)** and 1−1/4 in. hose clamps to **10 N·m (90 in−lb)**.
5. Remove and replace hydraulic filters.
6. Fill hydraulic reservoir with new hydraulic oil.
7. Properly fill hydraulic system (see Charge Hydraulic System (page 5–79)).
8. Stop engine and check for hydraulic oil leaks. Check hydraulic reservoir oil level.
9. Install side shrouds if previously removed and close hood (see Hood and Lower Shrouds (page 7–47)).

Gear Pump Service

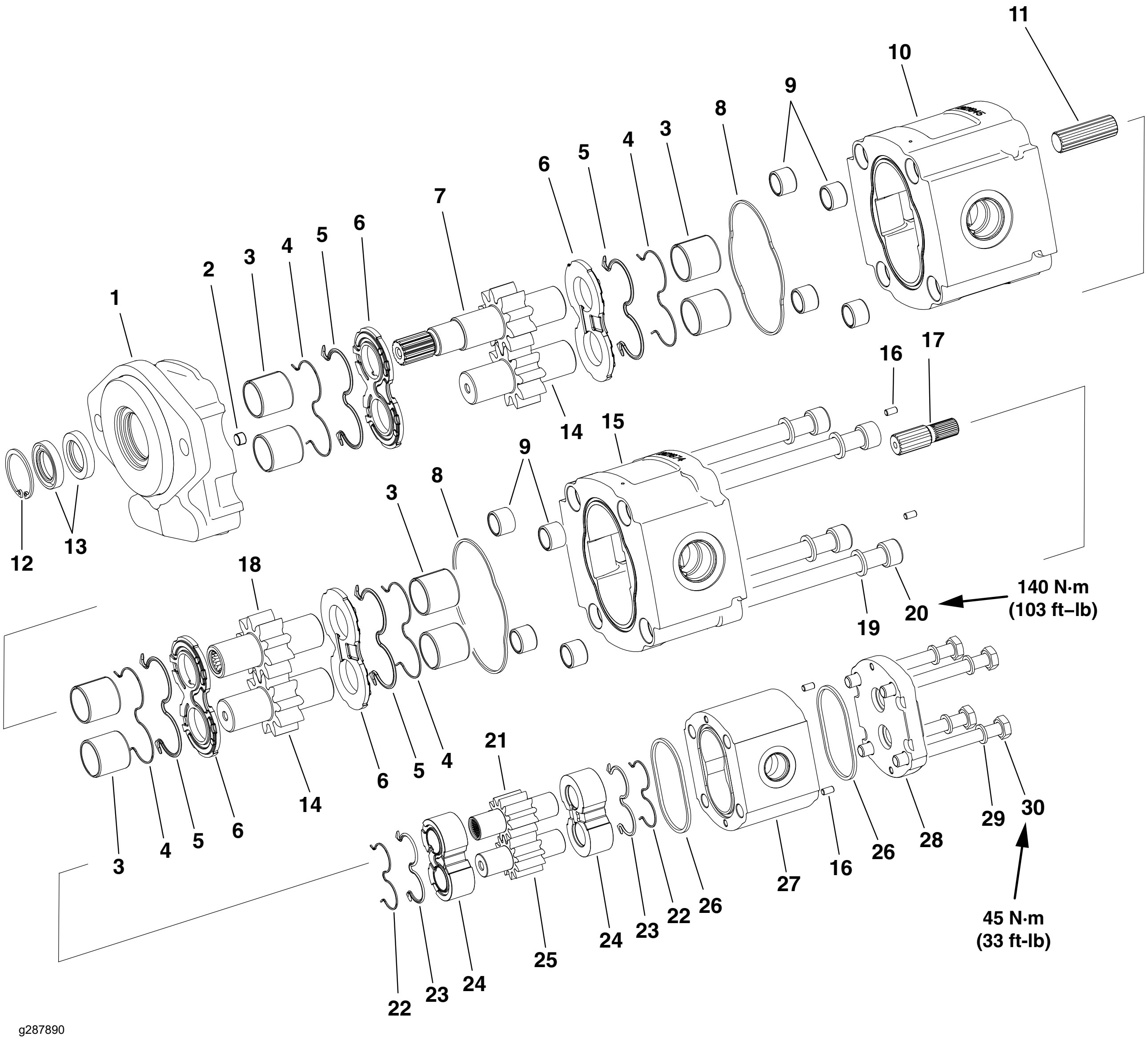

Figure 82

1. Front cover
2. Plug
3. Sleeve bearing (8)
4. Uni−ring (4)
5. Pressure seal (4)
6. Thrust plate (4)
7. Drive shaft/gear
8. Body seal (2)
9. Steel bushing (8)
10. Pump body − P1
11. Splined connecting shaft
12. Retaining ring
13. Shaft seal (2)
14. Idler shaft/gear (2)
15. Pump body − P2
16. Dowel pin (4)
17. Splined connecting shaft
18. Drive shaft/gear
19. Washer (4)
20. Cap screw (4)
21. Drive shaft/gear
22. Uni−ring (2)
23. Pressure seal (2)
24. Thrust plate (2)
25. Idler shaft/gear
26. Body seal
27. Pump body (P3)
28. Rear cover
29. Washer (4)
30. Cap screw (4)

Gear Pump Disassembly (Figure 82)

Note: If items other than pump seals are worn or damaged, the gear pump must be replaced as a complete assembly. Individual gears, housings and thrust plates are not available separately. Disassemble gear pump for cleaning, inspection and seal replacement only.

Gear Pump Disassembly (Figure 82) (continued)

IMPORTANT

Keep bodies, gears, flanges and thrust plates for each pump section together; do not mix parts between pump sections.

1. Plug pump ports and thoroughly clean exterior of pump with cleaning solvent. Make sure work area is clean.

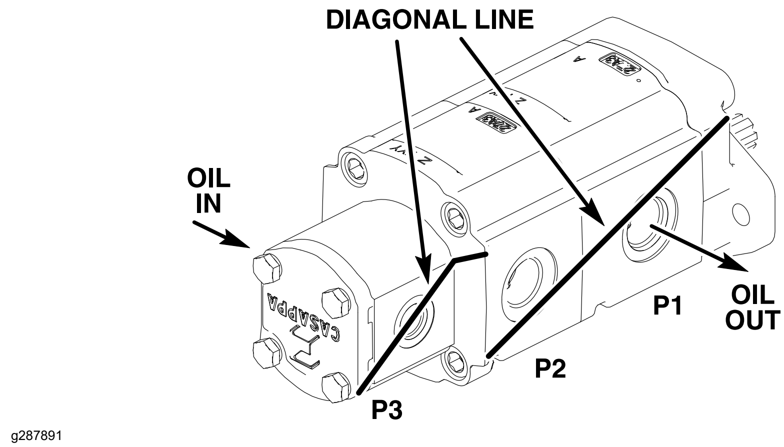

Figure 83

2. Use a marker to make diagonal lines across the gear pump sections for assembly purposes (Figure 83).

IMPORTANT

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

3. Secure the front cover of the pump in a vise with the drive shaft pointing down.
4. Support pump section P3 and gently tap the pump body with a soft face hammer to loosen the pump section. Remove pump section P3 from the remainder of the pump as an assembly. Be careful to not drop parts or disengage gear mesh.
5. Loosen the four (4) cap screws that secure the larger pump sections (P1 and P2) to the front cover.
6. Remove pump from vise and remove fasteners.
7. Support the pump assembly and gently tap the pump bodies with a soft face hammer to loosen the pump sections. Be careful to not drop parts or disengage gear mesh.

IMPORTANT

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

Gear Pump Disassembly (Figure 82) (continued)

8. Remove the thrust plates and seals from each pump section. Before removing each gear set, apply marking dye to mating teeth to retain ”timing”. Pump efficiency may be affected if the teeth are not installed in the same position during assembly. Keep the parts for each pump section together; do not mix parts between sections.

Gear Pump Inspection

1. Remove any nicks and burrs from all parts with emery cloth.

CAUTION

Use eye protection such as goggles when using compressed air.

2. Clean all parts with solvent. Dry all parts with compressed air.

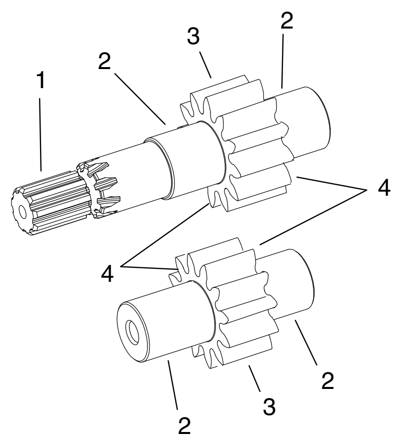

Figure 84

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

3. Inspect drive gears and idler gears for the following (Figure 84):
   A. Gear shafts should be free of rough surfaces and excessive wear at bushing points and sealing areas. Scoring, rough surfaces or wear on gear shafts indicates need for replacement.
   B. Gear teeth should be free of excessive scoring and wear. Any broken or nicked gear teeth must be replaced.
   C. Inspect gear face edge for sharpness. Sharp edges of gears will mill into thrust plates and, thus, must be replaced.
4. Inspect thrust plates for the following:
   A. Bearing areas should not have excessive wear or scoring.
   B. Face of thrust plates that are in contact with gears should be free of wear, roughness or scoring.
   C. Thickness of thrust plates should be equal.
5. Inspect front flange and rear cover for damage or wear.
6. If internal parts are found to be worn or damaged, gear pump replacement is necessary.

Gear Pump Assembly (Figure 82)

Note: When assembling the pump, check the marker line on each part to make sure the parts are properly aligned during assembly.

1. Lubricate body seals, pressure seals, uni−rings and thrust plate grooves with a thin coat of petroleum jelly. Lubricate all other internal parts freely with clean hydraulic oil.

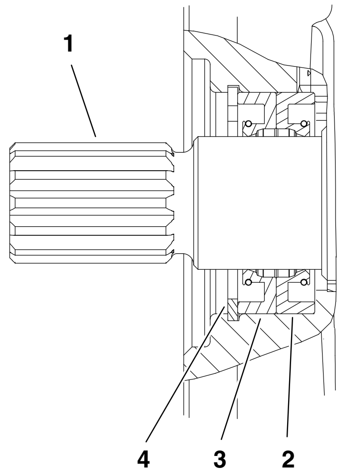

Figure 85

1. Drive shaft
2. Shaft seal
3. Dust seal
4. Retaining ring

2. Note seal orientation and install new seals into front cover (Figure 85):

   A. Press first shaft seal into front cover until it reaches the bottom of the bore.

   B. Install second shaft seal into front flange.

   C. Install retaining ring in front cover.

3. Place front flange, seal side down, on a flat surface.

4. Assembly pump section P1:

   A. Install the pressure seals, flat side outward, into the grooves in the thrust plates. Follow by carefully placing the uni−rings, flat side outward, between the pressure seals and the grooves in the thrust plate.

   B. Apply a light coating of petroleum jelly to the exposed side of the front flange.

   C. Lubricate the drive shaft/gear with clean hydraulic oil. Insert the drive end of the drive shaft through the thrust plate with the pressure seal side down and the open side of the pressure seal pointing to the inlet side of the pump. Install shaft into front cover.

   D. Lubricate the idler shaft/gear with clean hydraulic oil. Align the position markings made during disassembly and install idler gear shaft into the front thrust plate and front cover. Apply a light coating of clean hydraulic oil to gear faces.

   E. Install rear thrust plate with pressure seal side up and open side of the pressure seal pointing to the inlet side of the pump.

   F. Install steel bushings/dowel pins in body.

   G. Apply a light coating of petroleum jelly to new body seal and body seal groove in the body. Install new body seal into the body.

IMPORTANT

Do not dislodge seals during installation.

H. Align marker lines and slide the body over the gear assembly. A slight tap with a soft hammer on the pump body should be sufficient to engage the steel sleeves.

5. Repeat step 4 for pump section P2.
6. Install the four (4) cap screws with washers and hand tighten.

IMPORTANT

Prevent damage when clamping the pump in a vise; clamp on the front flange only. Also, use a vise with soft jaws.

7. Place front cover of the pump into a vise with soft jaws and alternately tighten the cap screws to **140 N·m (103 ft–lb)**.
8. Remove pump from vise.
9. Repeat step 4 for pump section P3.
10. Apply a light coating of petroleum jelly to new body seal and body seal groove in body. Install new body seal into the body.
11. Install dowel pins in rear cover.
12. Align marker lines and slide the rear cover over the shaft ends.
13. Install the four (4) cap screws with washers and hand tighten.
14. Place front cover of the pump into a vise with soft jaws and alternately tighten the cap screws to **45 N·m (33 ft–lb)**.
15. Remove pump from vise.
16. Place a small amount of clean hydraulic oil in the inlet of each pump and rotate the drive shaft away from the inlet one revolution (Figure 83). If any binding is noted, disassemble the pump and check for assembly problems.

Traction Circuit

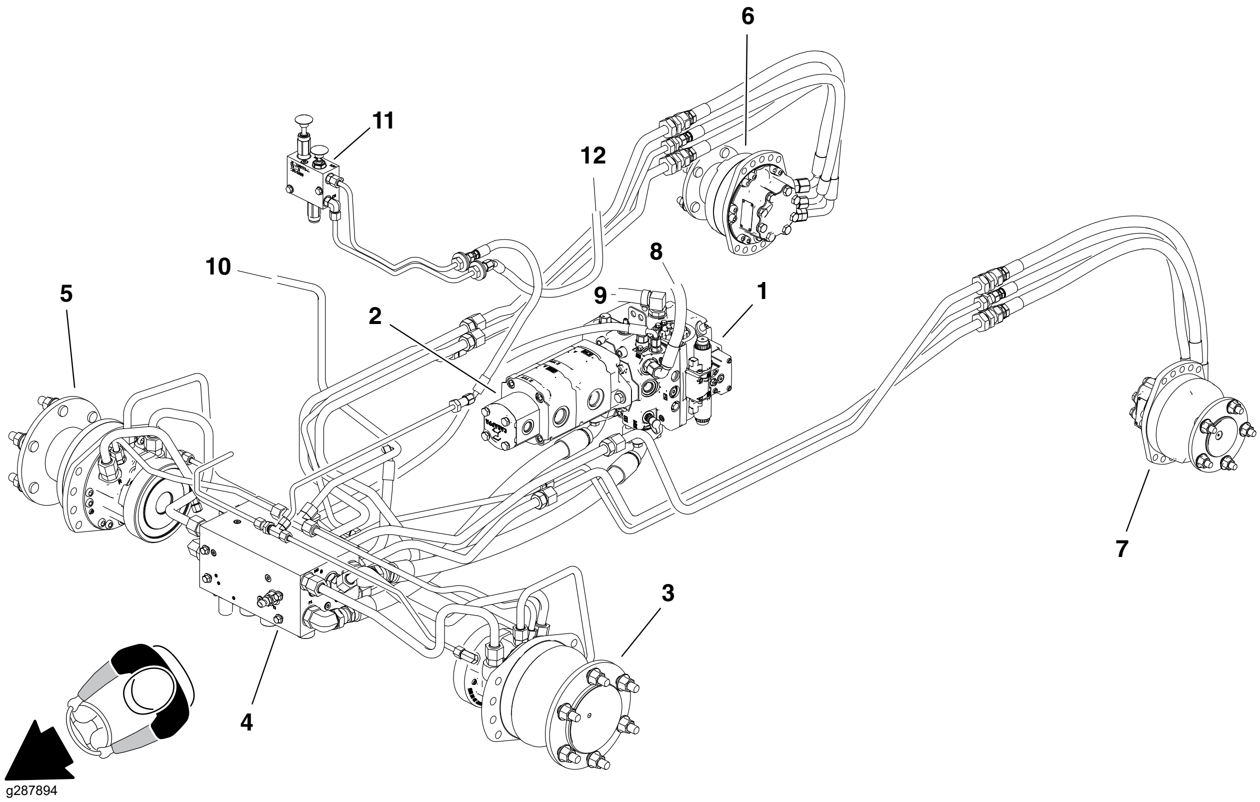

Figure 86

1. Piston (traction) pump
2. Gear pump
3. LH front wheel motor
4. Traction manifold
5. RH front wheel motor
6. RH rear wheel motor
7. LH rear wheel motor
8. Charge pressure − in
9. Charge return to reservoir − out
10. Case drain to reservoir − out
11. Brake release manifold
12. From steering/lift manifold − in

Figure 86 illustrates the components that are used in the Groundsmaster traction circuit. Procedures for removal, installation and disassembly/assembly of these components are provided on the following pages of this chapter.

Piston (Traction) Pump

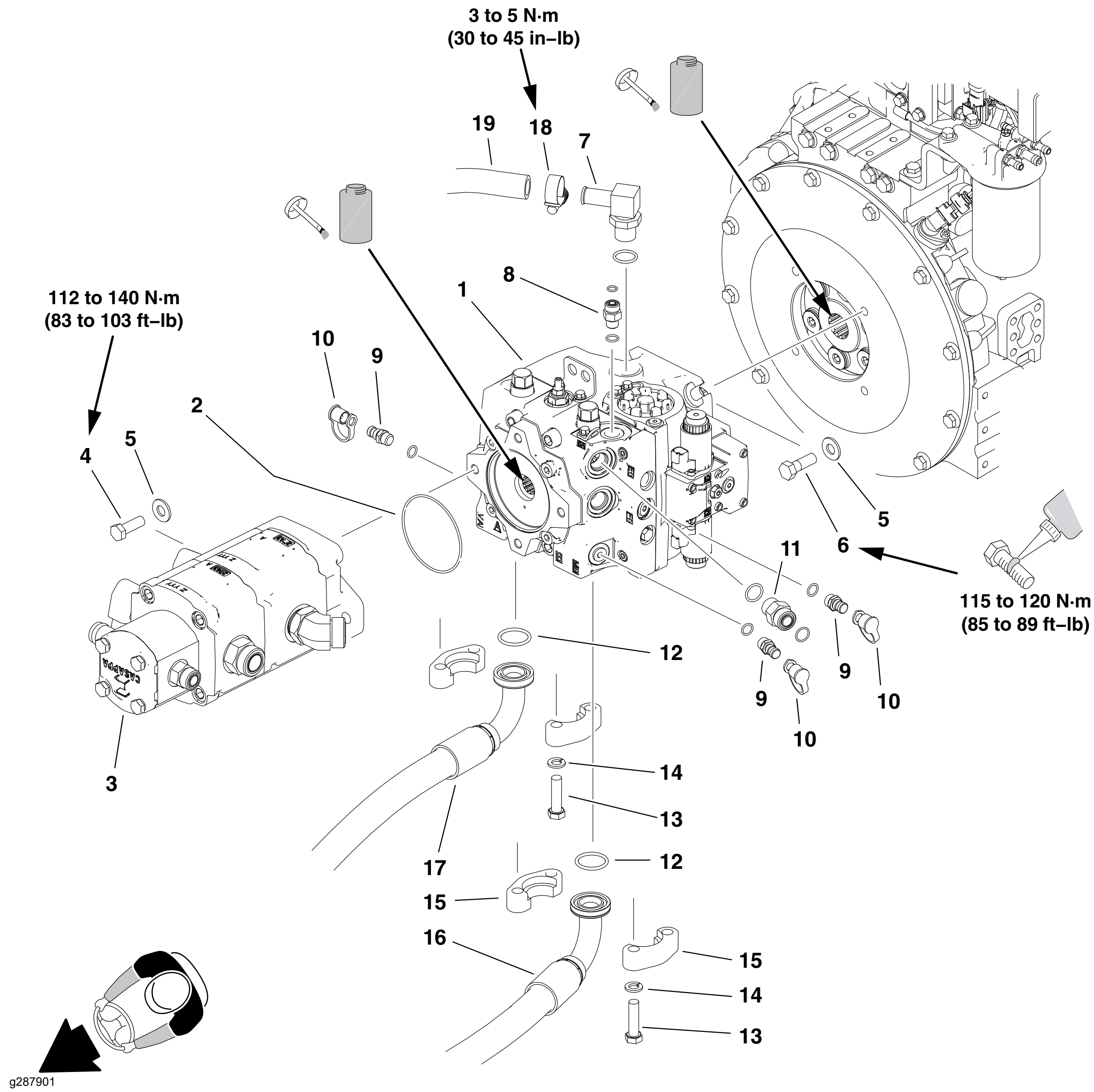

Figure 87

1. Piston (traction) pump
2. O−ring
3. Gear pump assembly
4. Cap screw (2)
5. Flat washer (6)
6. Cap screw (4)
7. Elbow fitting
8. Straight fitting
9. Diagnostic fitting (3)
10. Cap (3)
11. Straight fitting
12. O−ring (2)
13. Cap screw (8)
14. Lock washer (8)
15. Mounting flange (4)
16. Hydraulic hose assembly
17. Hydraulic hose assembly
18. Hose Clamp
19. Suction Hose

Piston (Traction) Pump Removal (Figure 87)

1. Park machine on a level surface, lower cutting decks fully, disengage PTO and stop engine. Remove key from key switch.
2. Open hood to gain access to hydraulic pumps. Remove side shrouds for improved overhead access to pumps if desired (see Hood and Lower Shrouds (page 7–47)).

Piston (Traction) Pump Removal (Figure 87) (continued)

3. Remove drain plug from the hydraulic reservoir and drain reservoir into a suitable container.
4. To prevent contamination of hydraulic system during removal, thoroughly clean exterior of pump assembly.

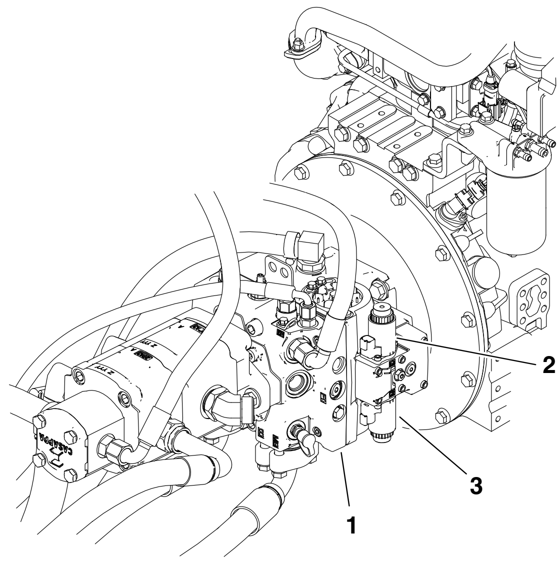

Figure 88

1. Piston pump
2. Forward solenoid coil (S1)
3. Reverse solenoid coil (S2)

5. Label wire harness connectors that attach to the two (2) solenoid coils on left side of piston pump (Figure 88). Disconnect harness connectors from solenoid coils on piston pump.
6. Read the General Precautions for Removing and Installing Hydraulic System Components (page 5–73).
7. For installation purposes, label all hydraulic lines that connect to gear pump and piston pump.
8. Put a drain pan below the pump assembly. Remove hydraulic hoses connected to piston and gear pump fittings. Put plugs or caps on disconnected hydraulic hoses and fittings to prevent contamination of the system.
9. Remove gear pump from machine (see Gear Pump (page 5–86)).

CAUTION

Make sure piston pump is properly supported before removing the pump mounting screws. Piston pump assembly weighs approximately 51 kg (110 lb).

10. Attach hoist to piston pump to support pump and allow safe removal of pump from machine.
11. Remove four (4) cap screws and washers retaining pump assembly to engine flywheel plate. Carefully pull pump assembly from flywheel plate and pump adapter plate (coupler), then lower the pump out of the machine.

Piston (Traction) Pump Removal (Figure 87) (continued)

12. If hydraulic fittings are to be removed from piston pump, mark fitting orientation to allow correct assembly. Remove fittings from pump and discard O−rings.

Piston (Traction) Pump Installation (Figure 87)

1. If fittings were removed from piston pump, lubricate and place new O−rings onto fittings. Install fittings into pump openings using marks made during the removal process to properly orientate fittings. Tighten fittings (see Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9)).
2. Attach hoist to piston pump to support pump and also to allow safe installation of pump into machine.
3. Apply anti seize lubricant to internal splines of pump coupler and external splines of pump shaft.

IMPORTANT

To prevent spring coupler damage, make sure that piston pump is properly supported and does not put side load on coupler during pump installation.

4. Carefully raise piston pump into the machine, align pump input shaft to spring coupler on engine and position it to the engine flywheel plate. Support pump to prevent it from producing any side load into coupler and also to align pilot diameter of pump to flywheel plate bore.
5. While maintaining pump alignment with spring coupler and flywheel plate, apply medium strength thread locker and install four (4) cap screws and washers to secure piston pump to flywheel cover plate. Tighten cap screws from **115 to 120 N·m (85 to 89 ft−lb)**.
6. Install gear pump to piston pump (see Gear Pump (page 5–86)).

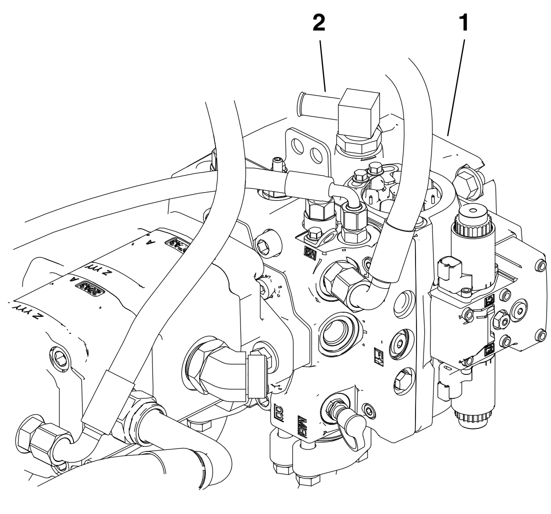

Figure 89

1. Piston (traction) pump
2. Piston pump charge return

7. Fill piston (traction) pump housing with 2.1 L (0.55 gal) of new hydraulic oil through the charge return (90o barbed fitting) at the top of the pump (Figure 89). This will ensure that internal pump components have adequate lubrication during initial operation.

Piston (Traction) Pump Installation (Figure 87) (continued)

8. Remove plugs and caps from disconnected hydraulic hoses and fittings of the pump assembly. Install hydraulic lines to correct location on gear and piston pumps (see Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9) and Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–7)). Tighten suction hose clamp from **3 to 5 N·m (30 to 45 in−lb)**.

9. Using labels placed during pump removal, connect wire harness connectors to the two (2) solenoid coils on left side of piston pump (Figure 88).

10. Lower machine to ground.

IMPORTANT

Refer to Traction Circuit Component Failure (page 5–5) for information regarding the importance of removing contamination from the traction circuit.

11. Install new hydraulic filter and fill hydraulic reservoir with correct oil.
12. Prime hydraulic pumps (see Priming Hydraulic Pumps (page 5–76)).
13. Properly fill hydraulic system (see Charge Hydraulic System (page 5–79)).
14. Stop engine and check for hydraulic oil leaks. Check hydraulic reservoir oil level and adjust if necessary.
15. Install side shrouds if previously removed and close hood (see Hood and Lower Shrouds (page 7–47)).

Piston (Traction) Pump Service

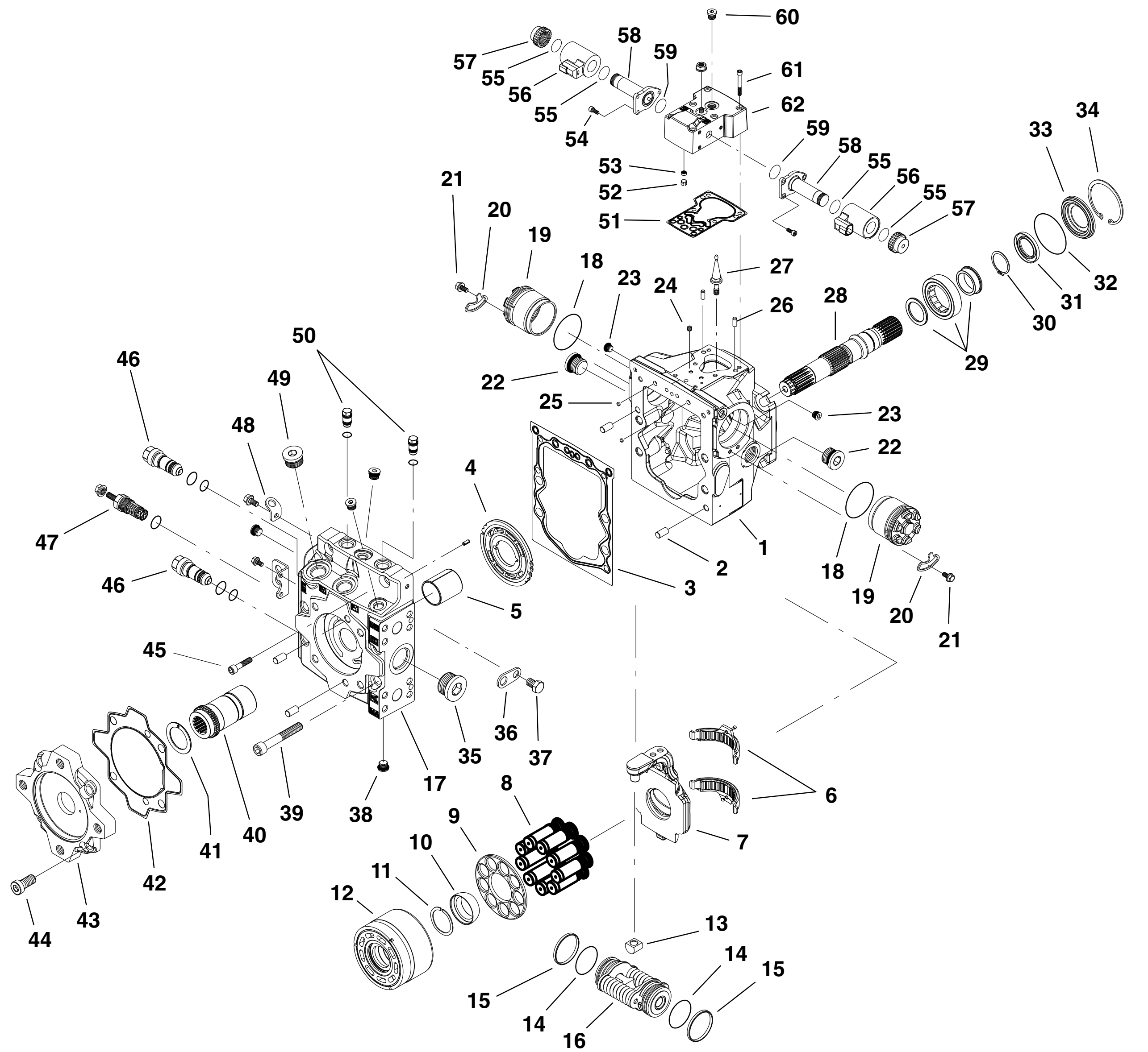

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Figure 90

Figure 90 (continued)

1. Housing
2. Dowel pin (4)
3. Gasket
4. Valve plate
5. Bearing
6. Swashplate bearing kit
7. Swashplate
8. Piston assembly
9. Slipper retainer
10. Slipper retainer guide
11. Slipper hold down
12. Cylinder block assembly
13. Slider block
14. O−ring (2)
15. Piston ring (2)
16. Servo piston
17. End cap
18. O−ring (2)
19. Servo cylinder (2)
20. Locking plate (2)
21. Flange head screw (4)
22. Plug with O−ring (2)
23. Plug with O−ring (2)
24. Orifice (2)
25. Screen (2)
26. Dowel pin (2)
27. Feedback pin
28. Shaft
29. Roller bearing assembly
30. Retaining ring
31. Lip seal
32. O−ring
33. Seal carrier
34. Retaining ring
35. Plug with O−ring
36. Lifting lug
37. Cap screw (2)
38. Plug with O−ring (4)
39. Screw (4)
40. Coupling
41. Thrust plate
42. Gasket
43. Adapter
44. Screw (4)
45. Screw (2)
46. High pressure relief valve (2)
47. Charge pressure relief valve
48. Lifting lug
49. Plug with O−ring (2)
50. Pressure limiter plug with O−ring (2)
51. Gasket
52. Locking ring
53. Screen
54. Screw (6)
55. O−ring (4)
56. Solenoid coil (2)
57. Coil nut (2)
58. Solenoid valve (2)
59. O−ring (2)
60. Plug with O−ring
61. Cap screw (6)
62. Control housing

Piston (Traction) Pump Service (Figure 90)

For service of the piston (traction) pump, see the Danfoss H1 Closed Circuit Axial Piston Pumps Service Manual and Danfoss H1 Closed Circuit Axial Piston Pumps Repair Instructions.

For servo control solenoid coil service information, see Piston (Traction) Pump Control Solenoid Coils (page 6–124).

Note: The forward and reverse solenoid valves and coils are identical.

IMPORTANT

If a piston (traction) pump failure occurred, refer to Traction Circuit Component Failure (page 5–5) for information regarding the importance of removing contamination from the traction circuit.

Front Wheel Motors

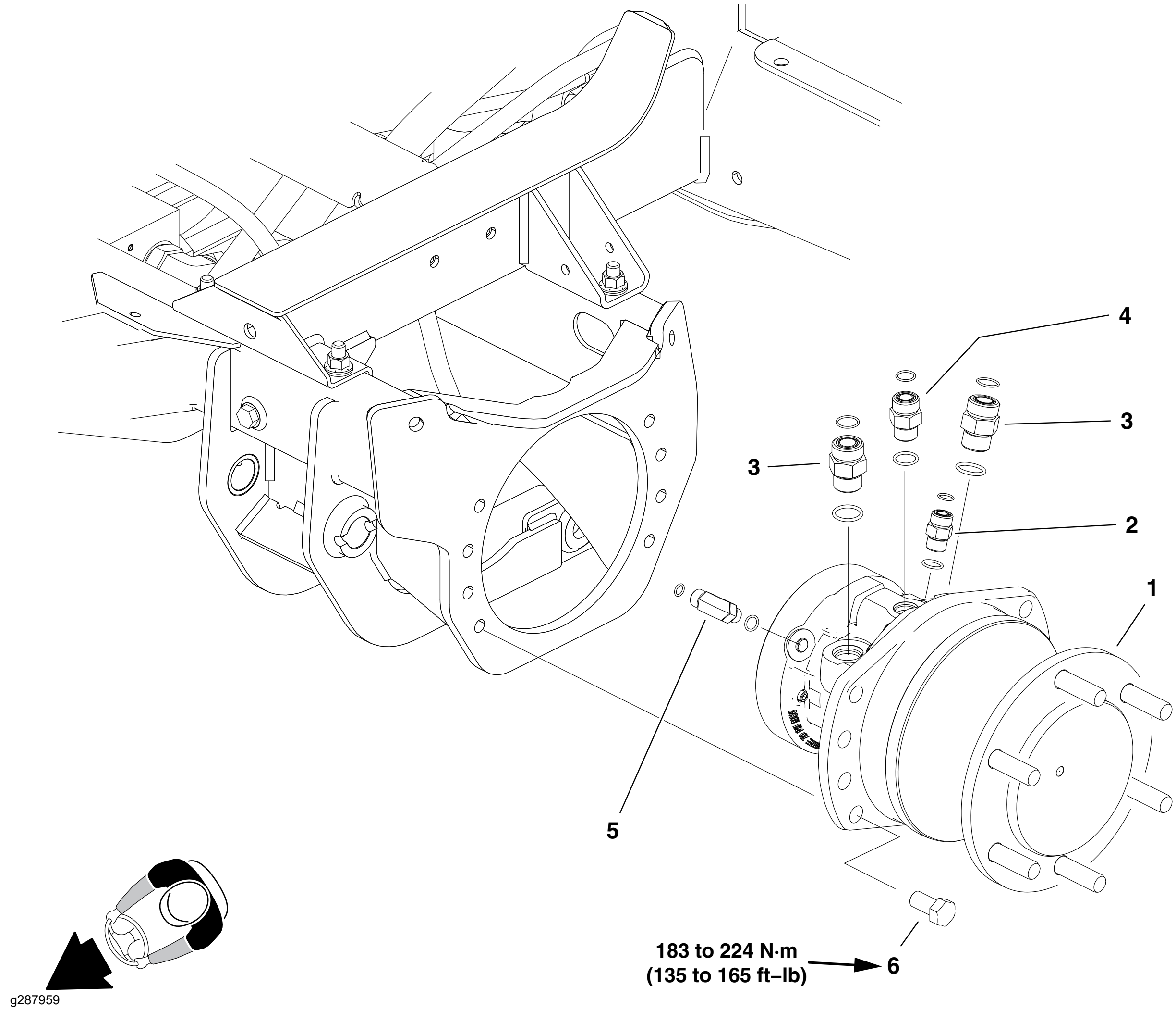

Figure 91

1. Front wheel motor
2. Hydraulic straight fitting
3. Hydraulic straight fitting (2)
4. Hydraulic straight fitting
5. Hydraulic elbow fitting
6. Cap screw (8)

Front Wheel Motor Removal (Figure 91)

1. Park machine on a level surface, lower cutting decks fully, disengage PTO and stop engine. Remove key from key switch.

IMPORTANT

The front wheel motors on Groundsmaster 5900 and 5910 machines look identical but contain unique internal components for right side and left side application. To avoid interchanging front wheel motors on machine, label front wheel motors RIGHT and LEFT for assembly purposes.

2. If removing the left front wheel motor, remove the fuel tank for better access to the wheel motor hydraulic lines (see Fuel System (page 4–17)). If removing the right front wheel motor, remove the hydraulic reservoir for better access to the wheel motor hydraulic lines (see Hydraulic Reservoir (page 5–83)).

Front Wheel Motor Removal (Figure 91) (continued)

3. Read the General Precautions for Removing and Installing Hydraulic System Components (page 5–73).
4. To prevent contamination of hydraulic system during motor removal, thoroughly clean exterior of motor, hydraulic tubes and fittings.

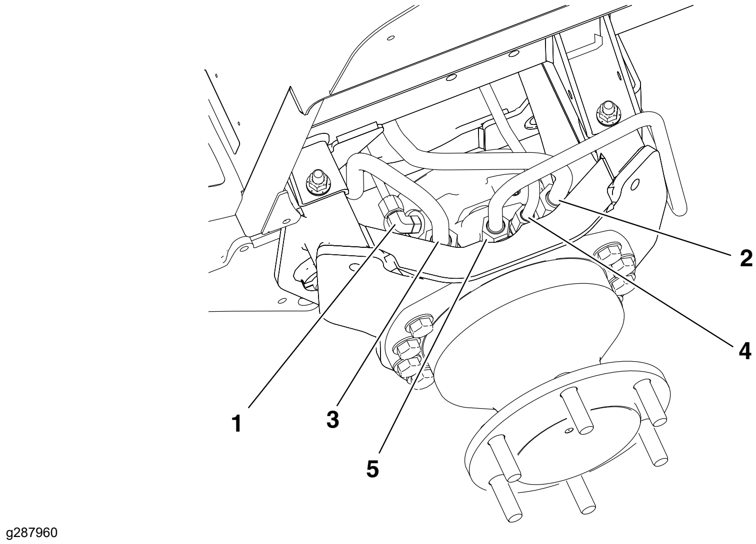

Figure 92
(LH Wheel Motor)

1. Disconnect/remove 1st
2. Disconnect/remove 2nd
3. Disconnect/remove 3rd
4. Disconnect/remove 4th
5. Disconnect/remove 5th

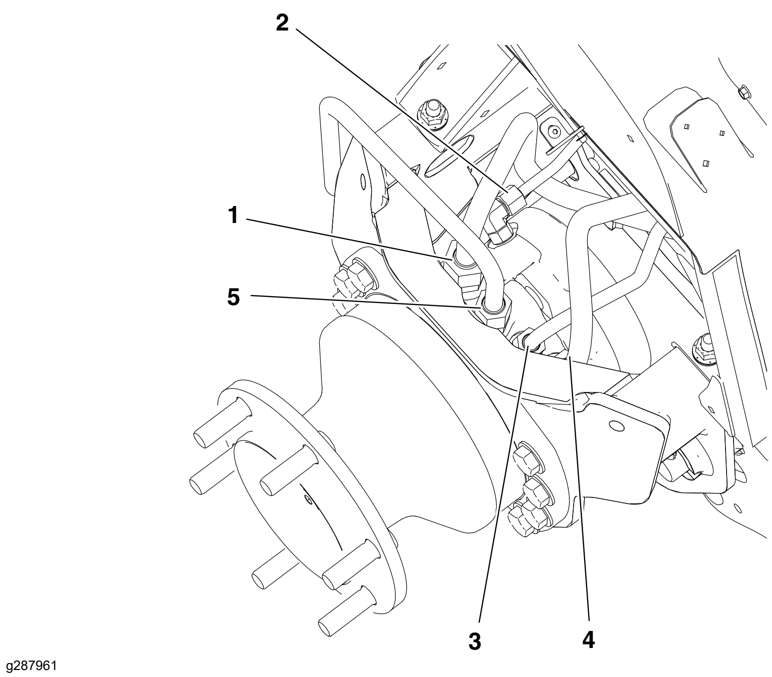

Figure 93
(RH Wheel Motor)

1. Disconnect/remove 1st
2. Disconnect/remove 2nd
3. Disconnect/remove 3rd
4. Disconnect/remove 4th
5. Disconnect/remove 5th

Front Wheel Motor Removal (Figure 91) (continued)

5. Disconnect or remove hydraulic tubes from the desired wheel motor in the order recommended (Figure 92 and Figure 93). It may be necessary to completely remove the hydraulic tube or loosen the opposite end of the hydraulic tube to allow wheel motor removal. If removed, mark or tag the tube positions for installation.
6. Put caps or plugs on disconnected hydraulic lines and fittings to prevent contamination.

   Note: Although the rear wheel motors are the same for left and right sides, do not interchange them as they have be run−in for one direction and inefficiencies will result if switched.

7. If both wheel motors are being removed, label motors left side or right side.

CAUTION

Make sure wheel motor is properly supported before removing the mounting screws. The wheel motor assembly weighs approximately 68 kg (150 lb).

8. Remove eight (8) cap screws that secure front wheel motor to the machine frame and remove the wheel motor.
9. If necessary, remove fittings from wheel motor and discard fitting O−rings.

Front Wheel Motor Installation (Figure 91)

IMPORTANT

Because of internal differences in front wheel motors, DO NOT interchange front wheel motors on machine (i.e. do not put right side motor on left side of machine). If necessary, use parts catalog and part number on wheel motor to identify RH and LH motors.

1. If fittings were removed from wheel motor, lubricate and place new O−rings onto fittings. Install fittings into motor ports and tighten fittings (see Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9)).
2. Position wheel motor in frame and secure with eight (8) cap screws. Tighten cap screws from **183 to 224 N·m (135 to 165 ft−lb)**.

Front Wheel Motor Installation (Figure 91) (continued)

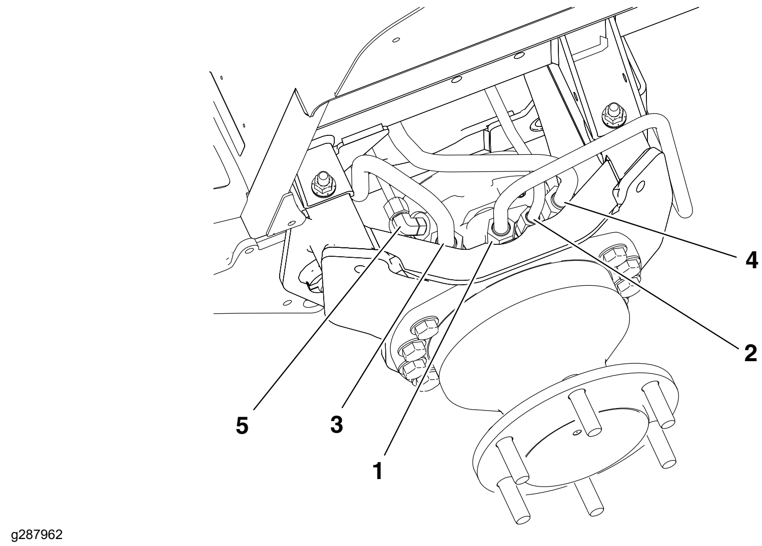

Figure 94

(LH Wheel Motor)

1. Connect/install 1st
2. Connect/install 2nd
3. Connect/install 3rd
4. Connect/install 4th
5. Connect/install 5th

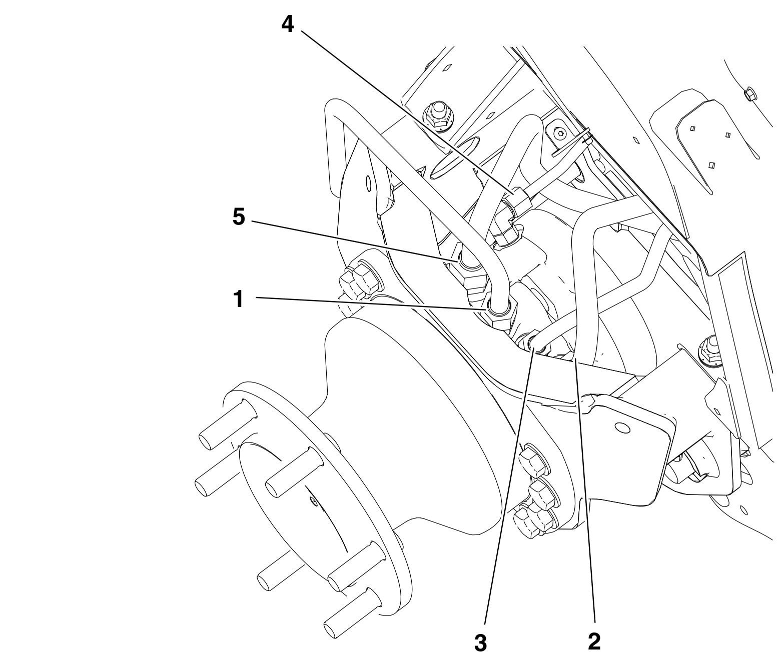

Figure 95

(RH Wheel Motor)

1. Connect/install 1st
2. Connect/install 2nd
3. Connect/install 3rd
4. Connect/install 4th
5. Connect/install 5th

3. Remove plugs from hydraulic lines and fittings and connect or install hydraulic tubes to the wheel motor being installed in the recommended order (Figure 94 and Figure 95). Tighten the connections at each end of hydraulic tubes (see Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–7)).

Front Wheel Motor Installation (Figure 91) (continued)

4. If previously removed, install the fuel tank (see Fuel System (page 4–17)) and/or the hydraulic reservoir (see Hydraulic Reservoir (page 5–83)).
5. Fill reservoir with new hydraulic fluid as required.
6. Check hydraulic system for leaks before returning the machine to service.

Rear Wheel Motors

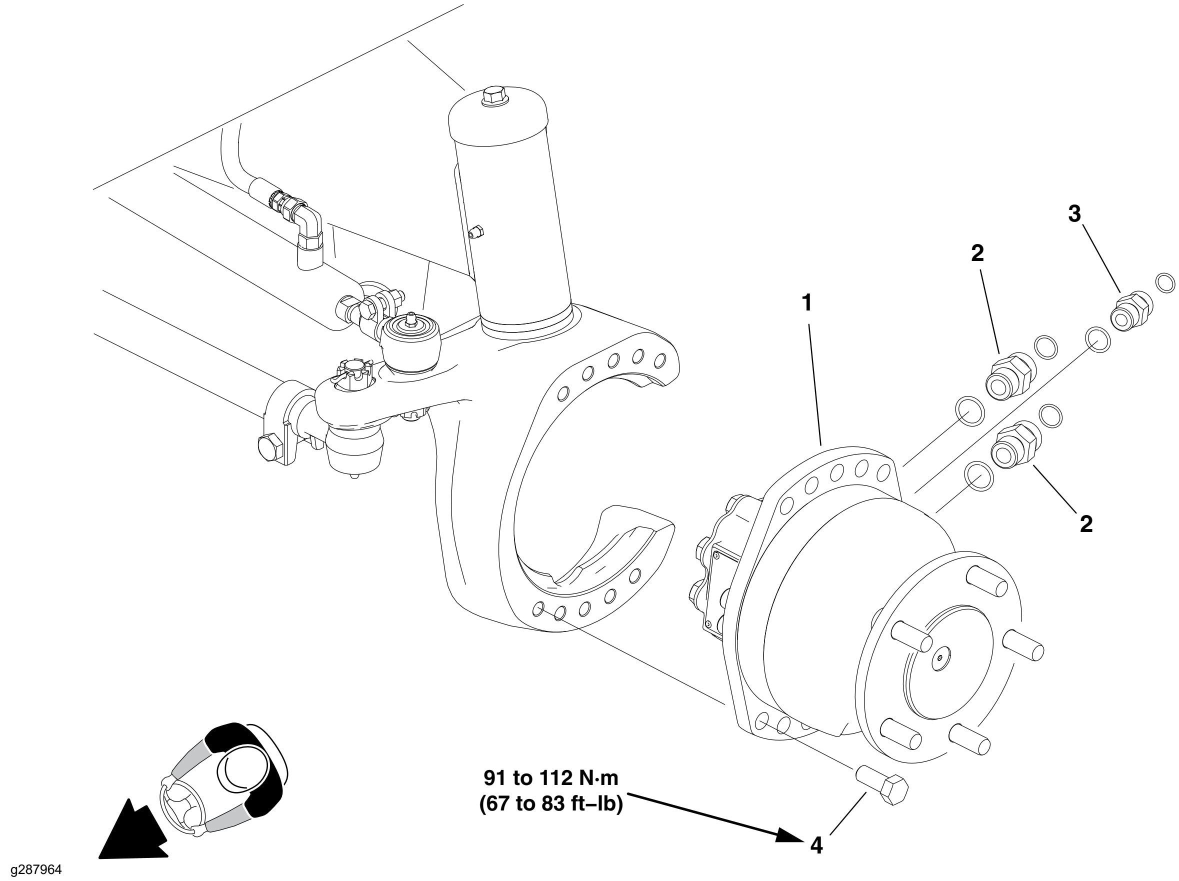

Figure 96

1. Rear wheel motor
2. Hydraulic straight fitting (2)
3. Hydraulic straight fitting
4. Cap screw (10)

Note: The rear wheel motors on Groundsmaster 5900 and 5910 machines are identical.

IMPORTANT

If a wheel motor failure occurred, refer to Traction Circuit Component Failure (page 5–5) for information regarding the importance of removing contamination from the traction circuit.

Rear Wheel Motor Removal (Figure 96)

1. Park machine on a level surface, lower cutting decks fully, disengage PTO and stop engine. Remove key from key switch.
2. Remove the rear wheel from the machine (see Wheels (page 7–3)).
3. Read the General Precautions for Removing and Installing Hydraulic System Components (page 5–73).
4. To prevent contamination of hydraulic system during motor removal, thoroughly clean exterior of motor, hydraulic hoses and fittings.
5. Label all hydraulic hoses for assembly purposes. Remove hydraulic hoses from fittings on wheel motor. Allow hoses to drain into a suitable container.
6. Put caps or plugs on disconnected hydraulic lines and fittings to prevent contamination.

Rear Wheel Motor Removal (Figure 96) (continued)

⚠ CAUTION ⚠

Make sure wheel motor is properly supported before removing the mounting screws. The wheel motor assembly weighs approximately 32 kg (70 lb).

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7. Remove ten (10) cap screws that secure rear wheel motor to the steering spindle and remove the wheel motor.
8. If necessary, remove fittings from wheel motor and discard fitting O−rings.

Rear Wheel Motor Installation (Figure 96)

1. If fittings were removed from wheel motor, lubricate and place new O−rings onto fittings. Install fittings into motor ports and tighten fittings (see Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9)).
2. Position rear wheel motor to steering spindle. Make sure that ports in wheel motor are facing toward the rear of the machine.
3. Secure wheel motor to spindle with ten (10) cap screws and flat washers. Tighten cap screws from **91 to 112 N·m (67 to 83 ft−lb)**.
4. Remove plugs from hydraulic lines and fittings. Using labels placed during the removal process, attach hydraulic hoses to wheel motor and tighten the connections (see Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–7)).
5. Install the rear wheel to the machine (see Wheels (page 7–3)).
6. Fill reservoir with new hydraulic fluid as required.
7. After assembly is completed, verify that hydraulic hoses and fittings do not contact anything through full range of axle motion.
8. Check hydraulic system for leaks before returning the machine to service.

Wheel Motor Service

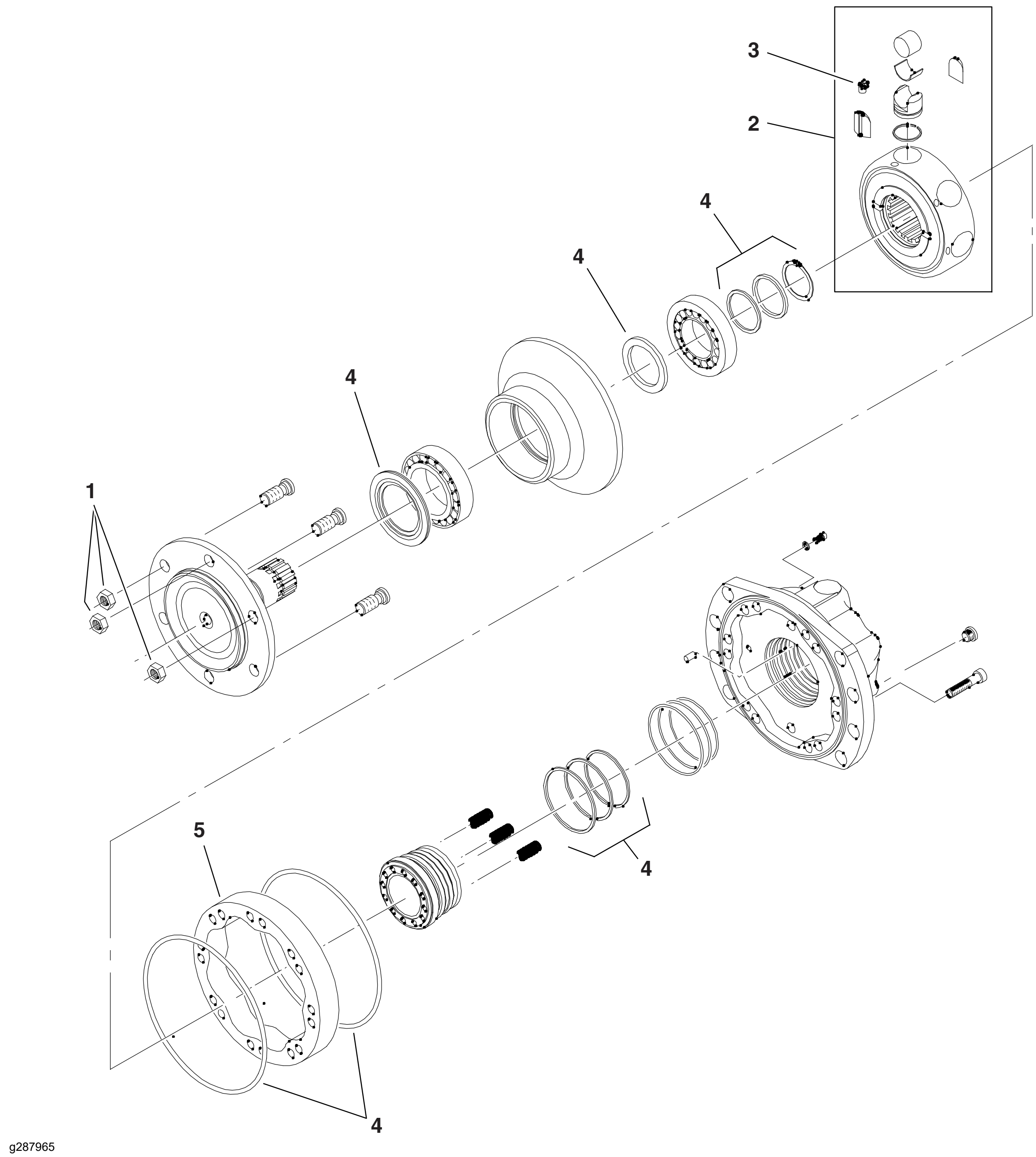

Figure 97

(Rear Motor Shown)

1. Flange nut(6)
2. Rotating group
3. Radial clip (6)
4. Seal kit
5. Cam

The front wheel motors on Groundsmaster 5900/5910 machines look identical but contain unique internal components for right side and left side application. To avoid interchanging front wheel motors on the machine, label front wheel motors RIGHT and LEFT for assembly purposes. The right and left rear wheel motors on the machines are identical. Use the manufacturers identification plate on the motor to identify the correct parts and service information for the motor.

Wheel Motor Service (continued)

Note: Contact an Authorized Toro Distributor for wheel motor service and repair. The *Poclain MS Series Service Manual* is available to Authorized Toro Distributors in the Service Library of Toro Gateway.

IMPORTANT

If a wheel motor failure occurred, refer to Traction Circuit Component Failure (page 5–5) for information regarding the importance of removing contamination from the traction circuit.

Traction Control Manifold

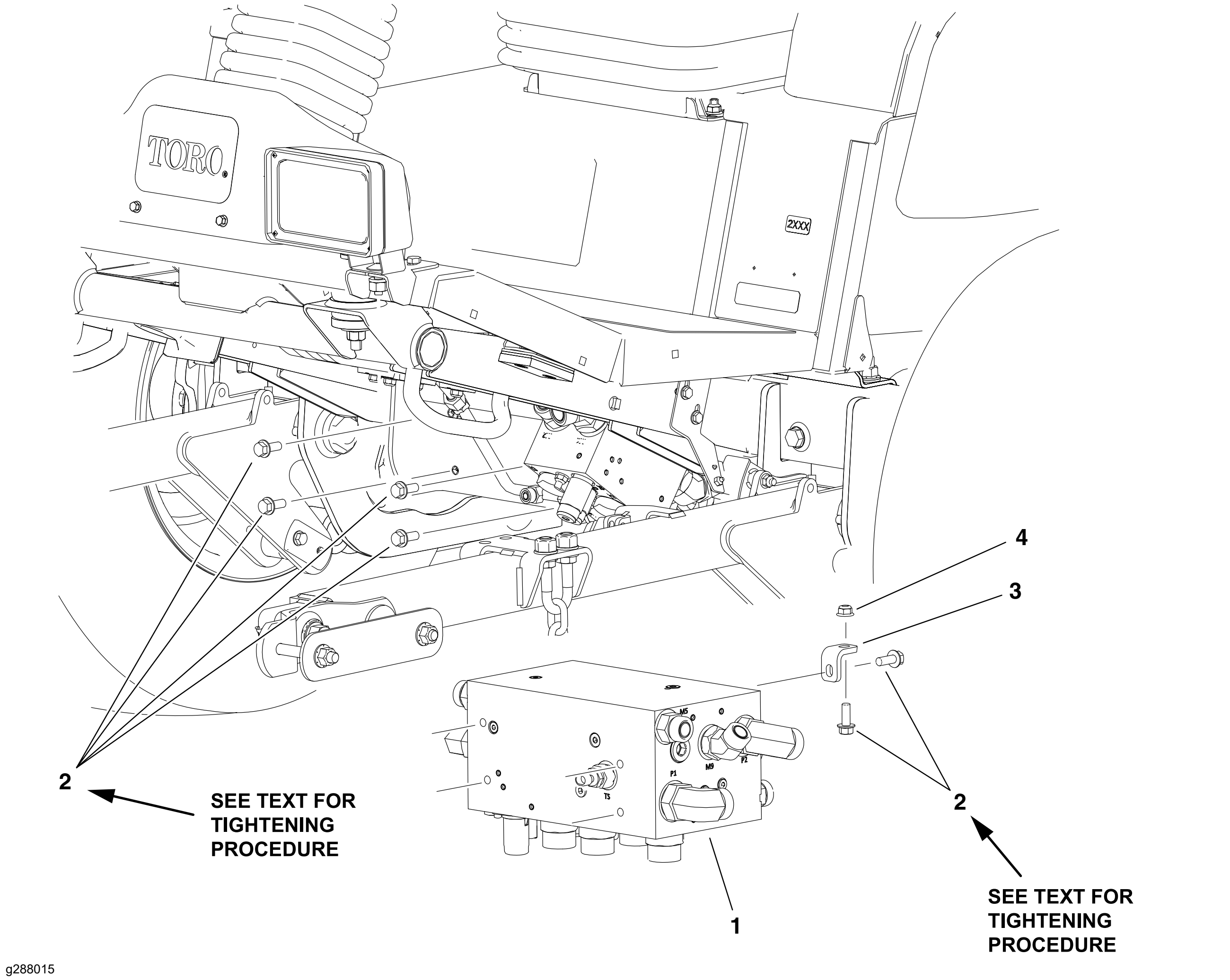

Figure 98

1. Traction control manifold
2. Flange head cap screw (6)
3. Mounting bracket
4. Flange nut

Note: The ports on the traction control manifold are marked for easy identification of components. Example: P1 is the piston pump connection port for the forward direction and SV is the location for the high/low speed solenoid valve (see A Hydraulic Schematic (page A–5) to identify the function of the hydraulic lines and cartridge valves at each port).

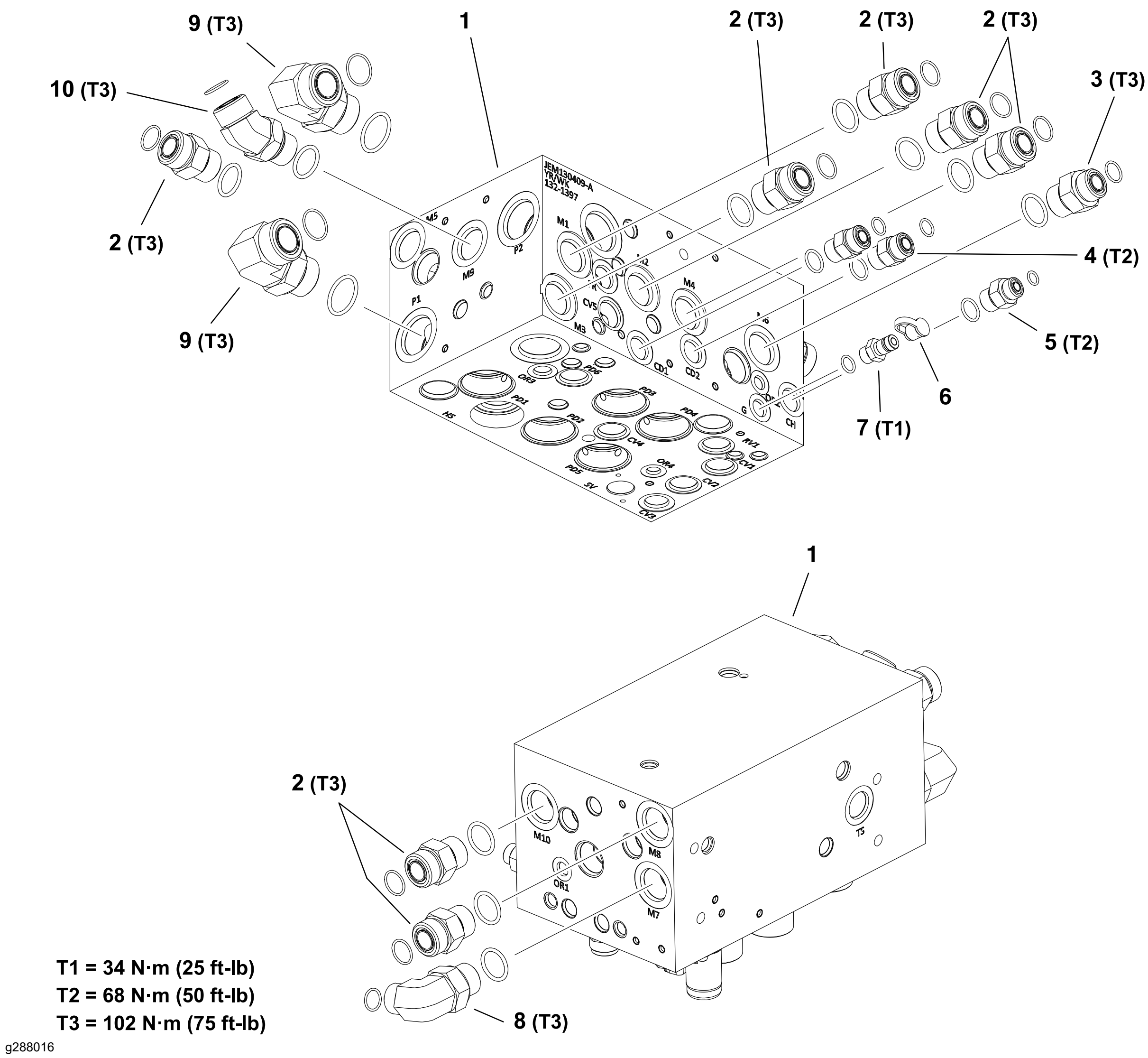

Figure 99

1. Manifold block
2. Straight fitting (7)
3. Straight fitting
4. Straight fitting (2)
5. Straight fitting
6. Dust cap
7. Diagnostic fitting
8. Elbow fitting
9. Elbow fitting (2)
10. Elbow fitting

Traction Control Manifold Removal (Figure 98)

1. Read the General Precautions for Removing and Installing Hydraulic System Components (page 5–73).
2. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold and fittings.
3. Disconnect wire harness connector from the solenoid valve and the temperature sender.
4. Disconnect all hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings to prevent system contamination. Label disconnected hydraulic lines for proper assembly.

Traction Control Manifold Removal (Figure 98) (continued)

⚠ CAUTION ⚠

Make sure hydraulic manifold is properly supported before removing the mounting screws. The hydraulic manifold assembly weighs approximately 50 kg (110 lb).

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5. Remove hydraulic manifold from the frame.
6. If hydraulic fittings are to be removed from manifold, mark fitting orientation to allow correct assembly. Remove fittings from manifold and discard O−rings.

Traction Control Manifold Installation (Figure 98)

1. If fittings were removed from manifold, lubricate and place new O−rings onto fittings. Install fittings into manifold openings using marks made during the removal process to properly orientate fittings. Tighten hydraulic fittings to torque value provided (Figure 99). For information on tightening procedures for hydraulic fittings, see Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9).
2. Position traction control manifold in the frame and secure with the mounting bracket and all manifold mounting cap screws. Tighten the cap screws finger tight only at this time.
3. Remove caps and plugs from fittings and tubes (hard lines). Using labels placed during removal, properly connect hydraulic tubes to manifold (see Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–7)).
4. Tighten manifold mounting cap screws from **58 to 72 N·m (43 to 53 ft−lb)**.
5. Remove caps and plugs from fittings and hoses (soft lines). Using labels placed during removal, properly connect hydraulic hoses to manifold (see Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–7)).
6. Connect wire harness connector to the solenoid valve and temperature sender.
7. Make sure hydraulic tank is full. Add correct oil if necessary.
8. Check hydraulic system for leaks before returning the machine to service.

Traction Control Manifold Service

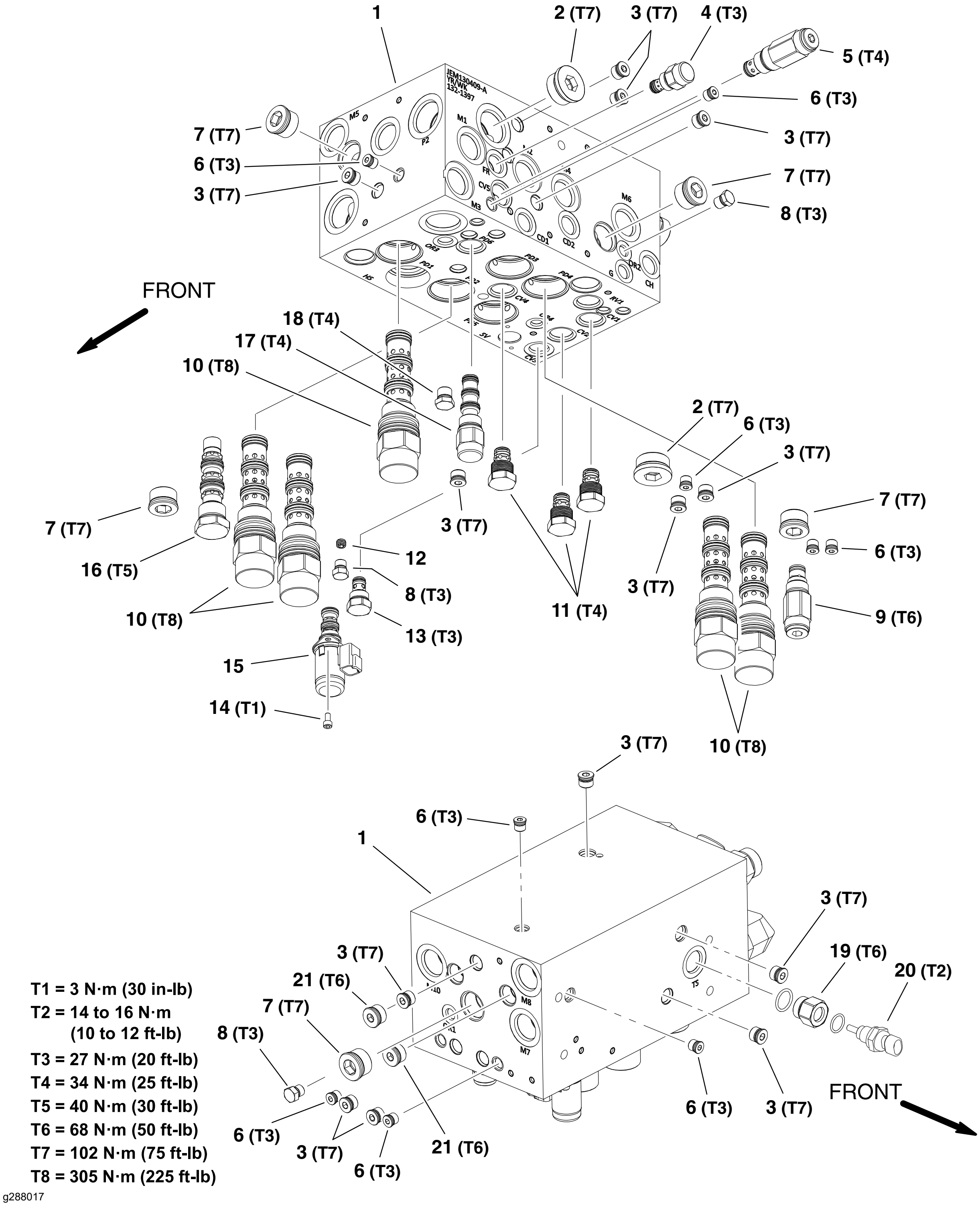

Figure 100

1. Manifold block
2. Plug (2)
3. #6 zero−leak plug with O−ring (13)
4. Flow regulator − FR
5. Check valve − CV5
6. #4 zero−leak plug with O−ring (9)
7. #12 zero−leak plug with O−ring (5)
8. #4 zero−leak plug with O−ring (3)
9. Relief valve − RV1
10. Directional valve − PD1 (5)
11. Check valve − CV 1 (3)
12. Orifice − 0.030 in − OR4
13. Check valve − CV4
14. Cap screw (2)
15. Solenoid valve − SV
16. Shuttle valve − HS
17. Piloted vent − PD6
18. #6 zero−leak plug with O−ring
19. Adapter fitting
20. Temperature sender − TS
21. #8 zero−leak plug with O−ring (2)

The ports on the traction control manifold are marked for easy identification of components. Example: P1 is the piston pump connection port for the forward direction and SV is the location for the high/low speed solenoid valve (see A Hydraulic Schematic (page A–5) to identify the function of the hydraulic lines and cartridge valves at each port).

Although not recommended in most situations, relief valve RV1 and check valve CV5 are adjustable (see Adjust Manifold Relief Valves (page 5–72)).

IMPORTANT

An orifice is placed beneath the plug in the control manifold OR4 port. If the plug is removed, make sure to remove the orifice and label its position for assembly purposes.

Note: The traction control manifold includes several zero−leak plugs. These plugs have a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero−leak plugs also have an O−ring as a secondary seal. If zero−leak plug removal is necessary, lightly rap the plug head using a punch and hammer before using an allen wrench to remove the plug: the impact will allow plug removal with less chance of damage to the socket head of the plug. Tighten plugs to torque value provided (Figure 100).

Cartridge Valve Service

For cartridge valve service procedures, see Cartridge Valve Service (page 5–158).

Brake Release Manifold

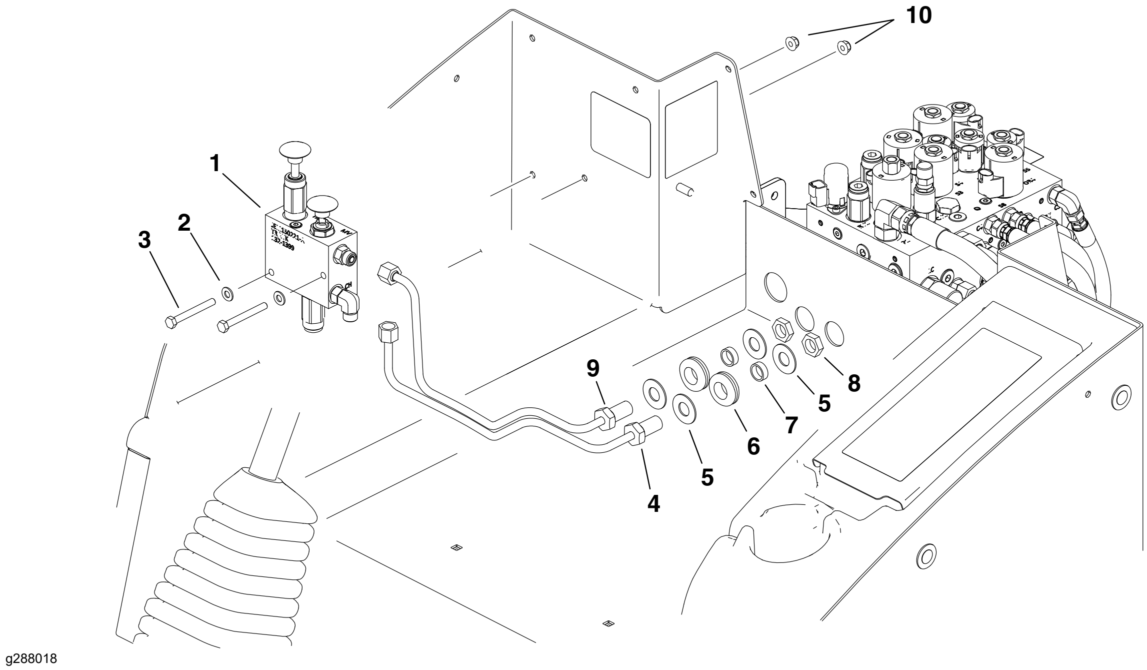

Figure 101

1. Brake release manifold
2. Flat washer (2)
3. Cap screw (2)
4. Hydraulic tube − from manifold
5. Washer (4)
6. Grommet (2)
7. Spacer (2)
8. Bulkhead nut (2)
9. Hydraulic tube − to brake
10. Flange nut (2)

Both front wheel motors include a multi−disc parking brake that engages when hydraulic pressure is not present (e.g. engine is running and parking brake switch is set to ON or engine is not running). The brake release manifold includes a manual release valve (MV), a hand pump (HP) and a relief valve (RV). When the engine is running the manual release valve (MV) opens, pressurizing the brake circuit and releasing the brakes. When the engine is not running, closing the manual release valve (MV) and pumping the hand pump (HP) pressurizes the brake circuit and releases the brakes for service. The relief valve (RV) keeps brake circuit pressure below 27.6 bar (400 psi) when using the hand pump.

Brake Release Manifold Removal (Figure 101)

1. Read the General Precautions for Removing and Installing Hydraulic System Components (page 5–73).
2. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold and fittings.
3. Disconnect all hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings to prevent system contamination. Label disconnected hydraulic lines for proper assembly.
4. Remove hydraulic manifold from the frame.
5. If hydraulic fittings are to be removed from manifold, mark fitting orientation to allow correct assembly. Remove fittings from manifold and discard O−rings.

Brake Release Manifold Installation (Figure 101)

1. If fittings were removed from manifold, lubricate and place new O−rings onto fittings. Install fittings into manifold openings using marks made during the removal process to properly orientate fittings. Tighten hydraulic fittings to torque value provided (Figure 102). For information on tightening procedures for hydraulic fittings, see Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9).
2. Position brake release manifold in the frame and secure with two (2) cap screws, flat washers and flange nuts.
3. Remove caps and plugs from fittings and tubes. Using labels placed during removal, properly connect hydraulic tubes to manifold (see Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–7)).
4. Make sure hydraulic tank is full. Add correct oil if necessary (see *Operator's Manual*).
5. Check hydraulic system for leaks, and check brake operation before returning the machine to service.

Brake Release Manifold Service

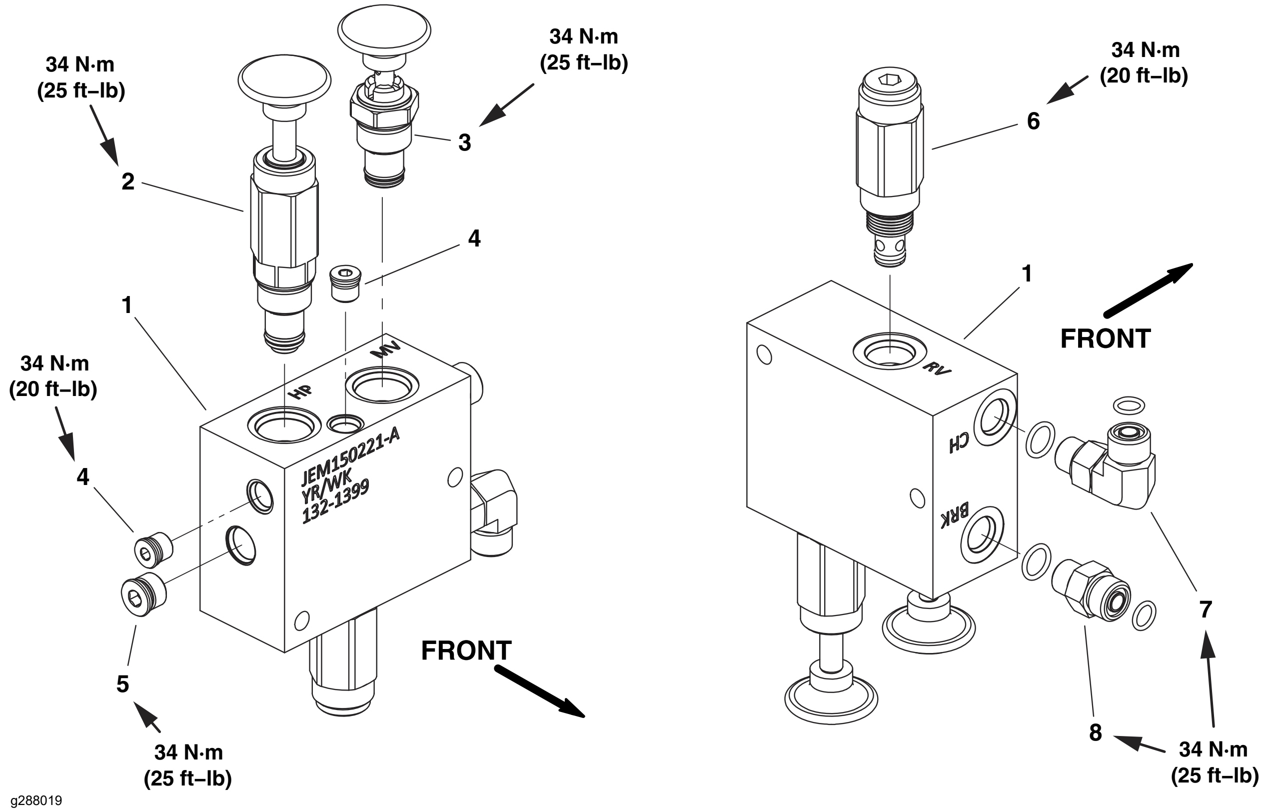

Figure 102

1. Manifold block
2. Hand pump − HP
3. Manual valve − MV (pull to open 0)
4. #6 zero−leak plug − with O−ring (2)
5. #6 zero−leak plug with O−ring
6. Relief valve − RV
7. Hydraulic elbow
8. Hydraulic straight fitting

The ports on the brake release manifold are marked for easy identification of components. Example: BRK is the connection port for the front wheel motor brakes and RV is the location for the pressure relief valve (see A Hydraulic Schematic (page A–5) to identify the function of the hydraulic lines and cartridge valves at each port).

Although not recommended in most situations, relief valve RV is adjustable (see Adjust Manifold Relief Valves (page 5–72)).

Note: The brake release manifold includes several zero−leak plugs. These plugs have a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero−leak plugs also have an O−ring as a secondary seal. If zero−leak plug removal is necessary, lightly rap the plug head using a punch and hammer before using an allen wrench to remove the plug: the impact will allow plug removal with less chance of damage to the socket head of the plug. Tighten plugs to torque value provided (Figure 102).

Cartridge Valve Service

For cartridge valve service procedures, see Cartridge Valve Service (page 5–158).

Cutting Deck Circuit

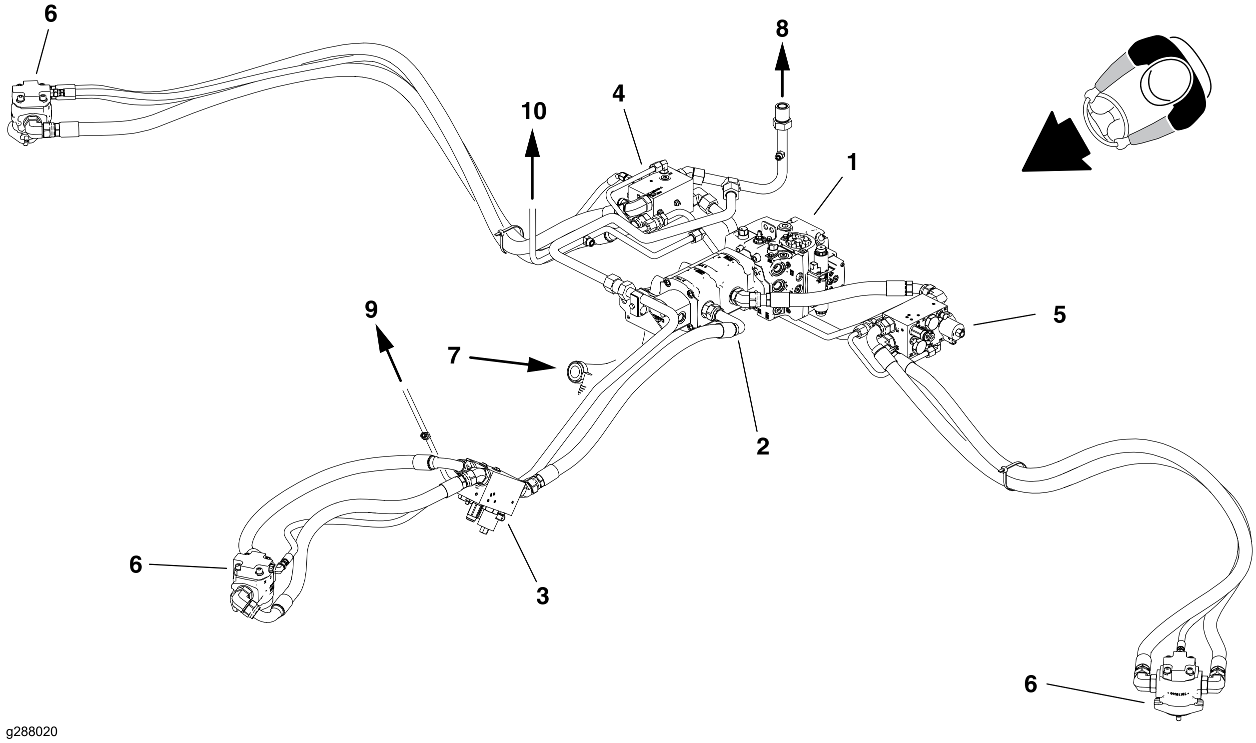

Figure 103

1. Piston (traction) pump
2. Gear pump
3. Front deck control manifold
4. Right wing deck control manifold
5. Left wing deck control manifold
6. Cutting deck motor (3)
7. Suction from reservoir − in
8. Return to oil cooler − out
9. Wing case drain to reservoir − out
10. Front case drain to reservoir − out

Figure 103 illustrates the components that are used in the Groundsmaster cutting deck circuit. Procedures for removal, installation and disassembly/assembly of these components are provided on the following pages of this chapter.

Cutting Deck Motor

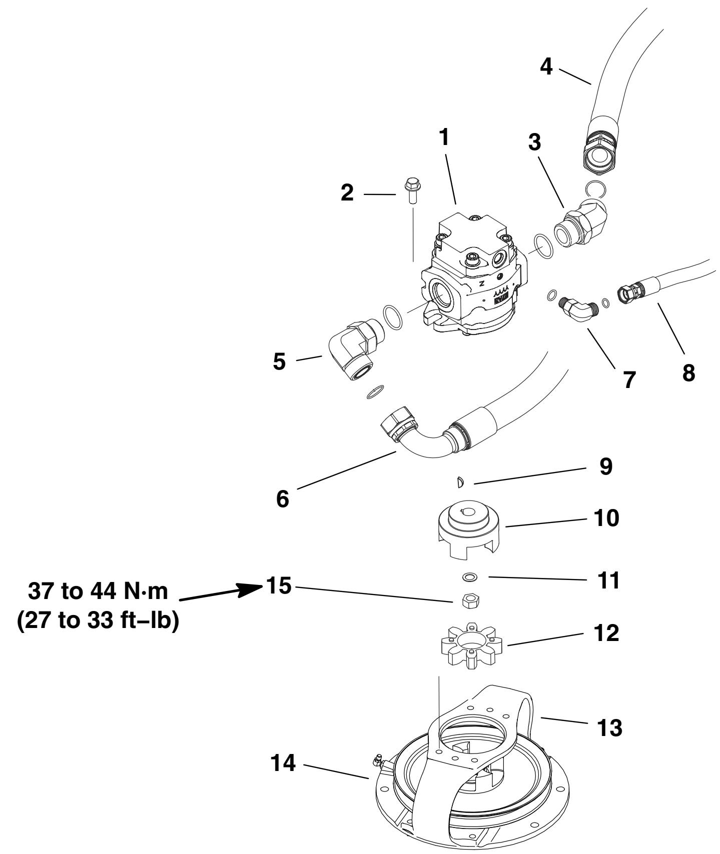

Figure 104

Front Deck Motor Shown

1.	Cutting deck motor	6.	Hydraulic hose − pressure	11.	Washer
2.	Flange head screw (2)	7.	Hydraulic fitting	12.	Spider
3.	45º hydraulic fitting	8.	Hydraulic hose − case drain	13.	Motor mount
4.	Hydraulic hose − return	9.	Woodruff key	14.	Spindle assembly
5.	Hydraulic fitting	10.	Coupler hub	15.	Hex nut

The hydraulic motors used on all cutting decks are the same.

Cutting Deck Motor Removal (Figure 104)

1. Park machine on a level surface, lower cutting decks fully, disengage PTO and stop engine. Remove key from key switch.
2. Read the General Precautions for Removing and Installing Hydraulic System Components (page 5–73).
3. To prevent contamination of hydraulic system during deck motor removal, thoroughly clean exterior of motor.
4. Disconnect hydraulic lines from deck motor. Put caps or plugs on fittings and hoses to prevent contamination of hydraulic system. Label hydraulic lines for proper assembly.
5. Remove two (2) flange head screws that secure hydraulic motor to cutting deck.
6. Lift hydraulic motor from cutting deck.
7. If hydraulic fittings are to be removed from deck motor, mark fitting orientation to allow correct assembly. Remove fittings from motor and discard O–rings.

Cutting Deck Motor Removal (Figure 104) (continued)

8. If required, remove hex nut and washer that secure coupler hub to motor shaft. Use suitable puller to remove hub from shaft. Remove woodruff key.

Cutting Deck Motor Installation (Figure 104)

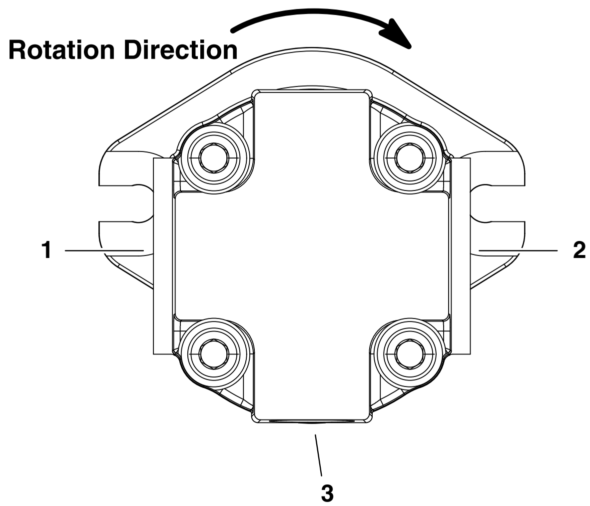

Figure 105

1. Flow − in
2. Flow − out
3. Case drain

---

1. If fittings were removed from deck motor, lubricate and place new O–rings onto fittings. Install fittings into motor ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9)).

2. If removed, install woodruff key and coupler hub to motor shaft. Secure with washer and hex nut. Tighten hex nut from **37 to 44 N·m (27 to 33 ft−lb)**.

3. Position spider (item 12) in spindle pulley. Align coupler hub on motor shaft with spider and place deck motor on the motor mount. Make sure the shoulder of the deck motor fits squarely inside the motor mount opening.

4. Secure motor to cutting deck with two (2) flange head screws.

   Note: Make sure IN/OUT hydraulic hoses are attached to correct deck motor ports or deck blades will spin backwards.

5. Remove caps or plugs from hydraulic fittings and hoses. Use labels attached during removal and connect hydraulic hoses to deck motor (see Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–7)).

6. Make sure hydraulic tank is full. Add correct oil if necessary.

7. After assembly is completed, raise and lower cutting units and verify that hydraulic hoses and fittings are not contacted by any moving components.

8. Check hydraulic system for leaks before returning the machine to service.

Cutting Deck Motor Service

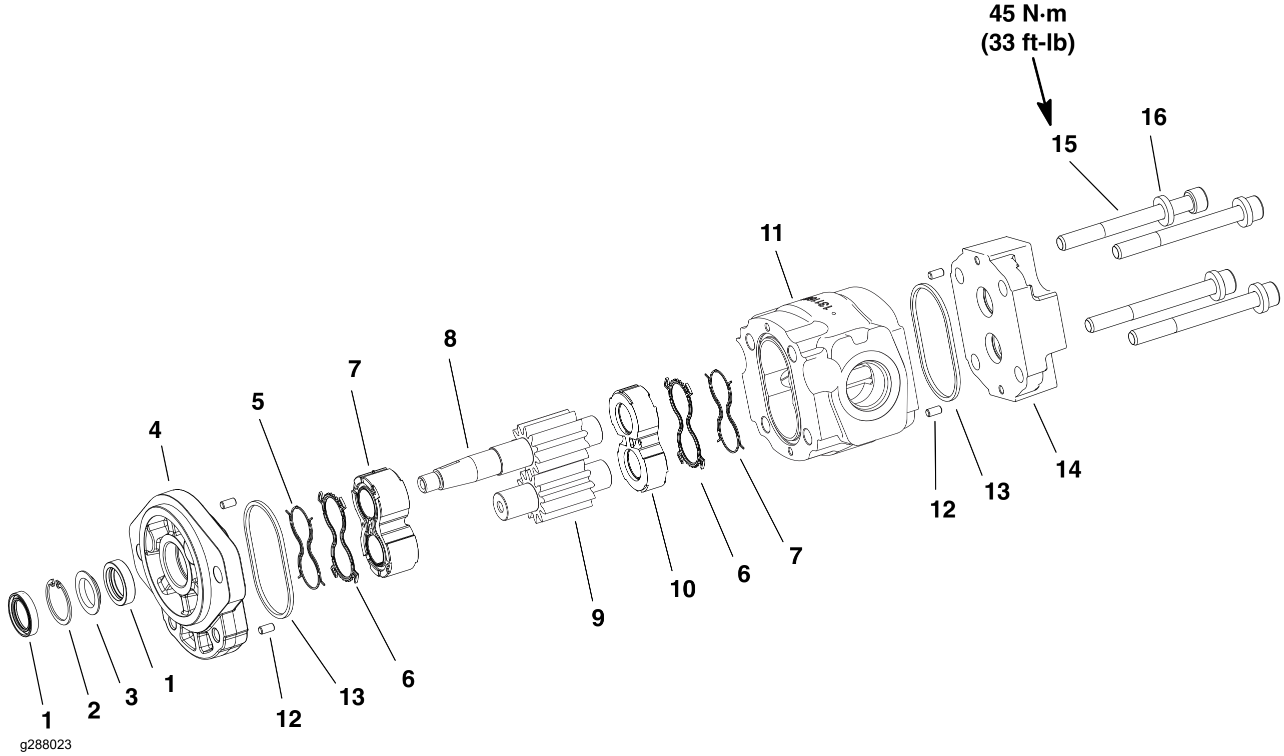

Figure 106

1. Shaft seal (2)
2. Retaining ring
3. Flange washer
4. Front flange
5. Pressure seal (5)
6. Backup gasket (6)
7. Front thrust plate
8. Drive gear
9. Idler gear
10. Rear thrust plate
11. Body
12. Dowel pin (4)
13. Seal (2)
14. Rear cover
15. Cap screw (4)
16. Washer (4)

Cutting Deck Motor Disassembly (Figure 106)

1. Plug motor ports and clean the outside of the motor thoroughly. After cleaning, remove plugs and drain any fluid out of the motor.

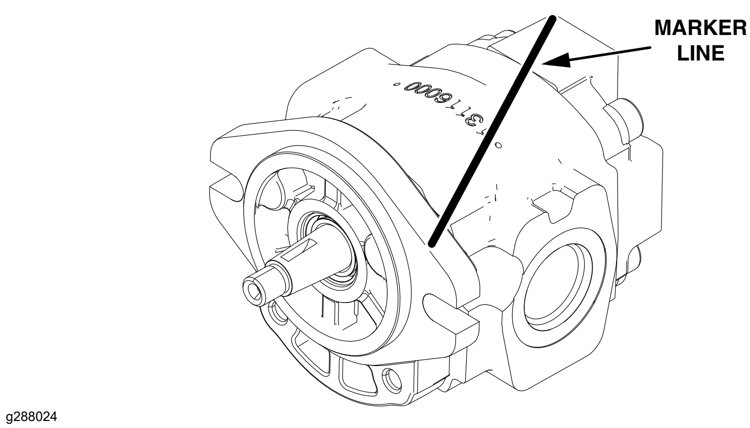

Figure 107

2. Use a marker to make a diagonal line across the front flange, body and rear cover for assembly purposes (Figure 107).

Cutting Deck Motor Disassembly (Figure 106) (continued)

IMPORTANT

Prevent damage when clamping the motor into a vise; clamp on the front flange only. Also, use a vise with soft jaws.

3. Clamp front flange of motor in a vise with soft jaws with the shaft end down.
4. Loosen cap screws from the rear cover.
5. Remove motor from the vise. Turn motor so that the shaft end is facing down. Remove cap screws.
6. Separate rear cover from body. Lift rear cover from motor.

IMPORTANT

Note position of the open and closed side of the thrust plates before removing. Identify thrust plates (front and rear, drive gear and idler gear) with a marker for proper assembly.

IMPORTANT

Mark the relative positions of the gear teeth so they can be reassembled in the same (mated) position. Do not touch the gear surfaces as residue on hands may be corrosive to gear finish.

7. Carefully remove body. Lift body straight up to remove. Make sure the rear thrust plate remains on the drive and idler gear shafts. Remove and discard O–rings from the body. Locate and retrieve dowel pins.
8. Carefully remove rear thrust plate, idler gear, drive gear and front thrust plate from the front flange.
9. Remove and discard back−up gaskets and pressure seals from thrust plates.

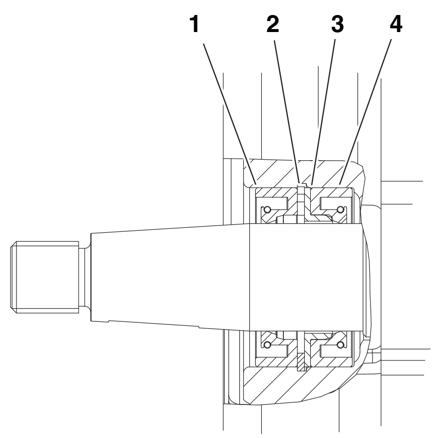

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Figure 108

1. Outer shaft seal
2. Retaining ring
3. Flange washer
4. Inner shaft seal

10. Turn front flange over, with seal side up.

Cutting Deck Motor Disassembly (Figure 106) (continued)

IMPORTANT

Make sure to not damage the front flange counter bore when removing the seals from the front flange.

11. Carefully remove outer shaft seal, retaining ring, flange washer and inner shaft seal from the front flange (Figure 108). Discard removed seals.

Cutting Deck Motor Inspection

1. Remove any nicks and burrs from all parts with emery cloth.

CAUTION

Use goggles or other appropriate eye protection when using compressed air for drying parts.

2. Clean all parts with solvent. Dry all parts with compressed air.

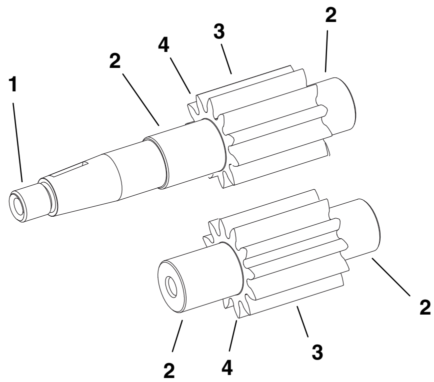

Figure 109

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

3. Inspect drive gears and idler gears for the following (Figure 109):
   A. Gear shafts should be free of rough surfaces and excessive wear at bushing points and sealing areas. Scoring, rough surfaces or wear on gear shafts indicates need for replacement.
   B. Gear teeth should be free of excessive scoring and wear. Any broken or nicked gear teeth indicate a need for motor replacement.
   C. Inspect gear face edge for sharpness. Sharp edges of gears will mill into thrust plates and, thus, must be replaced.
4. Inspect thrust plates for the following:
   A. Bearing areas should not have excessive wear or scoring.
   B. Face of thrust plates that are in contact with gears should be free of wear, roughness or scoring.
   C. Thickness of thrust plates should be equal.
5. Inspect front flange and rear cover for damage or wear.

Cutting Deck Motor Assembly (Figure 106)

Note: When assembling the motor, check the marker line on each part to make sure the parts are properly aligned during assembly.

1. Lubricate O–rings, pressure seals, back−up gaskets and thrust plate grooves with a thin coat of petroleum jelly. Lubricate all other internal parts freely with clean hydraulic fluid.
2. Install new seals into front flange (Figure 108):
   A. Press inner shaft seal into front flange until it reaches the bottom of the bore.
   B. Install flange washer into front flange and then install retaining ring into the groove of the front flange.
   C. Install outer shaft seal into front flange.
3. Place front flange, seal side down, on a flat surface.
4. Install the pressure seals, flat side outward, into the grooves in the thrust plates. Follow by carefully placing the backup gaskets, flat side outward, between the pressure seals and the grooves in the thrust plate.
5. Apply a light coating of petroleum jelly to the exposed side of the front flange.
6. Lubricate the drive gear shaft with clean hydraulic fluid. Insert the drive end of the drive shaft through the thrust plate with the pressure seal side down and the open side of the pressure seal pointing to the inlet side of the motor. Carefully install shaft into front flange. Be careful not to nick seals with shaft threads.
7. Lubricate the idler gear shaft with clean hydraulic fluid. Install idler gear shaft into the remaining position in the front thrust plate. Apply a light coating of clean hydraulic fluid to gear faces.
8. Install rear thrust plate with pressure seal side up and open side of the pressure seal pointing to the inlet side of the motor.
9. Apply a light coating of petroleum jelly to new O–rings and O–ring grooves in the body. Install new O–rings to the body.
10. Install locating dowels in body. Align marker line on the body and front flange.

IMPORTANT

Do not dislodge seals during installation.

11. Gently slide the body onto the assembly. Firm hand pressure should be sufficient to engage the dowels.
12. Check to make sure that the surface of the rear thrust plate is slightly below the face of the body. If the thrust plate is not below the body, check assembly for a shifted pressure seal, backup gasket or O–ring. Correct before proceeding.
13. Apply a light coating of petroleum jelly to the exposed side of the rear cover.
14. Place rear cover on assembly using marker line for proper location. Firm hand pressure should be sufficient to engage the dowel pins.
15. Install the four (4) cap screws with washers and hand tighten screws.

IMPORTANT

Prevent damage when clamping the motor into a vise; clamp on the front flange only. Also, use a vise with soft jaws.

Cutting Deck Motor Assembly (Figure 106) (continued)

16. Place front flange of the motor into a vise with soft jaws and alternately torque the cap screws **45 N·m (33 ft−lb)**.
17. Remove motor from vise.
18. Place a small amount of clean hydraulic fluid in the inlet of the motor and rotate the drive shaft away from the inlet one revolution. If any binding is noted, disassemble the motor and check for assembly problems.

Cutting Deck Control Manifolds

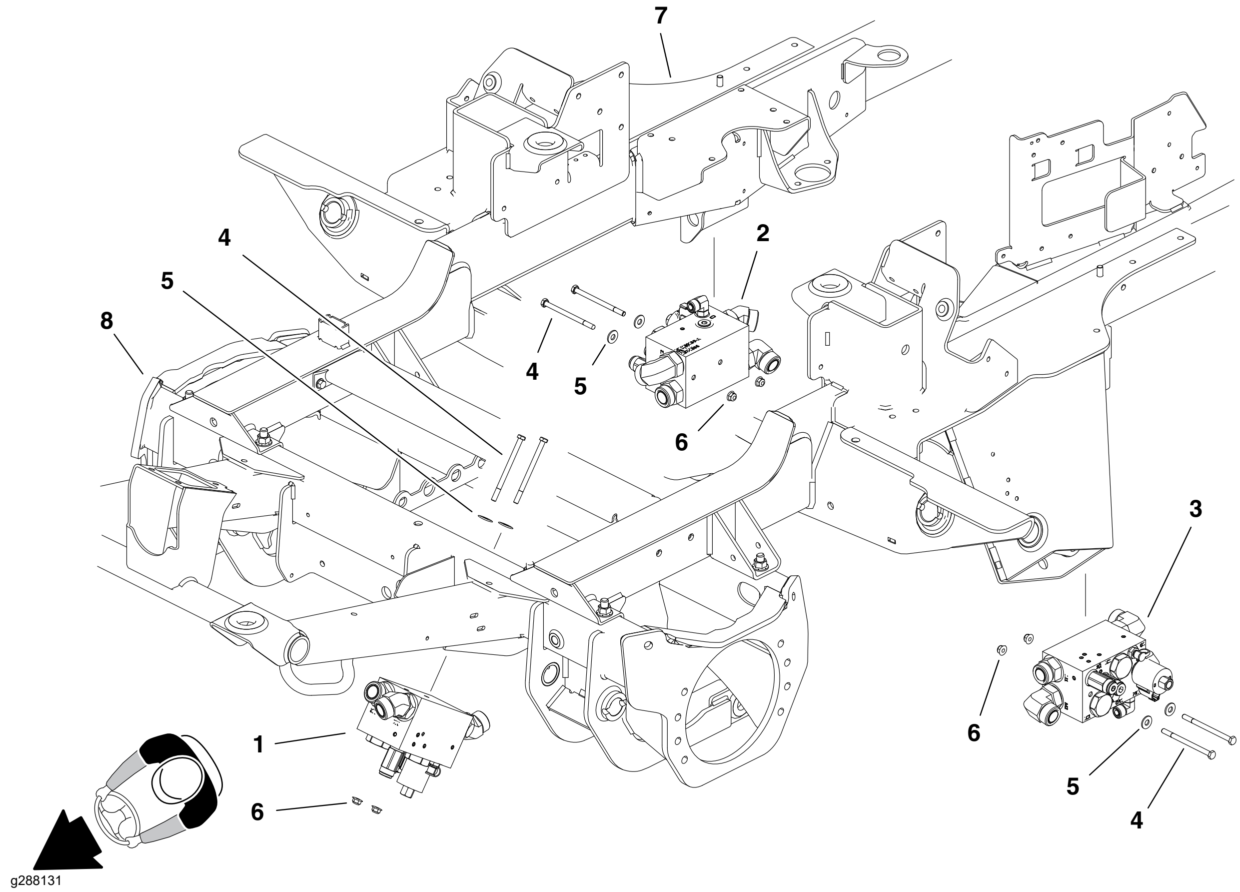

Figure 110

1. Front Deck control manifold
2. RH Deck control manifold
3. LH Deck control manifold
4. Cap screw (6)
5. Flat washer (6)
6. Flange nut (6)
7. Main frame
8. Front axle frame

The control manifolds for the three cutting deck sections are very similar.

Note: When servicing the control manifolds, DO NOT interchange parts from one control manifold to another.

Note: The ports on the cutting deck control manifolds are marked for easy identification of components. Example: PRV is the proportional relief valve and M2 is the return flow from the deck motor. See A Hydraulic Schematic (page A–5) to identify the function of the hydraulic lines and cartridge valves at each port.

Cutting Deck Control Manifold Removal (Figure 110)

1. Read the General Precautions for Removing and Installing Hydraulic System Components (page 5–73).
2. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold and fittings.
3. Disconnect wire harness connector from the proportional relief valve solenoid.
4. Disconnect hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper assembly.
5. Support the cutting deck control manifold to prevent it from falling.
6. Remove two (2) cap screws, flat washers and flange nuts that secure manifold to frame and remove the control manifold from the frame.

Cutting Deck Control Manifold Removal (Figure 110) (continued)

7. If hydraulic fittings are to be removed from manifold, mark fitting orientation to allow correct assembly. Remove fittings from manifold and discard O−rings.

Cutting Deck Control Manifold Installation (Figure 110)

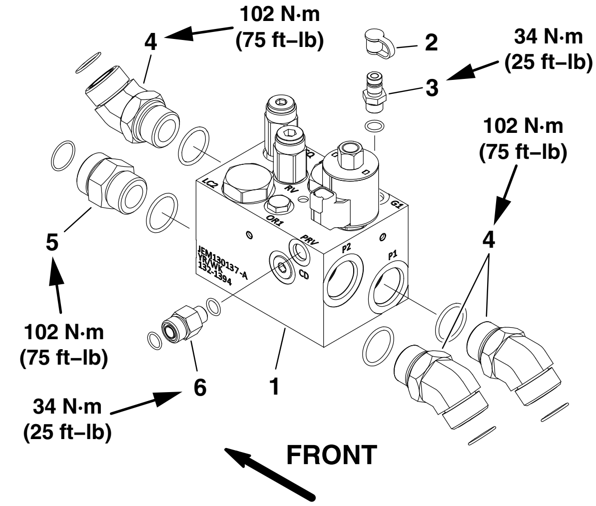

Figure 111

Front Deck Control Manifold

1. Front control manifold
2. Dust cap
3. Diagnostic fitting
4. Hydraulic 45º fitting (3)
5. Straight fitting
6. Straight fitting

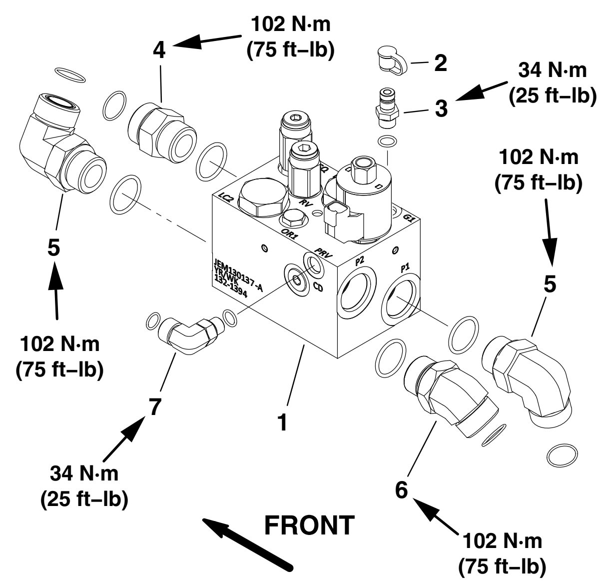

Figure 112

RH Cutting Deck Control Manifold

1. RH control manifold
2. Dust cap
3. Diagnostic fitting
4. Straight fitting
5. Hydraulic 90º fitting (2)
6. Hydraulic 45º fitting
7. Hydraulic 90º fitting

Cutting Deck Control Manifold Installation (Figure 110) (continued)

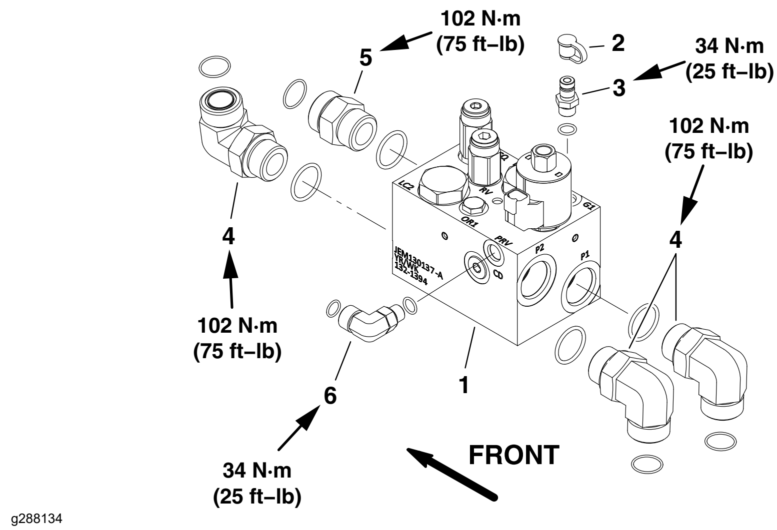

Figure 113

LH Deck Control Manifold

1. LH control manifold
2. Dust cap
3. Diagnostic fitting
4. Hydraulic 90º fitting (3)
5. Straight fitting
6. Hydraulic 90º fitting

---

1. If fittings were removed from manifold:

   A. Lubricate new O−rings with clean hydraulic oil. Install lubricated O−rings on fittings.

   B. Install fittings into manifold openings using marks made during the removal process to properly orientate fittings.

   C. Tighten hydraulic fittings to torque value provided (Figure 111, Figure 112 and Figure 113). For information on tightening procedures for hydraulic fittings, see Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9).

2. Position PTO control manifold to the frame and secure with two (2) cap screws, flat washers and flange nuts.

3. Remove caps and plugs from fittings and hoses. Properly connect hydraulic lines to manifold (see Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–7)).

4. Connect wire harness connector to the proportional relief valve solenoid.

5. Make sure hydraulic tank is full. Add correct oil if necessary.

6. Check hydraulic system for leaks before returning the machine to service.

Cutting Deck Control Manifold Service

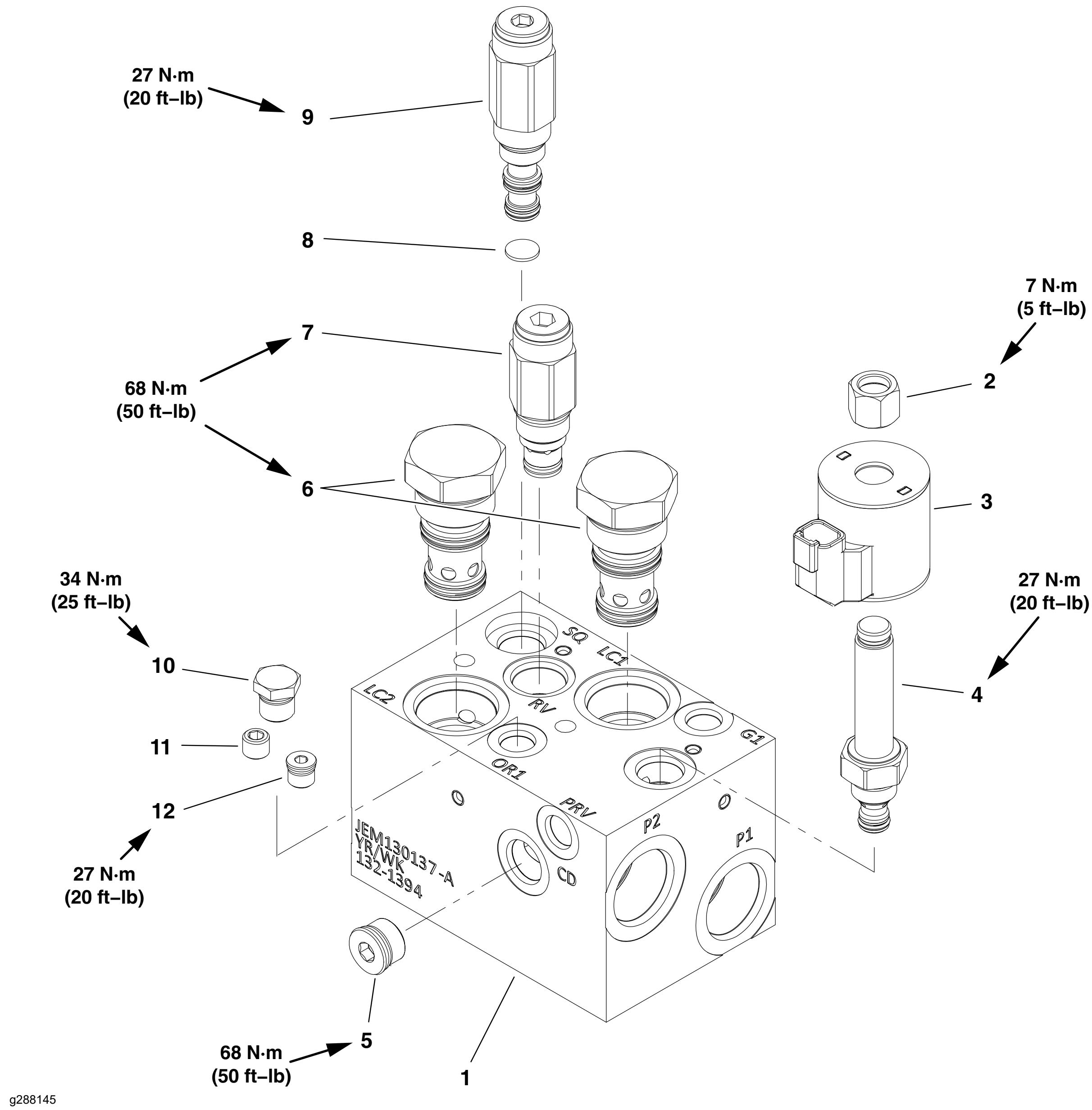

Figure 114

1.	Manifold body	5.	#8 zero−leak plug with O−ring	9.	Sequence valve (SQ)
2.	Nut	6.	Logic element (LC1 & LC2)	10.	#6 zero−leak plug with O−ring
3.	Solenoid coil	7.	Relief valve (RV)	11.	Orifice 0.063 in. (OR1) − RH and LH control manifolds only
4.	Proportional relief valve (PRV)	8.	Orifice 0.025 in. (OR2)	12.	#4 zero−leak plug with O−ring − Front control manifold only

The ports on the cutting deck control manifolds are marked for easy identification of components. Example: PRV is the proportional relief valve and M2 is the return flow from the deck motor. See A Hydraulic Schematic (page A–5) to identify the function of the hydraulic lines and cartridge valves at each port.

Although not recommended in most situations, relief valve (RV) and sequence valve (SQ) are adjustable (see Adjust Manifold Relief Valves (page 5–72)).

IMPORTANT

An orifice is placed beneath the plug in the OR1 port of the LH and RH cutting deck control manifolds only. If the plug is removed, make sure to remove the orifice and label its position for assembly purposes. The front cutting deck control manifold has an additional zero leak plug instead of an orifice in the OR1 port. When servicing the deck control manifolds, DO NOT interchange parts from one control manifold to another.

Note: The cutting deck control manifolds include several zero−leak plugs. These plugs have a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero−leak plugs also have an O−ring as a secondary seal. If zero−leak plug removal is necessary, lightly rap the plug head using a punch and hammer before using an allen wrench to remove the plug: the impact will allow plug removal with less chance of damage to the socket head of the plug. Tighten plugs to torque value provided (Figure 114).

Cartridge Valve Service

For cartridge valve service procedures, see Cartridge Valve Service (page 5–158).

Steering and Cutting Deck Lift Circuits

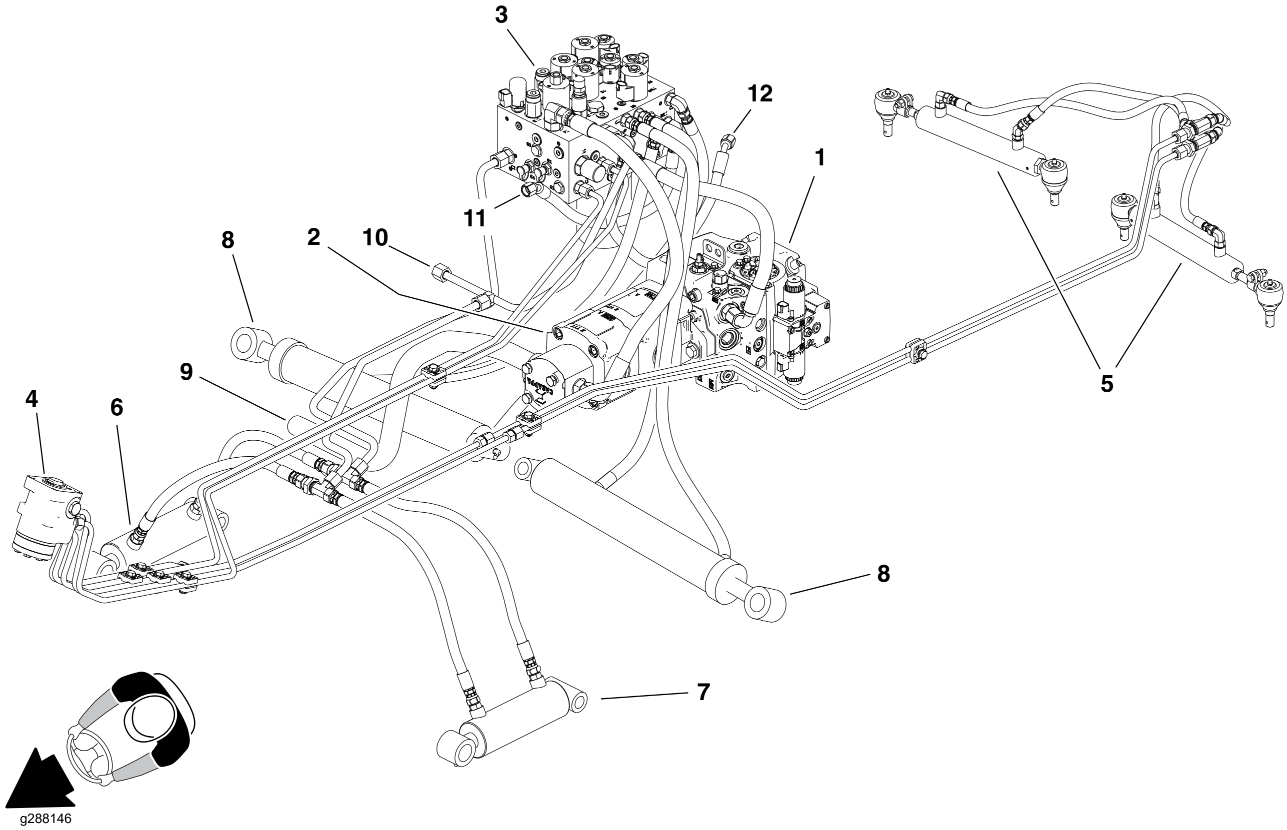

Figure 115

1. Piston (traction) pump
2. Gear pump
3. Steering/lift control manifold
4. Steering control valve
5. Steering cylinder (2)
6. Front deck lift cylinder − RH
7. Front deck lift cylinder − LH
8. Wing deck lift cylinder (2)
9. Suction from reservoir − in
10. Return to reservoir − out
11. Supply to brake release manifold − out
12. Return to oil cooler − out

Figure 115 illustrates the components that are used in the Groundsmaster steering and cutting deck lift circuits. Procedures for removal, installation and disassembly/ assembly of these components are provided in the following pages of this chapter.

Steering Control Valve (For machines serial number below 403450000)

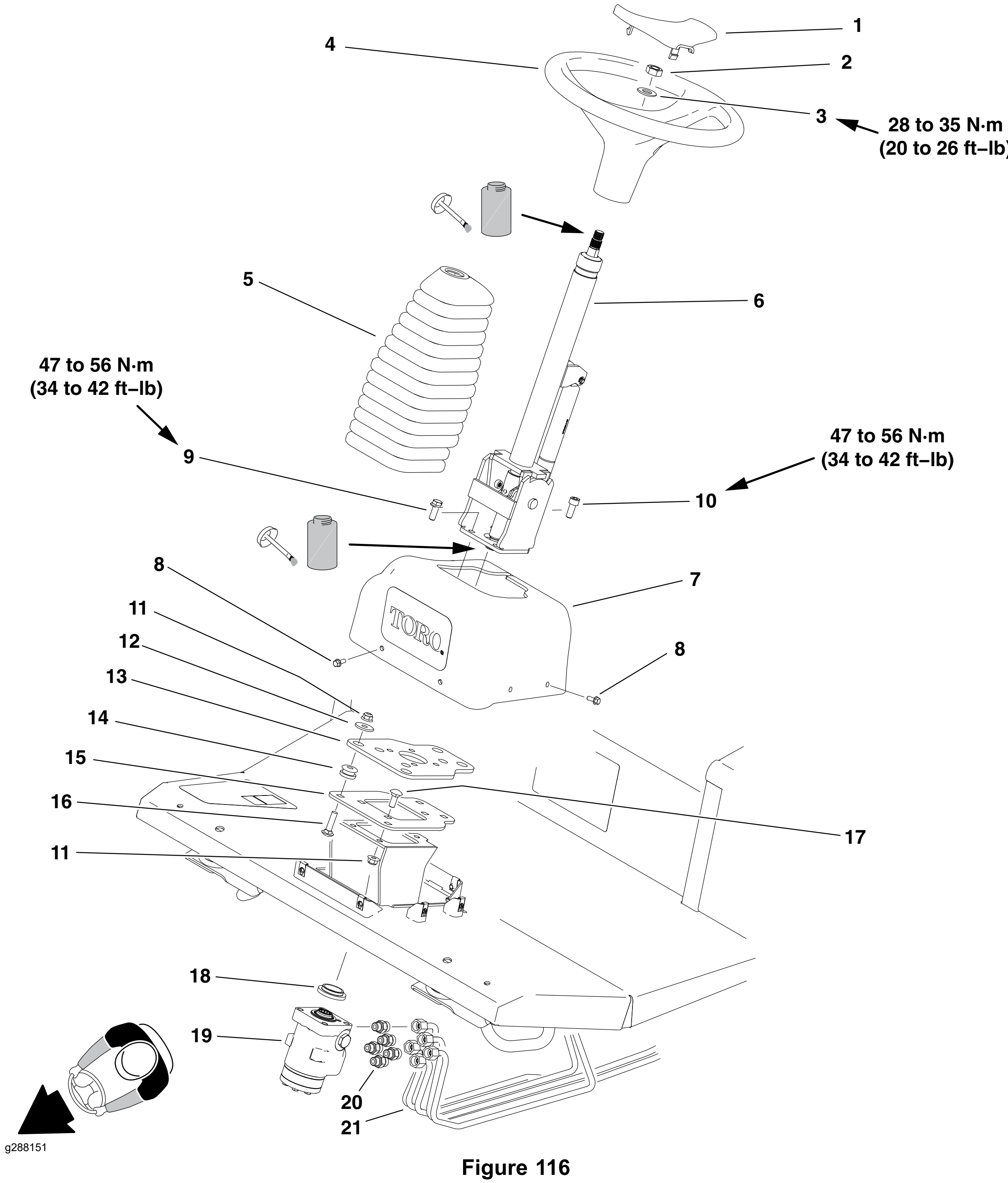

Figure 116

1.	Steering wheel cover	8.	Flange head screw (7)	15.	Lower mounting plate
2.	Hex nut	9.	Flange head screw (3)	16.	Carriage screw (4)
3.	Flat washer	10.	Socket head screw	17.	Carriage screw (3)
4.	Steering wheel	11.	Flange nut (7)	18.	Alignment bushing
5.	Steering column boot	12.	Flat washer (4)	19.	Steering control valve
6.	Steering column assembly	13.	Upper mounting plate	20.	Hydraulic fitting (5)
7.	Steering cover	14.	Rubber mount (4)	21.	Hydraulic tube (5)

Steering Control Valve Removal (Figure 116)

1. Park machine on a level surface, lower cutting decks fully, disengage PTO and stop engine. Remove key from the key switch.
2. Read the General Precautions for Removing and Installing Hydraulic System Components (page 5–73).
3. Remove the steering cover and slide the steering column boot upward (see Steering Column (For machines serial number below 403450000) (page 7–5)).
4. To prevent contamination of hydraulic system during steering valve removal, thoroughly clean exterior of steering valve, hydraulic tubes and fittings.

   Note: Access to hydraulic line fittings may require removal of five fasteners securing traction pedal assembly to Operator platform (see Traction Pedal (page 7–37)).
5. Disconnect hydraulic tubes from steering control valve. Put caps or plugs on fittings and tubes to prevent contamination. Tag hydraulic lines for proper assembly.
6. Support steering control valve and steering column to prevent them from falling.
7. Remove four (4) cap screws that secure steering control valve and steering column to machine. Slide steering control valve from lower end of steering shaft and remove steering control valve and steering column from machine.
8. Locate and remove alignment bushing (item 18).
9. If necessary, remove fittings from control valve and discard fitting O−rings. Plug control valve ports to prevent contamination.

Steering Control Valve Installation (Figure 116)

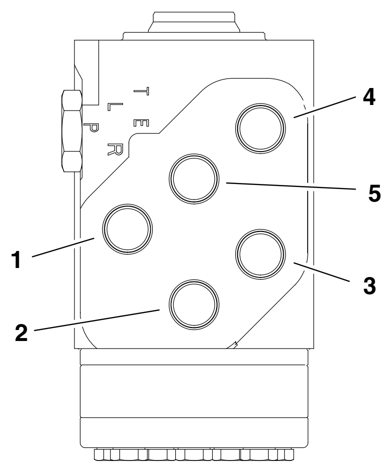

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Figure 117

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

---

1. If fittings were removed from steering control valve, lubricate and place new O−rings onto fittings. Remove plugs installed during removal and install fittings into control valve (see Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9)).
2. Apply never seize lubricant to splines on lower end of steering column.

Steering Control Valve Installation (Figure 116) (continued)

3. Hold steering column in position on machine and slide steering control valve onto lower end of steering column. Secure steering column and steering control valve to machine with four (4) cap screws. Tighten cap screws from **47 to 56 N·m (34 to 42 ft−lb)**.

4. Remove hydraulic caps or plugs installed during removal to prevent contamination.

5. Connect hydraulic tubes to fittings on steering valve using tags placed during control valve removal to identify correct tube placement (see Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–7)).

6. If traction pedal was removed to access hydraulic hoses, reinstall traction pedal to Operator platform and adjust traction pedal for neutral (see Traction Pedal Neutral Adjustment (page 6–49)).

7. Lower the steering column boot and install the steering cover (see Steering Column (For machines serial number below 403450000) (page 7–5)).

8. Fill reservoir with correct hydraulic fluid as required.

9. Check hydraulic system for leaks before returning the machine to service.

Steering Control Valve (For machines serial number above 403450001)

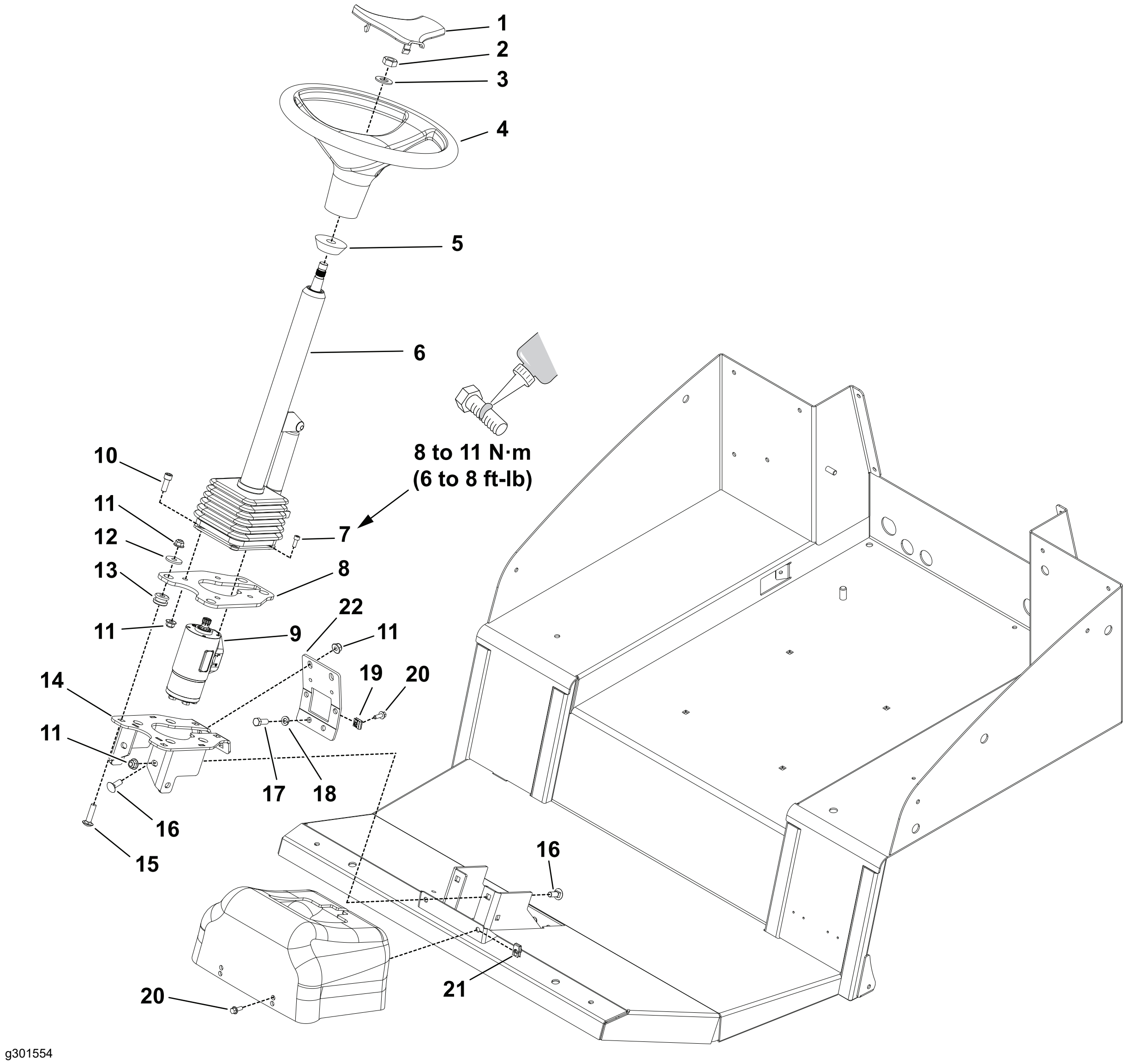

Figure 118

1. Steering wheel cover
2. Hex nut
3. Flat washer
4. Steering wheel
5. Foam collar
6. Steering shaft
7. Bolt (4 each)
8. Steering mount plate
9. Steering control valve
10. Bolt (4 each)
11. Nut (14 each)
12. Washer (4 each)
13. Mount (4 each)
14. Mount assembly
15. Carriage bolt (4 each)
16. Carriage bolt (6 each)
17. Bolt (2 each)
18. Lock washer (2 each)
19. Speed nut (2 each)
20. Bolt (4 each)
21. Clip (2 each)
22. Column support

Removal (Figure 118)

1. Park the machine on the level surface, lower the cutting decks, stop the engine, apply parking brake and remove the key from the key switch.
2. Remove the steering cover to allow access to the steering control valve.
3. Support the steering tower to prevent it from falling.

Removal (Figure 118) (continued)

4. Read the General Precautions for Removing and Installing Hydraulic System Components (page 5–73).
5. To prevent contamination of the hydraulic system during steering control valve removal, thoroughly clean the exterior of the control valve and fittings.
6. For assembly purpose, label all the hydraulic connections. Note the port designations on the steering control valve.

CAUTION

Before opening the hydraulic system, operate all hydraulic controls to release system pressure and avoid injury from the pressurized hydraulic fluid: refer to Relieving Hydraulic System Pressure (page 5–3).

7. Disconnect the hydraulic lines from the steering control valve. Allow the lines to drain into a suitable container.
8. Install the clean cap or plugs on the hydraulic lines and fittings to prevent contamination.
9. Remove the steering control valve from the machine using Figure 118 as a guide.
10. If the hydraulic fittings are to be removed from the steering control valve, mark the fitting orientation to allow correct assembly. Remove the fittings from the steering control valve and discard O-rings; refer to Figure 119 and Figure 120.

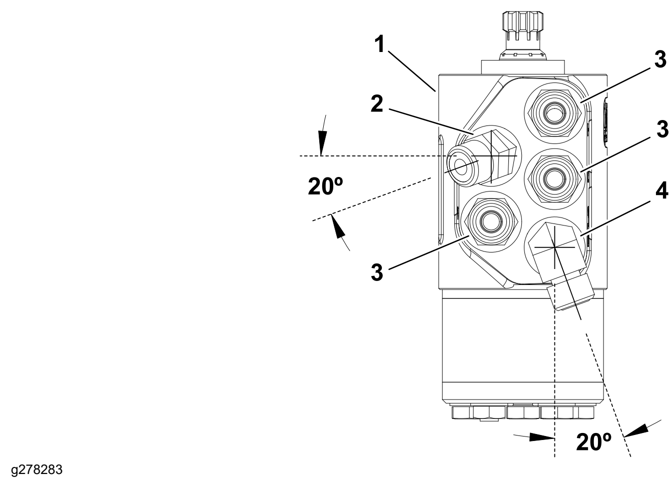

Figure 119

1. Steering control valve
2. 45º hydraulic fitting
3. Straight fitting (3 used)
4. 90º hydraulic fitting

Removal (Figure 118) (continued)

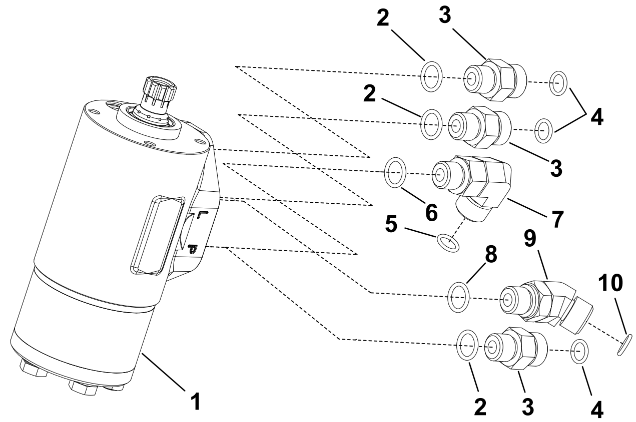

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Figure 120

1.	Steering control valve	6.	O-ring
2.	O-ring	7.	90º hydraulic fitting
3.	Straight fitting	8.	O-ring
4.	O-ring	9.	45º hydraulic fitting
5.	O-ring	10.	O-ring

Installation (Figure 118)

1. If the hydraulic fitting were removed from the steering valve, lubricate the new O-ring with clean hydraulic fluid, position the O-rings to the fittings. Install the fittings to the steering control valve using the marks made during the removal process to properly orientate fittings (Figure 119 and Figure 120). Tighten the fittings; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9).
2. Install the steering control valve using the Figure 118 as a guide.
3. Apply loctite to four (4) bolts (item 7 in Figure 118) and secure the steering control valve to the steering column with four (4) bolts. Torque bolts in a criss-cross pattern from **8 to 11 N·m (6 to 8 ft-lb)**.
4. Remove the caps and plugs that were installed to the hydraulic lines and fittings during the removal process.
5. Using the labels placed during steering control valve removal, properly install the hydraulic lines to steering control valve; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–7).
6. Check the hydraulic fluid level in the hydraulic tank and add correct quantity of the fluid if necessary; refer to the *Operator's Manual*.
7. Operate the machine functions slowly until the air is out of the system; refer to Charge Hydraulic System (page 5–79).
8. Install the steering tower cover to the machine.

Steering Control Valve Service (For machines serial number below 40345000)

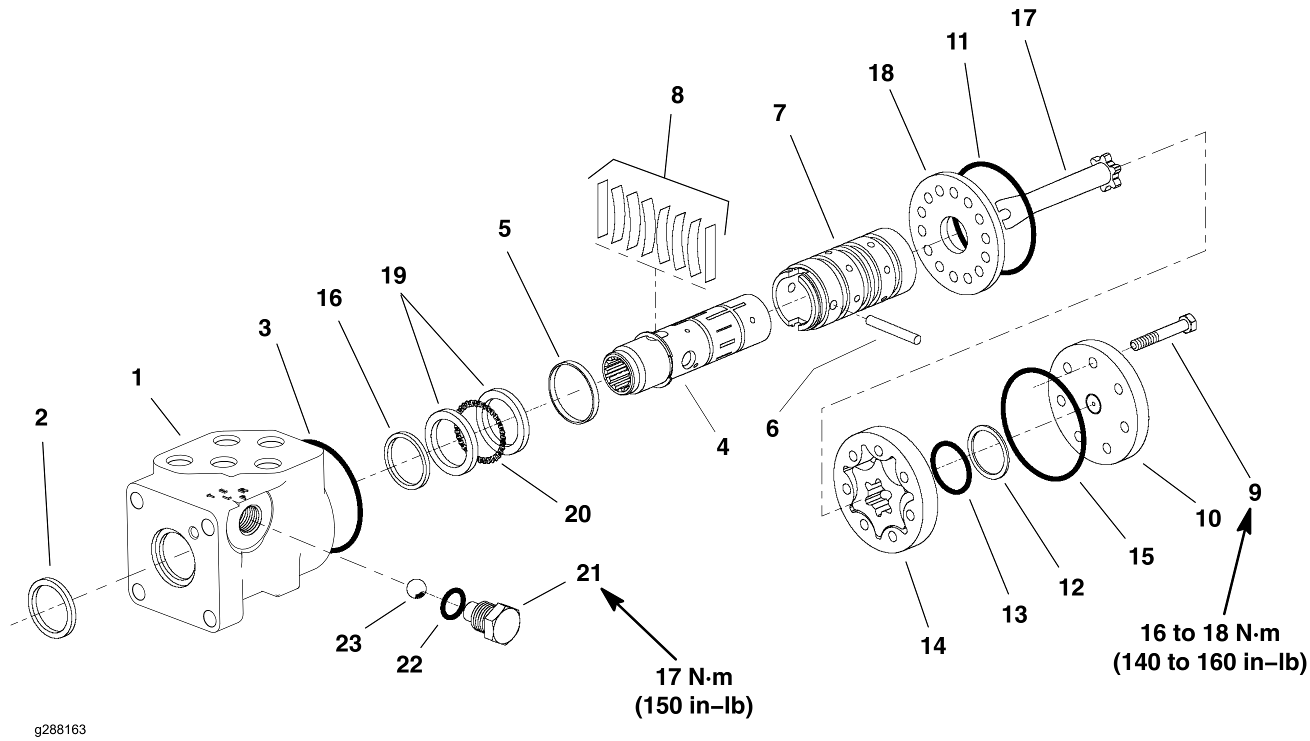


Figure 121

1. Steering valve housing
2. Dust seal
3. O–ring
4. Spool
5. Spring retaining ring
6. Pin
7. Sleeve
8. Centering springs/spacers
9. Cap screw (7)
10. End cap
11. O–ring
12. Seal ring
13. O–ring
14. Gerotor
15. O–ring
16. Quad seal
17. Gerotor drive
18. Wear plate
19. Bearing race
20. Thrust bearing
21. Plug
22. O–ring
23. Check ball

Note: For steering control valve repair procedures, see the Eaton Parts and Repair Information.

Steering Control Valve Service (For machines serial number above 403450001)

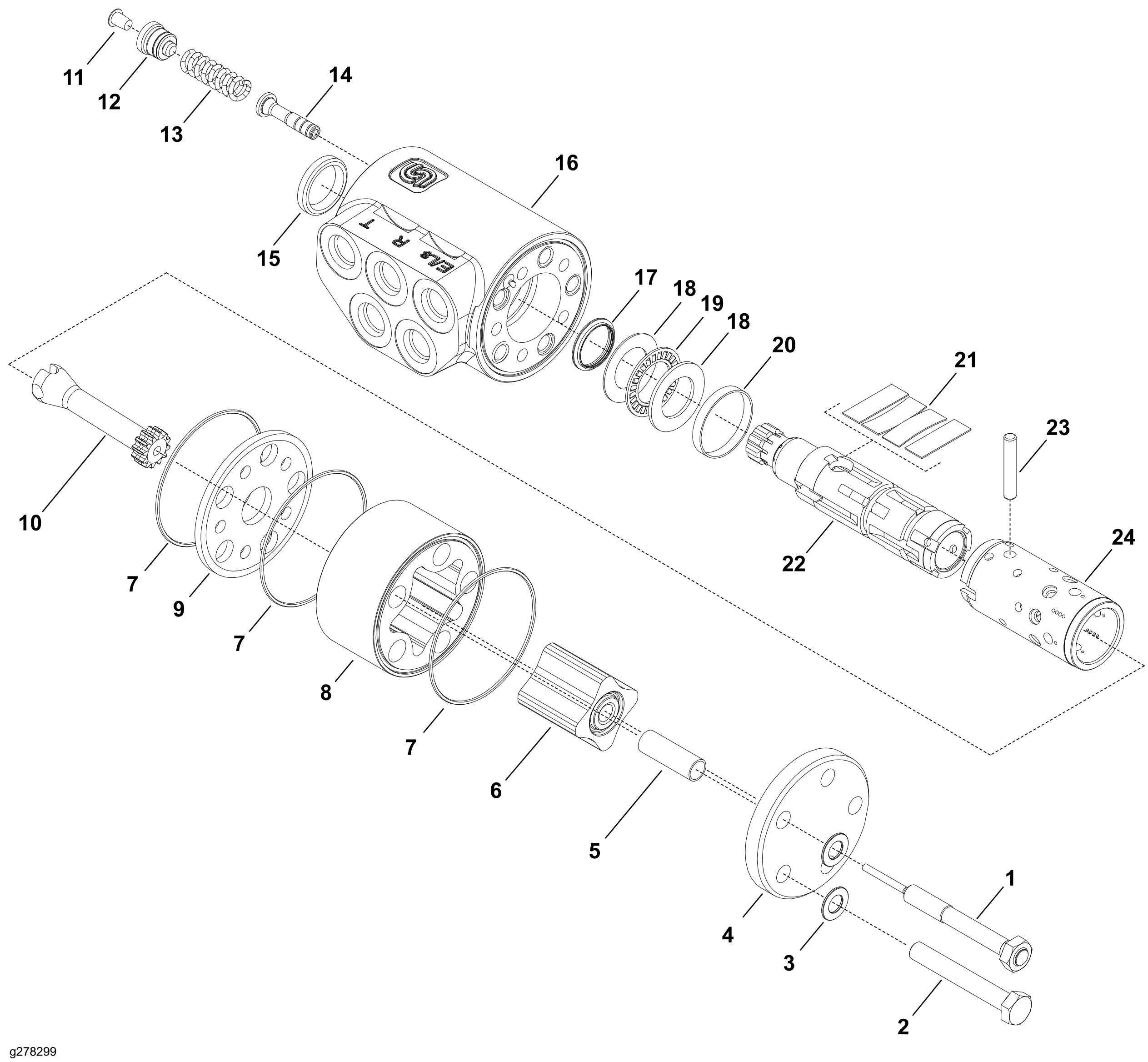


Figure 122

1. Pin bolt
2. Bolt (4 each)
3. Washer (5 each)
4. End cover
5. Tube (2 each)
6. Inner gearwheel
7. O-ring (3 each)
8. Outer gearwheel
9. Distributor plate
10. Cardan shaft
11. Plug
12. Plug
13. spring
14. Relief valve
15. Dust sealing ring
16. Housing
17. Shaft seal
18. Thrust washer (2 each)
19. Bearing
20. Ring
21. Spring set
22. Spool
23. Cross pin
24. Sleeve

Note: For the steering control valve repair procedures, refer to the Danfoss Steering Unit Type OSPM Service Manual.

Steering Cylinders

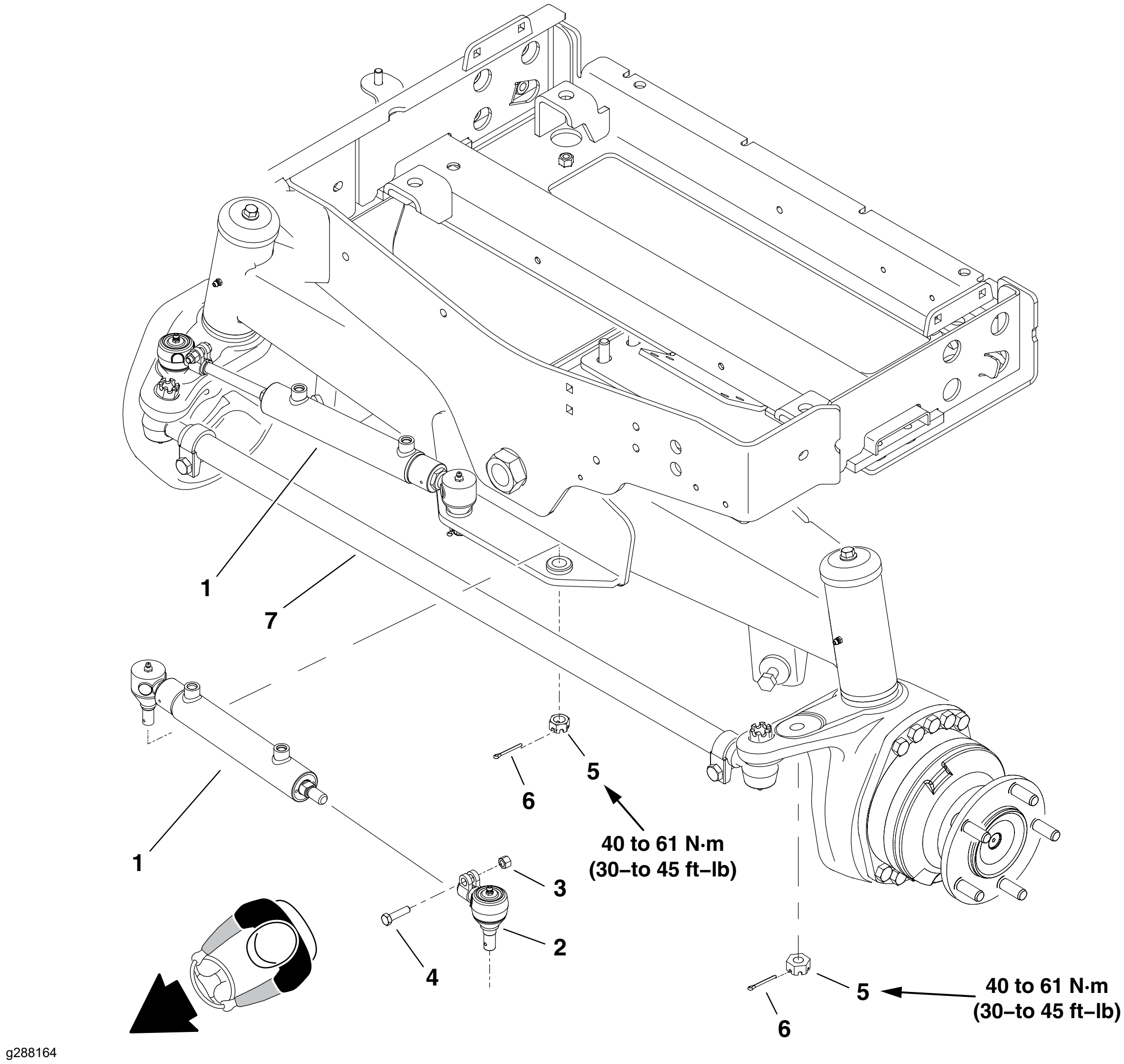


Figure 123

1. Steering cylinder
2. Ball joint
3. Lock nut
4. Cap screw
5. Slotted hex nut
6. Cotter pin
7. Tie rod assembly

Steering Cylinder Removal (Figure 123)

1. Park machine on a level surface, lower cutting decks fully, disengage PTO and stop engine. Remove key from the key switch.
2. Read the General Precautions for Removing and Installing Hydraulic System Components (page 5–73).
3. To prevent contamination of hydraulic system during steering cylinder removal, thoroughly clean exterior of cylinder, fittings and hoses.

   Note: To ease assembly, label all hydraulic hoses to identify their correct position on the steering cylinder.
4. Disconnect hydraulic hoses from steering cylinder fittings. Put caps or plugs on fittings and hoses to prevent contamination. Tag hydraulic lines for proper assembly.
5. Remove cotter pins and slotted hex nuts that secure the cylinder ball joints to rear axle and steering spindle.

Steering Cylinder Removal (Figure 123) (continued)

6. Use a suitable puller (pickle fork) to separate ball joints from rear axle and steering spindle.
7. If hydraulic fittings are to be removed from steering cylinder, mark fitting orientation to allow correct assembly. Remove fittings from steering cylinder and discard O−rings from fittings.

Steering Cylinder Installation (Figure 123)

1. If fittings were removed from steering cylinder, lubricate and place new O−rings onto fittings. Install fittings into cylinder ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9)).
2. Thoroughly clean tapers on steering cylinder ball joints. Also, clean ball joint bores of rear axle assembly and steering spindle.
3. Position steering cylinder to machine.
4. Secure steering cylinder to rear axle and steering spindle with slotted hex nuts. Torque slotted hex nuts from **41 to 61 N·m (30 to 45 ft−lb)** while aligning ball joint hole with slot in nut. Insert cotter pins.
5. Remove caps or plugs placed during removal to prevent contamination.
6. Using tags placed during cylinder removal, correctly attach hydraulic hoses to steering cylinder (see Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–7)).
7. Lubricate cylinder ball joint grease fittings.
8. After assembly is completed, operate steering cylinder from stop to stop to verify that hydraulic hoses and fittings do not contact any machine components.
9. Check hydraulic system for leaks before returning the machine to service.
10. Fill reservoir with correct hydraulic fluid as required (see *Operator's manual*).

Steering Cylinder Service

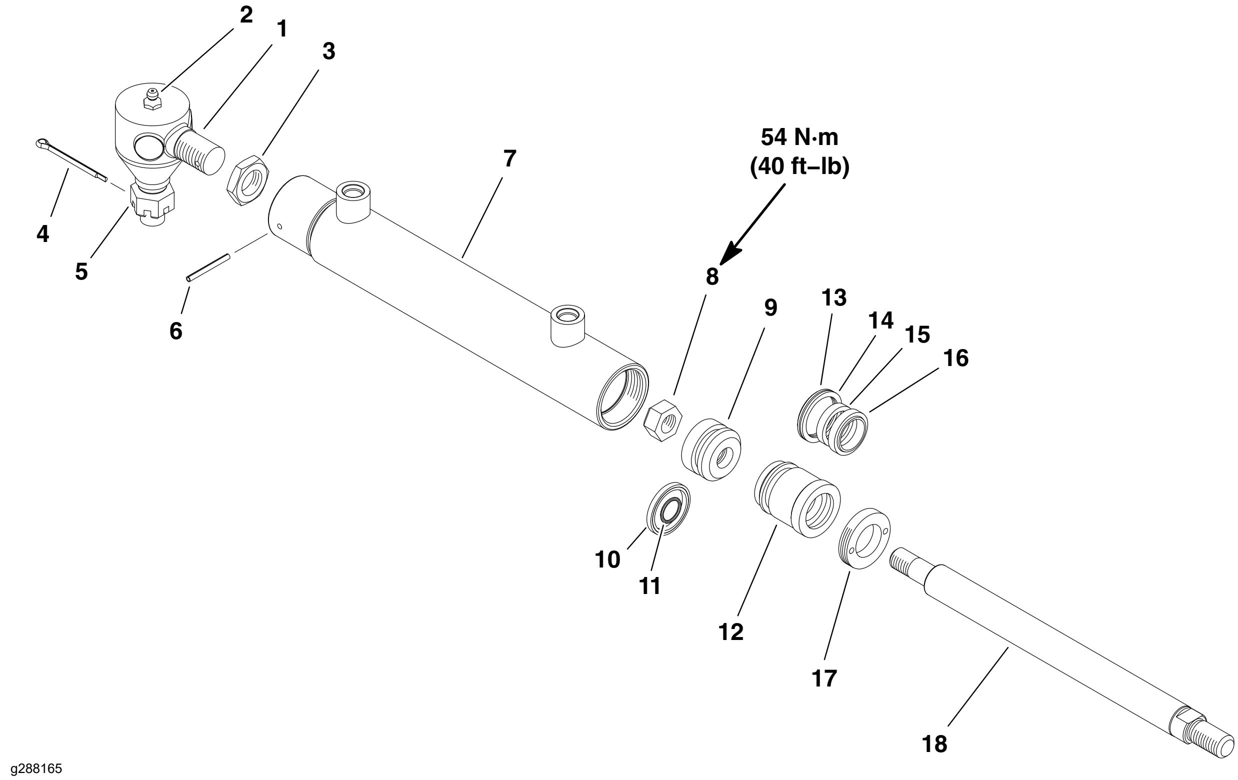


Figure 124

1.	Ball joint	7.	Barrel	13.	O−ring
2.	Grease fitting	8.	Lock nut	14.	Back−up ring
3.	Jam nut	9.	Piston	15.	Rod seal
4.	Cotter pin	10.	Piston seal	16.	Rod wiper
5.	Castle nut	11.	O−ring	17.	Internal collar
6.	Roll pin	12.	Head	18.	Piston rod

Steering Cylinder Disassembly (Figure 124)

1. Remove oil from steering cylinder by slowly pumping the piston rod. After removing oil from cylinder, plug both ports and thoroughly clean the outside of the cylinder.
2. Remove internal collar (item 17) that secures head in barrel.
3. Grasp end of piston rod and use a twisting and pulling motion to carefully extract piston, piston rod and head from cylinder barrel.
4. Using a wrench on the piston rod flats to prevent the rod from turning, remove lock nut (item 8) from rod. Remove piston and head from rod.
5. Remove all seals and O−rings from head and piston.
6. Wash parts in clean solvent. Dry parts with compressed air. Do not wipe parts dry with paper towels or cloth. Lint in a hydraulic system will cause damage.
7. Carefully inspect internal surface of barrel for damage (deep scratches, out−of−round, etc.). Replace entire cylinder if barrel is damaged. Inspect piston rod and piston for evidence of excessive scoring, pitting or wear. Replace any damaged parts.
8. If piston rod ball joint removal is necessary, loosen cap screw and lock nut and then unscrew ball joint from piston rod.

Steering Cylinder Disassembly (Figure 124) (continued)

9. If necessary, remove barrel end ball joint (item 1) from barrel as follows:
   A. Loosen jam nut (item 3).
   B. Drive roll pin (item 6) from barrel.
   C. Unscrew ball joint from barrel.

Steering Cylinder Assembly (Figure 124)

1. Use a complete repair kit when rebuilding the cylinder. Put a coating of clean hydraulic oil on all new seals and O−rings.
2. Install new O−rings and seal to the piston and new O−ring, back−up ring, rod seal and rod wiper to head.
3. Lubricate shaft with clean hydraulic oil. Slide head and piston onto piston rod.
4. Using a wrench on the piston rod flats to prevent the rod from turning, install and tighten lock nut (item 8). Torque lock nut to **54 N·m (40 ft−lb)**.
5. Put a coating of clean hydraulic oil on all cylinder parts to ease assembly.
6. Carefully slide piston rod assembly into cylinder barrel taking care to not damage seals or O−rings.
7. Secure head in barrel with internal collar.
8. If barrel end ball joint (item 2) was removed, install ball joint to barrel as follows:
   A. Thread ball joint into barrel so that roll pin hole in joint aligns with hole in barrel.
   B. Drive roll pin into aligned holes in barrel and ball joint.
   C. Tighten jam nut.

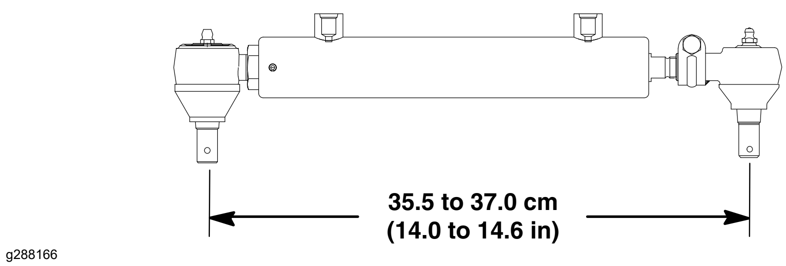


Figure 125

9. If piston rod end ball joint was removed, fully retract piston rod and thread ball joint onto rod so that center to center length is from **35.5 to 37.0 cm (14.0 to 14.6 in)** (Figure 125). Orient the head of the ball joint clamp screw toward the front of the machine and tighten the clamp screw and lock nut.

Front Cutting Deck Lift Cylinders

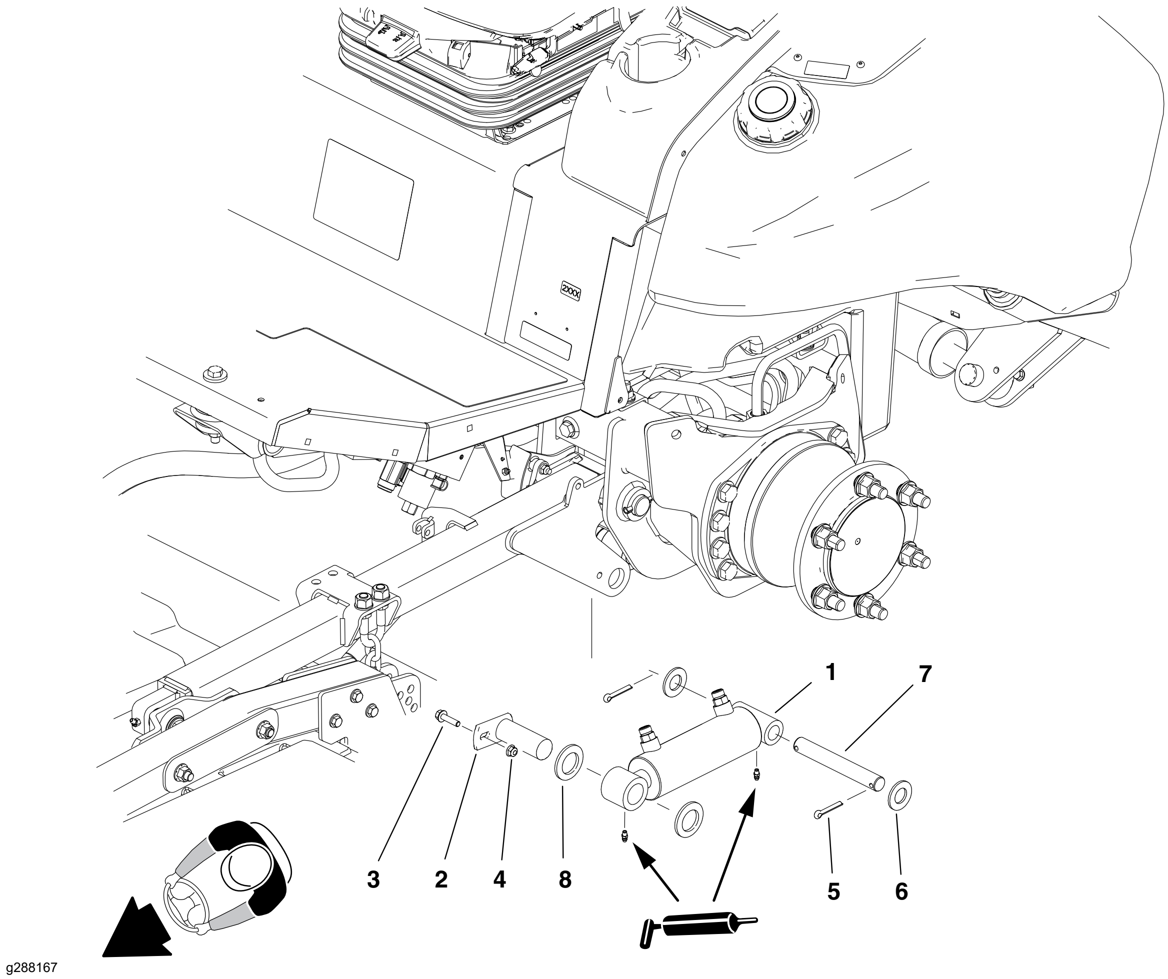


Figure 126

1. Lift cylinder
2. Pin
3. Flange head screw
4. Flange nut
5. Cotter pin (2 per pin)
6. Washer (2 per pin)
7. Clevis pin
8. Washer (2 per pin)

Front Cutting Deck Lift Cylinder Removal (Figure 126)

1. Park machine on a level surface, lower cutting decks fully, disengage PTO and stop engine. Remove key from the key switch.
2. Read the General Precautions for Removing and Installing Hydraulic System Components (page 5–73).
3. To prevent contamination of hydraulic system during lift cylinder removal, thoroughly clean exterior of cylinder and fittings.

IMPORTANT

Make sure to relieve lift system pressure before removing lift cylinder. See Relieving Hydraulic System Pressure (page 5–3).

Front Cutting Deck Lift Cylinder Removal (Figure 126) (continued)

⚠ WARNING ⚠

Make sure that cutting decks are fully lowered before loosening hydraulic lines from a lift cylinder. If cutting decks are not fully lowered as hydraulic lines are loosened, a cutting deck may drop unexpectedly.

Note: To ease assembly, label all hydraulic hoses to identify their correct position on the lift cylinder.

4. Disconnect hydraulic hoses from lift cylinder fittings. Put caps or plugs on fittings and hoses to prevent contamination. Tag hydraulic lines for proper assembly.
5. Remove flange head screw and flange nut that secure the pin to the lift arm. Remove pin from lift arm and cylinder shaft clevis which will free lift cylinder from lift arm.
6. Remove cotter pin and two (2) flat washers from one end of the clevis pin. Pull clevis pin from frame and cylinder barrel clevis. Discard cotter pin.
7. Remove lift cylinder from machine. Record lift cylinder location as right and left cylinders are different.
8. If hydraulic fittings are to be removed from lift cylinder, mark fitting orientation to allow correct assembly. Remove fittings from cylinder and discard O−rings.

Front Cutting Deck Lift Cylinder Installation (Figure 126)

1. If fittings were removed from lift cylinder, lubricate and place new O−rings onto fittings. Install fittings into cylinder ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9)).
2. Make sure that cotter pin and two (2) flat washers are installed on one end of clevis pin.
3. Position cylinder barrel clevis to frame and insert clevis pin into frame and cylinder clevis. Secure lift pin with two (2) flat washers and a new cotter pin.
4. Insert pin through lift arm and cylinder shaft clevis. Secure pin to lift arm with flange head screw and flange nut.
5. Remove caps or plugs placed during removal to prevent contamination.
6. Using tags placed during cylinder removal, correctly attach hydraulic hoses to lift cylinder (see Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–7)).
7. Lubricate lift cylinder grease fittings.
8. After assembly is completed, operate lift cylinder from stop to stop to verify that hydraulic hoses and fittings are not contacted by any machine components.
9. Check hydraulic system for leaks before returning the machine to service.
10. Fill reservoir with new hydraulic fluid as required (see *Operator's manual*).

Front Cutting Deck Lift Cylinder Service

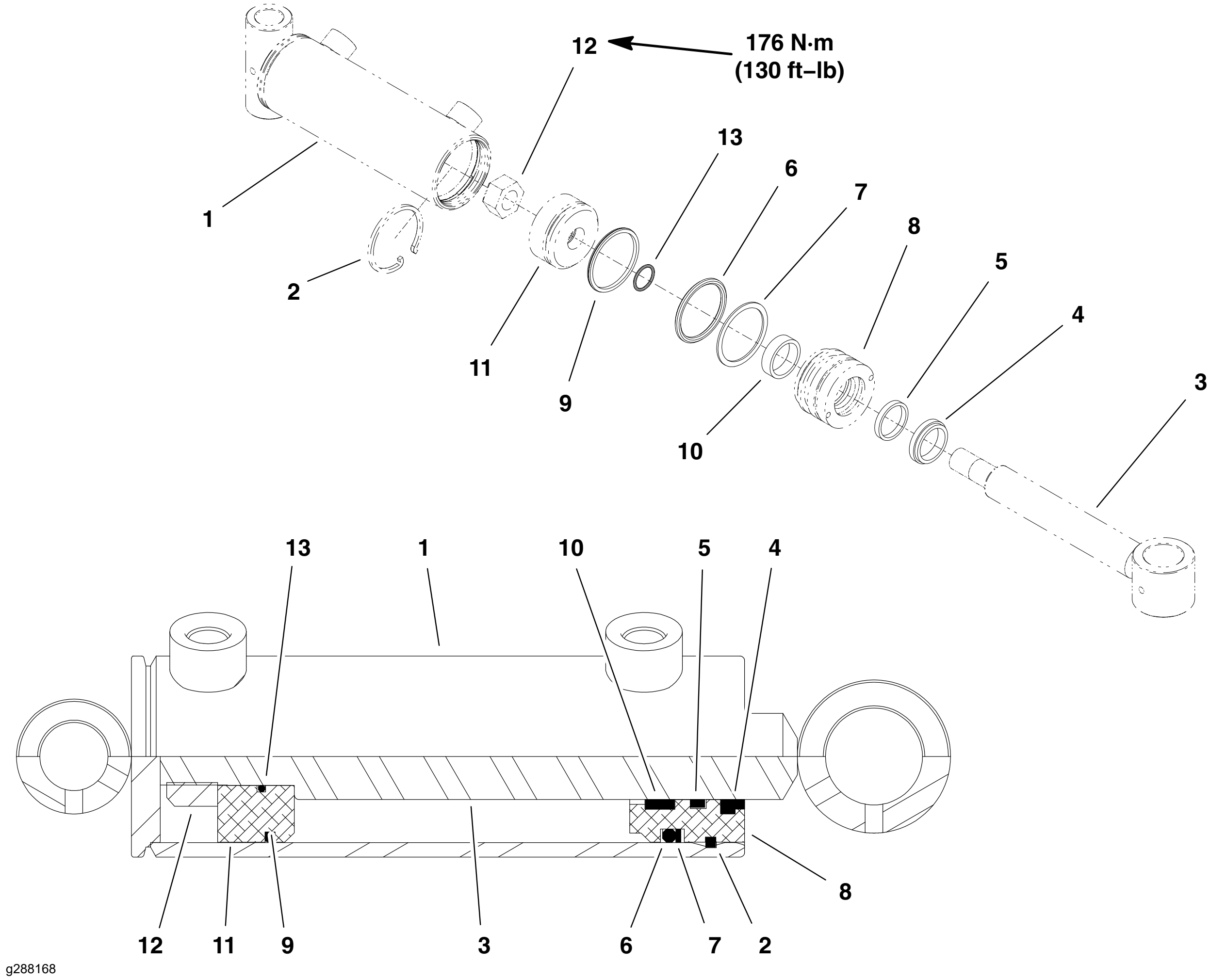


Figure 127

1. Barrel with clevis
2. Retaining ring
3. Shaft with clevis
4. Dust seal
5. Shaft seal
6. O–ring
7. Back–up ring
8. Head
9. Piston seal
10. Wear ring
11. Piston
12. Lock nut
13. O–ring

Front Cutting Deck Lift Cylinder Disassembly (Figure 127)

1. Remove oil from lift cylinder into a drain pan by slowly pumping the cylinder shaft. Plug both ports and clean the outside of the cylinder.

IMPORTANT

Prevent damage when clamping the cylinder's barrel into a vise; clamp on the clevis only. Do not close vise on barrel.

2. Mount lift cylinder in a vise equipped with soft jaws by clamping on the barrel clevis.
3. Remove retaining ring that secures head in barrel.
   A. Use a spanner wrench to rotate head clockwise until the edge of the retaining ring appears in the barrel opening.

Front Cutting Deck Lift Cylinder Disassembly (Figure 127) (continued)

B. Insert a screwdriver under the beveled edge of the retaining ring to start the retaining ring through the opening.

C. Rotate the head counter−clockwise to remove retaining ring from barrel and head.

4. Extract shaft with head and piston by carefully twisting and pulling on the shaft.

IMPORTANT

When securing shaft in vise, clamp on shaft clevis only. Do not clamp vise jaws against the shaft surface.

5. Mount shaft securely in a vise by clamping on the clevis of the shaft. Remove lock nut and piston from the shaft. Slide head from the shaft.
6. Remove piston seal and O−ring from the piston. Remove O−ring, back−up ring, wear ring, dust seal and shaft seal from the head.
7. Wash parts in clean solvent. Dry parts with compressed air. Do not wipe parts dry with paper towels or cloth. Lint in the hydraulic system will cause damage.
8. Carefully inspect internal surface of barrel for damage (deep scratches, out−of−round, etc.). Replace entire cylinder if barrel is damaged. Inspect shaft and piston for evidence of excessive scoring, pitting or wear. Replace any damaged parts.

Front Cutting Deck Lift Cylinder Assembly (Figure 127)

1. Make sure all parts are clean before reassembly.
2. Coat new O−rings, piston seal, wear ring, shaft seal, back−up ring and dust seal with clean hydraulic oil.

A. Install piston seal and O−ring to the piston.

B. Install back−up ring, O−ring, wear ring, shaft seal and dust seal to the head.

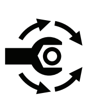
IMPORTANT

When securing shaft in vise, clamp on shaft clevis only. Do not clamp vise jaws against the shaft surface.

3. Mount shaft securely in a vise equipped with soft jaws by clamping on the shaft clevis.

A. Coat shaft with clean hydraulic oil.

B. Slide head and piston onto the shaft.



C. Secure piston to shaft with lock nut. Torque lock nut to **176 N·m (130 ft−lb)**.

4. Lubricate head and piston with clean hydraulic oil. Slide shaft assembly carefully into cylinder barrel.

IMPORTANT

Prevent damage when clamping the cylinder's barrel into a vise; clamp on the clevis only. Do not close vise on barrel.

5. Mount lift cylinder in a vise equipped with soft jaws by clamping on the barrel clevis.
6. Secure head in barrel with retaining ring.
   A. Align retaining ring hole in the head with the access slot in the barrel.
   B. Insert the retaining ring hook into the hole and rotate head clockwise until the retaining ring is completely pulled into the barrel and the ring ends are covered.

Wing Cutting Deck Lift Cylinders

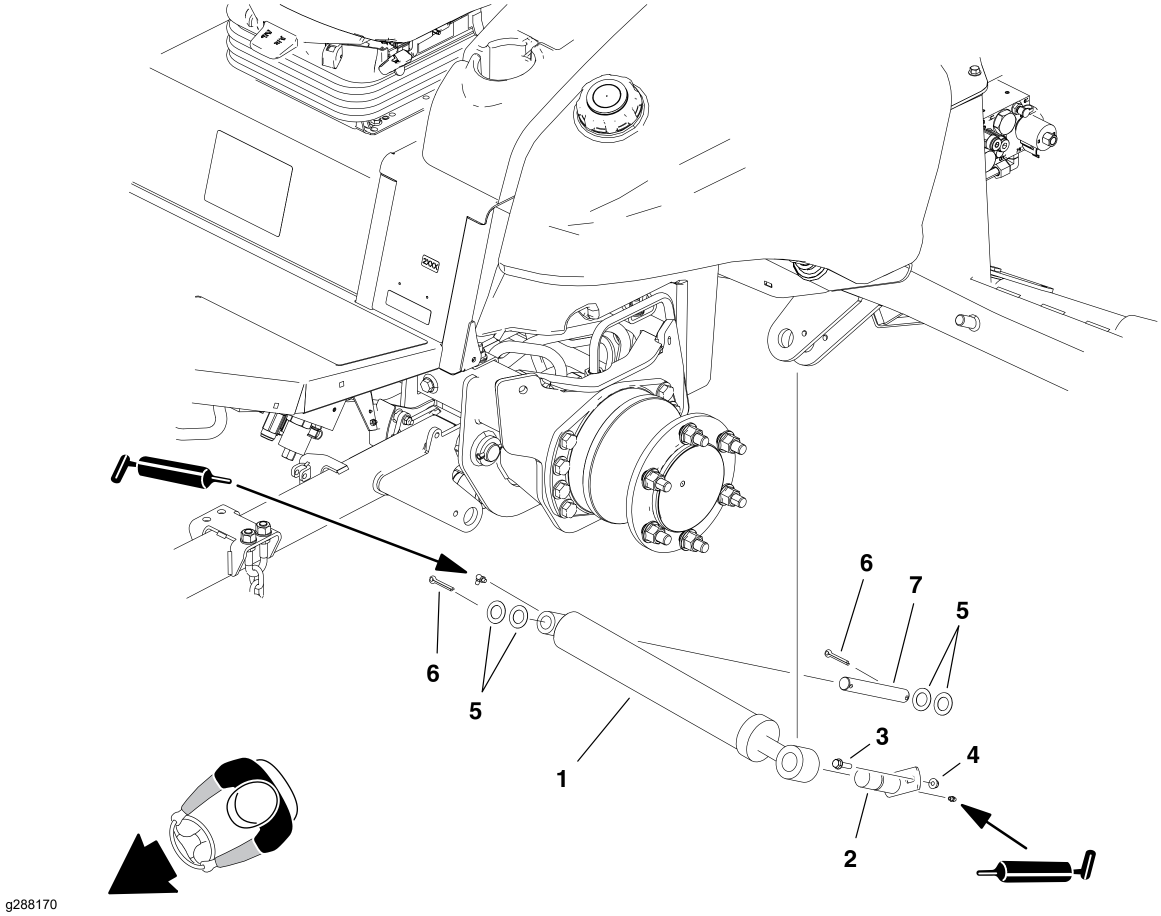


Figure 128

1. Wing deck lift cylinder (LH shown)
2. Pin
3. Flange head screw
4. Flange nut
5. Flat washer (4 per clevis pin)
6. Cotter pin (2 per clevis pin)
7. Clevis pin

Wing Cutting Deck Lift Cylinder Removal (Figure 128)

1. Park machine on a level surface, lower cutting decks fully, disengage PTO and stop engine. Remove key from the key switch.
2. Read the General Precautions for Removing and Installing Hydraulic System Components (page 5–73).
3. To prevent contamination of hydraulic system during lift cylinder removal, thoroughly clean exterior of cylinder and fittings.

IMPORTANT

Make sure to relieve lift system pressure before removing lift cylinder. See Relieving Hydraulic System Pressure (page 5–3).

Wing Cutting Deck Lift Cylinder Removal (Figure 128) (continued)

WARNING

Make sure that cutting decks are fully lowered before loosening hydraulic lines from a lift cylinder. If cutting decks are not fully lowered as hydraulic lines are loosened, a cutting deck may drop unexpectedly.

Note: To ease assembly, label all hydraulic hoses to identify their correct position on the lift cylinder.

4. Disconnect hydraulic hoses from lift cylinder fittings. Put caps or plugs on fittings and hoses to prevent contamination. Tag hydraulic lines for proper assembly.
5. Remove flange head screw and flange nut that secure the pin to the lift arm. Remove pin from lift arm and cylinder shaft clevis which will free lift cylinder from lift arm.
6. Remove cotter pin and two (2) flat washers from one end of the clevis pin. Pull clevis pin from frame and cylinder barrel clevis. Discard cotter pin.
7. Remove lift cylinder from machine.
8. If hydraulic fittings are to be removed from lift cylinder, mark fitting orientation to allow correct assembly. Remove fittings from cylinder and discard O−rings.

Wing Cutting Deck Lift Cylinder Installation (Figure 128)

1. If fittings were removed from lift cylinder, lubricate and place new O−rings onto fittings. Install fittings into cylinder ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9)).
2. Make sure that cotter pin and two (2) flat washers are installed on one end of clevis pin.
3. Position cylinder barrel clevis to frame and insert clevis pin into frame and cylinder clevis. Secure lift pin with two (2) flat washers and a new cotter pin.
4. Insert pin through lift arm and cylinder shaft clevis. Secure pin to lift arm with flange head screw and flange nut.
5. Remove caps or plugs placed during removal to prevent contamination.
6. Using tags placed during cylinder removal, correctly attach hydraulic hoses to lift cylinder (see Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–7)).
7. Fill reservoir with new hydraulic fluid as required.
8. Lubricate lift cylinder grease fittings.
9. After assembly is completed, operate lift cylinder from stop to stop to verify that hydraulic hoses and fittings are not contacted by anything.
10. Check hydraulic system for leaks before returning the machine to service.

Wing Cutting Deck Lift Cylinder Service

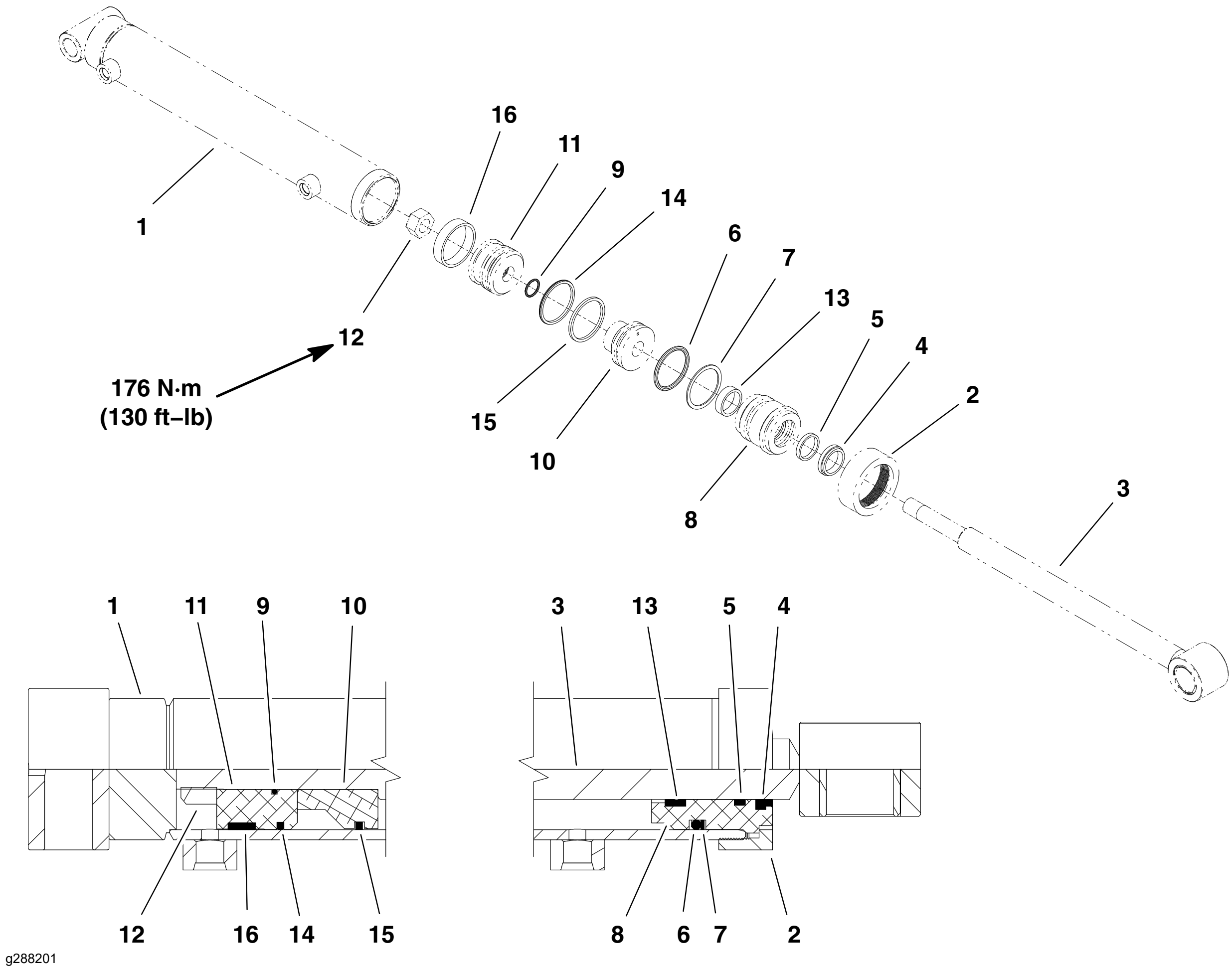


Figure 129

1. Barrel with clevis
2. External collar
3. Shaft with clevis
4. Dust seal
5. Shaft seal
6. O−ring
7. Back−up ring
8. Head
9. O−ring
10. Cushion
11. Piston
12. Lock nut
13. Wear ring
14. Piston seal
15. Steel ring − cushion
16. Wear ring

Wing Cutting Deck Lift Cylinder Disassembly (Figure 129)

1. Remove oil from lift cylinder by slowly pumping the cylinder shaft. After removing oil from cylinder, plug both ports and clean the outside of the cylinder.

IMPORTANT

Prevent damage when clamping the cylinder's barrel into a vise; clamp on the barrel clevis only. Do not close vise on barrel.

2. Mount lift cylinder in a vise equipped with soft jaws by clamping on the barrel clevis.
3. Use a spanner wrench to loosen and remove collar from barrel.
4. Extract shaft with head, cushion and piston by carefully twisting and pulling on the shaft.

Wing Cutting Deck Lift Cylinder Disassembly (Figure 129) (continued)

IMPORTANT

When securing shaft in vise, clamp on shaft clevis only. Do not clamp vise jaws against the shaft surface.

5. Mount shaft securely in a vise by clamping on the clevis of the shaft. Remove lock nut from the shaft. Slide shaft, cushion and head off the shaft.
6. Remove piston seal, wear ring and O−ring from the piston. Remove O−ring, back−up ring, dust seal, wear ring and shaft seal from the head.
7. Wash parts in clean solvent. Dry parts with compressed air. Do not wipe parts dry with paper towels or cloth. Lint in a hydraulic system will cause damage.
8. Carefully inspect internal surface of barrel for damage (deep scratches, out−of−round, etc.). Replace entire cylinder if barrel is damaged. Inspect shaft and piston for evidence of excessive scoring, pitting or wear. Replace any damaged parts.

Wing Cutting Deck Lift Cylinder Assembly (Figure 129)

1. Make sure all parts are clean before assembly.
2. Coat new O−rings, piston seal, rod seal, back−up ring, wear rings and dust seal with clean hydraulic oil.
   A. Install piston seal, wear ring and O−ring to the piston.
   B. Install back−up ring, O−ring, shaft seal, wear ring and dust seal to the head.

IMPORTANT

When securing shaft in vise, clamp on shaft clevis only. Do not clamp vise jaws against the shaft surface.

3. Mount shaft securely in a vise equipped with soft jaws by clamping on the shaft clevis.
   A. Coat shaft with clean hydraulic oil.
   B. Slide external collar, head, cushion and piston onto the shaft.
   C. Secure piston to shaft with lock nut. Torque lock nut to **176 N·m (130 ft-lb)**.
4. Lubricate head, cushion and piston with clean hydraulic oil. Slide shaft assembly carefully into cylinder barrel.

IMPORTANT

Prevent damage when clamping the cylinder's barrel into a vise; clamp on the barrel clevis only. Do not close vise on barrel.

5. Mount lift cylinder in a vise equipped with soft jaws by clamping on the barrel clevis.
6. Use a spanner wrench to tighten collar onto barrel.

Steering/Deck Lift Control Manifold

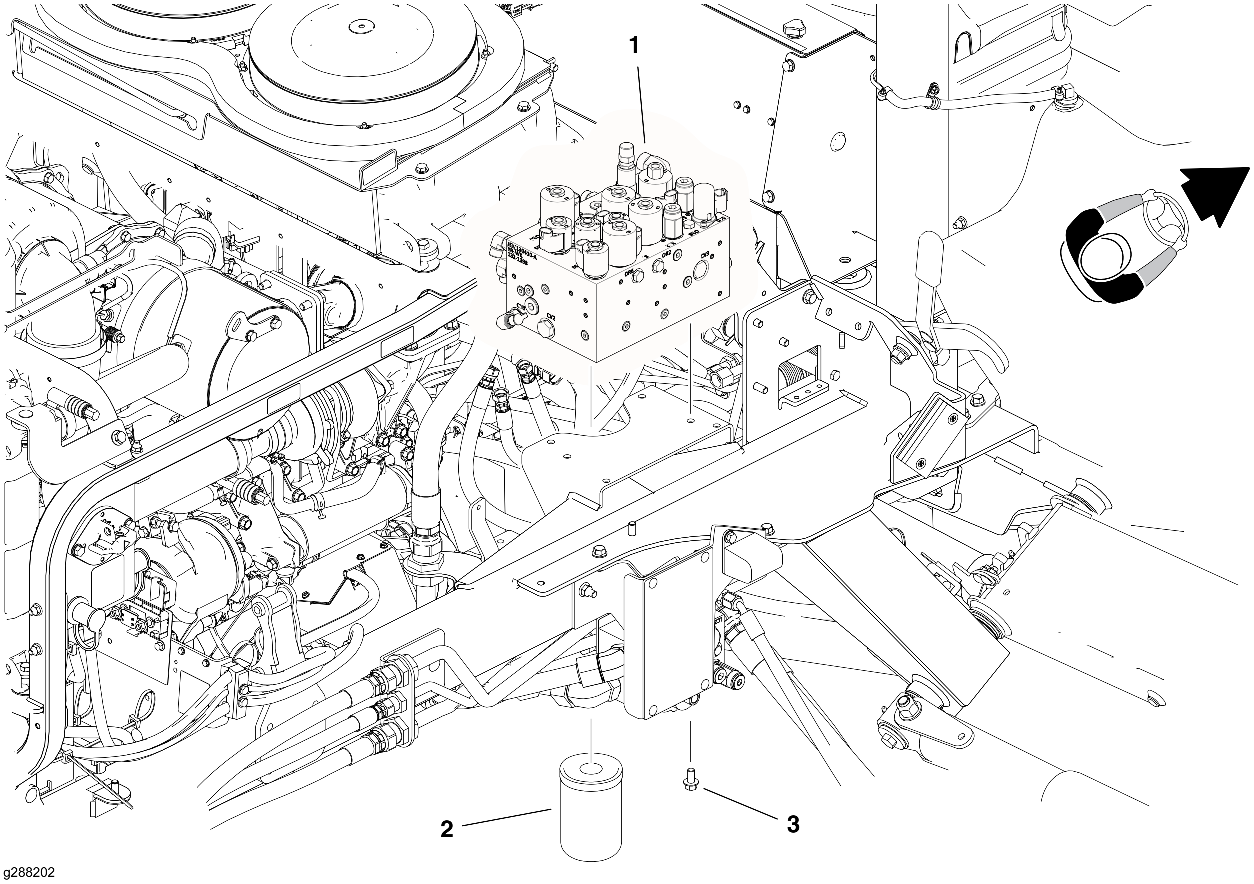


Figure 130

1. Steering/lift control manifold
2. Hydraulic filter
3. Flange head screw (4)

Note: The ports on the lift control manifold are marked for easy identification of components. Example: P1 is the supply port from the gear pump and S1 is the location for solenoid valve #1 (see A Hydraulic Schematic (page A–5) to identify the function of the hydraulic lines and cartridge valves at each port).

Steering/Lift Control Manifold Removal (Figure 130)

1. Park machine on a level surface, lower cutting decks fully, disengage PTO and stop engine. Remove key from the key switch.
2. Read the General Precautions for Removing and Installing Hydraulic System Components (page 5–73).
3. Raise hood and remove RH lower shroud to gain access to lift control manifold.
4. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold and fittings.
5. For assembly purposes, label wire harness leads for manifold solenoids. Disconnect wire harness connectors from solenoids on manifold.
6. Remove hydraulic filter from manifold and allow manifold to drain.
7. Disconnect all hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper assembly.
8. Remove the four (4) flange head screws from underneath the manifold and remove the steering/lift control manifold from the frame.

Steering/Lift Control Manifold Removal (Figure 130) (continued)

IMPORTANT

An orifice is placed beneath the hydraulic fittings in the control manifold LS (OR1), C3 (OR3), C2 (OR5) and C5 (OR7) ports. If any of these fittings are removed from manifold, make sure to remove the orifice, note its orientation and label its position for assembly purposes.

9. If hydraulic fittings are to be removed from manifold, mark fitting orientation to allow correct assembly. Remove fittings from manifold and discard O−rings.

Steering/Lift Control Manifold Installation (Figure 130)

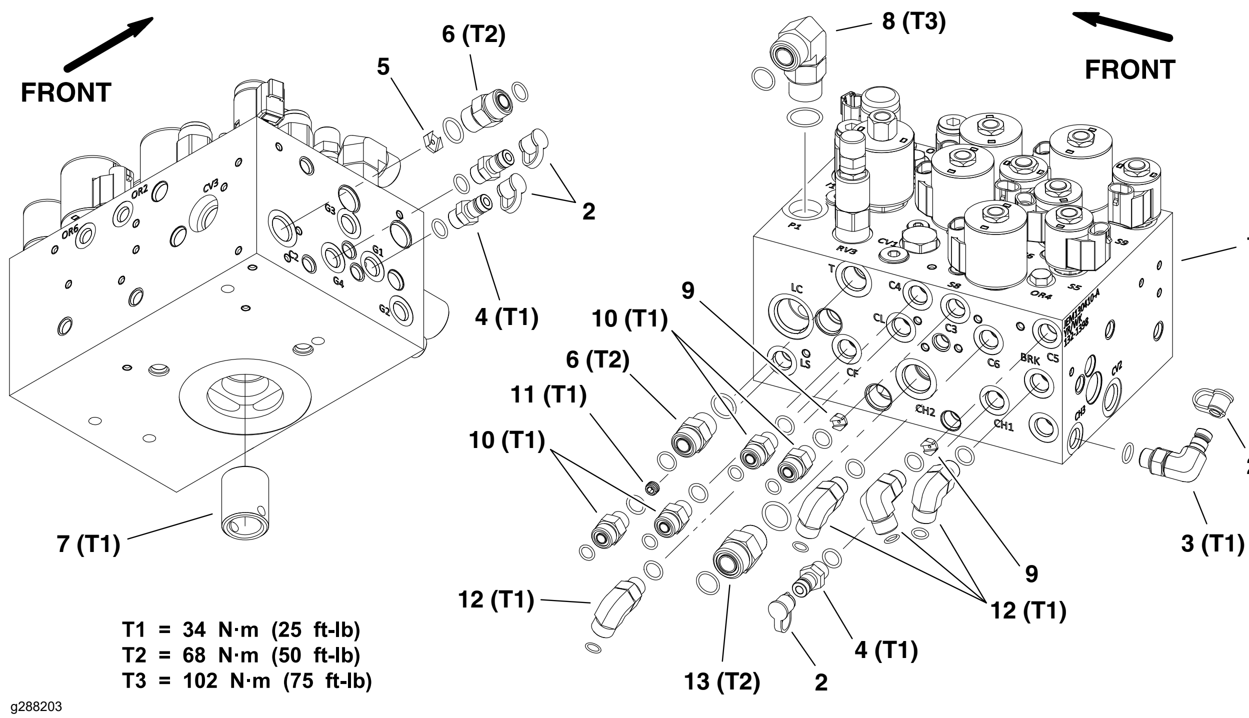


Figure 131

1. Manifold block
2. Dust cap (4)
3. Diagnostic fitting
4. Diagnostic fitting (3)
5. Orifice − 0.138 in
6. Straight fitting (2)
7. Oil filter adapter
8. Elbow fitting
9. Orifice − 0.088 in (2)
10. Straight fitting (4)
11. Orifice − 0.030 in
12. Elbow fitting (4)
13. Straight fitting

1. If fittings were removed from manifold:

   A. Lubricate new O−rings with clean hydraulic oil. Install lubricated O−rings on fittings.

IMPORTANT

When installing the orifice in manifold port C3 (OR3), C2 (OR5) and C5 (OR7), make sure that orifice is in the correct port, oriented correctly and flat in the base of the port cavity. Manifold damage is possible if the orifice is cocked in the cavity.

Steering/Lift Control Manifold Installation (Figure 130) (continued)

B. If fitting was removed from manifold port LS (OR1) C3 (OR3), C2 (OR5) and C5 (OR7), install appropriate orifice in port before installing fitting.

C. Install fittings into manifold openings using marks made during the removal process to properly orientate fittings.

D. Tighten hydraulic fittings to torque value provided (Figure 131). For information on tightening procedures for hydraulic fittings, see Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9).

2. Position steering/lift control manifold to the frame and secure with four (4) flange head screws.
3. Remove caps and plugs from fittings and hoses. Properly connect hydraulic lines to manifold (see Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–7)).
4. Install hydraulic filter to manifold:

   A. Lubricate the new filter gasket and fill the filter with hydraulic fluid.

   B. Ensure that the filter mounting area is clean and screw the filter on until the gasket contacts the manifold; then tighten the filter an additional 1/2 turn.
5. Using labels placed during removal, correctly connect wire harness connectors to solenoids on lift control manifold.
6. Make sure hydraulic tank is full. Add correct oil if necessary.
7. Check hydraulic system for leaks before returning the machine to service.
8. Secure RH lower shroud to machine. Lower and secure hood.

Steering/Deck Lift Control Manifold Service

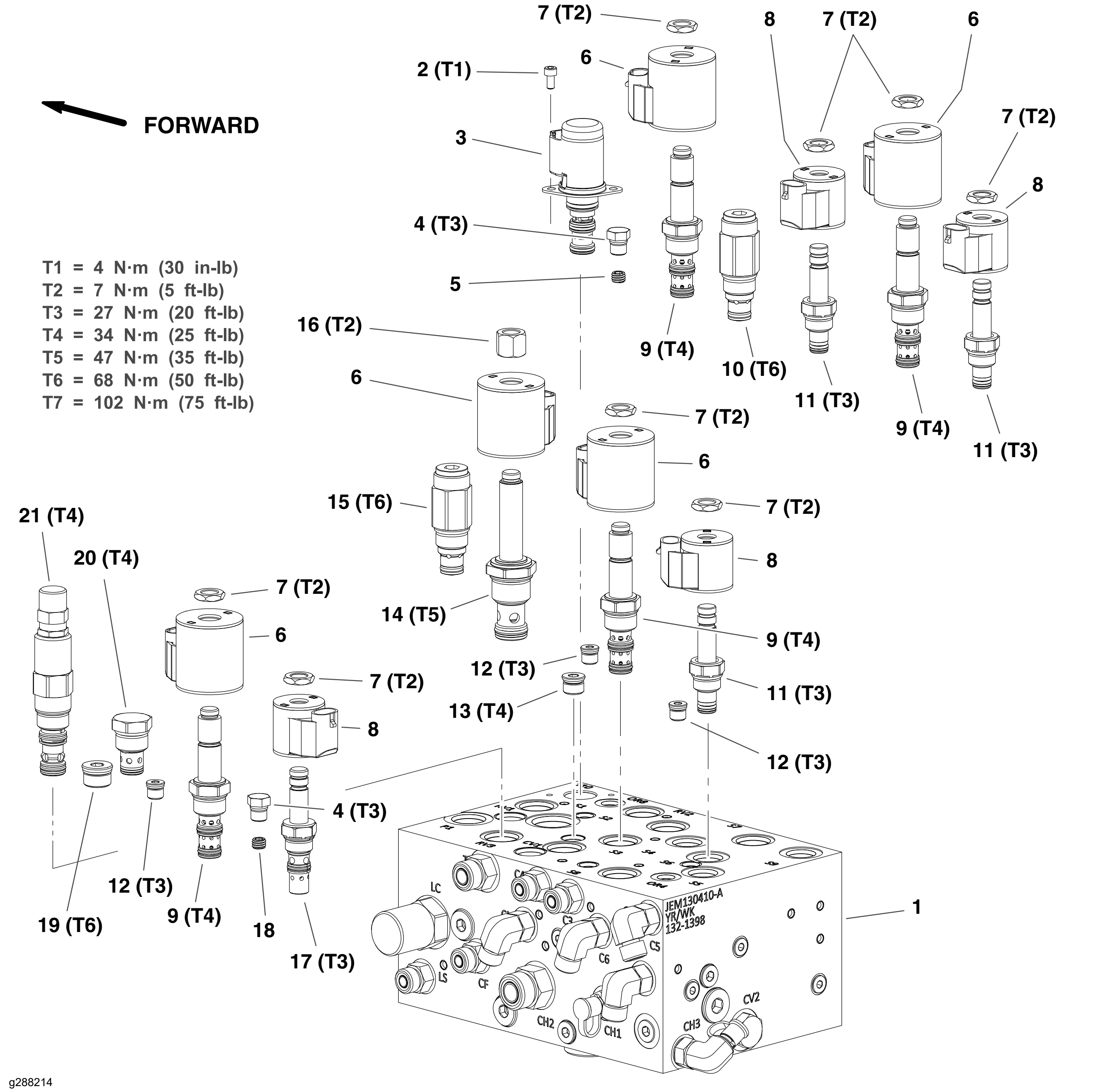


Figure 132

1. Manifold block
2. Socket head screw (2)
3. Solenoid valve − S10
4. #4 zero−leak plug with O−ring (2)
5. Orifice 0.030 in. − OR8
6. #10 solenoid coil (5)
7. Coil nut (8)
8. #8 solenoid coil (4)
9. Solenoid valve − S2, S3, S7 and S8
10. Relief valve − RV2
11. Solenoid valve − S4, S6 and S9
12. #4 zero−leak plug with O−ring (3)
13. #6 zero−leak plug with O−ring
14. Solenoid valve − S1
15. Relief valve − RV1
16. Coil nut
17. Solenoid valve − S5
18. Orifice 0.046 in. − OR4
19. #8 zero−leak plug with O−ring (2)
20. Check valve − CV1
21. Relief valve − RV3

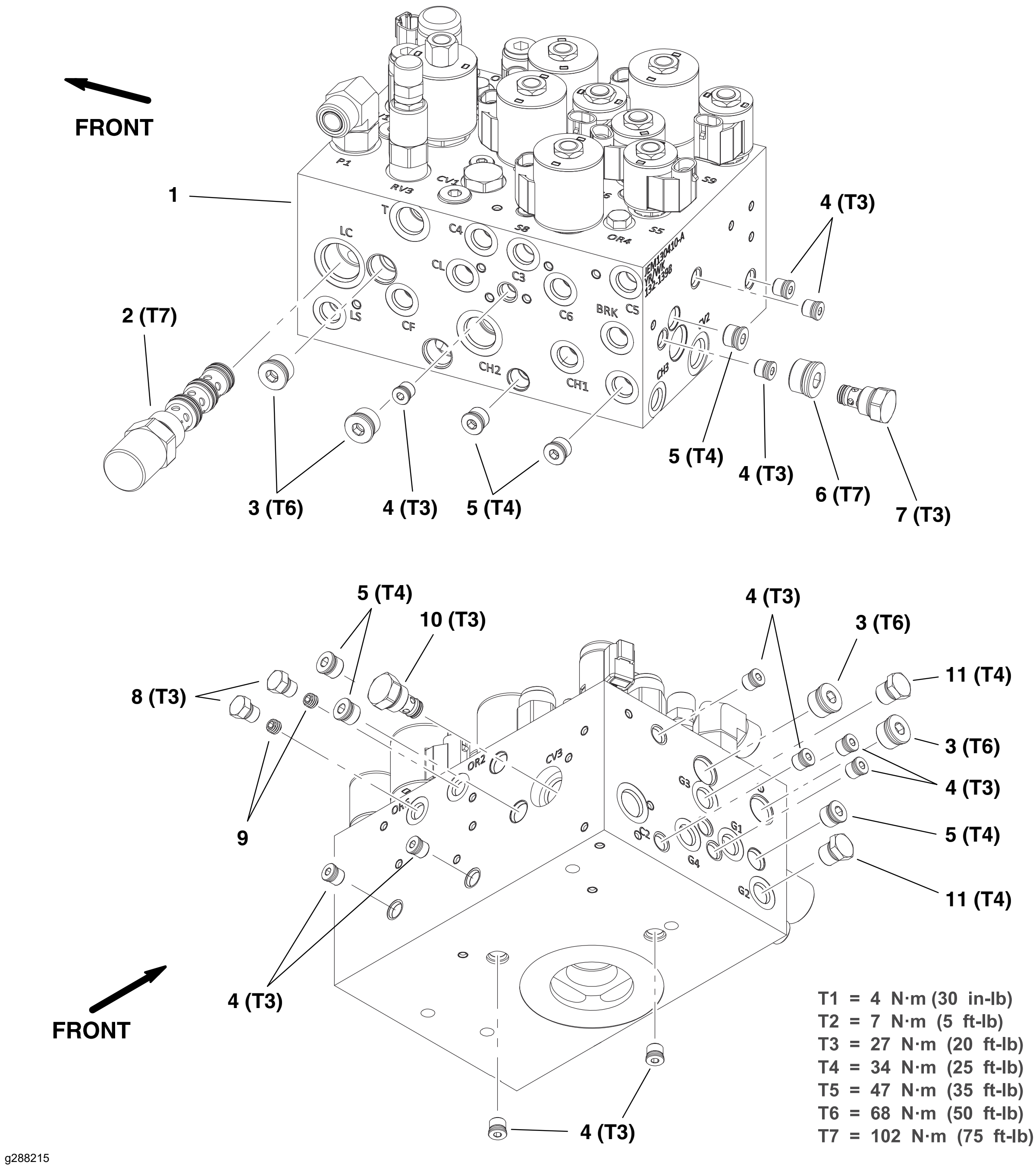


Figure 133

1. Manifold block
2. Pressure compensator − LC
3. #8 zero leak plug with O−ring (4)
4. #4 zero leak plug with O−ring (12)
5. #6 zero leak plug with O−ring (6)
6. #10 zero leak plug with O−ring
7. Check valve − CV2
8. #4 zero leak plug with O−ring (2)
9. Orifice − 0.055 in OR2 and OR6
10. Check valve − CV3
11. #6 zero leak plug with O−ring (2)

The ports on the lift control manifold are marked for easy identification of components. Example: P1 is the supply port from the gear pump and S1 is the location for solenoid valve #1 (see A Hydraulic Schematic (page A–5) to identify the function of the hydraulic lines and cartridge valves at each port).

Although not recommended in most situations, relief valve RV1, RV2 and RV3 are adjustable (see Adjust Manifold Relief Valves (page 5–72)).

IMPORTANT

An orifice is placed beneath the plug in the control manifold OR2, OR4, OR6 and OR8 ports. If the plugs are removed, make sure to remove the orifice, note its orientation and label its position for assembly purposes.

Note: The lift control manifold includes several zero− leak plugs. These plugs have a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero−leak plugs also have an O−ring as a secondary seal. If zero−leak plug removal is necessary, lightly rap the plug head using a punch and hammer before using an allen wrench to remove the plug: the impact will allow plug removal with less chance of damage to the socket head of the plug. When installing plugs, refer to manifold illustration for plug installation torque.

Cartridge Valve Service

For cartridge valve service procedures, see Cartridge Valve Service (page 5–158).

Cartridge Valve Service

1. Make sure the entire outer surface of the manifold is clean before removing the valve.

WARNING

If cartridge valve service involves any valves in the steering/deck lift manifold, make sure that cutting decks are fully lowered before loosening valves in the manifold. If cutting decks are not fully lowered as valves are loosened in the steering/ deck lift manifold, a cutting deck may drop unexpectedly.

2. If cartridge has a replaceable solenoid coil, remove nut securing solenoid coil to the cartridge valve. Carefully slide solenoid coil off the valve.

IMPORTANT

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

3. Remove the cartridge valve:
   A. Use a deep socket wrench for cartridge valves that thread directly into the manifold blocks.
   B. Use an extended hex wrench socket for flange mounted cartridge valves.
4. Record the location of seal kit components (O−rings, sealing rings, backup rings, etc.). Remove and discard old seal kit components.
5. Visually inspect the port in the manifold for damage to the sealing surfaces, damaged threads and contamination. Also, inspect cartridge valve for damaged sealing surfaces and contamination.
   A. Contamination may cause valves to stick or hang up. Contamination can become lodged in small valve orifices or seal areas causing 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.

6. Clean cartridge valve using clean mineral spirits. Submerge valve in clean mineral spirits to flush out contamination. Particles as fine as talcum powder can affect the operation of high pressure hydraulic valves. If cartridge design allows, use a wood or plastic probe to push the internal spool in and out 20 to 30 times to flush out contamination. Be extremely careful to not damage cartridge. Use compressed air for cleaning.
7. Reinstall the cartridge valve:
   A. Lubricate new seal kit components with clean hydraulic oil and install on valve. The O−rings, sealing rings and backup rings must be arranged properly on the cartridge valve for proper operation and sealing.

Cartridge Valve Service (continued)

IMPORTANT

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

B. Fit cartridge valve carefully into manifold port. The valve should go in easily without binding.

C. Tighten the cartridge valve using a deep socket (valves that thread directly into the manifold block) or an extended hex wrench socket (flange mounted cartridge valves) to the value identified in manifold service illustration.

D. If cartridge uses a replaceable solenoid coil, carefully install solenoid coil to the cartridge valve. Tighten coil nut to value identified in manifold service illustration. Over−tightening may damage the solenoid or cause the valve to malfunction.

8. If problems still exist, remove valve and clean again or replace valve.

Hydraulic Oil Cooler

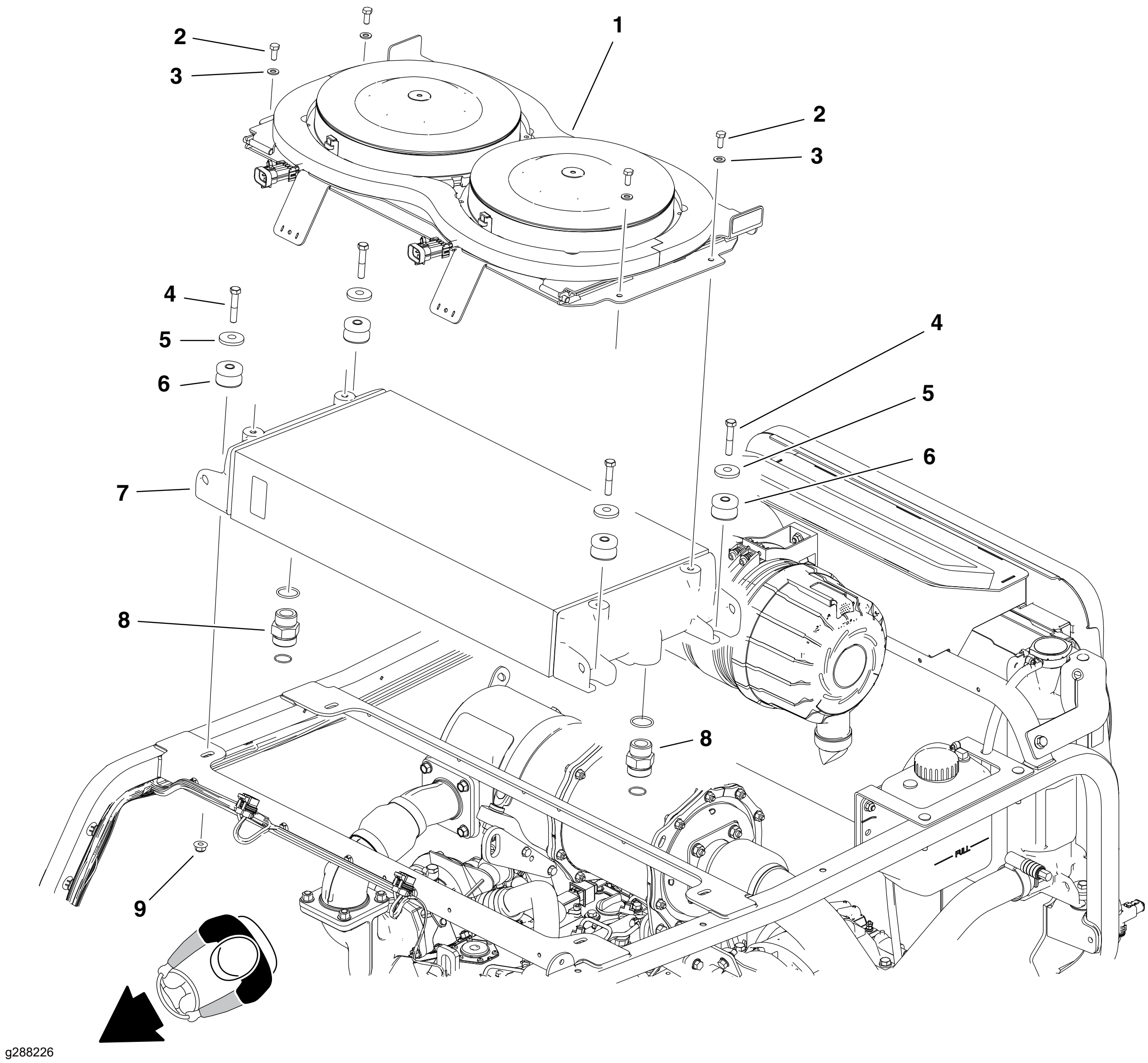


Figure 134

1.	Cooling fan assembly	4.	Cap screw (4)	7.	Oil Cooler
2.	Cap screw (4)	5.	Flat washer (4)	8.	Hydraulic straight fitting (2)
3.	Flat washer (4)	6.	Isolator Mount (4)	9.	Flange nut (4)

Hydraulic Oil Cooler Removal (Figure 133)

CAUTION

The oil cooler may be hot. To avoid possible burns, allow the engine and hydraulic systems to cool before working on the oil cooler.

1. Park machine on a level surface, lower cutting decks fully, disengage PTO and stop engine. Remove key from the key switch.
2. Raise hood to gain access to oil cooler.
3. Read the General Precautions for Removing and Installing Hydraulic System Components (page 5–73).

Hydraulic Oil Cooler Removal (Figure 133) (continued)

4. To prevent contamination of hydraulic system during oil cooler removal, thoroughly clean exterior of oil cooler, fittings and hydraulic hoses.
5. Disconnect the oil cooler hydraulic hoses at the frame bulkhead fitting (right side of machine) and allow the cooler to drain.
6. Disconnect hydraulic hose from oil cooler (left side of machine) Put caps or plugs on oil cooler and hydraulic hose openings to prevent contamination.
7. Disconnect both electric cooling fans from the machine wire harness.
8. Remove the four (4) cap screws and flat washers securing the electric cooling fan assembly to the oil cooler and remove the fan assembly.
9. Remove the four (4) cap screws, washers and flange nuts securing the oil cooler to the cooler frame and remove the oil cooler.
10. Remove hydraulic fittings from oil cooler if necessary and discard O−rings.

Hydraulic Oil Cooler Inspection

1. Back flush oil cooler with cleaning solvent. After cooler is clean, make sure all solvent is drained from the cooler.

CAUTION

Use eye protection such as goggles when using compressed air.

2. Dry inside of oil cooler using compressed air in the opposite direction of the oil flow.
3. Clean exterior of cooler. Take care not to damage cooler fins. Make sure all fins are clear of dirt and debris.
4. The oil cooler should be free of corrosion, cracked tubes and excessive pitting of tubes.
5. Check oil cooler isolator mounts (4) for damage. Replace isolator mounts as needed.
6. Inspect cooling fan assembly foam seals for evidence of wear or damage. Replace seals as needed.

Hydraulic Oil Cooler Installation (Figure 133)

1. If fittings were removed from oil cooler, lubricate and place new O−rings onto fittings. Install fittings into oil cooler. Tighten fittings (see Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9)).
2. Position oil cooler to cooler frame and loosely install four (4) cap screws, washers and flange nuts.
3. Secure cooling fan assembly to oil cooler with four (4) cap screws and flat washers.
4. Connect both electric cooling fans to the machine wire harness.
5. Align oil cooler assembly with hood:
   A. Lower hood and align oil cooler assembly with hood shroud front to back.

   B. Open hood and tighten oil cooler mounting fasteners.
6. Remove caps or plugs placed during removal to prevent contamination. Use a backup wrench on oil cooler fittings and install hydraulic hoses.
7. Fill reservoir with new hydraulic fluid as required.
8. Check hydraulic system for leaks before returning the machine to service.
9. Lower and secure hood.

Electrical System

Table of Contents

General Information

Operator's Manual

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

Operator Cab Components

Information regarding Groundsmaster 5910 cab components (blowers, fans, pressure switches, washer pump and windshield wipers) is included in Chapter 9: Operator Cab (page 9–1).

Toro Electronic Controllers (TEC)

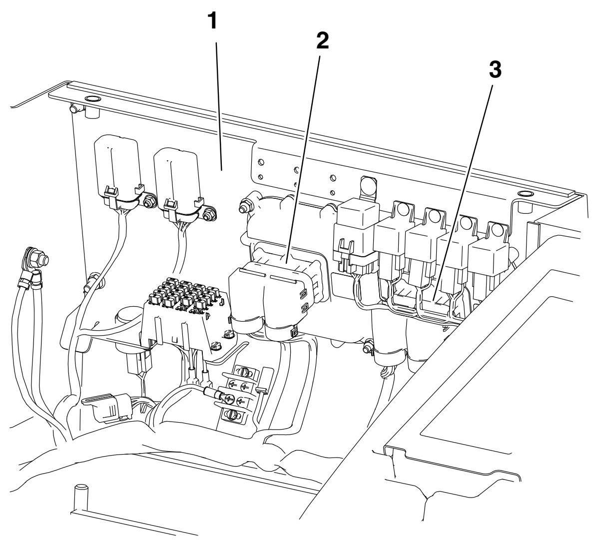


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Figure 135

1. Front power center (behind operator seat)
2. Primary controller
3. Secondary controller

Groundsmaster 5900 and 5910 machines use two (2) Toro Electronic Controllers (TEC) to manage machine electrical functions. The TEC is a microcontroller that monitors the condition of various machine switches and sensors (inputs) and directs electrical power to control appropriate machine functions (outputs) based on the state of the inputs. Communication between the two Toro controllers, the Yanmar engine controller and the InfoCenter Display is provided by a CAN bus network. The status of inputs to the controllers as well as outputs from the controllers can be monitored with the InfoCenter Display (see DIAGNOSTICS SCREENS (page 6–22)).

The TEC controllers are attached to the machine under the front power center cover behind the operator seat (Figure 135). The controllers are identical but they are programed in a "primary/secondary" configuration and therefore cannot be interchanged. The primary controller is primarily responsible for managing the engine start signal and interlocks. The secondary controller is primarily responsible for managing cutting unit operation.

Toro Electronic Controllers (TEC) (continued)

IMPORTANT

Before performing any welding on the machine, turn the battery−disconnect switch to the OFF position, disconnect the wire harness connectors from both Toro Electronic Controllers, disconnect the wire harness connectors from the engine controller and disconnect the terminal connector from the alternator to prevent damage to the machine electrical system.

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

Engine Electronic Control Unit (ECU)

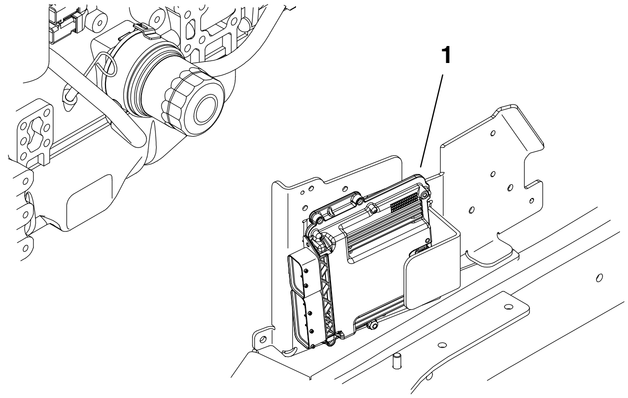

Figure 136

1. Yanmar engine ECU

The Yanmar engine that powers your Groundsmaster uses an Electronic Control Unit (ECU) for engine management. The engine ECU communicates with the Toro Electronic Controller (TEC) and the InfoCenter display on the machine. The engine ECU is located on the left side of the machine frame near the engine. All wire harness electrical connectors should be plugged into the ECU before the machine key switch is moved from the OFF position to either the ON or START position.

If the engine ECU is to be disconnected for any reason, make sure that the key switch is in the OFF position with the key removed for a minimum of thirty (30) seconds before disconnecting the engine ECU. Also, to prevent possible ECU damage when welding on the machine, disconnect the engine ECU from the machine before welding.

Yanmar Engine Electrical Components

When servicing or troubleshooting the engine electrical components, use the correct engine service manual and troubleshooting manual. Also, the Yanmar SMARTASSIST− Direct electronic control diagnostics service system is available to support the error diagnosis and maintenance services of engine electrical control devices.

Battery−Disconnect Switch

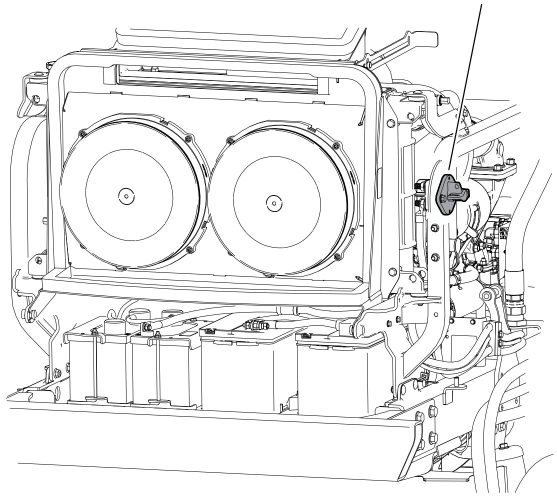

Figure 137

1. Battery−Disconnect switch

The machine includes a battery−disconnect switch located under the hood in the right rear corner of the engine compartment (Figure 137). Turning the battery disconnect switch to the OFF position opens the 12 Volt and 24 Volt battery ground circuit. The battery disconnect switch should be set to OFF when servicing the machine. The switch can be locked in the ON or OFF position if desired.

CAUTION

Do Not turn the battery−disconnect switch to the OFF position while the engine is running. The battery−disconnect switch is not an emergency shutoff. If the battery disconnect switch is set to OFF while the engine is running, the engine will continue to run on the power supplied by the 12 Volt alternator and you may cause damage to electrical components including the Toro Electronic Controllers (TECs).

Electrical System Operation

Groundsmaster 5900/5910 machines use two (2) separate electrical systems. Most machine functions operate on a typical 12 VDC system. The second system exists to operate the electric cooling fans and is 24 VDC.

12 Volt System

Engine electrical components, machine operation switches, hydraulic solenoid coils, the machine Toro electronic controllers (TECs), the Yanmar engine Engine Control Unit (ECU) and the InfoCenter display are all included in the 12 VDC system. Two 12 Volt batteries located at the rear of the machine are connected together in parallel to support the 12 Volt electrical system. The 12 Volt system is charged by an 80 Amp 12 volt alternator driven by a single row V- belt mounted to the engine.

Circuit protection for the 12 VDC system includes a variety of fuses located in the front or rear power centers and a pair of fusible links integrated into the starter circuit wiring. Additional fuses are located in the cab headliner of Groundsmaster 5910 machines.

The 12 Volt system uses the vehicle frame as a ground. A battery- disconnect switch is included on the machine which should be used to disconnect the 12 VDC and 24 VDC system components from the electrical power supply to prevent component damage or unexpected component operation when performing service.

Information about electrical components in the 12 VDC system is included in the Component Testing and Service and Repairs sections of this chapter.

24 Volt System

Groundsmaster 5900/5910 machines include two 12 Volt batteries located at the rear of the machine that are connected together in series to support the 24 Volt cooling fan circuit. The 24 Volt system is charged by an 105 Amp 24 Volt alternator mounted to the machine frame. The 24 Volt alternator is driven by a pulley attached to the engine crankshaft and a multi- row V- belt. Circuit protection for the 24 VDC system includes a pair of fuses located on the rear power center.

The 24 Volt system uses the vehicle frame as a ground. A battery- disconnect switch is included on the machine which should be used to disconnect the 12 VDC and 24 VDC system components from the electrical power supply to prevent component damage or unexpected component operation when performing service.

Groundsmaster 5900/5910 machines include two (2) panels of cooling fans. One panel cools the radiator and the other cools the hydraulic oil cooler. Each panel includes two (2) 24 volt cooling fans operating at the same speed and direction. All four cooling fans are identical.

Each of the four (4) fan assemblies include the 24 VDC fan motor and a 12 VDC fan controller. The cooling fan motors receive power from the 24 Volt system contactor. Using inputs from the coolant temperature sender and the hydraulic oil temperature sender, the primary TEC works with the internal fan controllers as necessary to control the fan speed and direction. In return, the fan controllers provide a hard wired fault signal used as an input to the primary TEC as the cooling fans are not on the CAN- bus system (see CAN−bus Communications (page 6–8)).

24 Volt System (continued)

In normal operating mode, the radiator fans will not operate until the engine coolant reaches the minimum temperature. Once the minimum coolant temperature is reached, the fans will begin to turn at low speed in the forward direction (pulling outside air through the radiator). The Hydraulic oil cooler fans will always run when the engine is running. They will also run at a low speed in the forward direction (pulling outside air through the oil cooler) until the minimum oil temperature. Fan speed will increase if the coolant/hydraulic oil temperature increases. If maximum fan speed in the forward direction does not maintain the coolant/hydraulic oil temperature at its desired temperature, the fans will reverse direction and operate at maximum speed for 6 seconds. Fan reverse cycles can occur at one minute intervals as needed.

Irregardless of coolant temperature, the radiator fans are programmed to reverse periodically to clean debris from the radiator screen.

Additional information about electrical components in the 24 VDC system is included in the Component Testing and Service and Repairs sections of this chapter.

CAN−bus Communications

The two (2) TEC controllers, the Yanmar Engine Controller and the InfoCenter Display used on the Groundsmaster 5900 and 5910 communicate with each other on a Controller Area Network (CAN) bus system. Using this network allows the traction unit to fully integrate all the different electrical components of the tractor and bring them together as one. The CAN bus system reduces the number of electrical components and connections used on the machine and allows the number of wires in the wire harness to be significantly reduced. The integration of electrical functions also allows the Info- Center Display to assist with electrical system diagnostics.

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

Two (2) specially designed, twisted wires form the CAN bus. These wires provide the data pathways between the components on the network. The engineering term for these cables are CAN High and CAN Low. The bus wires for the 12 VDC circuits are black/white and red/ white. At the end of the twisted pair of bus cables is a 120 ohm termination resistor.

IMPORTANT

The termination resistor at the end of the bus wires is required for proper electrical system operation.

Electrical Drawings

The electrical schematic and wire harness drawings for the Groundsmaster 5900 and 5910 are located in Appendix A (page A–1).

InfoCenter Display

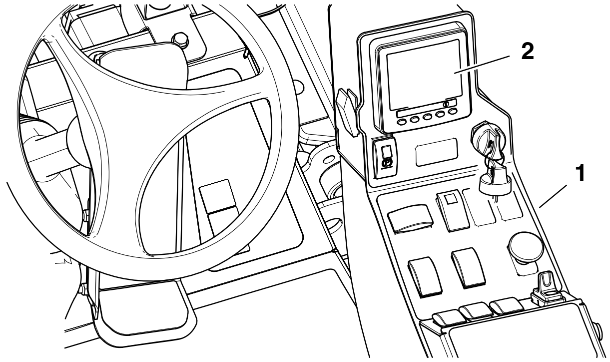

Figure 138

1. Operator control console
2. InfoCenter Display

The Groundsmaster InfoCenter Display is a LCD device that is located in the Operator control console. The Info- Center display provides information for the machine operator during machine operation, provides electrical system diagnostic assistance for technicians and allows inputs for adjustable machine settings.

Power for the InfoCenter is available when the main power relay is energized (key switch is in the START or RUN position). A 2 Amp fuse (F−B5) protects the Info- Center power circuit. A CAN bus network involving the master and secondary Toro Electronic Controllers (TECs), the Yanmar engine ECU and the InfoCenter is used to communicate machine information to and from the Info- Center display.

Note: The TEC controllers and the InfoCenter Display used on the Groundsmaster 5900 and 5910 are matched for correct machine operation. If any of these components are replaced for any reason, system software needs to be reprogrammed (contact an Authorized Toro Distributor for assistance).

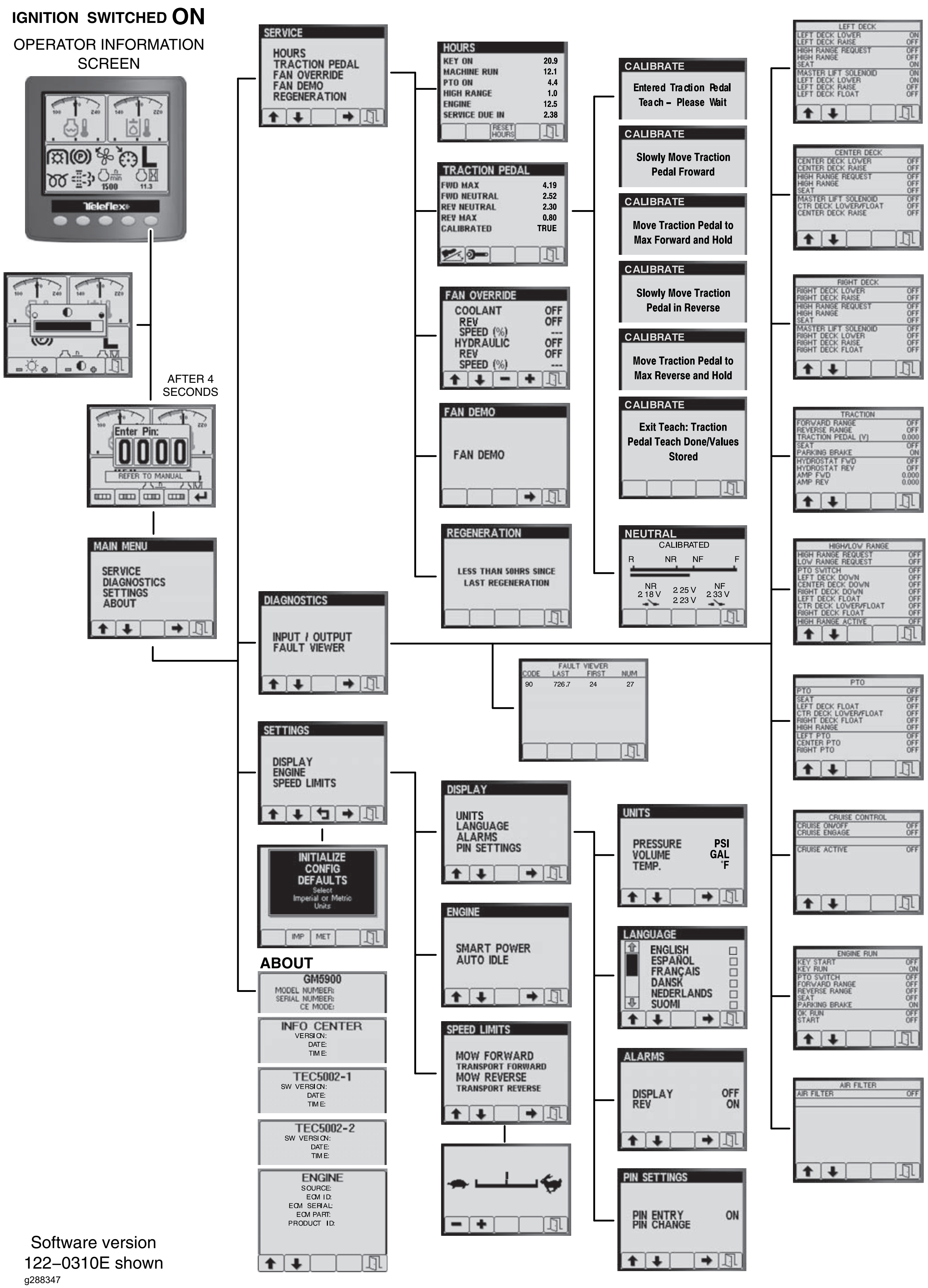

Figure 139

InfoCenter Display Screens

Operator Information Screen

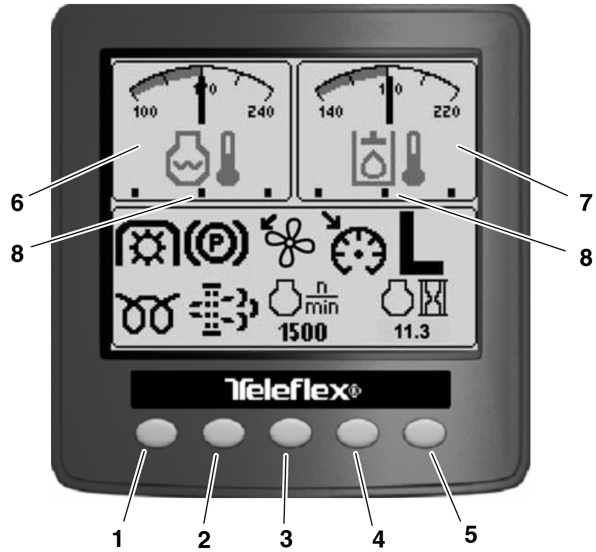

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Figure 140

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Left gauge screen (coolant temp shown)
7. Right gauge screen (hydraulic oil temp shown)
8. Fan speed indicator

The InfoCenter replaces traditional gauges by displaying engine and machine status. The operator information screen is the default InfoCenter screen and is displayed when the key switch is in either the RUN or START position. See the machine *Operator's Manual* for additional operator information screen information.

The upper left portion of the screen is used to display any of three (3) different gauges:

- Engine coolant temperature and radiator cooling fan speed/direction
- Engine RPM
- Electrical systems voltage

The upper right portion of the screen is used to display any of two (2) different gauges:

- Hydraulic oil temperature and hydraulic oil cooler fan speed/direction
- Fuel level

To select the desired gauge, expose the InfoCenter navigation pane by pressing any button 1, 2, 3 or 4 on the display (Figure 140). From the navigation pane, pressing buttons 1 or 2 on the display scrolls through the various gauge options.

Note: The navigation pane will automatically close after a short time or it can be closed manually by pressing button 5 under the open door icon.

The lower portion of the screen is used to display the following conditions (see machine *Operator's Manual*):

- Machine hours
- Engine RPM
- Traction speed range
- Diesel Particulate Filter (DPF) regeneration status
- Glow plugs (energized)

Operator Information Screen (continued)

- PTO (engaged)
- Parking brake (engaged)
- Engine cooling fan (in reverse)
- Cruise control (engaged)

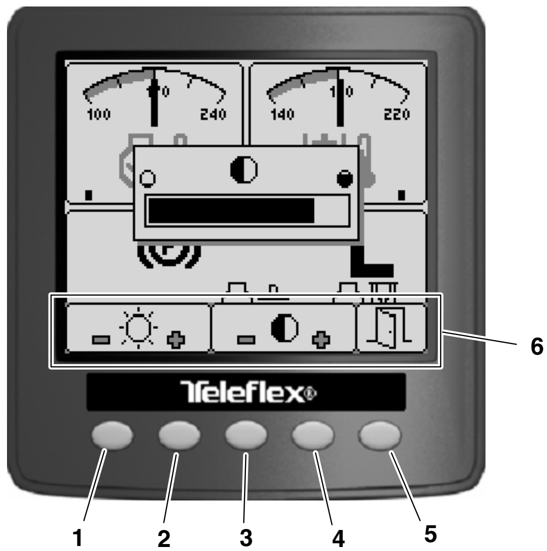

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Figure 141

1.	Button 1	4.	Button 4
2.	Button 2	5.	Button 5
3.	Button 3	6.	Display controls

InfoCenter display controls can be accessed by pressing button 5 on the display (Figure 141). When the display controls appear, use buttons 1 or 2 to adjust the display screen brightness, and buttons 3 or 4 to adjust the display screen contrast.

Return to the previous screen by pressing button 5.

MAIN MENU

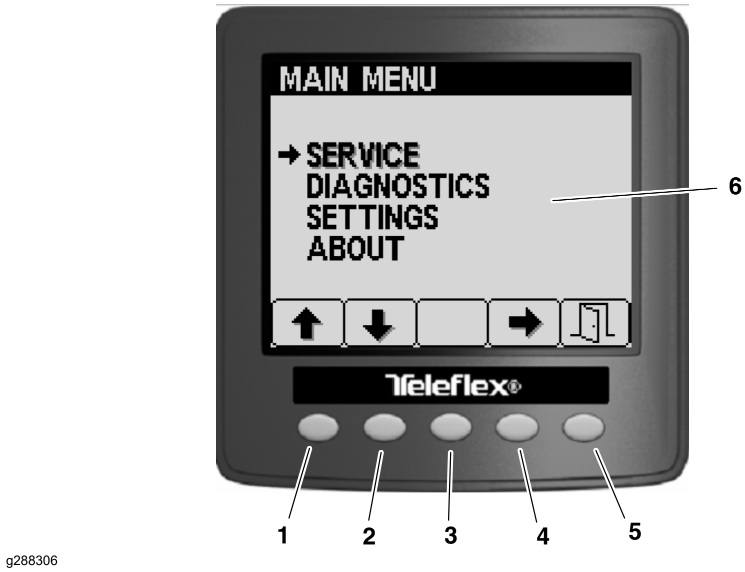

Figure 142

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Main Menu screen

The main menu (Figure 142) provides access to the following screens:

- Service
- Diagnostics
- Settings
- About

The main menu screen is accessed by pressing an holding button 5 on the display for approximately 4 seconds.

Note: Access to the main menu screens may require entering a Personal Identification Number (PIN). The default PIN is either 1234 or 5900. See the machine *Operator's Manual* for additional PIN information.

Return to the previous screen by pressing button 5.

SERVICE

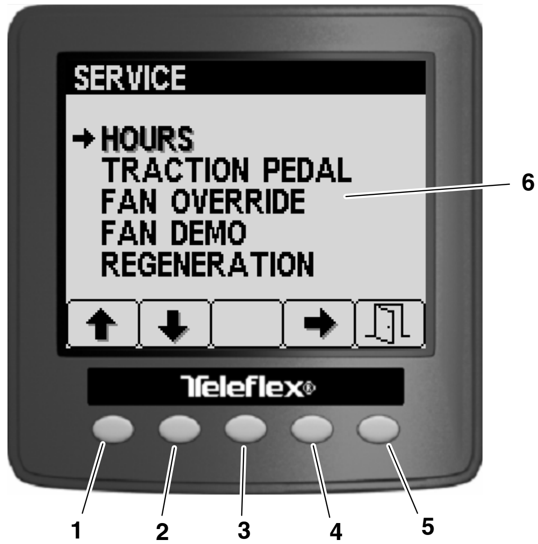

Figure 143

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Service screen

The service screen (Figure 143) is accessed from the main menu and provides access to the following screens:

- Hours
- Traction Pedal
- Fan Override
- Fan Demo
- Regeneration

Access the service screens by pressing buttons 1 or 2 to highlight the desired screen and button 4 to select the highlighted screen.

Return to the previous screen by pressing button 5.

HOURS

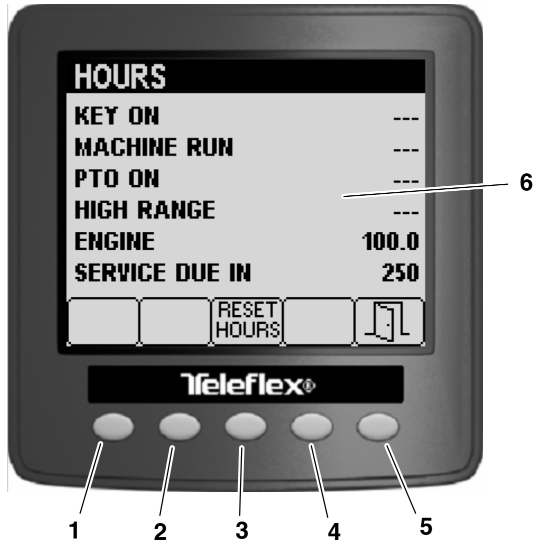

Figure 144

1.	Button 1	4.	Button 4
2.	Button 2	5.	Button 5
3.	Button 3	6.	Hours screen

The hours screen contains a variety of machine hour meters (Figure 144).

Use the Service Due In hour meter to notify the operator via the InfoCenter Display when scheduled maintenance is due.

To reset the service due in hour meter, press button 3 from the hours screen. Use buttons 1 or 2 to highlight the desired time increment and button 4 to select the highlighted item.

Return to the previous screen by pressing button 5.

TRACTION PEDAL

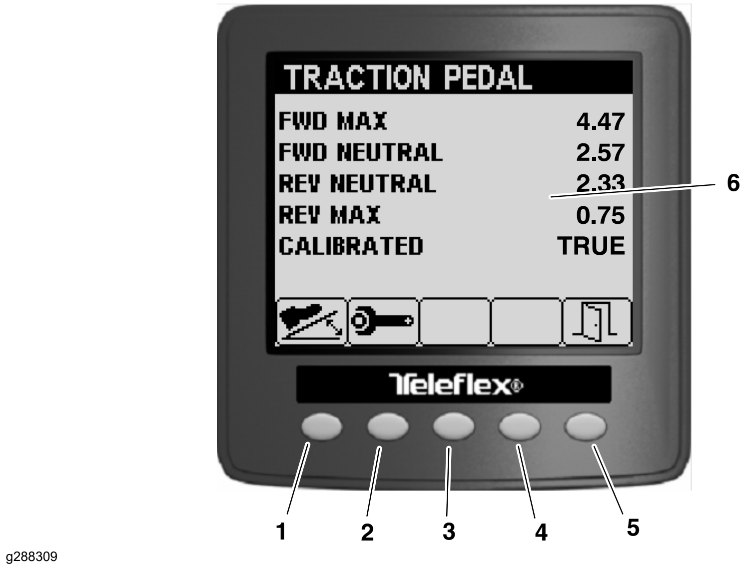

Figure 145

1.	Button 1	4.	Button 4
2.	Button 2	5.	Button 5
3.	Button 3	6.	Traction pedal screen

The traction pedal screen lists the calibration values stored in the primary controller for different traction pedal positions (traction pedal position sensor). This screen also identifies that the traction pedal position sensor calibration has been completed.

To begin the traction pedal position sensor calibration process, press button 1 (see Traction Pedal Position Sensor Calibration (page 6–51)).

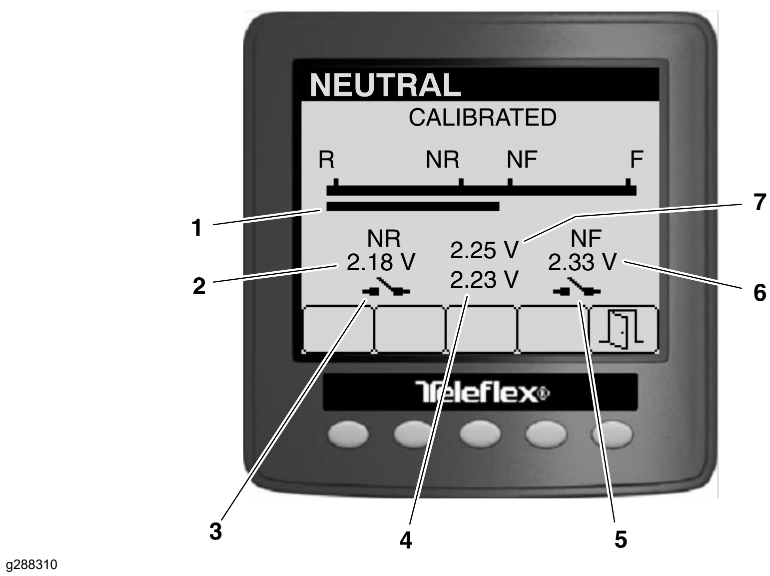

Figure 146

1.	Position indicator bar	5.	Forward switch state icon
2.	Neutral to reverse (open to close) voltage	6.	Neutral to forward (open to close) voltage
3.	Reverse switch state icon	7.	Neutral center target voltage
4.	Voltage for pedal in present position		

TRACTION PEDAL (continued)

Access the Neutral screen (Figure 146) to check or adjust the traction pedal neutral position by pressing button 2 (see Traction Pedal Neutral Adjustment (page 6–49)).

Return to the previous screen by pressing button 5.

FAN OVERRIDE

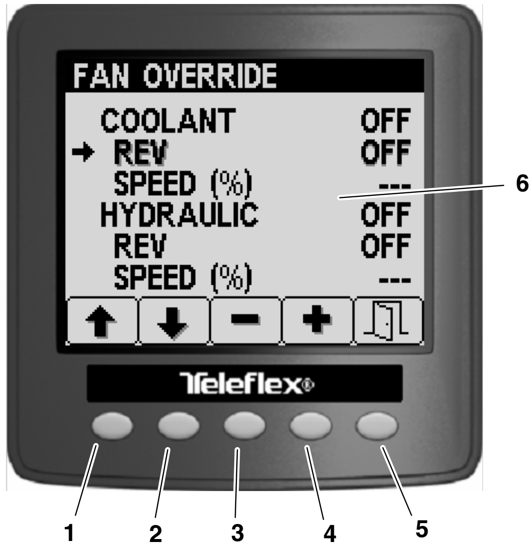

Figure 147

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Fan override screen

The fan override screen (Figure 147) allows the direction and speed of the radiator and hydraulic oil cooler cooling fans to be operated manually for testing purposes only.

Note: The engine must be running, no coolant or hydraulic oil temperature warnings can be active and the parking brake needs to be engaged or an operator must be in the seat for fan override to be operational.

To manually control the cooling fan direction, press buttons 1 or 2 to highlight REV under the desired fan and buttons 3 or 4 to shift the fan direction (forward = OFF and reverse = ON). When reverse is ON, the selected fans will operate in the reverse direction for approximately six (6) seconds, pause for approximately nine (9) seconds and repeat.

To manually control the cooling fan speed, press buttons 1 or 2 to highlight SPEED (%) under the desired fan and buttons 3 or 4 to increase or decrease the fan speed.

Cancel fan override and return to the previous screen by pressing button 5.

FAN DEMO

Figure 148

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Fan demo screen

The fan demo screen (Figure 148) allows the cooling fans to be put into a demonstration cycle for testing or demonstration purposes only.

Note: The engine must be running, no coolant or hydraulic oil temperature warnings can be active and the parking brake needs to be engaged or an operator must be in the seat for fan demo to be operational.

To begin the fan demo, press button 3 (ON). The following four (4) stage fan operating sequence will begin automatically:

- Radiator fans at maximum speed in forward direction and hydraulic oil cooler fans at maximum speed in forward direction for one minute.
- Radiator fans at maximum speed in reverse direction and hydraulic oil cooler fans at maximum speed in forward direction for one minute.
- Radiator fans at maximum speed in reverse direction and hydraulic oil cooler fans at maximum speed in reverse direction for one minute.
- Radiator fans at maximum speed in forward direction and hydraulic oil cooler fans at maximum speed in reverse direction for one minute.
- Repeat sequence.

When operating in the reverse direction, the selected fans will be energized for approximately six (6) seconds, pause for approximately nine (9) seconds and repeat until the stage times out.

Cancel fan demo and return to the previous screen by pressing button 5.

REGENERATION

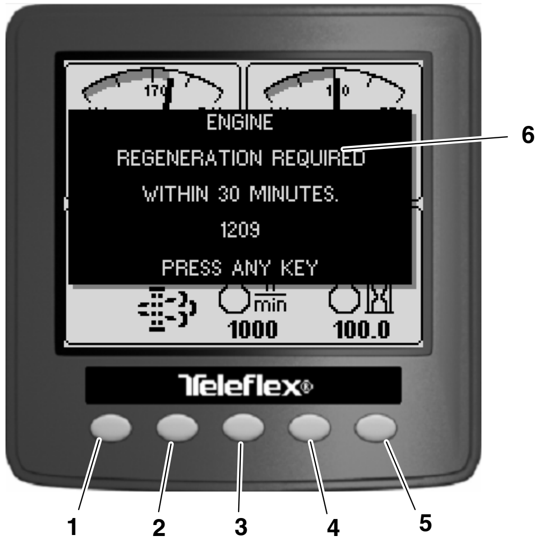

Figure 149

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Regeneration screen

Regeneration provides the necessary procedure for performing a regeneration of the exhaust system DPF (diesel particulate filter). If the engine ECU identifies that a DPF regeneration is necessary, an engine fault will occur on the InfoCenter display (Figure 149). See Engine Faults (page 3–27).

The engine ECU may request a stationary regeneration or a recovery regeneration. When a stationary regeneration is needed, engine performance is derated to 85% until a stationary regeneration is performed. A stationary regeneration takes approximately 20 to 40 minutes depending on DPF condition.

Note: A recovery regeneration is a lengthy process and should be avoided if possible by performing a stationary regeneration when requested.

If a stationary regeneration is not performed with 30 minutes, a recovery regeneration will be requested. The engine performance will be derated to 50% until a recovery regeneration is performed.

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Figure 150

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5

Park the machine on a hard level surface in a well ventilated area where it can remain until the process is complete. Make sure the machine has an adequate supply of fuel before beginning the automated regeneration process. When ready, access the regeneration screen and press button 4 (Figure 150). During the regeneration process, the InfoCenter display will identify the percent of the process completed.

Return to the previous screen by pressing button 5.

DIAGNOSTICS SCREENS

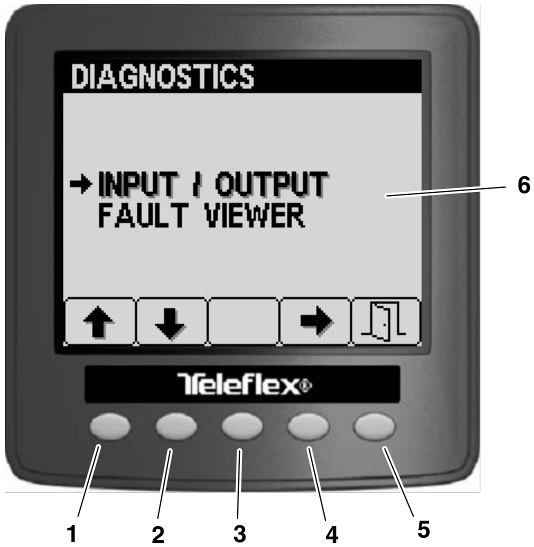


Figure 151

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Diagnostics screen

The Diagnostic screen (Figure 151) is accessed from the main menu and provides access to the following screens:

- Input / Output
- Fault Viewer

Access the diagnostics screens by pressing buttons 1 or 2 to highlight the desired screen and button 4 to select the highlighted screen.

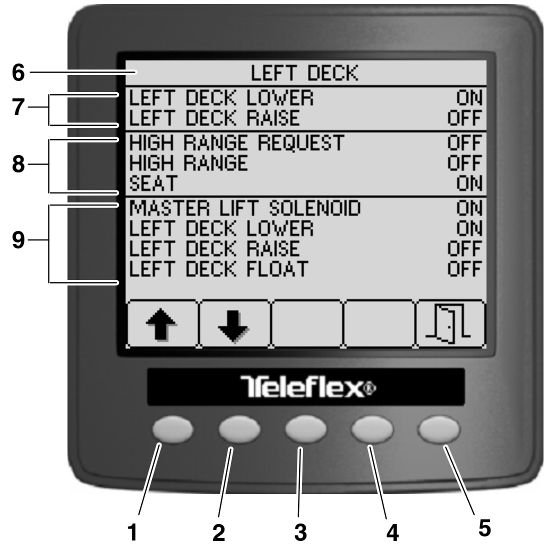
Return to the previous screen by pressing button 5.

INPUT/OUTPUT

The input/output screens display the current state of the various Toro Electronic Controller (TEC) inputs, qualifiers and outputs necessary to allow a machine functions to occur. The input/output screens should be used to troubleshoot machine operation issues, and check that necessary components and circuit wiring are functioning correctly (see Troubleshooting chapter). Scroll through the input/output screens by pressing buttons 1 or 2.

Each of the following machine functions has its own input/ output screen:

- Left cutting deck raise and lower
- Center cutting deck raise and lower
- Right cutting deck raise and lower
- Traction control forward and reverse
- Traction control high/low speed range selection
- PTO engagement
- Cruise control
- Engine starting and running
- Air filter service indicator



g288315

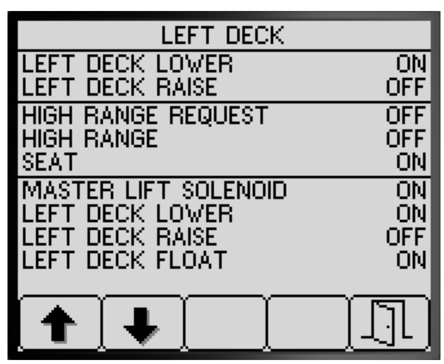
Figure 152

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Machine function
7. Inputs
8. Qualifiers
9. Outputs

Each screen (with exception of air filter service indicator) is separated into four (4) areas of information (Figure 152). The first area identifies the machine function. The second area identifies the inputs that are necessary for the machine function to occur. The third area identifies qualifiers that are involved with the machine function (safety interlocks). The fourth area identifies the outputs that are necessary for the machine function to occur.

Return to the previous screen by pressing button 5.

Left Wing Deck



g288316

Figure 153

(Lower)

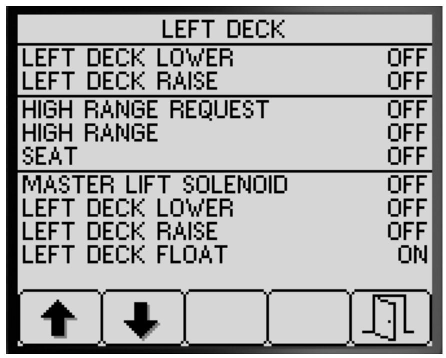
Note: The cutting decks will not raise or lower if the high/low traction speed range switch is in the HIGH position. The cutting decks will not raise or lower if an operator is not in the seat.

To lower the left wing deck, the following inputs and qualifiers are required (Figure 153):

- Operator seat needs to be occupied (SEAT ON).
- High/Low traction speed range switch in LO position (HIGH RANGE REQUEST OFF).
- Hydraulic solenoid valve SV should be de−energized (HIGH RANGE OFF).
- Left wing deck raise/lower switch pressed to lower (LEFT DECK LOWER ON).

If the proper inputs and qualifiers exist, the following outputs should occur (Figure 153):

- Hydraulic solenoid valve S1 should be energized (MASTER LIFT SOLENOID ON).
- Hydraulic solenoid valve S3 should be energized (LEFT DECK LOWER ON).
- Hydraulic solenoid valve S4 should be energized (LEFT DECK FLOAT ON).



g288317

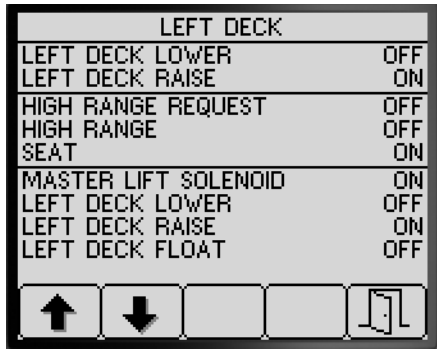
Figure 154

(Float)

Once the deck is fully lowered, the deck should float and following outputs should occur (Figure 154):

- Hydraulic solenoid valve S4 should be energized (LEFT DECK FLOAT ON).

Note: If a deck is already fully lowered when the key switch is moved from OFF to RUN, the deck will not be in float until the deck raise/lower switch is momentarily pressed to lower.



g288318

Figure 155

(Raise)

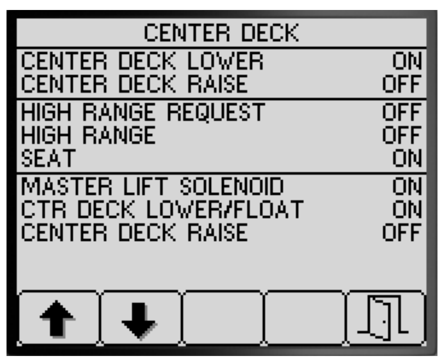
To raise the left wing cutting deck, the following inputs and qualifiers are required (Figure 155):

- Operator seat needs to be occupied (SEAT ON).
- High/Low traction speed range switch in LO position (HIGH RANGE REQUEST OFF).
- Hydraulic solenoid valve SV should be de−energized (HIGH RANGE OFF).
- Left wing deck raise/lower switch pressed to raise (LEFT DECK RAISE ON).

If the proper inputs exist, the following outputs should occur (Figure 155):

- Hydraulic solenoid valve S1 should be energized (MASTER LIFT SOLENOID ON).
- Hydraulic solenoid valve S2 should be energized (LEFT DECK RAISE ON).

Front (Center) Deck



g288319

Figure 156

(Lower)

Note: The cutting decks will not raise or lower if the high/low traction speed range switch is in the HIGH position. The cutting decks will not raise or lower if an operator is not in the seat.

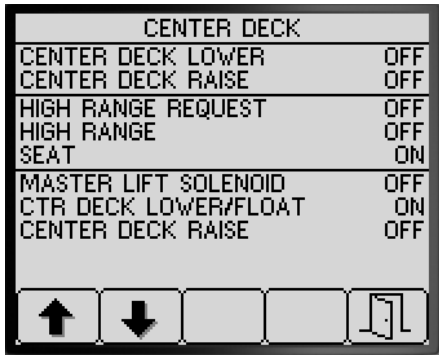
To lower the front deck, the following inputs and qualifiers are required (Figure 156):

- Operator seat needs to be occupied (SEAT ON).
- High/Low traction speed range switch in LO position (HIGH RANGE REQUEST OFF).

- Hydraulic solenoid valve SV should be de−energized (HIGH RANGE OFF).
- Front deck raise/lower switch pressed to lower (CENTER DECK LOWER ON).

If the proper inputs and qualifiers exist, the following outputs should occur (Figure 156):

- Hydraulic solenoid valve S1 should be energized (MASTER LIFT SOLENOID ON).
- Hydraulic solenoid valve S6 should be energized (CENTER DECK LOWER/FLOAT ON).



g288320

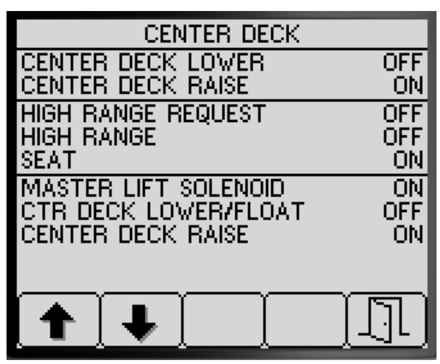
Figure 157

(Float)

Once the deck is fully lowered, the deck should float and following outputs should occur (Figure 157):

- Hydraulic solenoid valve S6 should be energized (CENTER DECK LOWER/FLOAT ON).

Note: If a deck is already fully lowered when the key switch is moved from OFF to RUN, the deck will not be in float until the deck raise/lower switch is momentarily pressed to lower.



g288321

Figure 158

(Raise)

To raise the front cutting deck, the following inputs and qualifiers are required (Figure 158):

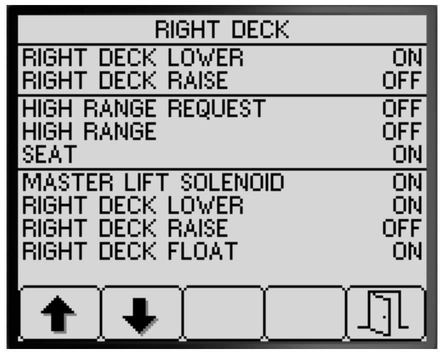
- Operator seat needs to be occupied (SEAT ON).
- High/Low traction speed range switch in LO position (HIGH RANGE REQUEST OFF).

- Hydraulic solenoid valve SV should be de−energized (HIGH RANGE OFF).
- Front deck raise/lower switch pressed to raise (CENTER DECK RAISE ON).

If the proper inputs exist, the following outputs should occur (Figure 158):

- Hydraulic solenoid valve S1 should be energized (MASTER LIFT SOLENOID ON).
- Hydraulic solenoid valve S5 should be energized (CENTER DECK RAISE ON).

Right Wing Deck



g288322

Figure 159

(Lower)

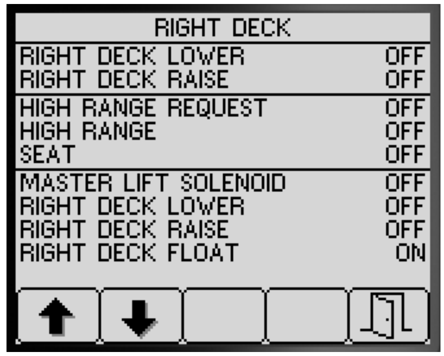
Note: The cutting decks will not raise or lower if the high/low traction speed range switch is in the HIGH position. The cutting decks will not raise or lower if an operator is not in the seat.

To lower the right wing deck, the following inputs and qualifiers are required (Figure 159):

- Operator seat needs to be occupied (SEAT ON).
- High/Low traction speed range switch in LO position (HIGH RANGE REQUEST OFF).
- Hydraulic solenoid valve SV should be de−energized (HIGH RANGE OFF).
- Right wing deck raise/lower switch pressed to lower (RIGHT DECK LOWER ON).

If the proper inputs and qualifiers exist, the following outputs should occur (Figure 159):

- Hydraulic solenoid valve S1 should be energized (MASTER LIFT SOLENOID ON).
- Hydraulic solenoid valve S8 should be energized (RIGHT DECK LOWER ON).
- Hydraulic solenoid valve S9 should be energized (RIGHT DECK FLOAT ON).



g288323

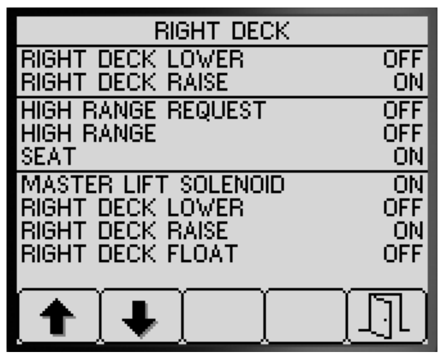
Figure 160

(Float)

Once the deck is fully lowered, the deck should float and following outputs should occur (Figure 160):

- Hydraulic solenoid valve S9 should be energized (RIGHT DECK FLOAT ON).

  Note: If a deck is already fully lowered when the key switch is moved from OFF to RUN, the deck will not be in float until the deck raise/lower switch is momentarily pressed to lower.



g288324

Figure 161

(Raise)

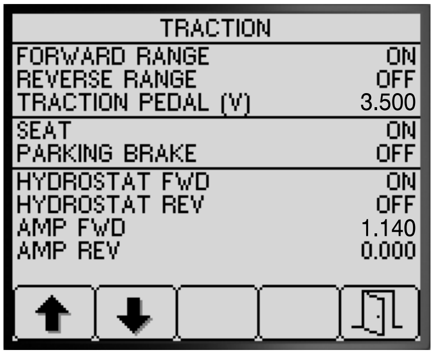
To raise the right wing cutting deck, the following inputs and qualifiers are required (Figure 161):

- Operator seat needs to be occupied (SEAT ON).
- High/Low traction speed range switch in LO position (HIGH RANGE REQUEST OFF).
- Hydraulic solenoid valve SV should be de−energized (HIGH RANGE OFF).
- Right wing deck raise/lower switch pressed to raise (RIGHT DECK RAISE ON).

If the proper inputs exist, the following outputs should occur (Figure 161):

- Hydraulic solenoid valve S1 should be energized (MASTER LIFT SOLENOID ON).
- Hydraulic solenoid valve S7 should be energized (RIGHT DECK RAISE ON).

Traction



g288325

Figure 162

(Forward)

Note: The traction system will not engage if the operator is not in the seat or if the parking brake is engaged.

To engage forward traction, the following inputs and qualifiers are required (Figure 162):

- Operator seat needs to be occupied (SEAT ON).
- Parking brake must be disengaged (PARKING BRAKE OFF).
- Traction pedal pushed to forward (FORWARD RANGE ON).
- Traction pedal position sensor voltage should be within the range determined during traction pedal calibration (TRACTION PEDAL (V) between FWD MAX and FWD NEUTRAL on Traction Pedal Screen).

If the proper inputs and qualifiers exist, the following outputs should occur (Figure 162):

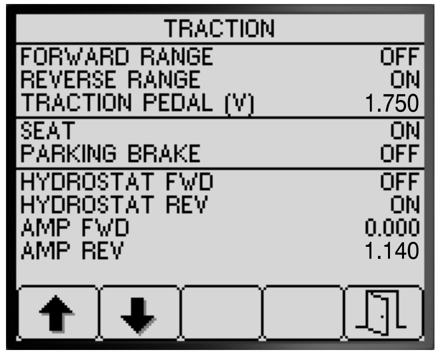
- Parking brake hydraulic solenoid valve S10 should be energized (output not displayed on this screen).
- Hydrostat solenoid S1 should be energized (HYDROSTAT FWD ON).
- Hydrostat solenoid S1 output current should be within range (AMP FWD 0.640 to 1.800).

In neutral, the following conditions should be present:

- Traction pedal position sensor voltage should be within the range determined during traction pedal calibration (TRACTION PEDAL (V) between REV NEUTRAL and FWD NEUTRAL on Traction Pedal Screen).
- Hydrostat solenoid S1 output current should be zero (AMP FWD 0.000).
- Hydrostat solenoid S2 output current should be zero (AMP REV 0.000).

Note: The traction system will not engage if the operator is not in the seat and if the parking brake is engaged.

INPUT/OUTPUT (continued)



g288326

Figure 163

(Reverse)

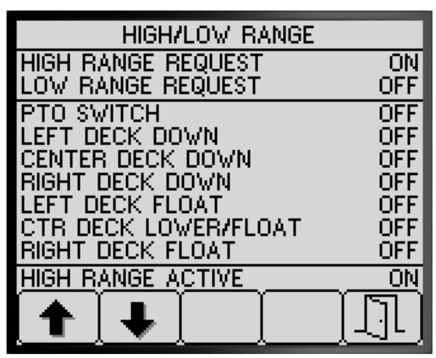
To engage reverse traction, the following inputs and qualifiers are required (Figure 163):

- Operator seat needs to be occupied (SEAT ON).
- Parking brake must be disengaged (PARKING BRAKE OFF).
- Traction pedal pushed to reverse (REVERSE RANGE ON).
- Traction pedal position sensor voltage should be within the range determined during traction pedal calibration (TRACTION PEDAL (V) between REV MAX and REV NEUTRAL on Traction Pedal Screen).

If the proper inputs and qualifiers exist, the following outputs should occur (Figure 163):

- Parking brake hydraulic solenoid valve S10 should be energized (output not displayed on this screen).
- Hydrostat solenoid S2 should be energized (HYDROSTAT FWD ON).
- Hydrostat solenoid S2 output current should be within range (AMP REV 0.640 to 1.800).

HIGH/LOW Range



g288327

Figure 164

(High Speed Range)

Note: The traction system will not engage HIGH range speed if the PTO is engaged or if any cutting deck is lowered or floating. Also, the cruise control must not be engaged, the traction pedal must be in neutral and the hydraulic oil temperature must be above 4 ºC (40 ºF).

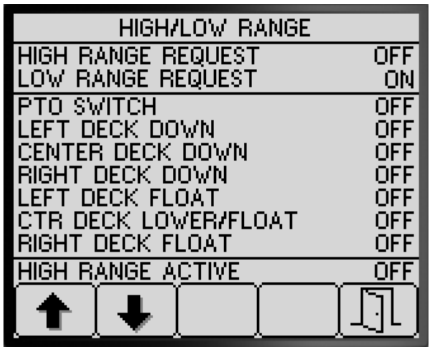
INPUT/OUTPUT (continued)

To engage high range traction speed, the following inputs and qualifiers are required (Figure 164):

- PTO switch needs to be disengaged (PTO SWITCH OFF).
- No cutting decks can be lowered (LEFT DECK DOWN OFF), (CENTER DECK DOWN OFF) and (RIGHT DECK DOWN OFF).
- No cutting decks can be floating (LEFT DECK FLOAT OFF), (CENTER DECK LOWER/FLOAT OFF) and (RIGHT DECK FLOAT OFF).
- High/Low range traction speed switch pressed to HI (HIGH RANGE REQUEST ON).

If the proper inputs and qualifiers exist, the following outputs should occur (Figure 164):

- Hydraulic solenoid valve SV should be energized (HIGH RANGE ACTIVE ON).



g288328

Figure 165

(Low Speed Range)

Note: The traction system will not engage LOW range speed if the cruise control is engaged or the traction pedal is not in neutral. The cutting units can be in any position and the PTO can be engaged or disengaged for LOW range speed operation.

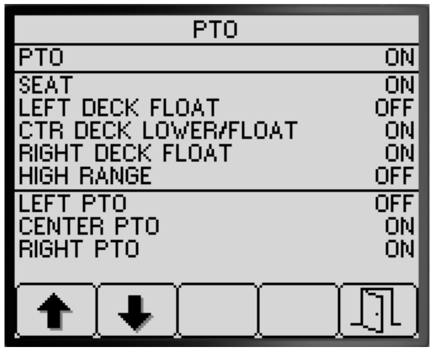
To engage low range traction speed, the following input is required (Figure 165):

- High/Low range traction speed switch pressed to LOW (LOW RANGE REQUEST ON).

If the proper inputs and qualifiers exist, the following outputs should occur (Figure 165):

- Hydraulic solenoid valve SV should be de−energized (HIGH RANGE ACTIVE OFF).

PTO



g288329

Figure 166

Note: The PTO will not engage if the operator is not in the seat, the high/low range traction speed switch is in HIGH or the engine coolant temperature is above 102 ºC (215 ºF). Also, one or more cutting decks must be floating before the PTO will engage. The PTO will only engage the floating cutting deck(s).

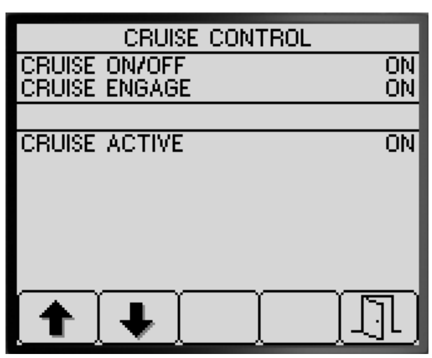
To engage the PTO, the following inputs and qualifiers are required (Figure 166):

- Operator seat needs to be occupied (SEAT ON).
- One or more cutting decks must be floating (LEFT DECK FLOAT ON), (CENTER DECK LOWER/ FLOAT ON) or (RIGHT DECK FLOAT ON).
- Hydraulic solenoid valve SV should be de−energized (HIGH RANGE OFF).
- PTO switch engaged (PTO ON).

If the proper inputs and qualifiers exist, the following outputs should occur (Figure 166):

- Hydraulic solenoid valve PRV in left cutting deck control manifold should be energized (LEFT PTO ON) if the deck is floating.
- Hydraulic solenoid valve PRV in front cutting deck control manifold should be energized (CENTER PTO ON) if the deck is floating.
- Hydraulic solenoid valve PRV in right cutting deck control manifold should be energized (RIGHT PTO ON) if the deck is floating.

Cruise Control



g288330

Figure 167

Note: The cruise control will not engage if the traction pedal is in neutral or reverse, and the traction speed is below the minimum.

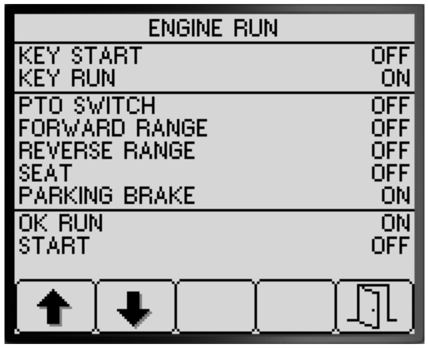
To engage the PTO, the following inputs are required (Figure 167):

- Cruise control switch in the ON position (CRUISE ON/OFF ON).
- Cruise control switch depressed to engage cruise control (CRUISE ENGAGE ON).

If the proper inputs exist, the following outputs should occur (Figure 167):

- Cruise control will be engaged (CRUISE ACTIVE ON).

Engine Run



g288331

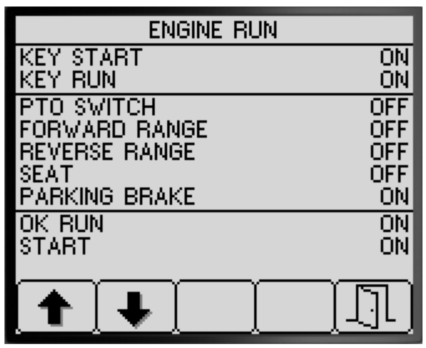
Figure 168

(RUN)

When the key switch is in the RUN position (KEY RUN ON), the following output should occur (Figure 168):

- The electric fuel pump should be energized (OK RUN ON).

Note: The engine will not start if the operator is not in the seat and the parking brake is disengaged, the PTO is engaged and the traction pedal is in forward or reverse.



g288332

Figure 169

(START)

To start the engine, the following inputs and qualifiers are required (Figure 169):

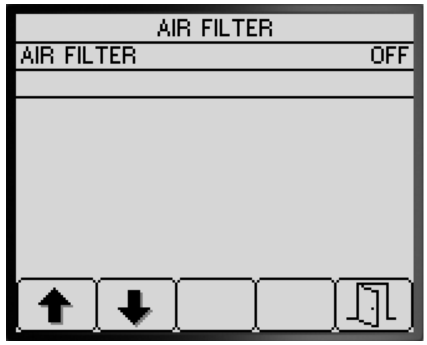
- Operator seat needs to be occupied (SEAT ON) or the parking brake needs to be applied (PARKING BRAKE ON).
- PTO switch disengaged (PTO ENABLED OFF).
- Traction pedal in neutral (FORWARD RANGE OFF) and (REVERSE RANGE OFF).
- Key switch needs to be turned to the START position (KEY START ON) and (KEY RUN ON).

INPUT/OUTPUT (continued)

If the proper inputs and qualifiers exist, the following outputs should occur (Figure 169):

- The start relay should be energized, the starter motor should engage and the electric fuel pump should be energized (START ON) and (OK RUN ON).

Air Filter



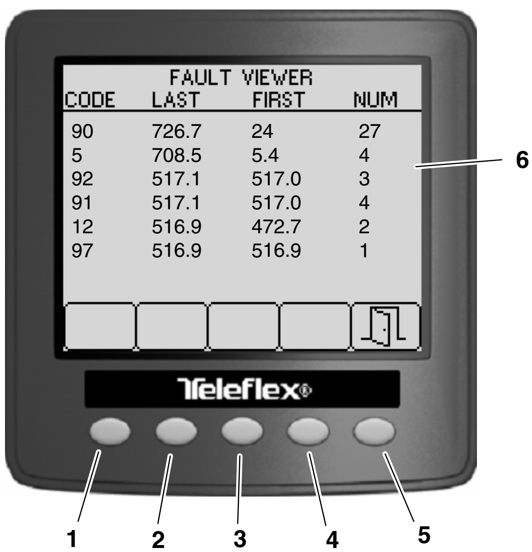
g288333

Figure 170

The air filter diagnostic screen identifies the state of the engine air filter service indicator (Figure 170).

- During normal operating conditions (AIR FILTER OFF) should display.
- If the engine air filter becomes dirty or blocked, a high vacuum condition occurs and (AIR FILTER ON) should display.

FAULT VIEWER



g288334

Figure 171

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Machine faults

Machine faults are generated by the Toro Electronic Controllers (TEC) to identify an electrical system malfunction (fault) that occurs during machine operation. When a machine fault occurs, an audible alarm will sound and the InfoCenter will display information about the fault. Machine faults can be viewed via the

InfoCenter Fault Viewer (Figure 171). See Machine Faults (page 3–23) for additional information about specific machine faults.

The Yanmar Engine Control Unit (ECU) can also generate electrical faults. The faults generated by the ECU are specific to the engine and cannot be viewed via the fault viewer (see Engine Faults (page 3–27)).

The fault viewer displays the following information about a machine fault:

- CODE: Fault code number.
- LAST: The last time the fault occurred expressed in Key ON hours.
- FIRST: The first time the fault occurred expressed in Key ON hours.
- NUM: The number of times the fault has occurred.

Scroll through the fault viewer screens by pressing buttons 1 or 2. Return to the previous screen by pressing button 5.

Settings Screens

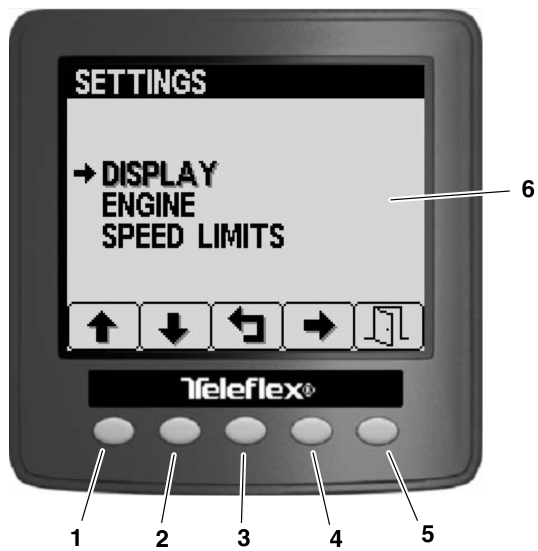


Figure 172

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Settings screen

Settings Screens (continued)

g288336

Figure 173

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5

The Settings screen (Figure 172) is accessed from the main menu and provides access to the following screens:

- Display
- Engine
- Speed Limits

Access the various settings screens by pressing buttons 1 or 2 to highlight the desired screen and button 4 to select the highlighted screen.

To reset the InfoCenter to the factory defaults, press button 3 then use button 2 to select Imperial units or button 3 to select Metric units (Figure 173). OK will flash over the unit type selected to confirm the reset.

Return to the previous screen by pressing button 5.

DISPLAY

g288337

Figure 174

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5

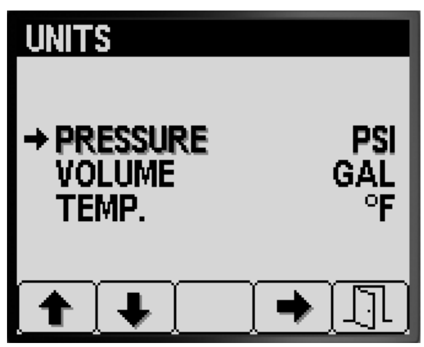
The display settings are accessed from the settings screen and provide access to the following screens (Figure 174):

- Units
- Language
- Alarms
- PIN Settings

Access the various items by pressing buttons 1 or 2 to highlight the desired item and button 4 to scroll through the display options.

Return to the previous screen by pressing button 5.

Units



g288338

Figure 175

The UNITS settings allow the display to show pressure, volume and temperature in U.S. or Metric units (Figure 175).

DISPLAY (continued)

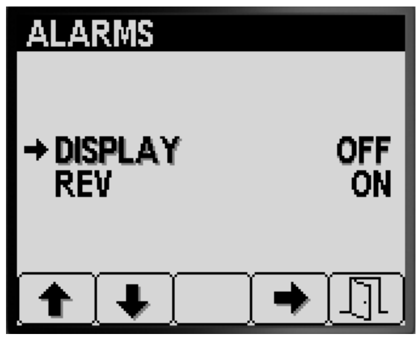
Language

g288339

Figure 176

The LANGUAGE setting allows the InfoCenter Display language to be chosen (Figure 176).

Alarms



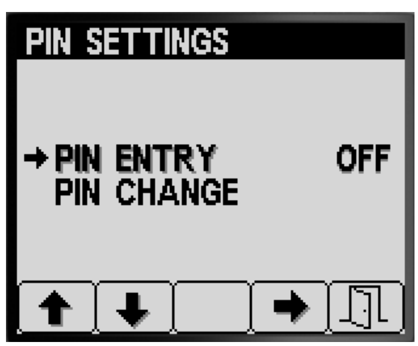
g288340

Figure 177

When DISPLAY is ON, a tone will sound whenever a button on the InfoCenter is pressed. When DISPLAY is OFF, no tone will sound (Figure 177).

An optional Backup Alarm is available for Groundsmaster 5900/5910 machines. When the alarm is installed and REV is ON, a tone will sound from the backup alarm. When REV is OFF, no tone will sound (Figure 177).

PIN Settings



g288341

Figure 178

DISPLAY (continued)

Use of a PIN allows the ability to password protect access to all screens other than the Operator's Information Screen. Use the PIN settings screen for turning the PIN protection feature ON or OFF (PIN ENTRY) and entering a custom PIN (PIN CHANGE) (Figure 178). See the machine *Operator's Manual* for additional information.

Note: If PIN use is chosen (PIN ENTRY ON), and a custom PIN is entered, make sure to record the PIN for future InfoCenter Display access. If PIN reset is necessary (e.g. PIN has been forgotten), contact your Authorized Toro Distributor.

ENGINE

Figure 179

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5

The engine settings are accessed from the settings screen and provide access to the following screens (Figure 179):

- Smart Power
- Auto Idle

Access the various items by pressing buttons 1 or 2 to highlight the desired item and button 4 to scroll through the display options.

Return to the previous screen by pressing button 5.

Smart Power

Use this screen to turn the Smart Power feature ON or OFF as desired.

Auto Idle

When the engine idle speed is at any setting other than low idle, and there is no load on the engine (e.g. traction movement or PTO engagement) the engine will return to the low idle setting automatically when the Auto Idle time elapses. Use this screen to set the auto idle time to OFF or 8, 10, 15, 20 or 30 seconds as desired.

SPEED LIMITS

g288343

Figure 180

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5

Use the speed limits settings to limit the maximum ground speed for the machine in the desired direction and speed range. The speed limits settings are accessed from the settings screen and provide access to the following screens:

- Mow Forward
- Transport Forward
- Mow Reverse
- Transport Reverse

g288344

Figure 181

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5

Access the various settings screens by pressing buttons 1 or 2 to highlight the desired screen and button 4 to select the highlighted item (Figure 180).

SPEED LIMITS (continued)

Adjust the speed limit by pressing buttons 1 or 2 (− or +) (Figure 181).

Return to the previous screen by pressing button 5.

About Screens

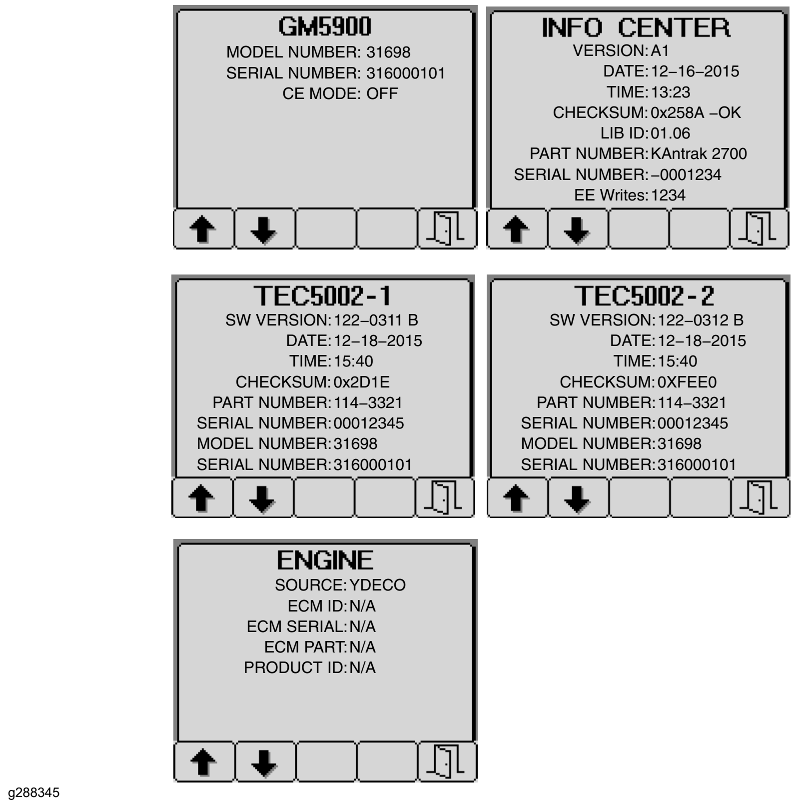


Figure 182

The About screens provide information about the machine, the InfoCenter Display, the two (2) Toro Electronic Controllers (TECs) and the Yanmar Engine Control Unit (ECU). The About screens (Figure 182) are accessed from the main menu.

Access the various settings screens by pressing buttons 1 or 2 to highlight the desired screen and button 4 to select the highlighted screen. Scroll through the various about screens by pressing buttons 1 or 2.

Return to the previous screen by pressing button 5.

Note: The TEC controllers and the InfoCenter Display software is matched for correct machine operation. If any of these components are replaced for any reason, system software needs to be reloaded (contact your Authorized Toro Distributor).

Electrical System Quick Checks

Battery Test (Open Circuit Test)

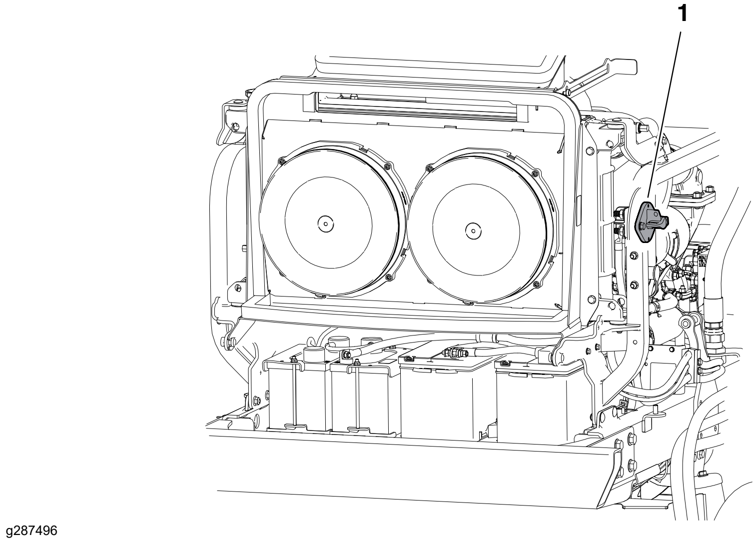


Figure 183

1. Battery−disconnect switch

The Groundsmaster 5900/5910 uses four (4) 12 Volt maintenance free batteries (Figure 183). Two batteries are connected together in parallel to support the 12 Volt electrical system and two (2) batteries are connected together in series to support the 24 Volt cooling fan circuit.

Note: The InfoCenter display can be used to monitor the 12 Volt and 24 Volt systems. Keep in mind that the voltage displayed represents the combined power of both batteries in the specific system.

To test the batteries, they must be disconnected (isolated from the other batteries in the system) before testing them individually.

1. Park machine on a level surface, lower cutting decks, stop engine and remove ignition key.
2. Open hood and turn the battery−disconnect switch to the OFF position (Figure 183).

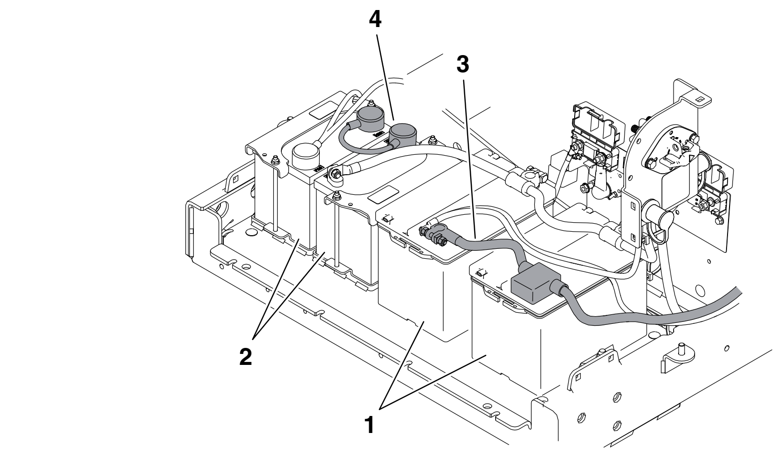


Figure 184

1. 12 Volt system battery (2)
2. 24 Volt cooling fan system battery (2)
3. Positive battery cable (12 Volt system)
4. Jumper cable (24 Volt system)

Battery Test (Open Circuit Test) (continued)

3. Access the batteries (see Battery Removal (page 6–140) and Battery Installation (page 6–142)) and disconnect the battery to be tested as follows (Figure 184):

   A. 12 Volt system batteries: Disconnect the positive (+) red battery cable from either of the 12 Volt system batteries.

   B. 24 Volt cooling fan system batteries: Disconnect either end of the red jumper cable between the two (2) 24 Volt system batteries.

   Note: This test provides a relative condition of the battery. Load testing of the battery will provide additional and more accurate information (see Battery Service (page 6–139)).

4. Use a multimeter to measure the voltage between the battery terminals of any isolated battery. Set multimeter to the DC volts setting. The battery should be at a temperature of 16 to 38 ºC (60 to 100 ºF). Connect the positive (+) meter lead to the positive battery post and the negative (−) meter lead to the negative battery post (see below 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 (or lower)	0% charged

Charging System Tests

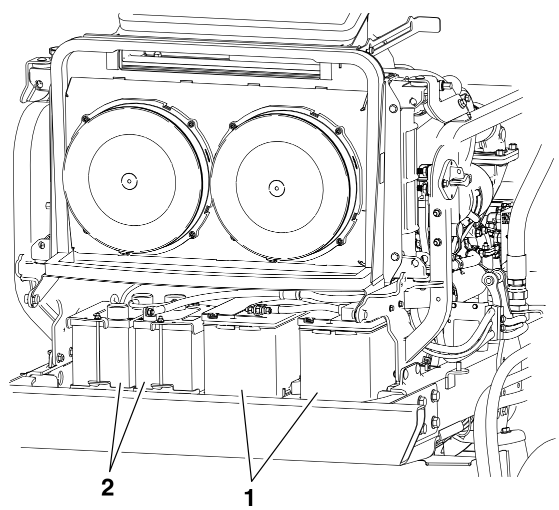


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Figure 185

1. 12 Volt system batteries
2. 24 Volt cooling fan batteries

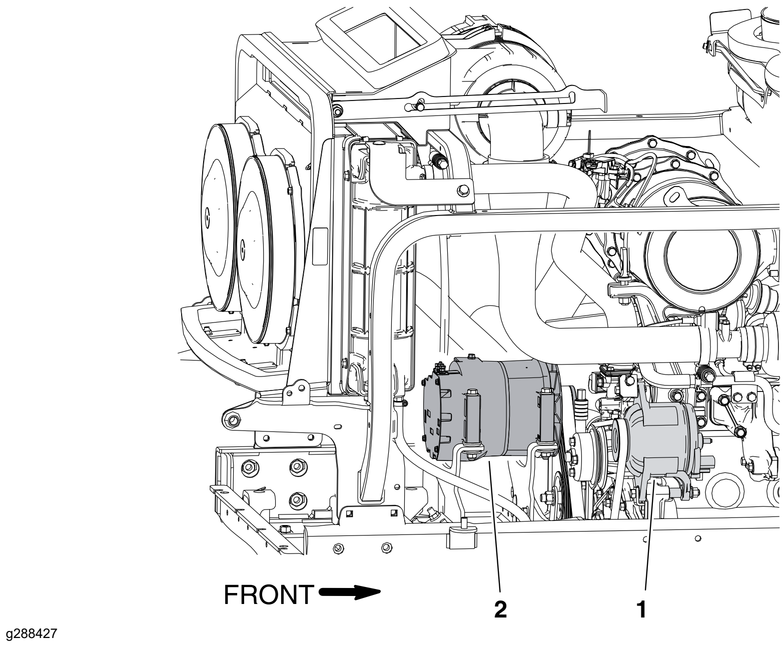


Figure 186

1. 12 Volt alternator
2. 24 Volt alternator

The Groundsmaster 5900/5910 uses four (4) 12 Volt maintenance free batteries. Two batteries are connected together in parallel to support the 12 Volt electrical system and two (2) batteries are connected together in series to support the 24 Volt cooling fan circuit (Figure 185). The 12 Volt system is charged by an 80 Amp 12 volt alternator mounted to the engine, which is driven by a single row V-belt (Figure 186). The 24 Volt system is charged by an 105 Amp 24 Volt alternator mounted to the frame, which is driven by a multi-row V-belt.

Use the InfoCenter display to monitor the 12 Volt and 24 Volt systems. It will tell you if the desired charging system has an output, but not its capacity.

1. Check to make sure each alternator drive belt is not loose, worn or damaged.
2. Turn the key switch to the RUN position and set the InfoCenter display to view the voltmeter (see Info- Center Display − Operator Information Screen (page 6–11)).
3. Record the initial system voltage for both the 12 Volt and 24 Volt system.
4. Start the engine and warm the engine to normal operating temperature.
5. Set the engine RPM to 2000 RPM.

   12 Volt System Check:

   - Turn on all additional 12 Volt system loads (e.g. lights, heater/AC blower).
   - The 12 Volt system voltage should be at least 0.5 volt higher then the initial voltage recorded in step 3.
   - If the 12 Volt charging system performance is less than desired, see the Yanmar Service Manual or Yanmar Troubleshooting Manual for additional information.

24 Volt System Check:

- Use the InfoCenter display to enter Fan Demo Mode (see InfoCenter - SERVICE (page 6–14) Screens). The cooling fans should begin to operate at maximum speed.
- The 24 Volt system voltage should be at least 0.5 volt higher than the initial voltage recorded in step 3.
- If the 24 Volt charging system performance is less than desired, see 24 Volt Alternator (page 6–130) for additional information.

Check Operation of Interlock Switches

CAUTION

Do not disconnect 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.

Your Groundsmaster is equipped with two (2) Toro Electronic Controllers (TEC) which monitor interlock switch operation. If all of the interlock switches necessary to allow a specific machine operation are not in their desired position, an Operator's Advisory will appear on the Info- Center Display (see Operator Advisories (page 3–16)).

The interlock system used on your Groundsmaster includes the seat switch, the traction pedal position sensor, the parking brake switch, the cutting deck position switches, the mow/transport switch and the PTO switch.

Use the InfoCenter Display to test the various interlock switches (TEC inputs and outputs) before physically testing the switch and its circuitry (see InfoCenter Display (page 6–9)). Physically testing individual interlock switches is included in the Testing (page 6–56).

Adjustments

Cutting Deck Position Switch Adjustment

A normally open proximity switch is located near the frame pivot of the front right lift arm and each wing deck lift arm to inform the secondary controller of the current cutting deck position.

Adjustment

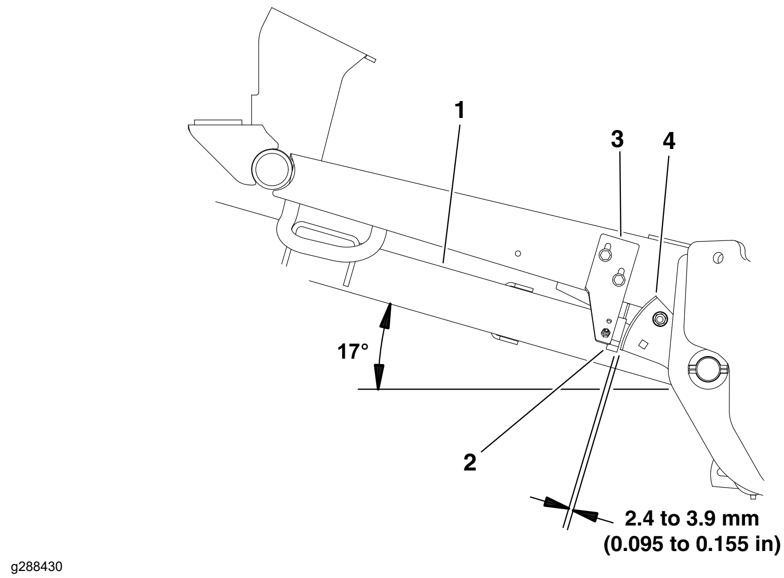


Figure 187

1. Front lift arm
2. Position switch
3. Switch bracket
4. Sensing plate

1. Park machine on a level surface with the cutting decks lowered. Stop engine and remove key from the key switch.
2. All cutting deck position switches should have a 2.3 to 3.8 mm (0.090 to 0.150 in) clearance between the sensing eye of the position switch and the sensing plate.

   Note: The position switches used on machines with serial numbers above 316000200 include an LED on the cable end of the switch body. The switch LED should be illuminated (switch closed) when the cutting decks are lowered.

Adjustment (continued)

3. For machine serial numbers below 316000200 adjust the front deck switch as follows (Figure 187):

   A. Raise the front deck to a 17 degree angle and safely support the deck to prevent it from lowering during the adjustment procedure.

   B. Loosen fasteners securing switch bracket to frame.

   C. Set the position switch so the sensing eye of the switch is at the lower edge of the sensing plate and the correct clearance exists between the target eye and the sensing plate.

   D. Tighten the position switch bracket fasteners.

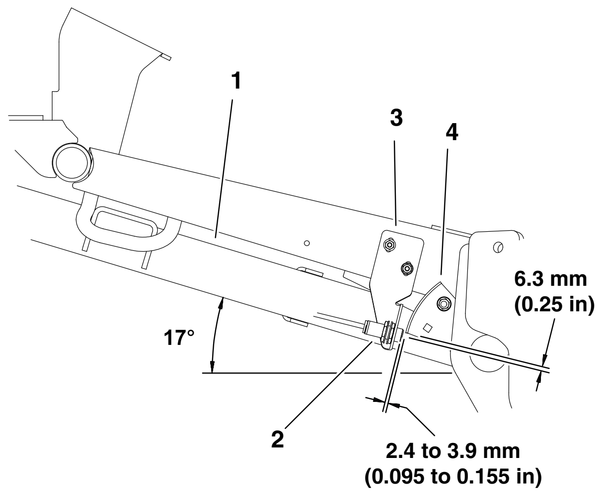


Figure 188

1.	Front lift arm	3.	Switch bracket
2.	Position switch	4.	Sensing plate

4. For machine serial numbers above 316000200 adjust the front deck switches as follows (Figure 188):

   A. Raise the front deck to a 17 degree angle and safely support the deck to prevent it from lowering during the adjustment procedure.

   B. The center of the switch sensing eye should be 6.3 mm (0.25 in) below the lower edge of the sensing plate. Loosen the switch bracket mounting fasteners to adjust the switch as needed.

   C. Loosen the lock nuts securing the switch to the switch bracket and set the clearance between the target eye and the sensing plate. Tighten the position switch lock nuts from **19 to 21 N·m (14 to 16 ft–lb)**.

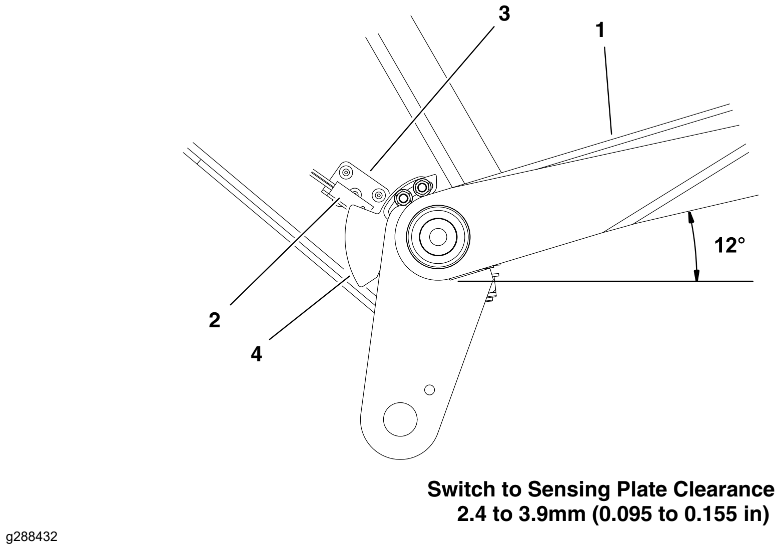


Figure 189

1. Wing deck lift arm
2. Position switch
3. Switch bracket
4. Sensing plate

5. For machine serial numbers below 316000200 adjust the wing deck switches as follows (Figure 189):

   A. Raise the wing deck to a 12 degree angle and safely support the deck to prevent it from lowering during the adjustment procedure.

   B. Loosen the lock nut securing the switch to the switch bracket and set the position switch so the correct clearance exists between the target eye and the sensing plate.

   C. Set the position switch so the sensing eye of the switch is at the upper edge of the sensing plate. Loosen the sensing plate mounting fasteners to adjust the plate as needed.

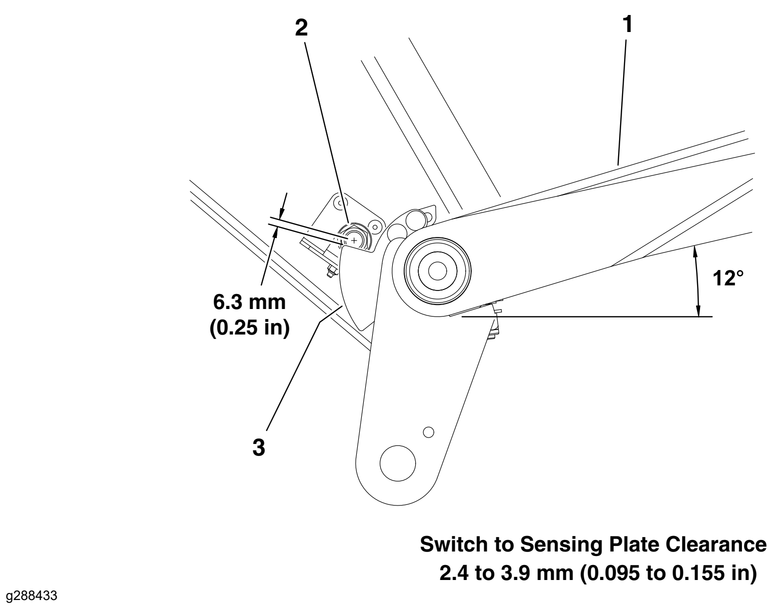


Figure 190

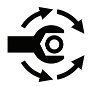
1. Wing deck lift arm
2. Position switch
3. Sensing plate

Adjustment (continued)

6. For machine serial numbers above 316000200 adjust the wing deck switches as follows (Figure 190):

   A. Raise the wing deck to a 12 degree angle and safely support the deck to prevent it from lowering during the adjustment procedure.

   B. The center of the switch sensing eye should be 6.3 mm (0.25 in) above the upper edge of the sensing plate. Loosen the sensing plate mounting fasteners to adjust the plate as needed.



   C. Loosen the lock nuts securing the switch to the switch bracket and set the position switch so the correct clearance exists between the target eye and the sensing plate. Tighten the position switch lock nuts from **19 to 21 N·m (14 to 16 ft−lb)**.

Traction Pedal Neutral Adjustment

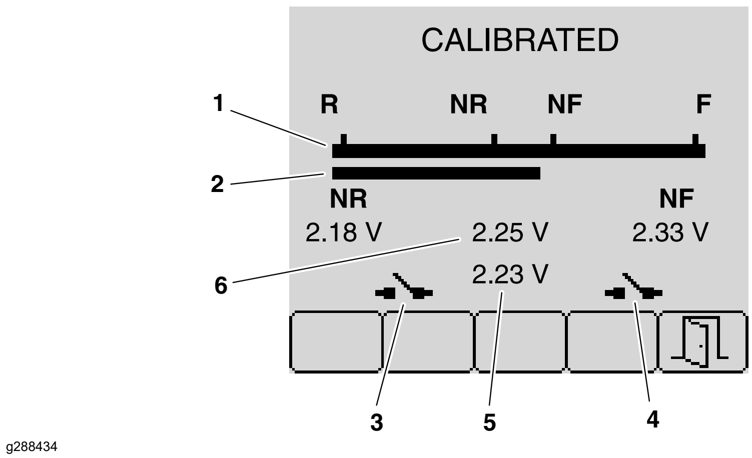


Figure 191

1.	Bar graph	4.	Forward switch icon
2.	Position indicator bar	5.	Neutral voltage
3.	Reverse switch icon	6.	Midpoint voltage

The traction pedal includes a neutral assembly that is used to adjust the traction pedal neutral position. Traction pedal adjustment may be necessary to ensure the traction pedal movement provides the correct full reverse and full forward positions for the traction pedal position sensor. Use the InfoCenter display to check traction pedal adjustment using the following procedure:

1. Park machine on a level surface, lower cutting decks and stop engine.
2. Turn key switch to RUN but do not start engine.
3. Use the InfoCenter Display to access the Traction Pedal screen (see InfoCenter Display − SERVICE (page 6–14) Screens).
4. Press button 2 from the Traction Pedal screen to view the Neutral screen (Figure 191).

Traction Pedal Neutral Adjustment (continued)

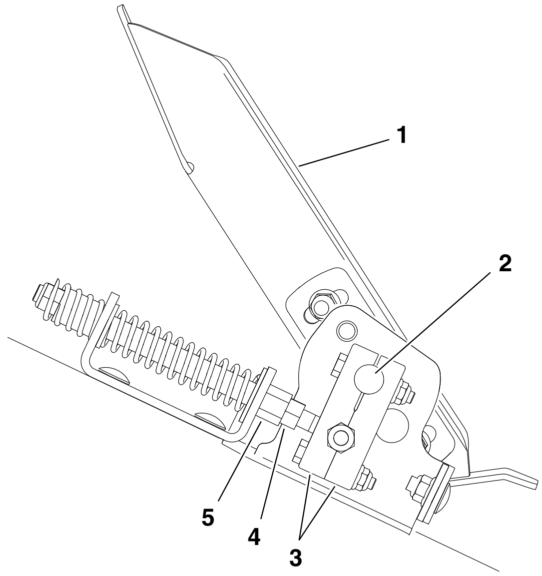


Figure 192

1. Traction pedal
2. Traction pedal shaft
3. Clamp blocks
4. Lock nut
5. Spring shaft

---

5. On the bar graph in the screen, the position indicator bar should be between NR and the NF. Also, the reverse switch and forward switch icons should both be open.

   To adjust the position indicator bar location:

   A. Remove screws securing steering cover and move steering cover up steering column to access traction pedal assembly (see Traction Pedal (page 7–37)).

   B. Loosen hex nut that secures neutral spring adjustment (Figure 192).

   C. Slowly rotate the spring shaft while watching the switch icons (Figure 192). When one of the switch icons close, stop rotating and mark the shaft position. Then slowly rotate the shaft in the opposite direction until the second switch icon closes and mark the shaft position.

   D. Slowly rotate the spring shaft to the mid−point of the two shaft positions. Tighten the hex nut to secure the adjustment. At this setting, the position indicator bar should be between the NR and the NF. Also, the neutral voltage value should be within 0.02 V of the midpoint voltage.

   Note: When adjusting traction pedal, voltage values should be similar to values shown (Figure 191).

   E. Install steering cover.

6. After adjusting the traction pedal for neutral, and before returning the machine to regular service, calibrate traction pedal position sensor (see Traction Pedal Position Sensor Calibration (page 6–51)).

Traction Pedal Position Sensor Calibration

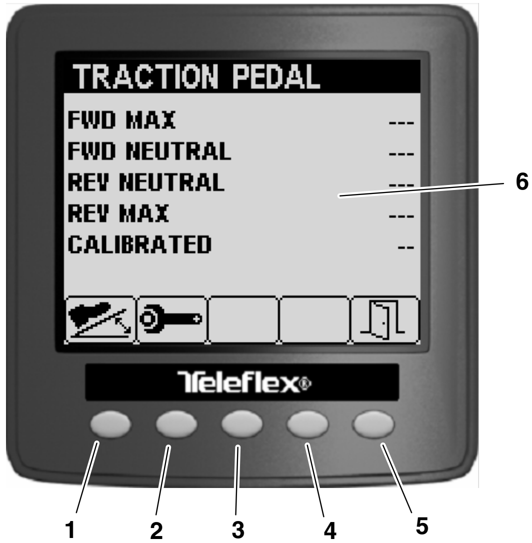


Figure 193

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Traction pedal screen

Calibration of the traction pedal position sensor ensures that the Toro Electronic Controller (TEC) can identify the traction neutral, forward, full forward, reverse and full reverse positions. Make sure the traction pedal neutral position is properly adjusted before calibrating the traction pedal position sensor (see Traction Pedal Neutral Adjustment (page 6–49)).

1. Park machine on a level surface, lower cutting decks and stop engine.
2. Turn key switch to RUN but do not start engine.
3. Access the InfoCenter Display Settings screen (see InfoCenter Display − Settings Screens (page 6–35)). Entering a Personal Identification Number (PIN) may be required to access the screens.
4. Access the Traction Pedal screen and press button 1 to begin the calibration process (Figure 193).
5. Follow the prompts on the InfoCenter display screen to calibrate the traction pedal position sensor or cancel the calibration process and return to the previous screen if necessary by pressing button 5.

   The calibration steps are listed in order below:

   A. “Entered Traction Pedal Teach − Please Wait” should appear on the InfoCenter display to indicate the traction pedal calibration process has begun.

   B. Return the traction pedal to the neutral position.

   Note: It may be easier to perform the following step by operating the traction pedal by hand.

   C. Slowly press traction pedal in the forward direction until “Neutral Fwd Capture Passed” appears on the InfoCenter display.

   D. Continue to press and hold traction pedal to the full forward position until “Max Fwd Capture Passed” appears on the InfoCenter display.

   E. Allow traction pedal to return to the neutral position.

   Note: It may be easier to perform the following step by operating the traction pedal by hand.

Traction Pedal Position Sensor Calibration (continued)

F. Slowly press traction pedal in the reverse direction until “Neutral Rev Capture Passed” appears on the InfoCenter display.

G. Continue to press and hold traction pedal to the full reverse position until “Max Rev Capture Passed” appears on the InfoCenter display.

H. Allow traction pedal to return to the neutral position.

I. “Exit Teach: Traction Pedal Teach Done/Values Stored” should appear on the InfoCenter display to indicate a successful calibration process.

6. Turn key switch to OFF which exits the traction pedal calibration menu.

Component Testing

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

Note: For engine component testing information, see the Yanmar Model 4TNV98CT−NTRL Yanmar Service Manual or Yanmar Troubleshooting Manual.

CAUTION

When testing electrical components for continuity with a multimeter (ohms setting), make sure that power to the circuit has been disconnected.

Fusible Link Harness

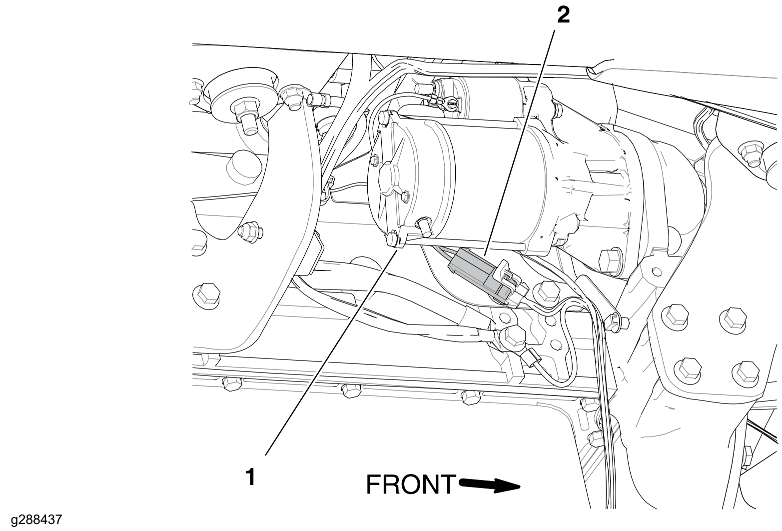


Figure 194

1. Starter motor shield removed)
2. Fusible link harness

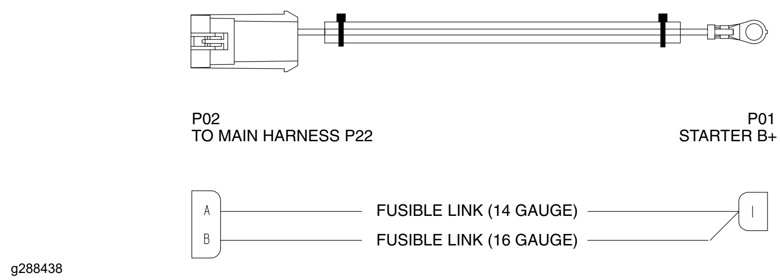


Figure 195

Your Groundsmaster uses two (2) fusible links for circuit protection. These fusible links are located in a harness that connects the starter B+ terminal to the wire harness (Figure 195). If either of these links should fail, current to the protected circuits will be interrupted. Refer to Appendix A (page A–1) for additional fusible link information.

Testing

1. Park machine on a level surface, lower cutting units and stop engine. Remove key from key switch.
2. Raise hood and turn the battery−disconnect switch to the OFF position.
3. Remove the shield over the starter motor.
4. Locate and unplug fusible link connector from machine wire harness.
5. Use a multimeter to make sure that continuity exists between the fusible link terminals.
6. If either fusible link is open, replace the fusible link harness.

   Note: It is not recommended to 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.

Testing (continued)

7. After fusible link testing is complete, make sure that fusible link harness is securely attached to starter B+ terminal and wire harness.
8. Turn the battery−disconnect switch to the ON position before returning the machine to service.
9. Lower and secure hood.

Mega Fuses

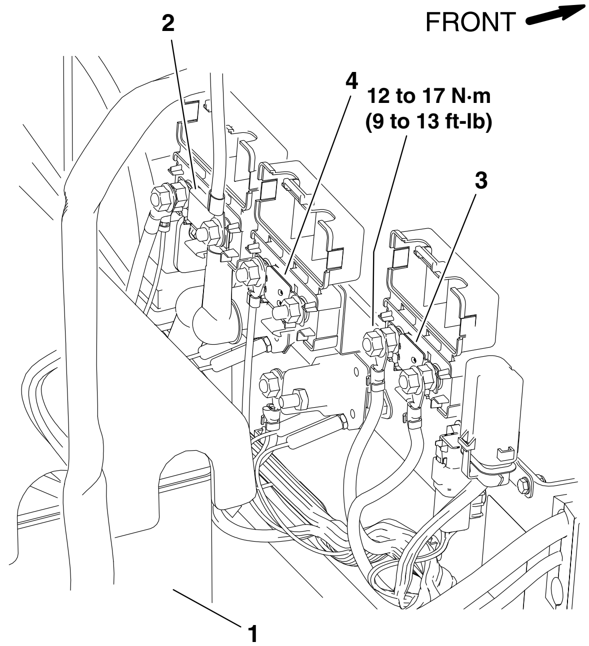


Figure 196

1. 12 volt battery
2. 100 Amp mega fuse
3. 60 Amp mega fuse (traction unit)
4. 60 Amp mega fuse (cab)

Three (3) mega fuses are used on the machine for protection of high amperage circuits. The mega fuse blocks are attached to the rear power center in the right rear corner of the engine compartment (Figure 196).

- A 100 Amp mega fuse protects the 24 Volt cooling fan circuit.
- A 60 Amp mega fuse protects the 12 Volt traction unit circuit.
- An additional 60 Amp mega fuse protects the 12 Volt cab circuits on Groundsmaster 5910 machines.

Testing

1. Make sure key switch is OFF. Remove key from key switch.
2. Raise hood to gain access to the mega fuse holders.
3. Turn the battery−disconnect switch to the OFF position.
4. Open fuse holder cover and remove flange nuts and lock washers that secure fuse in holder (Figure 196). Remove fuse for testing.
5. Fuse should have continuity across the terminals.
6. After testing, slide fuse onto fuse holder studs and place removed cables and jumper straps onto studs.
7. Secure fuse and conductors with lock washers and flange nuts. Torque nuts from **12 to 17 N·m (9 to 13 ft−lb)**.
8. Close and secure fuse holder cover.
9. Turn the battery−disconnect switch to the ON position.
10. Lower and secure hood.

Fuses

Circuit protection for the 24 VDC system includes a 100 Amp mega fuse (see Mega Fuses (page 6–56)) and a 5 Amp fuse located on the rear power center.

The entire 12 VDC system is protected by a 60 Amp mega fuse (see Mega Fuses (page 6–56)). The individual 12 Volt traction unit control circuits are protected by a variety of smaller amperage fuses located at the front or rear power centers. The front power center is located behind the operator seat and the rear power center is in the right rear corner of engine compartment.

Groundsmaster 5910 machines (with cab) include additional 12 VCD circuit protection via a 60 Amp mega fuse (see Mega Fuses (page 6–56)), a 10 Amp fuse for the radio attached to the right side of the cooler support frame and eight (8) fuses in a fuse block located in the cab headliner.

Fuse Identification, Location and Function

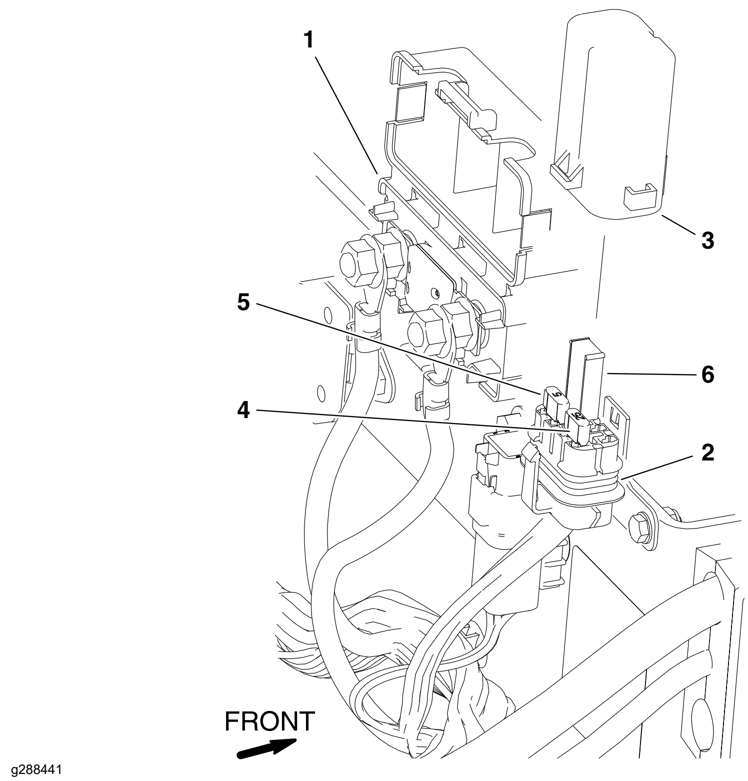


Figure 197

1. 60 Amp mega fuse holder (traction unit)
2. Fuse/Diode holder base
3. Fuse/Diode holder cover
4. 25 Amp fuse (Yanmar ECU)
5. 5 Amp fuse (24 Volt alternator)
6. Diode (24 Volt alternator)

Raise hood to access rear power center in right rear corner of engine compartment (Figure 197).

- A **25 Amp** fuse supplies power to Yanmar ECU.
- A **5 Amp** fuse supplies power to 24 Volt alternator sense terminal.

Fuse Identification, Location and Function (continued)

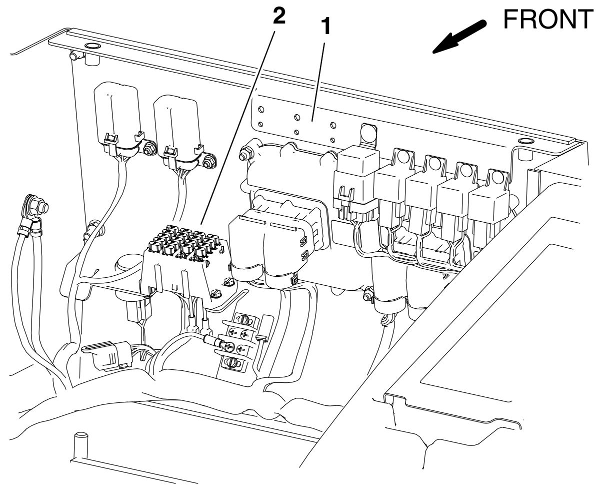


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Figure 198

1. Front power center (behind operator seat) 2. Front fuse block

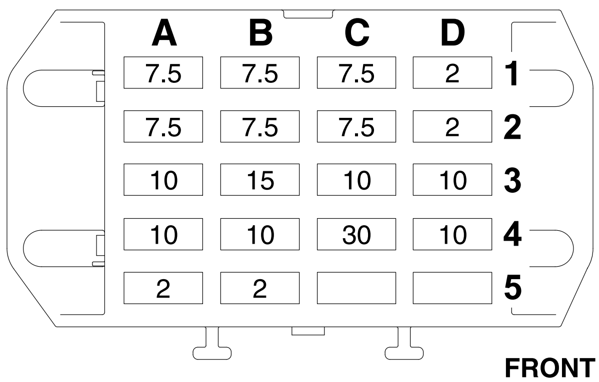

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Figure 199

Front Power Center Fuse Block

Remove cover from front power center behind operator seat to access fuses (Figure 198 and Figure 199).

- **Fuse F−A1 (7.5 Amp)** supplies power to primary TEC outputs 11 to 14.
- **Fuse F−B1 (7.5 Amp)** supplies power to primary TEC outputs 1 to 4.
- **Fuse F−C1 (7.5 Amp)** supplies power to primary TEC outputs 5 to 10.
- **Fuse F−D1 (2 Amp)** supplies logic power to primary TEC.
- **Fuse F−A2 (7.5 Amp)** supplies power to secondary TEC outputs 11 to 14.
- **Fuse F−B2 (7.5 Amp)** supplies power to secondary TEC outputs 1 to 4.
- **Fuse F−C2 (7.5 Amp)** supplies power to secondary TEC outputs 5 to 10.
- **Fuse F−D2 (2 Amp)** supplies logic power to secondary TEC.
- **Fuse F−A3 (10 Amp)** supplies power to the EU road light kit hazard circuit.
- **Fuse F−B3 (15 Amp)** supplies power to the road lights.
- **Fuse F−C3 (10 Amp)** supplies power to the power point.
- **Fuse F−D3 (10 Amp)** supplies power to key switch terminals 1 and 6.
- **Fuse F−A4 (10 Amp)** supplies power to the air ride seat suspension.
- **Fuse F−B4 (10 Amp)** supplies power to the brake lights.

Fuse Identification, Location and Function (continued)

- **Fuse F−C4 (30 Amp)** supplies power to the horn.
- **Fuse F−D4 (10 Amp)** supplies power to the US hazard lights.
- **Fuse F−A5 (2 Amp)** supplies power to the telematics connector.
- **Fuse F−B5 (2 Amp)** supplies power to the InfoCenter display.
- **Fuse F−C5** is unused and available for optional equipment.
- **Fuse F−D5** is unused and available for optional equipment.

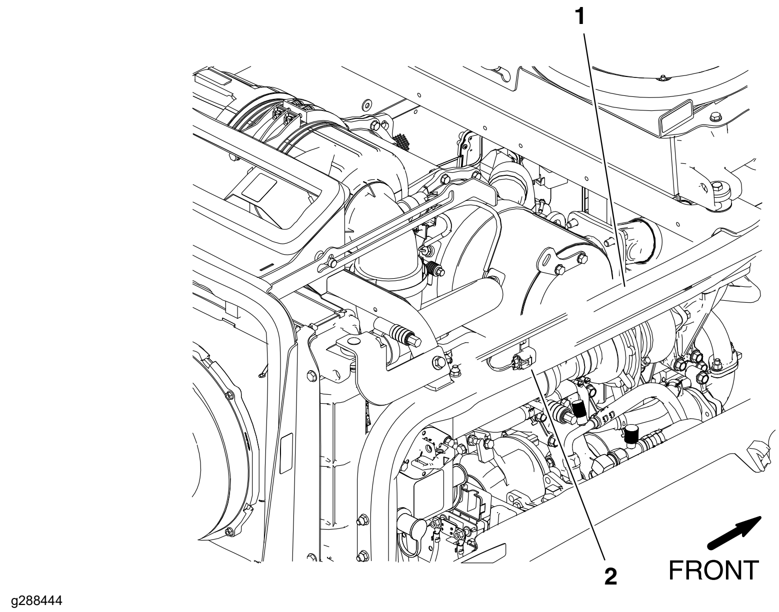

Figure 200

1. Cooler frame (right side)
2. 10 amp accessory fuse

Raise hood to access fuse holder attached to right side of cooler frame (Groundsmaster 5910) (Figure 200).

- A **10 Amp** fuse is used to supply power to an optional radio. The fuse is un−switched (always energized) and is intended to power the radio memory circuit.

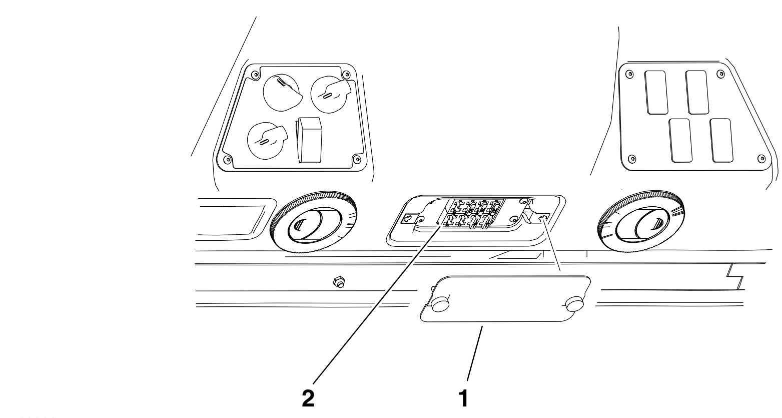

Figure 201

1. Cover
2. Operator cab fuse block

Fuse Identification, Location and Function (continued)

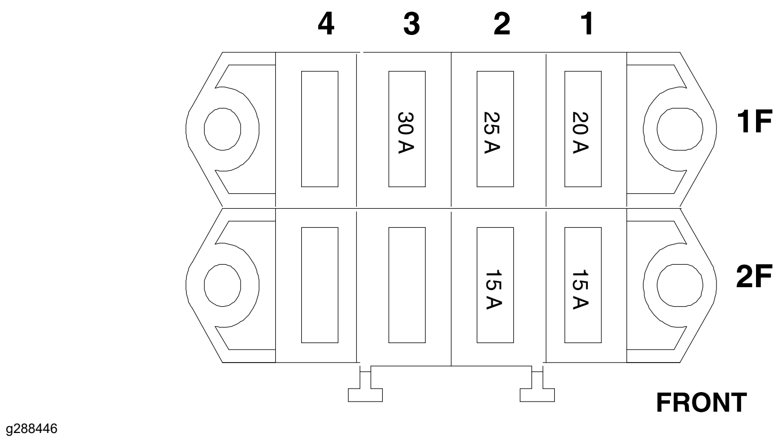

Figure 202

Loosen the knobs and remove the cover at the front of the cab headliner to access the operator cab fuses (Groundsmaster 5910) (Figure 201 and Figure 202).

- **Fuse 1F1 (20 Amp)** supplies power to the cab work lights.
- **Fuse 1F2 (25 Amp)** supplies power to the heater/air conditioner fan circuit.
- **Fuse 1F3 (30 Amp)** supplies power to the air conditioner circuit.
- **Fuses 1F4** is unused and available for optional equipment. This fuse can be used for a radio or other cab accessory that is mounted in or near the cab headliner.
- **Fuse 2F1 (15 Amp)** supplies power to the windshield wiper.
- **Fuse 2F2 (15 Amp)** supplies power to the cab dome light.
- **Fuses 2F3 and 2F4** is unused and available for optional equipment. These fuses can be used for a radio or other cab accessories that are mounted in or near the cab headliner.

Fuse Testing

1. Make sure that key switch is OFF and key is removed from switch.
2. Turn the batter−disconnect switch to the OFF position.
3. Remove fuse from fuse block for testing. Fuse should have continuity across the terminals.
4. After fuse testing is completed, install fuse and secure cover.
5. Turn the battery−disconnect switch to the ON position before returning the machine to service.

Battery−Disconnect Switch

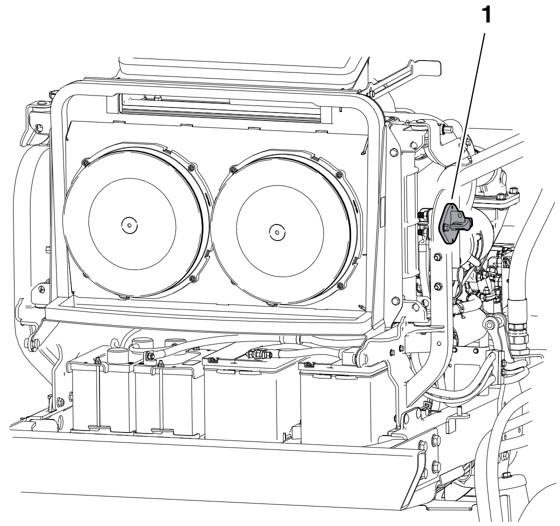

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Figure 203

1. Battery−Disconnect switch

The machine includes a battery−disconnect switch located under the hood in the right rear corner of the engine compartment (Figure 203). Turning the battery disconnect switch to the OFF position opens the 12 Volt and 24 Volt battery ground circuit. The battery disconnect switch should be set to OFF when servicing the machine. The switch can be locked in the ON or OFF position if desired.

CAUTION

Do Not turn the battery−disconnect switch to the OFF position while the engine is running. The battery−disconnect switch is not an emergency shutoff. If the battery disconnect switch is set to OFF while the engine is running, the engine will continue to run on the power supplied by the 12 Volt alternator and you may cause damage to electrical components including the Toro Electronic Controllers (TECs).

Testing

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from key switch.
2. Raise the hood arm to gain access to the switch.

Testing (continued)

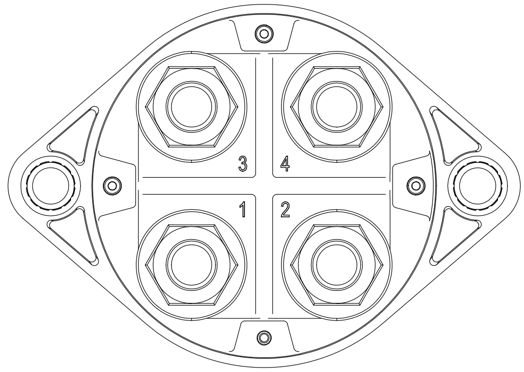

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Figure 204

Back of Switch

3. The switch terminals are marked as shown in Figure 204. The circuit logic of the battery−disconnect switch is shown in below table. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
OFF	NONE	1 + 2 and 3 + 4
ON	1 + 2 and 3 + 4	NONE

4. Replace the switch if testing determines that it is faulty.
5. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Appendix A (page A–1)).
6. Turn the battery−disconnect switch to the ON position before returning the machine to service.

Toro Electronic Controllers (TECs)

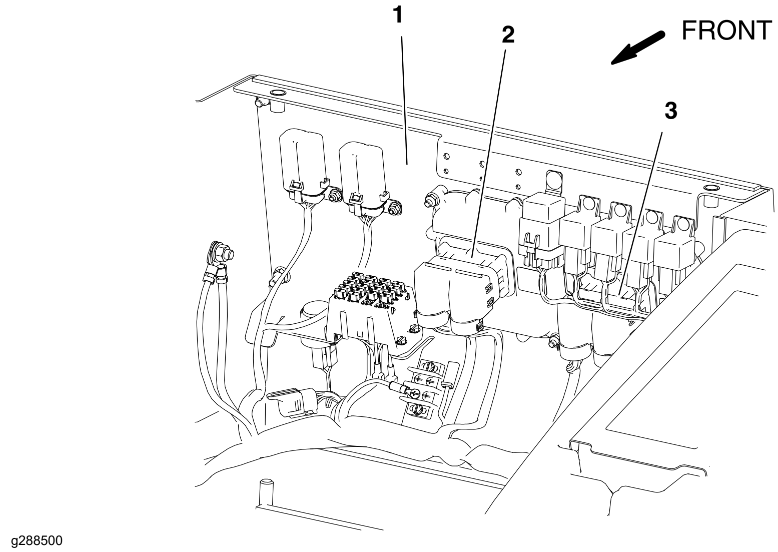


Figure 205

1. Front power center (behind operator seat)
2. Primary controller
3. Secondary controller

Groundsmaster 5900 and 5910 machines use two (2) Toro Electronic Controllers (TEC). The controllers contain a microcontroller that monitors the condition of various switches and senders (inputs). The controllers then direct electrical power to control appropriate machine functions (outputs) based on the input conditions. The controllers are attached to the front power center behind the operator seat (Figure 205).

Logic power is provided to both of the controllers as long as the battery cables are connected to the batteries and the battery−disconnect switch is set to the ON position. Fuses F−D1 and F−D2 (2 Amp) provide circuit protection for this logic power to the controllers.

The electrical power for controller outputs is provided through three (3) connector terminals (PWR 2, PWR 3 and PWR 4). Three (3) 7.5 amp fuses (F−A1, F−B1 and F−C1) provide circuit protection for the primary controller outputs. Three (3) 7.5 amp fuses (F−A2, F−B2 and F−C2) provide circuit protection for the secondary controller outputs.

The primary TEC monitors the states of the following components as inputs:

Primary TEC Input Number	Description
IN 1	Traction Pedal Position Switch − Neutral/Forward
IN 2	Traction Pedal Position Switch − Neutral/Reverse
IN 3	Parking Brake Switch
IN 4	High/Low Range Traction Speed Switch − High Range
IN 5	High/Low Range Traction Speed Switch − Low Range
IN 6	Not Used
IN 7	Air Cleaner Service Indicator
IN 8	Seat Switch

Toro Electronic Controllers (TECs) (continued)

IN 9	Engine Speed Switch – Increase
IN 10	Engine Speed Switch – Decrease
IN 11	Electric Radiator Fan Controllers – Fault
IN 12	Electric Hydraulic Oil Cooler Fan Controllers – Fault
ANALOG IN 3	Traction Pedal Position Switch – Position Signal
ANALOG IN 4	24 Volt Bus Monitor
ANALOG IN 5	Hydraulic Oil Temperature Sender
ANALOG IN 6	Fuel Level Sender

The primary TEC controls electrical output to the following outputs:

Primary TEC Input Number	Description
OUT 1	Engine ECU – START
OUT 2	Engine ECU – RUN
OUT 3	Brake Lights
OUT 4	Parking Brake Solenoid (S10)
OUT 5	Electric Radiator Fan Controllers
OUT 6	Electric Hydraulic Oil Cooler Fan Controllers
OUT 7	Not Used
OUT 8	Not Used
OUT 9	Traction Pump – Forward Solenoid
OUT 10	Traction Pump – Reverse Solenoid
OUT 11	24 Volt System Remote Sense Relay
OUT 12	24 Volt System Contactor Coil
OUT 13	Reverse Alarm Kit (Optional)
OUT 14	Not Used

The InfoCenter display should be used to check inputs and outputs of the controllers (see Using the InfoCenter Display (page 6–9) to Test TEC Inputs and Outputs).

The machine electrical schematic and wire harness drawings in Appendix A (page A–1) can be used to identify possible circuit problems between the controller and the input or output devices (e.g. switches and solenoid coils).

Toro Electronic Controllers (TECs) (continued)

The secondary TEC monitors the states of the following components as inputs:

Secondary TEC Input Number	Description
IN 1	Front Deck Raise/Lower Switch − Raise
IN 2	Front Deck Raise/Lower Switch − Lower
IN 3	Left Wing Deck Raise/Lower Switch − Raise
IN 4	Left Wing Deck Raise/Lower Switch − Lower
IN 5	Right Wing Deck Raise/Lower Switch − Raise
IN 6	Right Wing Deck Raise/Lower Switch − Lower
IN 7	Front Deck Position Sensor
IN 8	Left Wing Deck Position Sensor
IN 9	Right Wing Deck Position Sensor
IN 10	PTO Switch
IN 11	Cruise Control Switch − Enable
IN 12	Cruise Control Switch − Engage

IMPORTANT

When testing for wire harness continuity at the connector for the TEC, take care to not damage the connector pins with multimeter test leads. If connector pins are enlarged or damaged during testing, connector repair may be necessary for proper machine operation.

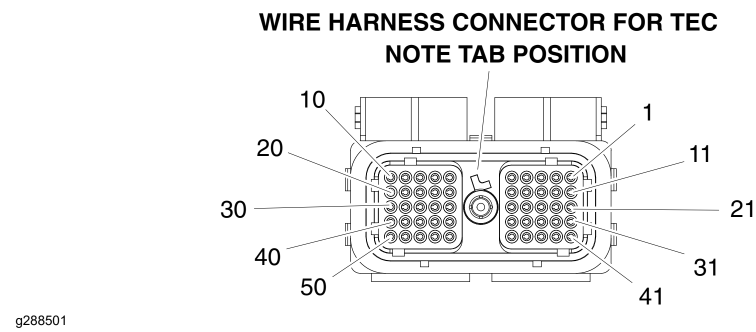


Figure 206

Toro Electronic Controllers (TECs) (continued)

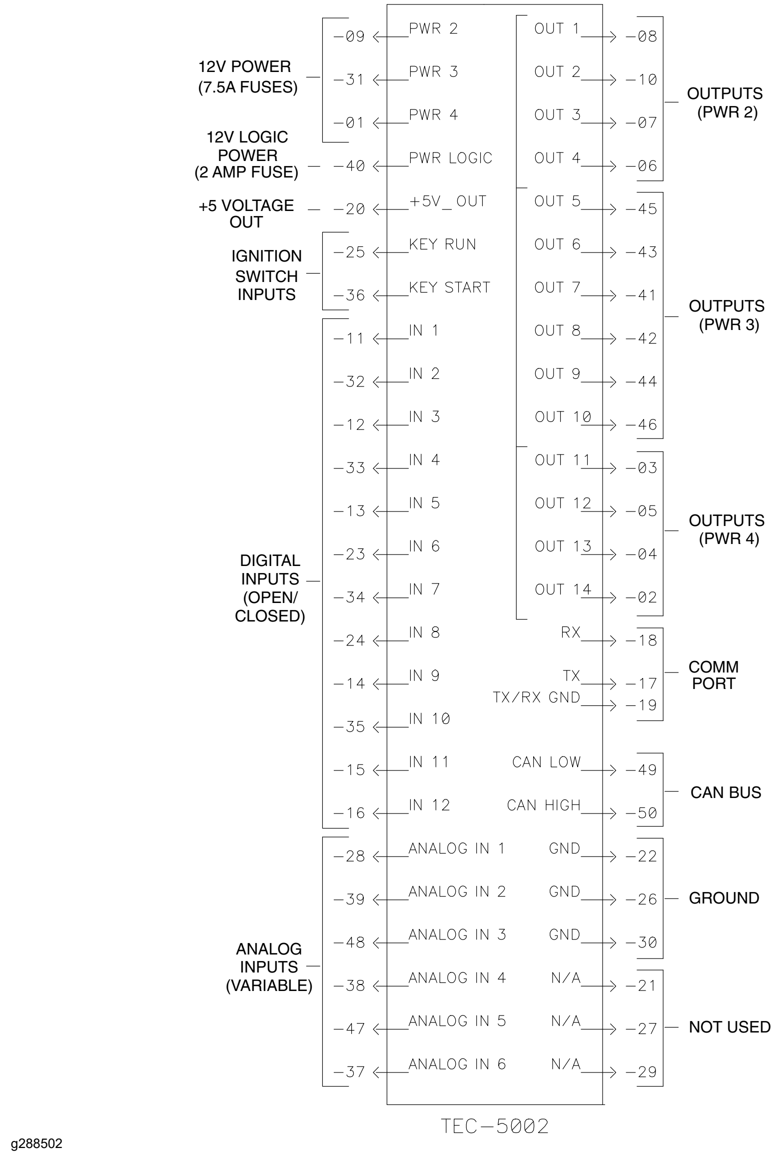


Figure 207

Fifty (50) pin wire harness connectors attach to the controllers (Figure 206). The connection terminal functions for the controllers and the wire harness connector pins are identified in Figure 207.

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

Note: The Toro Electronic Controllers used on the Groundsmaster 5900/5910 are programed for correct machine operation. If either TEC is replaced for any reason, system software needs to be reprogrammed (contact your Authorized Toro Distributor).

The secondary TEC controls electrical output to the following outputs:

Primary TEC Input Number	Description
OUT 1	Front Deck Raise Solenoid (S5)
OUT 2	Front Deck Float Solenoid (S6)
OUT 3	Left Wing Deck Raise Solenoid (S2)
OUT 4	Left Wing Deck Lower Solenoid (S3)
OUT 5	Front Deck PTO (PRV)
OUT 6	Left Wing Deck PTO (PRV)
OUT 7	Right Wing Deck PTO (PRV)
OUT 8	Deck Raise/Lower Enable Solenoid (S1)
OUT 9	High/Low Range Traction Speed Solenoid (SV)
OUT 10	Alarm
OUT 11	Left Wing Deck Float Solenoid (S4)
OUT 12	Right Wing Deck Raise Solenoid (S7)
OUT 13	Right Wing Deck Lower Solenoid (S8)
OUT 14	Right Wing Deck Float Solenoid (S9)

IMPORTANT

Before performing welding on the machine, turn the battery−disconnect switch to the OFF position, disconnect the wire harness connector from the TECs and disconnect the terminal connector from the 12 Volt alternator. Also, disconnect and remove the Yanmar ECU. These steps will prevent damage to the machine electrical system when welding.

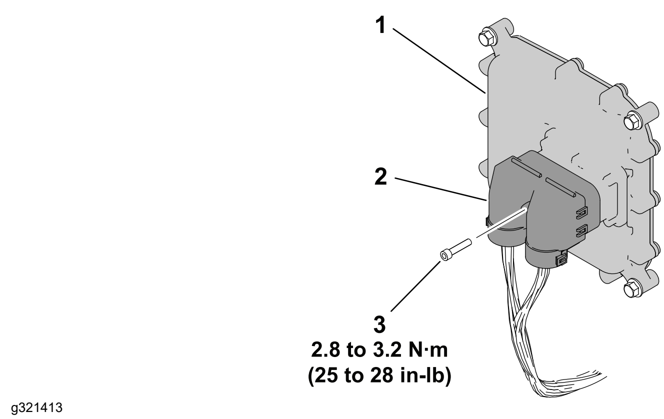
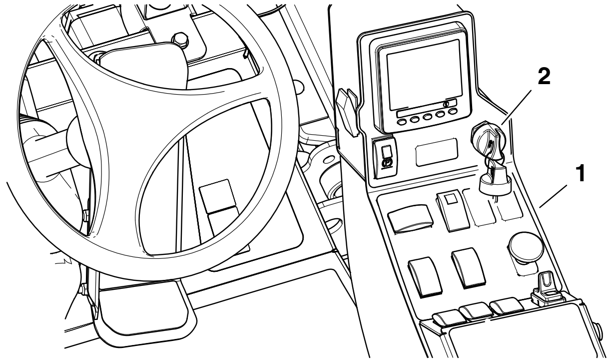


Figure 208

1. TEC controller
2. Machine harness connector
3. Socket head screw

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

Key Switch



g288503

Figure 209

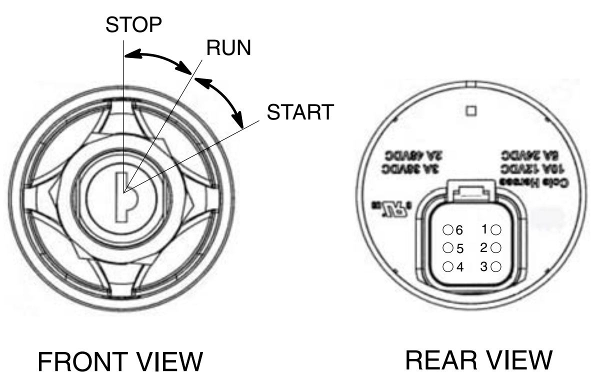
1. Operator control console
2. Key switch

The key switch on the console arm has three (3) positions − OFF, ON and START. The key switch is an input used by the master Toro Electronic Controller (TEC) to manage various machine functions.

Testing

The key switch and its circuit wiring can be tested as a TEC input using the InfoCenter Display (see InfoCenter Display (page 6–9)). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from key switch.
2. Turn battery−disconnect switch to the OFF position.
3. Disassemble console arm to gain access to key switch (see Console Arm (page 7–35)).
4. Disconnect wire harness connector from the key switch.



g288504

Figure 210

5. The key switch terminals are identified in Figure 210 and the circuitry of the switch is shown in below table. With the use of a multimeter (ohms setting), the switch functions can be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

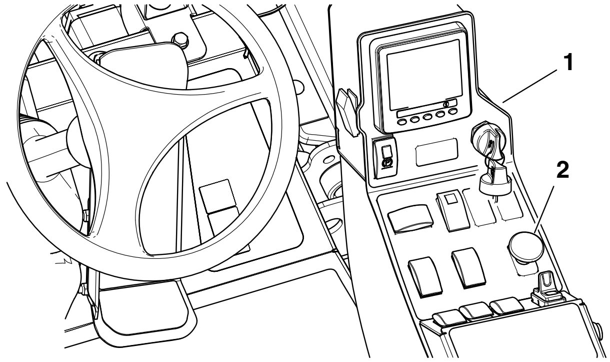
Testing (continued)

SWITCH POSITION	CIRCUITS
STOP	1 + 6
RUN	1 + 3 + 4 + 5 + 6
START	1 + 2 + 4 + 5 + 6

6. Replace key switch if testing determines that it is faulty.
7. If key switch tests correctly and a circuit problem still exists, check the wire harnesses (see Appendix A (page A–1)).
8. After testing is complete, connect machine wire harness connector to key switch.
9. Assemble console arm (see Console Arm (page 7–35)).
10. Turn the battery−disconnect switch to the ON position before returning the machine to service.

Note: Key switch terminals 1 and 6 are connected internally. Terminals 4 and 5 are also connected internally. These terminals should have continuity regardless of switch position.

PTO Switch



g288505

Figure 211

1. Operator control console
2. PTO switch

The PTO switch is located on the console arm (Figure 211). The PTO switch is pulled up to engage the cutting decks.

The secondary controller monitors the position of the PTO switch (engage or disengage). Using inputs from the PTO switch and other switches in the interlock system, the secondary controller energizes the hydraulic solenoid valves (PRV) located in the cutting deck hydraulic manifolds drive the cutting deck motors.

IMPORTANT

During machine operation, if the PTO shuts down and the InfoCenter indicates excessive engine coolant temperature, avoid shutting off the engine. Under this condition, the operator should disengage the PTO, slowly drive to a safe flat area, lower the engine speed to the SLOW position and engage the parking brake. The engine should be allowed to idle for several minutes while it cools to a safe level. Then, the cooling system should be checked before returning the machine to service.

Testing

The PTO switch and its circuit wiring can be tested as a TEC input using the InfoCenter Display (see InfoCenter Display (page 6–9)). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from key switch.
2. Turn battery−disconnect switch to the OFF position.
3. Disassemble the console arm to gain access to the switch (see Console Arm (page 7–35)).
4. Disconnect machine wire harness connector from the switch being tested.

Testing (continued)

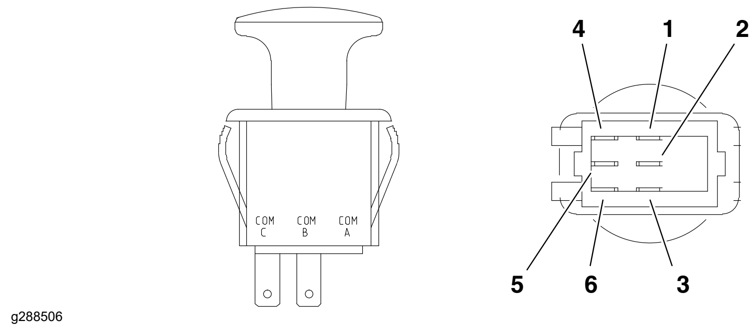


Figure 212

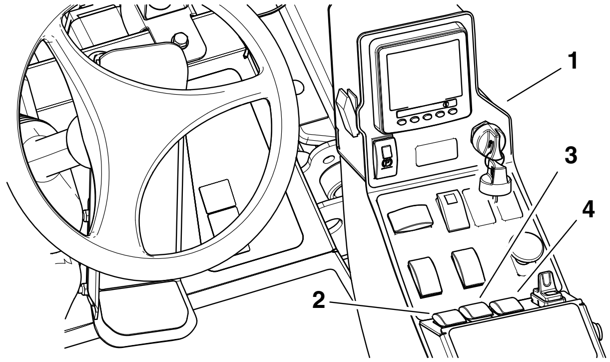
1. COM B terminal
2. NO B terminal
3. NC B terminal
4. COM C terminal
5. NO C terminal
6. NC C terminal

5. The switch terminals are marked as shown in Figure 212. The circuit logic of the PTO switch is shown in below table. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
OFF (DOWN)	COM B + NC B COM C + NC C	COM B + NO B COM C + NO C
ON (UP)	COM B + NO B COM C + NO C	COM B + NC B COM C + NC C

6. Replace switch if testing determines that it is faulty.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Appendix A (page A–1)).
8. After testing is complete, connect machine wire harness connector to switch.
9. Assemble console arm (see Console Arm (page 7–35)).
10. Turn the battery−disconnect switch to the ON position before returning the machine to service.

Cutting Deck Raise/Lower Switches



g288507

Figure 213

1. Operator control console
2. Left deck raise/lower switch
3. Front deck raise/lower switch
4. Right deck raise/lower switch

The three (3) cutting deck raise/lower switches are located on the console arm (Figure 213). When the front of a raise/lower switch is depressed and held, the controlled deck (left, front or right) will lower. Once lowered, when the front of the raise/lower switch is depressed again, the controlled deck will float. When the rear of a lift switch is depressed and held, the controlled deck will raise. The deck will remain in position when the switch is released.

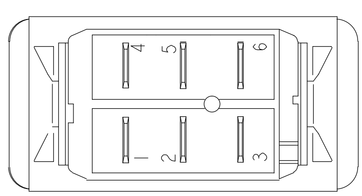
The secondary controller monitors the position of the raise/ lower switches (raise, lower or float). Using inputs from the raise/lower switches and other switches in the interlock system, the secondary controller energizes the hydraulic solenoid valves in the steering/lift control hydraulic manifold as necessary.

Note: The decks do not lower while the machine is in the HIGH speed range, and the decks do not raise or lower if the operator is out of the seat while the engine is running. The deck raising function is limited at engine speeds below 2,000 rpm. The cutting decks will raise one at a time below 2,000 engine rpm.

Testing

The raise/lower switches and their circuit wiring can be tested as TEC inputs using the InfoCenter Display (see InfoCenter Display (page 6–9)). If testing determines that a switch and its circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park machine on a level surface, lower cutting decks if possible and stop engine. Remove key from key switch.
2. Turn battery−disconnect switch to the OFF position.
3. Disassemble the console arm to gain access to the switches (see Console Arm (page 7–35)).
4. Disconnect machine wire harness connector from the switch being tested.



g288508

Figure 214
Back of Switch

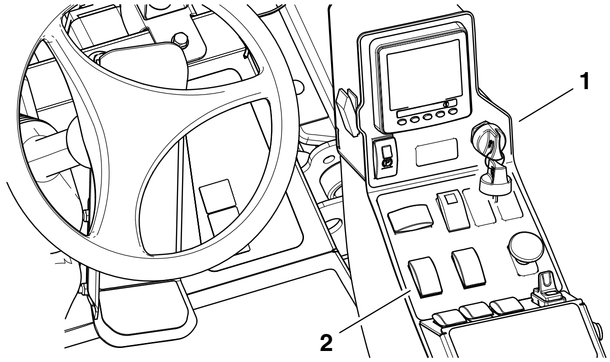
Testing (continued)

5. The switch terminals are marked as shown in Figure 214. The circuit logic of the raise/lower switches are shown in below table. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
DECK LOWER	2 + 3 and 5 + 6	2 + 1 and 5 + 4
NEUTRAL	NONE	ALL
DECK RAISE	2 + 1 and 5 + 4	2 + 3 and 5 + 6

6. Replace the switch if testing determines that it is faulty.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Appendix A (page A–1)).
8. After testing is complete, connect machine wire harness connector to the switch.
9. Assemble console arm (see Console Arm (page 7–35)).
10. Turn the battery−disconnect switch to the ON position before returning the machine to service.

Throttle Switch



g288509

Figure 215

1. Operator control console
2. Throttle switch

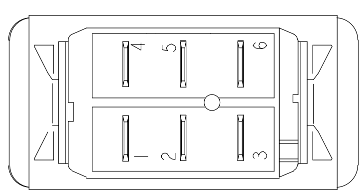
The throttle switch is located on the console arm (Figure 215). When the front of the throttle switch is depressed and held, the engine rpm will increase to its HIGH idle setting. When the rear of the throttle switch is depressed and held, the engine rpm will decrease to its LOW idle setting. If the throttle switch is depressed momentarily, the engine speed will increase or decrease in 100 RPM increments accordingly.

The engine speed switch is used as an input for the engine electronic control unit to raise or lower the engine speed. When the switch is depressed and held in the forward position, the engine speed will increase. Conversely, when the rear of the switch is depressed, engine speed will decrease.

The primary controller monitors the position of the throttle switch (increase or decrease). Using input from the throttle switch the primary controller communicates the desired change in engine RPM to the Yanmar ECU via the CAN network. The Yanmar ECU adjusts the engine throttle a requested.

Testing

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from key switch.
2. Turn battery−disconnect switch to the OFF position.
3. Disassemble the console arm to gain access to the switch (see Console Arm (page 7–35)).
4. Disconnect machine wire harness connector from the switch being tested.



g288510

Figure 216

Back of Switch

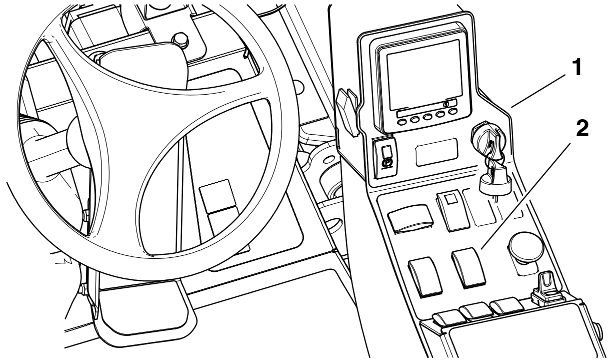
5. The switch terminals are marked as shown in Figure 216. The circuit logic of the throttle switch is shown in below table. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

Testing (continued)

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
INCREASE ENGINE RPM	2 + 3 and 5 + 6	2 + 1 and 5 + 4
NEUTRAL	NONE	ALL
DECREASE ENGINE RPM	2 + 1 and 5 + 4	2 + 3 and 5 + 6

6. Replace the switch if testing determines that it is faulty.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Appendix A (page A–1)).
8. After testing is complete, connect machine wire harness connector to the switch.
9. Assemble console arm (see Console Arm (page 7–35)).
10. Turn the battery−disconnect switch to the ON position before returning the machine to service.

High/Low Range Traction Speed Switch



g288511

Figure 217

1. Operator control console
2. High/Low range traction speed switch

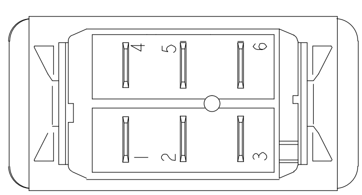
The High/Low range traction speed switch is located on the console arm (Figure 217). When the front of the High/ Low range traction speed switch is depressed, the traction system will shift to HIGH range traction speed. When the rear of the High/Low range traction speed switch is depressed, the traction system will shift to LOW range traction speed.

The primary controller monitors the position of the High/ Low range traction speed switch (high or low). Using inputs from the High/Low range traction speed switch and other switches in the interlock system, the primary controller communicates the switch position to the secondary controller via the CAN network. The secondary controller energizes the hydraulic solenoid valve (SV) located in the traction hydraulic manifold for high range operation and de−energizes the solenoid valve for low range operation.

Testing

The High/Low range traction speed switch and its circuit wiring can be tested as TEC inputs using the InfoCenter Display (see InfoCenter Display (page 6–9)). If testing determines that the switch and its circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from key switch.
2. Turn battery−disconnect switch to the OFF position.
3. Disassemble the console arm to gain access to the switch (see Console Arm (page 7–35)).
4. Disconnect machine wire harness connector from the switch being tested.



g288512

Figure 218

Back of Switch

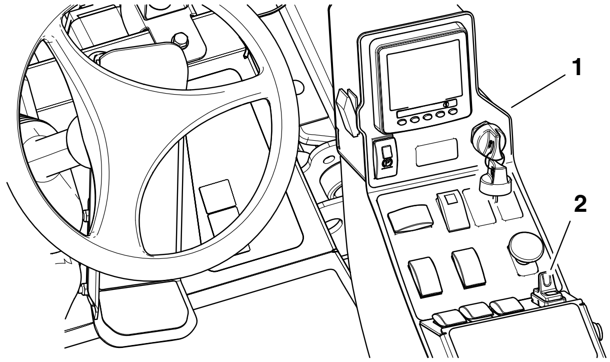
Testing (continued)

5. The switch terminals are marked as shown in Figure 218. The circuit logic of the throttle switch is shown in below table. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
HIGH SPEED	2 + 3 and 5 + 6	2 + 1 and 5 + 4
NEUTRAL	NONE	ALL
LOW SPEED	2 + 1 and 5 + 4	2 + 3 and 5 + 6

6. Replace the switch if testing determines that it is faulty.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Appendix A (page A–1)).
8. After testing is complete, connect machine wire harness connector to the switch.
9. Assemble console arm (see Console Arm (page 7–35)).
10. Turn the battery−disconnect switch to the ON position before returning the machine to service.

Cruise Control Switch



g288513

Figure 219

1. Operator control console
2. Cruise control switch

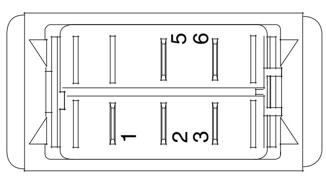
The cruise control switch is located on the console arm (Figure 219). When the top of the cruise control switch is depressed, the cruise control feature is off. When the switch is moved to the center position, the cruise control feature is enabled but no speed is set. When the machine is moving in the forward direction above the minimum speed and the switch is momentarily moved downward, the cruise control feature is engaged and the current traction speed will be maintained.

The secondary controller monitors the position of the cruise control switch (off, enable or engage). The secondary controller communicates the switch position to the primary controller via the CAN network. Using inputs from the cruise control switch and the traction pedal position sensor, the primary controller holds the piston (traction) pump forward control solenoid in its current position. Once engaged, the cruising speed can be increased (+) or decreased (−) incrementally through the InfoCenter Display (see InfoCenter Display (page 6–9)).

Note: The cruise function is disengaged when the cruise control switch is set to OFF or if the traction pedal is pressed to the reverse direction.

Testing

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from key switch.
2. Turn battery−disconnect switch to the OFF position.
3. Disassemble the console arm to gain access to the switch (see Console Arm (page 7–35)).
4. Disconnect machine wire harness connector from the switch being tested.



g288514

Figure 220

Back of Switch

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5. The switch terminals are marked as shown in Figure 220. The circuit logic of the cruise control switch is shown in below table. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals.

Testing (continued)

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
OFF	NONE	ALL
CRUISE ENABLE	2 + 3	5 + 6
CRUISE ENGAGE	2 + 3 and 5 + 6	NONE

6. Replace the switch if testing determines that it is faulty.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Appendix A (page A–1)).
8. After testing is complete, connect machine wire harness connector to the switch.
9. Assemble console arm (see Console Arm (page 7–35)).
10. Turn the battery−disconnect switch to the ON position before returning the machine to service.

Headlight Switch

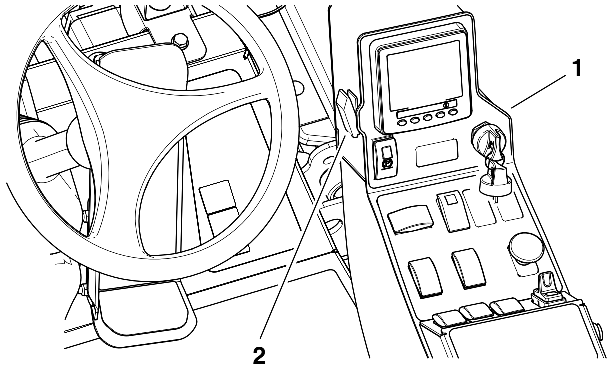


Figure 221

1. Operator control console
2. Headlight switch

The headlight switch is located on the operator side of the control console (Figure 221). When the top of the switch is depressed, the headlights should illuminate. The headlight switch receives power from fuse F−B3 (15 Amp).

Testing

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from key switch.
2. Turn battery−disconnect switch to the OFF position.
3. Disassemble the console arm to gain access to the switch (see Console Arm (page 7–35)).
4. Disconnect machine wire harness connector from the switch being tested.

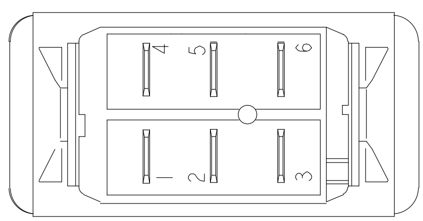


Figure 222
Back of Switch

5. The switch terminals are marked as shown in Figure 222. The circuit logic of the throttle switch is shown in below table. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

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 it is faulty.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Appendix A (page A–1)).

Testing (continued)

8. After testing is complete, connect machine wire harness connector to the switch.
9. Assemble console arm (see Console Arm (page 7–35)).
10. Turn the battery−disconnect switch to the ON position before returning the machine to service.

Turn Signal Switch

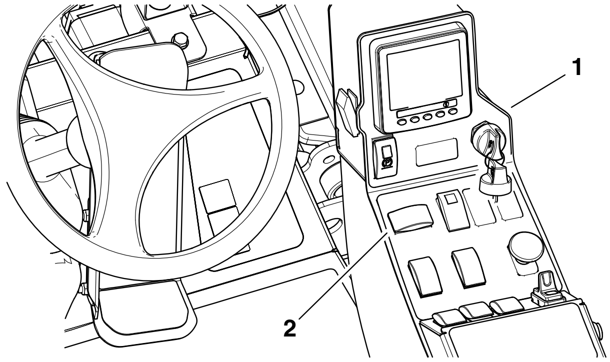


Figure 223

1. Operator control console
2. Turn signal switch

The turn signal switch is located on the console arm (Figure 223). When the turn signal switch is depressed (left or right), power is sent to the flasher module to illuminate the corresponding signal lights. The signal lights will continue to flash until the switch is returned to the OFF (center) position. The turn signal switch receives power from fuse F−B3 (15 Amp).

Testing

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from key switch.
2. Turn battery−disconnect switch to the OFF position.
3. Disassemble the console arm to gain access to the switch (see Console Arm (page 7–35)).
4. Disconnect machine wire harness connector from the switch being tested.

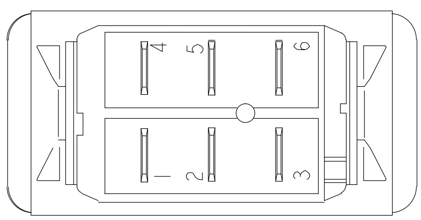


Figure 224
Back of Switch

5. The switch terminals are marked as shown in Figure 224. The circuit logic of the throttle switch is shown in below table. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
RIGHT TURN	2 + 1 and 5 + 4	2 + 3 and 5 + 6
OFF	NONE	ALL
LEFT TURN	2 + 3 and 5 + 6	2 + 1 and 5 + 4

6. Replace the switch if testing determines that it is faulty.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Appendix A (page A–1)).

Testing (continued)

8. After testing is complete, connect machine wire harness connector to the switch.
9. Assemble console arm (see Console Arm (page 7–35)).
10. Turn the battery−disconnect switch to the ON position before returning the machine to service.

Hazard Switch

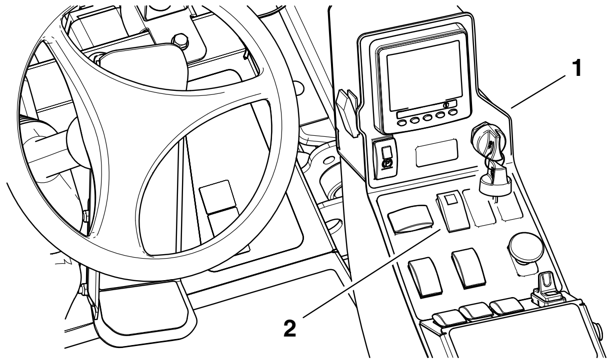


Figure 225

1. Operator control console
2. Hazard switch

The hazard switch is located on the console arm (Figure 225). When the forward end of the hazard switch is depressed, power is sent to the flasher module to illuminate the hazard lights. The hazard lights will continue to flash until the switch is returned to the OFF (rearward) position. The hazard switch receives power from fuse F−D4 (10 Amp).

Testing

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from key switch.
2. Turn battery−disconnect switch to the OFF position.
3. Disassemble the console arm to gain access to the switch (see Console Arm (page 7–35)).
4. Disconnect machine wire harness connector from the switch being tested.

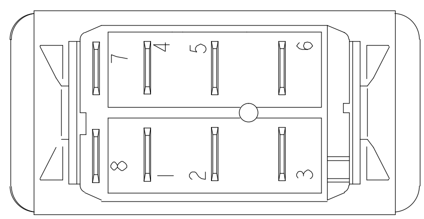


Figure 226
Back of Switch

5. The switch terminals are marked as shown in Figure 226. The circuit logic of the throttle switch is shown in below table. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

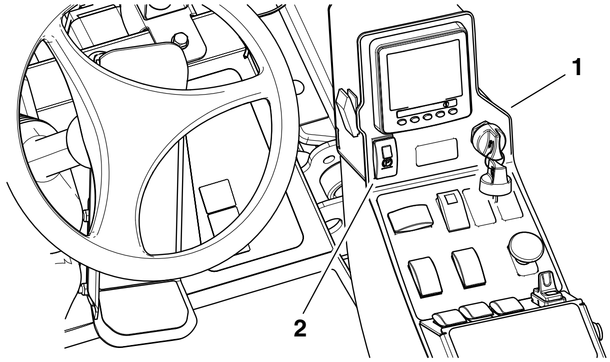
SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
ON (LIGHT END DEPRESSED)	2 + 3 and 5 + 6	2 + 1 and 5 + 4
OFF	2 + 1 and 5 + 4	2 + 3 and 5 + 6

6. Replace the switch if testing determines that it is faulty.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Appendix A (page A–1)).

Testing (continued)

8. After testing is complete, connect machine wire harness connector to the switch.
9. Assemble console arm (see Console Arm (page 7–35)).
10. Turn the battery−disconnect switch to the ON position before returning the machine to service.

Parking Brake Switch



g288531

Figure 227

1. Operator control console
2. Parking brake switch

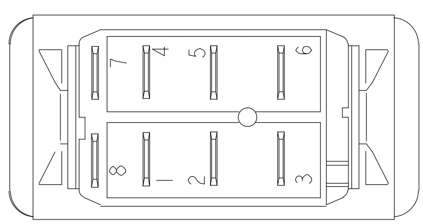
The parking brake switch is located on the console arm (Figure 227). The parking brake comes on automatically when the engine is not running. For service or towing, the parking brake can be released while the engine is not running by using the hydraulic bypass valve and plunger (see machine *Operator's Manual*). To engage the parking brake while the engine is running, release the switch lock and depress the upper portion of the parking brake switch. The switch illuminates when the parking brake is ON.

The primary controller monitors the position of the parking brake switch. Using inputs from the parking brake switch and the traction pedal position sensor, the primary controller energizes hydraulic solenoid valve S10 in the steering/lift control hydraulic manifold as necessary.

Testing

The parking brake switch and its circuit wiring can be tested as a TEC input using the InfoCenter Display (see InfoCenter Display (page 6–9)). If testing determines that a switch and its circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from key switch.
2. Turn battery−disconnect switch to the OFF position.
3. Disassemble the console arm to gain access to the switch (see Console Arm (page 7–35)).
4. Disconnect machine wire harness connector from the switch being tested.



g288532

Figure 228
Back of Switch

Testing (continued)

5. The switch terminals are marked as shown in Figure 228. The circuit logic of the throttle switch is shown in below table. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
ON (SWITCH LIGHT ON)	2 + 3 and 5 + 6	2 + 1 and 5 + 4
NEUTRAL	NONE	ALL
OFF	2 + 1 and 5 + 4	2 + 3 and 5 + 6

6. Replace the switch if testing determines that it is faulty.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Appendix A (page A–1)).
8. After testing is complete, connect machine wire harness connector to the switch.
9. Assemble console arm (see Console Arm (page 7–35)).
10. Turn the battery−disconnect switch to the ON position before returning the machine to service.

Horn Button

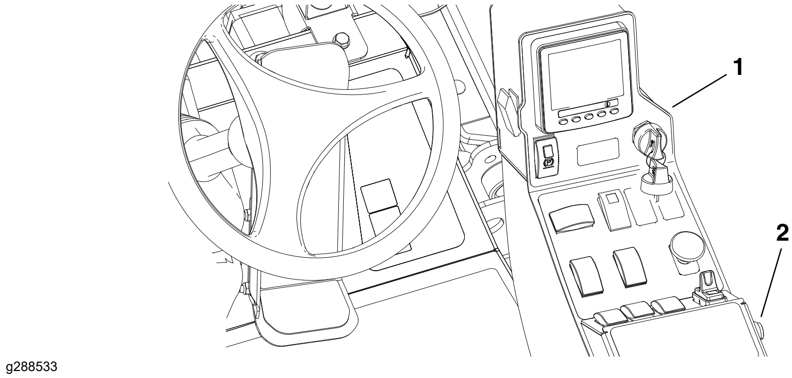


Figure 229

1. Operator control console
2. Horn button

The horn button is a momentary push button switch used to sound the horn. The horn button is located on the outside of the control console (Figure 229).

With the key switch in the RUN or START position, a continuous supply of voltage is available to the horn button. When pressed the horn button energizes the horn relay, sounding the horn.

Testing

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from key switch.
2. Turn battery−disconnect switch to the OFF position.
3. Disassemble the console arm to gain access to the switch (see Console Arm (page 7–35)).
4. Disconnect machine wire harness connector from the switch being tested.
5. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists across the terminals for each switch position. Continuity (zero ohms resistance) should exist across the switch terminals when the switch is depressed. There should not be continuity (infinite ohms resistance) across the switch terminals when the switch is not depressed.
6. Replace the switch if testing determines that it is faulty.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Appendix A (page A–1)).
8. After testing is complete, connect machine wire harness connector to the switch.
9. Assemble console arm (see Console Arm (page 7–35)).
10. Turn the battery−disconnect switch to the ON position before returning the machine to service.

Contactors

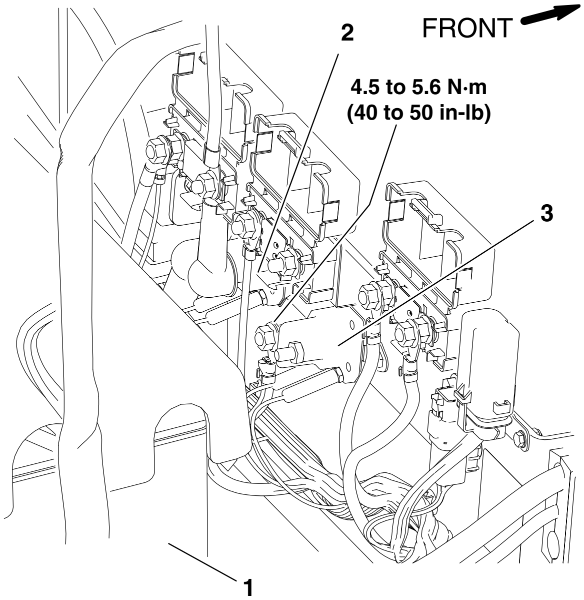


Figure 230

1. 12 volt battery
2. 24 Volt cooling fan contactor
3. Cab component contactor

A contactor is used on all Groundsmaster 5900 and 5910 machines to provide current to the 24 volt cooling fans. The contactor is attached to the rear power center in the right rear corner of the engine compartment (Figure 230). The contactor is energized by the primary controller when the key switch is in the START or RUN position.

An additional contactor is used on all Groundsmaster 5910 machines to provide current to the cab mounted electrical components. The contactor is attached to the rear power center in the right rear corner of the engine compartment (Figure 230). The contactor is energized when the key switch is in the START or RUN position.

Testing

1. Make sure key switch is OFF. Remove key from key switch.
2. Turn battery−disconnect switch to the OFF position.
3. Record wire connector locations on contactor being tested for assembly purposes. Disconnect all harness electrical connectors from contactor.

   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) that 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.

Testing (continued)

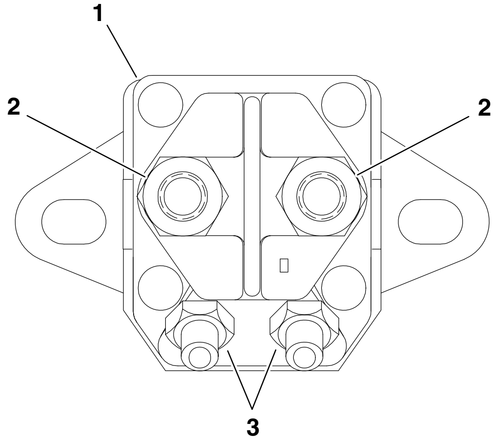
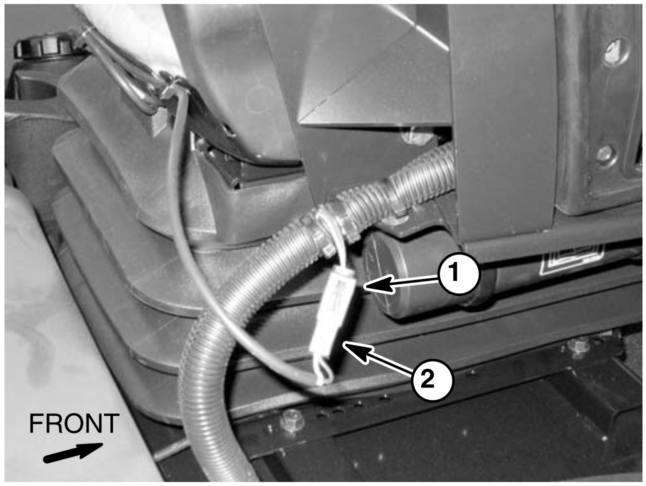


Figure 231

1. Contactor
2. Main posts
3. Coil posts

4. Using jumper wires, apply 12 VDC directly across the contactor coil posts (Figure 231). The contactor should click. With the contactor coil energized, resistance across the contactor main posts should be less than 1 ohm.
5. Remove voltage from contactor coil posts. The contactor should click. With the contactor coil not energized, resistance across the contactor main posts should be infinite ohms.
6. With voltage removed from all contactor posts, measure resistance across the contactor coil posts. Resistance of the coil should be approximately 18.6 ohms.
7. With voltage removed from all contactor posts, measure resistance across the contactor main posts. Resistance should be infinite ohms.
8. If testing determines that contactor is faulty, replace contactor.
9. After testing, connect harness electrical connectors to contactor. Secure main post connectors with flange nuts and tighten nuts from **12 to 17 N·m (9 to 13 ft−lb)**.
10. Turn the battery−disconnect switch to the ON position before returning the machine to service.

Seat Switch



g288536

Figure 232

1. Wire harness connector
2. Seat switch connector

The seat switch and its electrical connector are located in the seat assembly. The seat switch is a normally open proximity switch that closes when the operator is on the seat. Testing of the switch can be done without seat removal by disconnecting the switch wire from the machine wire harness (Figure 232).

The primary controller monitors the position of the seat switch. Using seat switch position (open or closed) and a variety of other switches and sensors, the master and secondary controllers manage engine start, traction control and PTO functions.

Testing

The seat switch and its circuit wiring can be tested as a TEC input using the InfoCenter Display (see InfoCenter Display (page 6–9)). If testing determines that the switches and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from key switch.
2. Disconnect seat switch connector from the machine wire harness connector.
3. Check the continuity of the switch by connecting a multimeter (ohms setting) across the seat switch connector terminals.
4. With no pressure on the seat, there should be no continuity between the seat switch terminals.
5. Press directly onto the seat switch through the seat cushion. There should be continuity as the seat cushion approaches the bottom of its travel.
6. Replace the switch if testing determines that it is faulty (see Operator Seat Service (page 7–42)).
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Appendix A (page A–1)).
8. After testing is complete, connect machine wire harness connector to the switch.

Windshield Wiper/Washer Switch (Groundsmaster 5910)

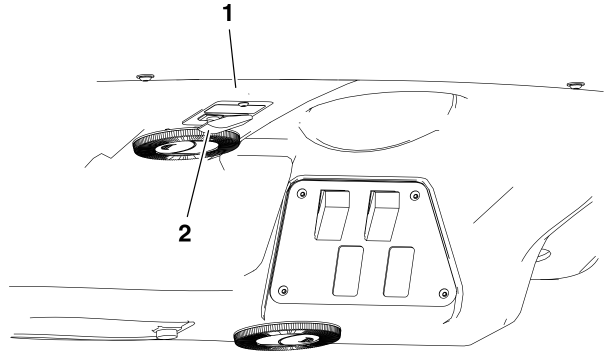


Figure 233

1. Cab headliner (center switch panel)
2. Wiper/washer switch

The windshield wiper/washer switch is located in the cab headliner (Figure 233). The windshield wiper/washer switch is used to control operation of the windshield wiper and washer pump. The windshield wiper/washer switch receives power from fuse 2F−1 (15 Amp).

For windshield wiper service information, see Windshield Wiper Assembly (page 9–29). The washer pump is integrated into the washer fluid reservoir and is not serviceable separately.

Testing

1. Make sure key switch is OFF. Remove key from key switch.
2. To access the switch, remove roof panel from top of cab (see Roof Assembly (page 9–9)).
3. Remove the left or right defrost vent hose from the heat/AC mixing box to access the flange nuts securing the switch panel and remove the switch panel from cab headliner.
4. Disconnect machine wire harness connector from the switch being tested.

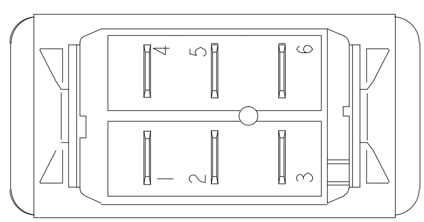


Figure 234
Back of Switch

5. The switch terminals are marked as shown in Figure 234. The circuit logic of the wiper/washer switch is shown in below table. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals.

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
OFF	2 + 1 and 5 + 4	2 + 3 and 5 + 6
WIPER ON	2 + 3	2 + 1 and 5 + 4 and 5 + 6
WASHER ON	2 + 3 and 5 + 6	2 + 1 and 5 + 4

Testing (continued)

6. Replace the switch if testing determines that it is faulty.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Appendix A (page A–1)).
8. After testing is complete, connect machine wire harness connector to the switch and install switch panel and vent hoses.
9. Install cab roof (see Roof Assembly (page 9–9)).

Air Conditioning Switch (Groundsmaster 5910)

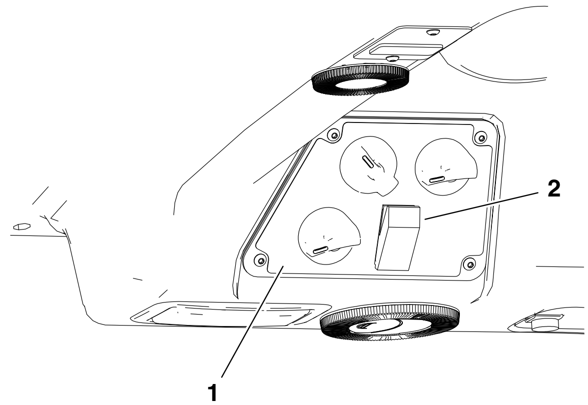


Figure 235

1. Cab headliner (left switch panel)
2. Air conditioning switch

The air conditioning switch is located in the cab headliner (Figure 235). The switch is used to turn the air conditioning system on and off.

Testing

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from key switch.
2. To access the switch, remove roof panel from top of cab (see Roof Assembly (page 9–9)).
3. Remove the switch panel from cab headliner.
4. Disconnect machine wire harness connector from the switch being tested.

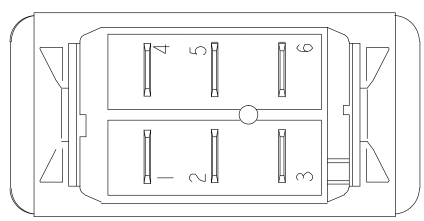


Figure 236
Back of Switch

5. The switch terminals are marked as shown in Figure 236. The circuit logic of the throttle switch is shown in below table. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

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 it is faulty.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Appendix A (page A–1)).
8. After testing is complete, connect machine wire harness connector to the switch and install switch panel.
9. Install cab roof (see Roof Assembly (page 9–9)).

Fan Speed Switch (Groundsmaster 5910)

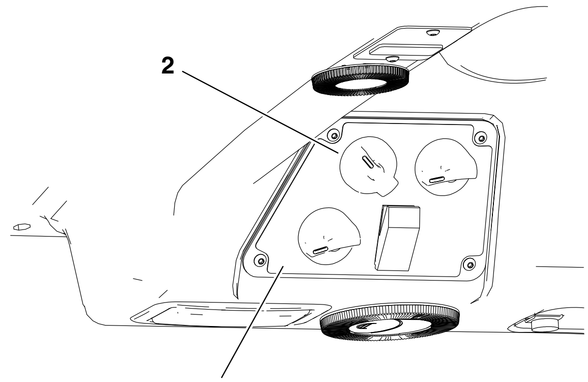


Figure 237

1. Cab headliner (left switch panel)
2. Fan speed switch

The fan speed switch is located in the cab headliner (Figure 237). The switch is used to select the air conditioning/ heater fan speed (off, low, medium or high).

Testing

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from key switch.
2. To access the switch, remove roof panel from top of cab (see Roof Assembly (page 9–9)).
3. Remove the switch panel from cab headliner.
4. Disconnect machine wire harness connector from the switch being tested.

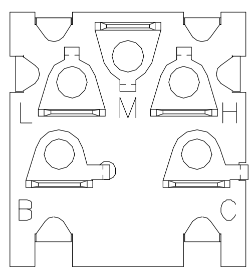


Figure 238
Back of Switch

5. The switch terminals are marked as shown in Figure 238. The circuit logic of the throttle switch is shown in below table. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between only the terminals listed for each switch position. Verify continuity between switch terminals.

SWITCH POSITION	CLOSED CIRCUITS
OFF	L + H
LOW	B + C + L
MEDIUM	B + C + M
HIGH	B + C + H

6. Replace the switch if testing determines that it is faulty.

Testing (continued)

7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Appendix A (page A–1)).
8. After testing is complete, connect machine wire harness connector to the switch and install switch panel.
9. Install cab roof (see Roof Assembly (page 9–9)).

Work Light and Beacon Switches (Groundsmaster 5910 − Optional)

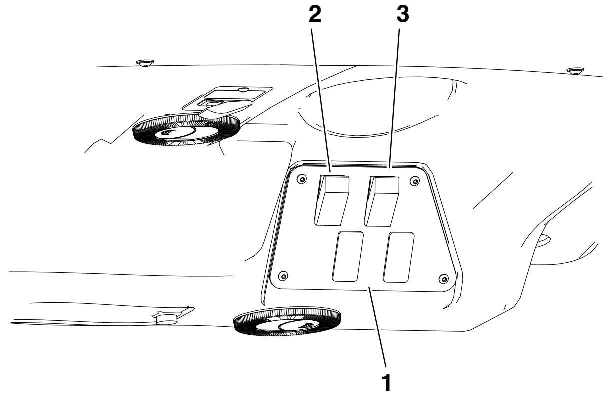


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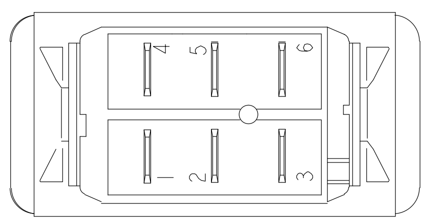
Figure 239

1. Cab headliner (right switch panel)
2. Work light switch (optional)
3. Beacon switch (optional)

The switches are located in the cab headliner (Figure 239). The switches are used to turn the optional light kits on and off.

Testing

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from key switch.
2. To access the switch, remove roof panel from top of cab (see Roof Assembly (page 9–9)).
3. Remove the switch panel from cab headliner.
4. Disconnect machine wire harness connector from the switch being tested.



g288544

Figure 240
Back of Switch

5. The switch terminals are marked as shown in Figure 240. The circuit logic of the throttle switch is shown in below table. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

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 it is faulty.

Testing (continued)

7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Appendix A (page A–1)).
8. After testing is complete, connect machine wire harness connector to the switch and install switch panel.
9. Install cab roof (see Roof Assembly (page 9–9)).

Relays with Four (4) Terminals

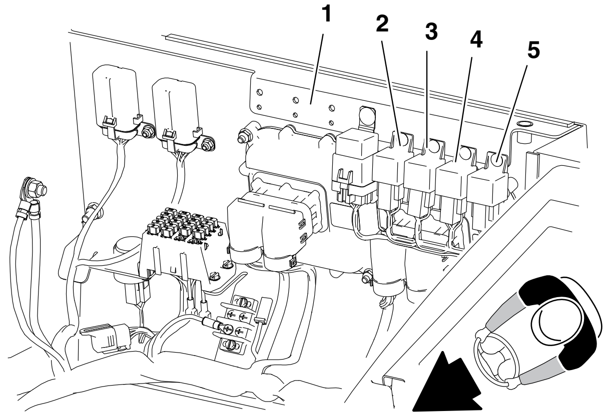


Figure 241

1. Front power center
2. Horn relay
3. Main power relay
4. TEC power relay 2
5. TEC power relay 1

The Groundsmaster 5900 and 5910 use a number of electrical relays that have four (4) terminals. A tag near the wire harness relay connector can be used to identify each relay. The following relays are located in the front power center behind the operator's seat (Figure 241):

- The main power relay supplies electrical power for the InfoCenter Display, operator seat compressor, power point receptacle, horn switch, road light switch, brake light relay and optional electrical equipment. The main power relay is energized when the key switch is in the START or RUN position.
- Two (2) controller relays supply power for the master and secondary controller outputs. TEC power relay 1 supplies primary controller PWR 4 (outputs 11−14) and secondary controller PWR 2−4 (outputs 1−14). TEC power relay 2 supplies primary controller PWR 2−3 (outputs 1−10). The TEC power relays are energized when the key switch is in the START or RUN position.
- The horn relay supplies power to the horn. The horn relay is energized when the key switch is in the START or RUN position (main power relay energized) and the horn button is pressed.

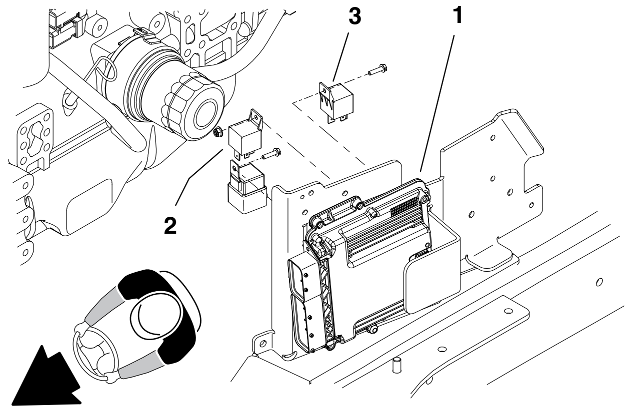


Figure 242

1. Yanmar ECU
2. Start relay
3. Glow plug relay

The following relays are located on the left side of the engine near the Yanmar ECU (Figure 242):

- The start relay supplies power to the engine starter. The glow plug relay is energized by the Yanmar ECU.
- The glow plug relay supplies power to the engine glow plugs. The glow plug relay is energized by the Yanmar ECU.

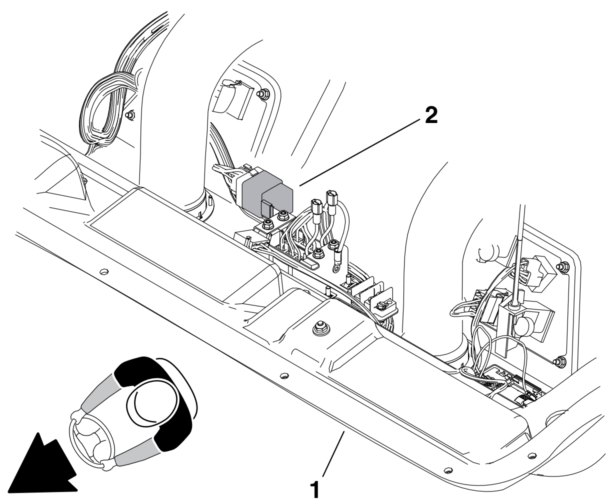


Figure 243

1. Cab headliner (roof removed)
2. Air conditioner relay

The air conditioner relay used on the Groundsmaster 5910 supplies power to the air conditioning system evaporator fans and the compressor clutch. This relay is energized when the key switch is in the START or RUN position (cab contactor closed), the fan speed switch is set to low, medium or high speed and the air conditioning switch is set to ON. The air conditioner relay is located in the cab headliner near the fuse block (Figure 243). To access the relay, remove roof panel from top of cab (see Roof Assembly (page 9–9)).

Testing

1. Make sure key switch is OFF. Remove key from key switch.
2. Turn battery−disconnect switch to the OFF position.
3. Verify the location of the relay being tested (above) and access the relay.

4. Disconnect the machine wire harness connector from the relay. Remove relay from mounting bracket for testing.

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

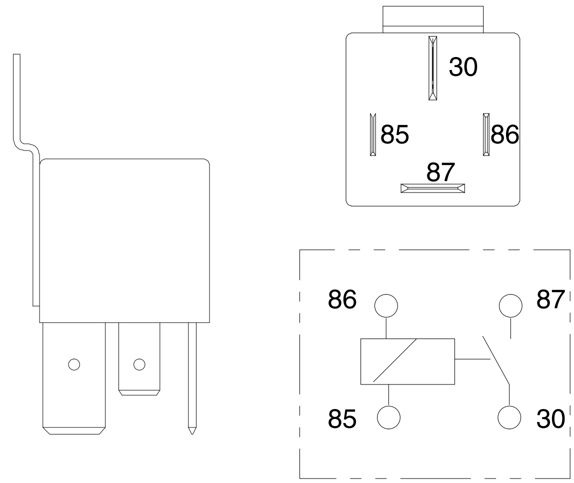


Figure 244

5. Using a multimeter (ohms setting), measure coil resistance between terminals 85 and 86 (Figure 244). Resistance should be between 70 and 100 ohms.
6. Verify infinite resistance (no continuity) between terminals 30 and 87.
7. 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.
8. Disconnect meter leads and jumper wires from the relay terminals. Reconnect machine wire harness connector to relay.
9. Install and secure panels and covers removed to access relays.
10. Turn the battery−disconnect switch to the ON position before returning the machine to service.

Relays with Five (5) Terminals

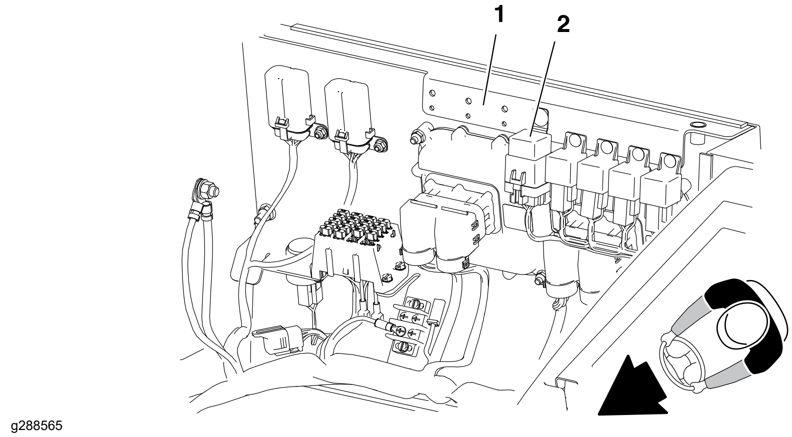


Figure 245

1. Front power center
2. Brake light relay

The Groundsmaster 5900 and 5910 use a number of electrical relays that have five (5) terminals. A tag near the wire harness relay connector can be used to identify each relay.

The brake light relay supplies power to the brake lights. The brake light relay is energized by the primary controller. The brake light relay is located in the front power center behind the operator's seat (Figure 245).

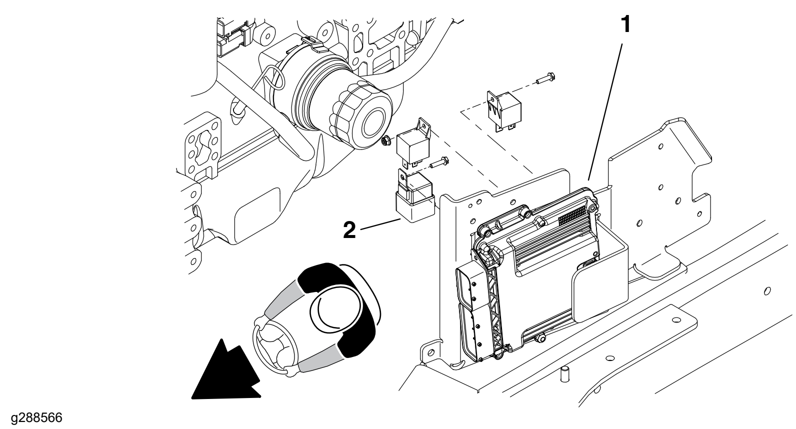
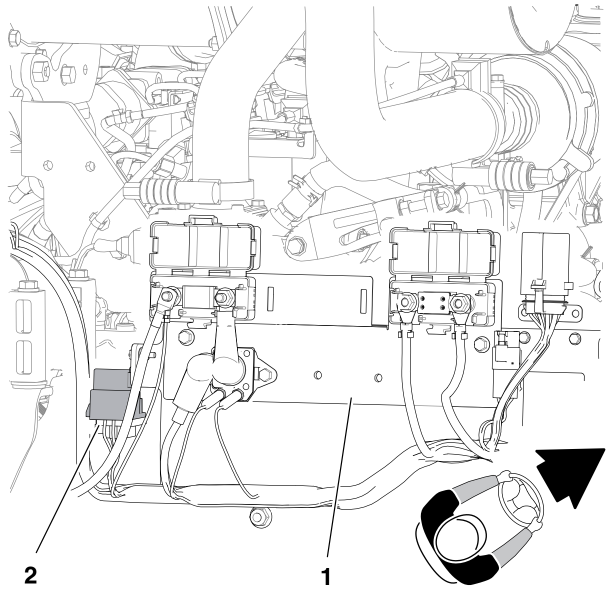


Figure 246

1. Yanmar ECU
2. EGR relay

The EGR relay is used to provide current to the engine EGR valve. The EGR relay is energized by the Yanmar ECU. The EGR relay is located on the left side of the engine near the Yanmar ECU (Figure 246).



g288567

Figure 247

1. Rear power center
2. Remote sense relay

The remote sense (24 Volt enable) relay provides power to the 24 volt alternator sense terminal. The 24 volt alternator with internal voltage regulator use this circuit to monitor the 24 volt system battery voltage. The remote sense relay is energized by the primary controller. The remote sense relay is attached to the rear power center in the right rear corner of the engine compartment (Figure 247).

Testing

1. Make sure key switch is OFF. Remove key from key switch.
2. Turn battery−disconnect switch to the OFF position.
3. Verify the location of the relay being tested (above) and access the relay.
4. Disconnect wire harness connector from relay. Remove relay from mounting bracket for testing.

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

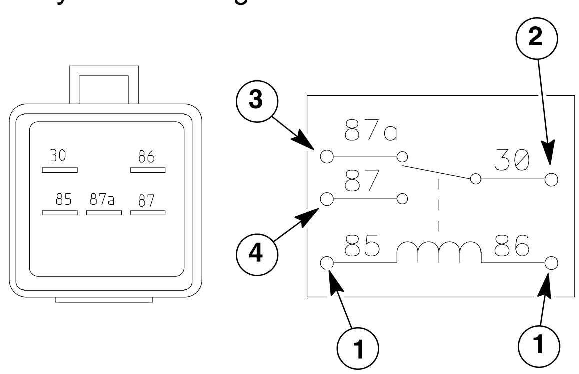


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Figure 248

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

Testing (continued)

5. Using a multimeter, verify that coil resistance between terminals 85 and 86 is from 71 to 88 ohms (Figure 248).
6. 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.
7. Disconnect voltage from terminal 85 and multimeter lead from terminal 87.
8. Connect multimeter (ohms setting) leads to relay terminals 30 and 87A. Apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87A as +12 VDC is applied and removed from terminal 85.
9. Disconnect voltage and test leads from the relay terminals.
10. If testing determines that the relay is not functioning correctly, replace the relay.
11. If the relay tests correctly and a circuit problem still exists:
    A. Check wire harness (see Appendix A (page A–1)).
    B. Use the InfoCenter Display to check specific TEC output operation (see InfoCenter Display (page 6–9)).
12. Secure relay to mounting bracket and connect wire harness connector to relay.
13. Install and secure panels and covers removed to access relays.
14. Turn the battery−disconnect switch to the ON position before returning the machine to service.

Hydraulic Solenoid Valves

There are numerous coil actuated hydraulic solenoid valve on the Groundsmaster hydraulic manifolds. When the coils are energized, hydraulic valve shift occurs to control hydraulic flow.

Note: A faulty solenoid coil or solenoid circuit wiring problem will not be identified by the Info Center Display. The Info Center Display can be used to verify that output current from the appropriate TEC is available for the solenoid coil but the Display will not verify that the solenoid coil and circuit wiring is functioning correctly (see InfoCenter Display (page 6–9)).

Testing

Testing solenoid coils can be done without removing the coil or hydraulic valve as follows:

1. Locate the solenoid valve coil to be tested and disconnect the wire harness electrical connector from the coil.

   Note: Prior to taking small resistance readings with a digital multimeter, short the meter test leads together. The meter may 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.

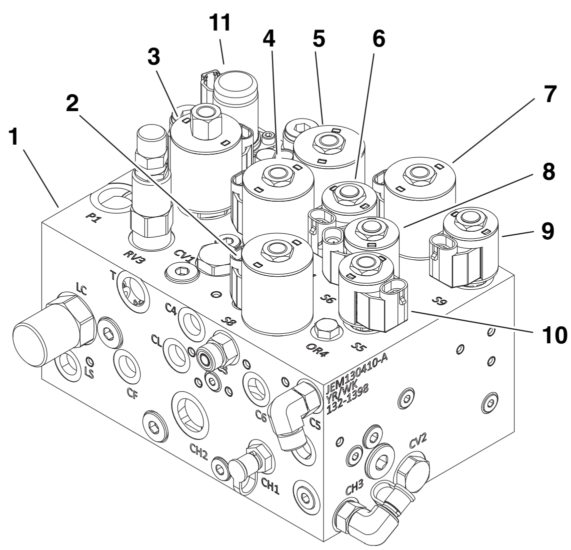

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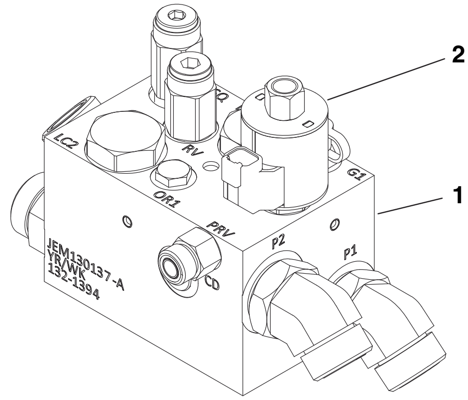
Figure 249

1. Steering/Lift manifold
2. Solenoid valve S8
3. Solenoid valve S1
4. Solenoid valve S3
5. Solenoid valve S2
6. Solenoid valve S4
7. Solenoid valve S7
8. Solenoid valve S6
9. Solenoid valve S9
10. Solenoid valve S5
11. Solenoid valve S10

Testing (continued)



g288590

Figure 250

1. Cutting Deck manifold front shown)
2. Solenoid valve PRV

2. Using a multimeter (ohms setting), measure resistance between the two (2) connector terminals on the solenoid coil. The resistance for the solenoid coils is identified below:

   A. The coils of the solenoid valves at the following locations are the same. Resistance of these coils should be approximately 8.8 ohms when tested at 20 ºC (68 ºF):

   Steering/Lift manifold S4, S5, S6 and S9 (Figure 249)

   B. The coils of the solenoid valves at the following locations are the same. Resistance of these coils should be approximately 7.1 ohms when tested at 20 ºC (68 ºF):

   Steering/Lift manifold S1, S2, S3, S7 and S8 (Figure 249).

   Cutting Deck manifolds (front, left and right) PRV (Figure 250).

   Note: To assist in troubleshooting, identical replaceable solenoid coils can be exchanged. If the problem follows the coil, the coil is likely at fault. If the problem remains unchanged, something other than the coil is the likely problem source (e.g. switch, circuit wiring, hydraulic problem).

   Note: Hydraulic solenoid valves S1 through S9 (steering/lift manifold) and PRV (cutting deck manifolds) have replaceable coils. If these solenoid coils fail a resistance test, replace the entire valve assembly (see Hydraulic Solenoid Valve Coils (page 6–146)).

Testing (continued)

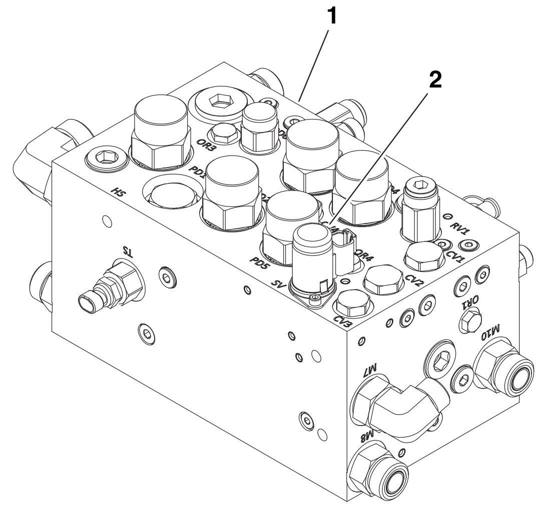


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Figure 251

1. Traction control manifold
2. Solenoid valve SV

C. The coils of the solenoid valves at the following locations are the same. Resistance of these coils should be approximately 7.25 ohms when tested at 20 ºC (68 ºF):

   Steering/Lift manifold S10 (Figure 249).

   Traction manifold SV (Figure 251).

   Note: Hydraulic solenoid valve SV (traction manifold) and S10 (steering/lift manifold) do not have replaceable coils. If these solenoid coils fail a resistance test, replace the entire valve assembly (see Cartridge Valve Service (page 5–158)).

3. After testing is complete, connect wire harness electrical connector to the solenoid coil.

Air Filter Service Indicator

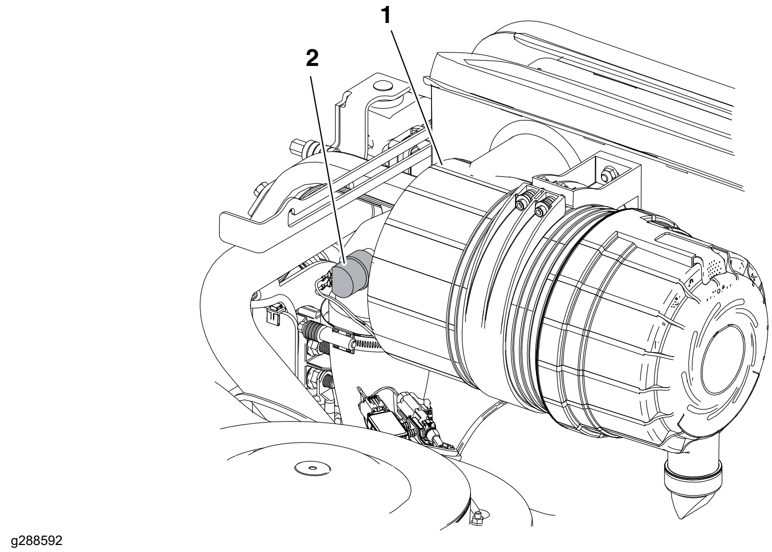

Figure 252

1. Air filter
2. Air filter service indicator

The air filter service indicator is a normally open (N.O.) vacuum actuated switch attached to the air filter body (Figure 252). A high vacuum condition occurs when the engine is running and the air filter elements become restricted, closing the switch.

Testing

The air filter service indicator and its circuit wiring can be tested as a TEC input using the InfoCenter Display (see InfoCenter Display (page 6–9)). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Make sure key switch is OFF. Remove key from key switch.
2. Disconnect the service indicator from the wiring harness and remove (unscrew) service indicator from air cleaner assembly.
3. Check the continuity of the service indicator by connecting a multimeter (ohms setting) across the indicator terminals.
4. There should be no continuity (infinite resistance) between the service indicator terminals.
5. Connect a hand operated vacuum pump to the switch fitting and apply 25 in. Hg (−84 bar) of vacuum to close the switch. There should be continuity (zero resistance) between the service indicator terminals.
6. If testing determines that service indicator is faulty, replace the indicator.
7. Install the service indicator and connect the indicator to the machine wiring harness (see Air Filter (page 4–11)).
8. If the service indicator tests correctly and a circuit problem still exists, check the wire harness (see Appendix A (page A–1)).

Fuel Sender

The fuel sender is attached to the top of the fuel tank. The resistance of the fuel sender increases as the fuel level in the fuel tank decreases. The fuel sender is an input to the Toro Electronic Controller (TEC) and provide information for the InfoCenter fuel gauge. The fuel sender is a sliding float design with a single wire harness connector.

Testing

1. Make sure key switch is OFF. Remove key from key switch.
2. Turn battery−disconnect switch to the OFF position.
3. Disconnect the fuel sender from the machine wire harness connector.
4. Remove screws and lock washers that secure the fuel sender to the fuel tank.
5. Carefully remove fuel sender and gasket from the fuel tank. Clean all fuel from the sender.
6. Inspect sender gasket for damage and replace if necessary.

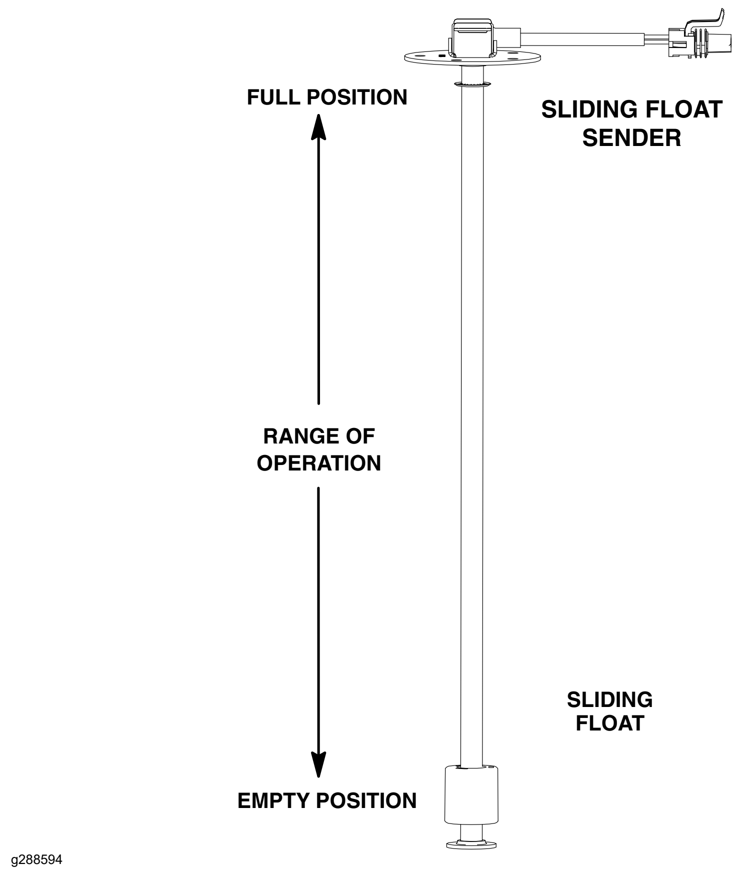

Figure 253

7. Verify fuel sender float is able to move freely through its entire range of operation (Figure 253).

   Note: Before taking small resistance readings with a digital multimeter, short meter test leads together. The meter will display a small resistance value. This internal resistance of the meter and test leads should be subtracted from the measured value of the component.

Testing (continued)

⚠ CAUTION ⚠

Make sure fuel sender is completely dry (no fuel on it) before testing. Perform test away from the fuel tank to prevent an explosion or fire from sparks.

8. Using a multimeter and check resistance of the sender with the float in the full and empty positions shown in below table:

SLIDING FLOAT SENDER	RESISTANCE (FULL)	RESISTANCE (EMPTY)
Single Harness Connector	28 to 33 Ohms	240 to 250 Ohms

9. Replace sender if testing determines that it is faulty.
10. If the sender tests correctly and a circuit problem still exists, check the wire harnesses (see Appendix A (page A–1)).
11. Carefully install sender into fuel tank and attach wire harness connector to fuel sender.
12. Turn the battery−disconnect switch to the ON position before returning the machine to service.

Fuel Pump

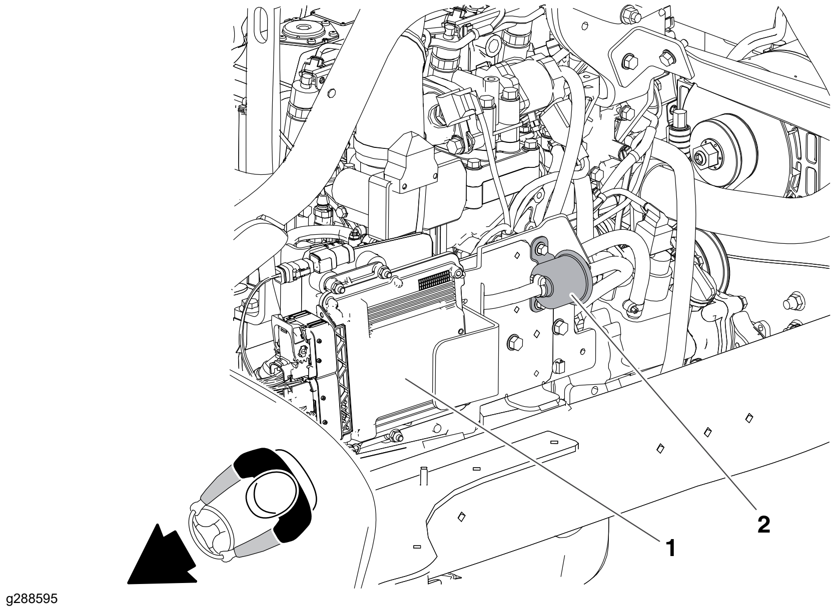

Figure 254

1. Yanmar ECU
2. Fuel pump

The electric fuel pump is attached to then left frame rail near the Yanmar ECU (Figure 254).

Testing

1. Park machine on a level surface, lower cutting decks and stop engine.
2. Raise the hood and remove side panel from left side of machine to gain access to fuel pump. Allow engine and exhaust to cool before doing any disassembly of fuel system components.
3. Make sure fuel hoses attached to the fuel pump are free of obstructions.
4. Disconnect fuel pump discharge hose from the fuel/ water separator.
5. Place disconnected end of pump discharge hose into a large, graduated cylinder sufficient enough to collect 1 quart (0.95 liter).

IMPORTANT

When testing fuel pump output, do not turn key switch to the START position.

6. Collect fuel in the graduated cylinder by turning key switch to the ON position. Allow pump to run for thirty (30) seconds, then turn switch to OFF.
7. The amount of fuel collected in the graduated cylinder should be approximately 350 ml (11.8 fl oz) after thirty (30) seconds.
8. Replace fuel pump if output specification is not met.
9. If the fuel pump output specifications are met and a circuit problem still exists, check the wire harness (see Appendix A (page A–1)).
10. Connect fuel pump discharge hose to fuel water separator and secure with hose clamp.
11. Add fuel to the tank and prime the fuel system (see Prime the Fuel System (page 4–18)). Check fuel system for leaks before returning the machine to service.

Testing (continued)

12. Install and secure side panel to left side of machine.
13. Lower and secure hood.

Fuel Pump Specifications

Pump Capacity	700 ml/min (23.5 fl oz/min)
Pressure	22.8 kPa (3.3 PSI)
Current Draw	0.9 amp

Hydraulic Oil Temperature Sender

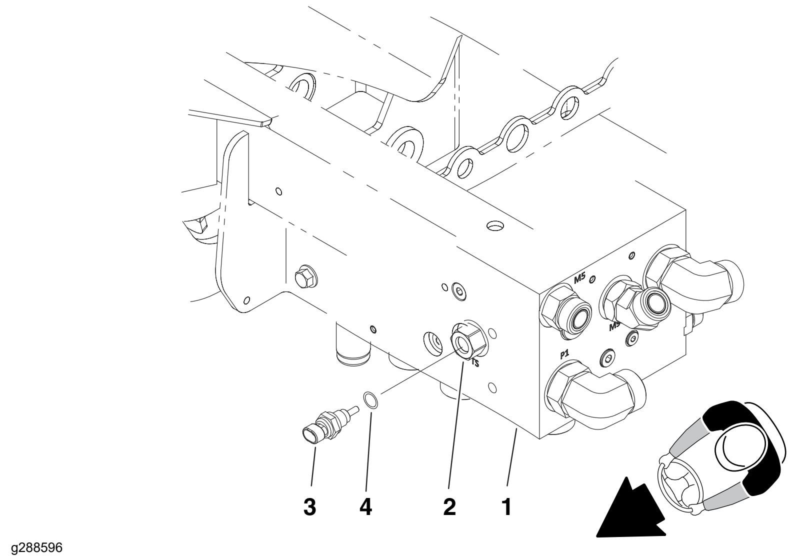

Figure 255

1. Hydraulic traction manifold
2. Adapter fitting
3. Hydraulic oil temperature sender
4. O−ring

The hydraulic oil temperature sender is attached to the hydraulic traction manifold in port TS (Figure 255).

Testing

1. Locate hydraulic oil temperature sender and disconnect wire harness connector from temperature sender.
2. Thoroughly clean hydraulic traction manifold around temperature sender. Remove sender from the adapter fitting.

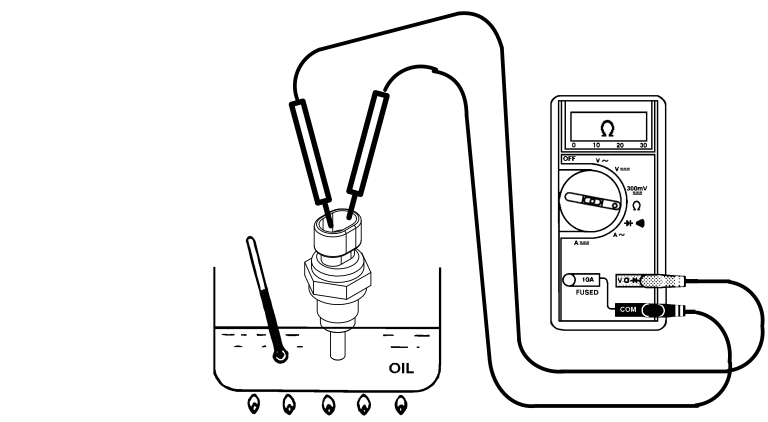

Figure 256

3. Put sensing end of sender in a container of oil with a thermometer and slowly heat the oil (Figure 256).

CAUTION

Handle the hot oil with extreme care to prevent personal injury or fire.

Testing (continued)

Note: Prior to taking 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.

4. Check resistance of the sender with a multimeter (ohms setting) as the oil temperature increases.

   A. The meter should indicate from 11.6 to 13.5 kilohms at 20 ºC (68 ºF).

   B. The meter should indicate from 2.3 to 2.5 kilohms at 60 ºC (140 ºF).

   C. The meter should indicate from 605 to 669 ohms at 100 ºC (212 ºF).

   D. Replace sender if specifications are not met.

5. Install sender in the traction control manifold.

   A. Install new O−ring on sender.

   B. Install sender into the hydraulic manifold. Tighten sender to **14 to 16 N·m (10 to 12 ft−lb)**.

   C. Reconnect harness wire to sender.

6. Check and fill hydraulic system to proper level.

CAN−bus Terminator Resistor

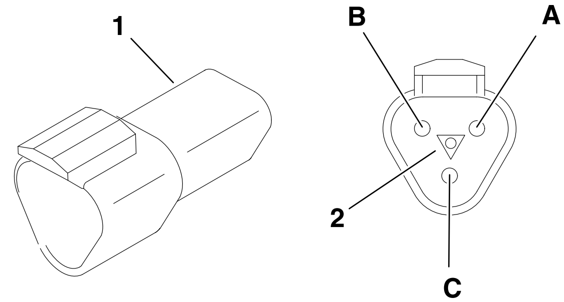

Figure 257

1. Termination resistor
2. Keyway

System communication between electrical components on Groundsmaster 5900/5910 machines is accomplished on a CAN−bus communication system. Two (2) specially designed, twisted cables form the bus for the network used on the machine. These wires provide the data pathways between machine components.

All Groundsmaster 5900/5910 machines have two (2) 120 ohm termination resistors. One resistor is located at the end of the twisted pair of bus cables located in the operator control console (see Appendix A (page A–1)). The resistor can be accessed by removing the operator console side cover. The wire harness connector has a blue insert to identify the proper location for the termination resistor.

The second CAN−bus termination resistor is integrated into the Yanmar ECU and can be tested as part of the CAN−bus wiring. The resistor is not replaceable separately.

Note: Refer to the Electrical Schematics and Wire Harness Drawings in Appendix A (page A–1) for additional information on the terminator resistor locations and CAN−bus wiring.

IMPORTANT

The terminator resistor is required for proper electrical system operation.

Testing

1. The terminator resistor in the Operator control console (Figure 257) can be tested separately using a digital multimeter (ohms setting). Locate resistor and remove cable tie that secures resistor to wire harness. Unplug the resistor from the wire harness for testing.

   Note: The insulator wedge in the termination resistor is blue for identification purposes. There also is a center keyway to prevent the termination resistor from plugging into the wrong wire harness connector.

2. Use a digital multimeter (ohms setting) to measure the resistance value for the termination resistor. There should be 120 ohms resistance between terminals A and B. Terminal C is not used.
3. If testing determines that termination resistor is faulty, replace resistor.
4. After testing is complete, make sure that termination resistor is fully installed into wire harness connector and secured to wire harness with cable tie.

Resistor Assemblies

Three (3) different resistors are used on all Groundsmaster 5900/5910 machines. Each resistor has a different resistance rating and location on the machine.

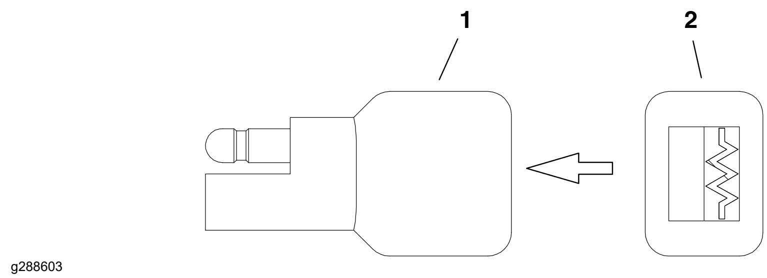

Figure 258

1. Resistor assembly
2. End of resistor body

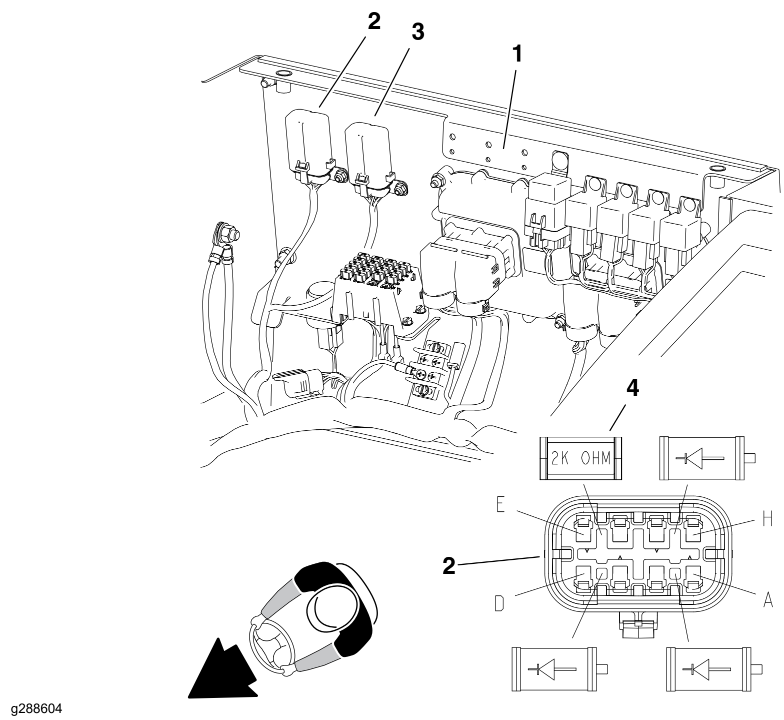

Figure 259

1. Front power center (behind operator seat)
2. Diode block 2
3. Diode block 1
4. 2K ohm resistor

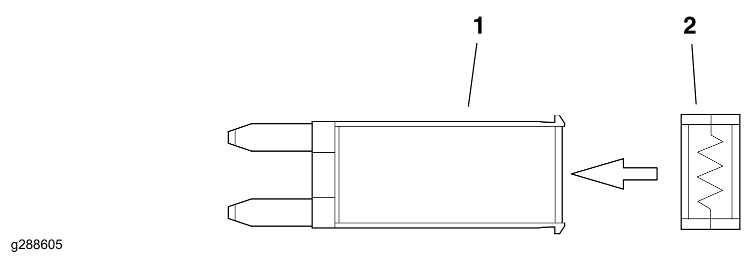

Figure 260

1. Mini resistor
2. End of resistor body

- A **75 ohm** resistor assembly is used for proper key switch operation. The resistor plugs into the console wire harness near the key switch (see Appendix A (page A–1)). The resistor can be identified by its gray color, resistor symbol and Toro part number on the end of the resistor body (Figure 258).
- A **1.6K ohm (1600 ohm)** resistor assembly is used for proper 12 Volt alternator operation. The resistor plugs into the engine wire harness near the starter (see Appendix A (page A–1)). The resistor can be identified by its gray color, resistor symbol and Toro part number on the end of the resistor body (Figure 258).
- A **2K ohm (2000 ohm)** mini resistor is used for monitoring the 24 Volt electrical system. The resistor plugs into diode block 2 in the front power center behind the operator seat (Figure 259). The resistor can be identified by its silver color and resistor symbol on the end of the resistor body (Figure 260).

Testing

1. Disconnect the resistor from the wire harness or remove the diode block cover and pull the resistor from the diode block.
2. Measure the resistance across the resistor terminals using a digital multimeter (ohms setting). The resistance across the terminals should be at or near the resistors rated resistance. Replace the resistor if a reading other than the rated resistance is obtained.

Diode Assemblies

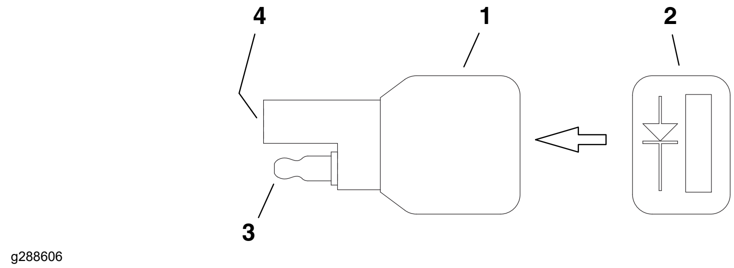

Figure 261

1. Diode
2. End of diode body
3. Terminal B (male)
4. Terminal A (female)

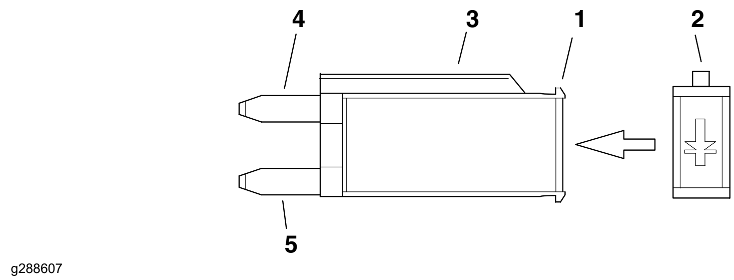

Figure 262

1. Mini diode
2. End of diode body
3. Key
4. Terminal A
5. Terminal B

Ten (10) different diodes are used on all Groundsmaster 5900/5910 machines. The maximum current allowed through any of the diodes is 6 amps.

- A diode assembly (D1) is used for circuit protection from voltage spikes that occur when the starter solenoid is de−energized. The diode plugs into the engine wire harness near the fuel water separator (see Appendix A (page A–1)). The diode can be identified by its black color, diode symbol and Toro part number on the end of the diode body (Figure 261).
- A diode assembly (D2) is used to protect the engine ECU from reverse polarity in the EGR relay circuit. The diode plugs into the engine wire harness near the Yanmar ECU (see Appendix A (page A–1)). The diode can be identified by its black color, diode symbol and Toro part number on the end of the diode body (Figure 261).
- A mini diode is used to protect the 24 Volt system from voltage spikes that occur when the 24 volt contactor is de−energized. The diode plugs into a fuse and diode holder in the rear power center in the right rear corner of the engine compartment (Figure 263). The Diode can be identified by its silver color and diode symbol on the end of the diode body (Figure 262).
- Seven (7) mini diodes are located in two (2) diode block in the front power center behind the operator seat (Figure 264). The purpose of each diode is listed in the following table. The diodes can be identified by their silver color and diode symbol on the end of the diode body (Figure 262).

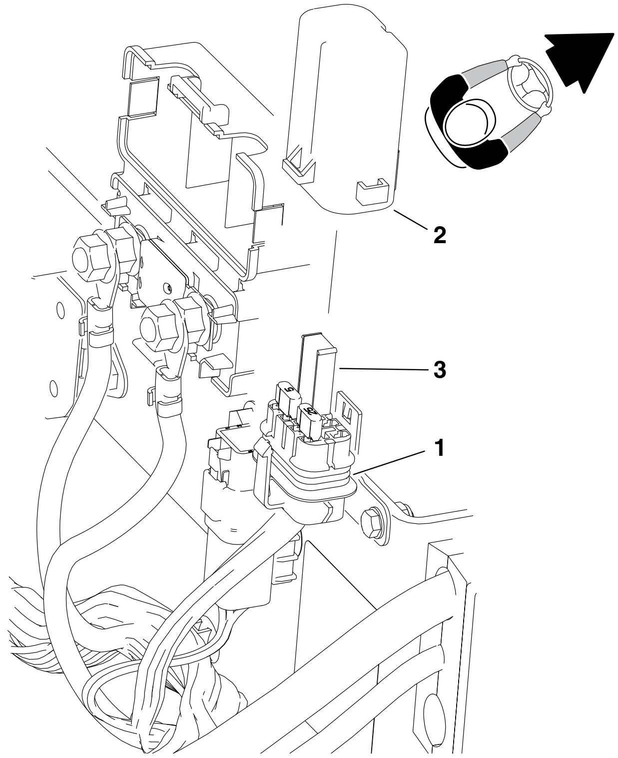

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Figure 263

1. Fuse/Diode holder base
2. Fuse/Diode holder cover
3. Mini diode (24 Volt alternator)

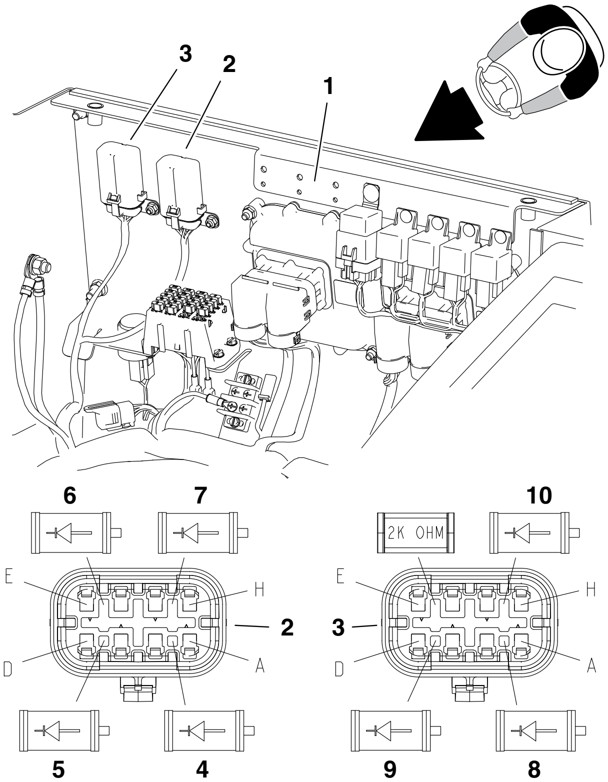


Figure 264

1. Front power center (behind operator seat)
2. Diode block 1
3. Diode block 2
4. 24 Volt remote sense relay diode
5. 24 Volt contactor latch diode
6. Radiator fan fault diode
7. Hydraulic oil cooler fan fault diode
8. Hydraulic oil cooler fan diode
9. Radiator fan diode
10. TEC power diode

Mini Diode Location	Mini Diode Function
Diode Block 1 pins A–B	24 Volt Remote Sense Relay
Diode Block 1 pins C–D	24 Volt Contactor Latch
Diode Block 1 pins E–F	Radiator Fan Fault
Diode Block 1 pins G–H	Hydraulic Oil Cooler Fan Fault
Diode Block 2 pins A–B	Hydraulic Oil Cooler Fan
Diode Block 2 pins C–D	Radiator Fan
Diode Block 2 pins G–H	TEC Power

Testing

Note: Record the direction of the diode symbol or key before removing a mini diode, and install the mini diode in the same orientation after testing.

1. Remove the diode from the wire harness or remove the diode block cover and pull the mini diode from the diode block.

Testing (continued)

2. Test the diode as follows:

   Use a multimeter to check for voltage drop across the diode terminals (diode test setting). Contact the multimeter red (+) lead to diode terminal A and the black (−) lead to diode terminal B. A reading of less than 0.7 volts should be displayed on the multimeter.

   OR

   Use the following table and a multimeter (ohms setting) to measure the resistance across the diode terminals.

Multimeter Red Lead (+)	Multimeter Black Lead (−)	Resistance
Terminal A	Terminal B	VERY LOW
Terminal B	Terminal A	VERY HIGH

3. Replace the diode if necessary.

Audible Alarm

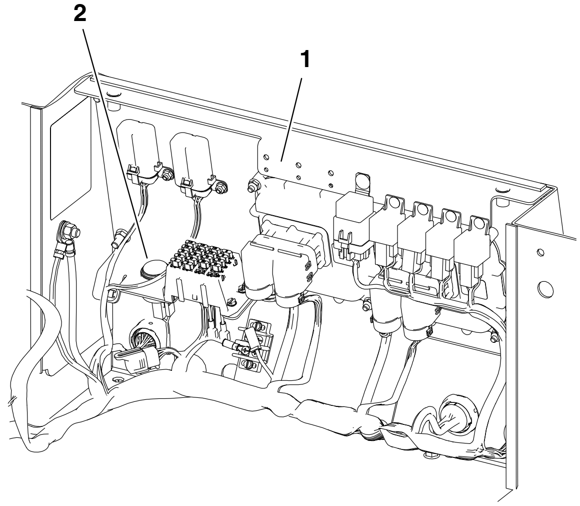


Figure 265

1. Front power center
2. Audible alarm

The audible alarm sounds to notify the operator when a machine problem exists. Electrical current for the alarm is provided as an output from the secondary controller. The audible alarm is located in the front power center behind the operator seat (Figure 265).

Testing

1. Make sure key switch is OFF. Remove key from key switch.
2. Remove power center cover from operator platform to access audible alarm and disconnect machine wire harness from alarm.

IMPORTANT

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

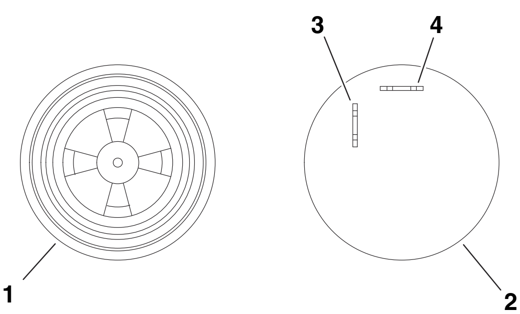


Figure 266

1. Top view
2. Bottom view
3. Positive (+) terminal
4. Negative (−) terminal

3. Correctly connect 12VDC power to the terminals as shown (Figure 266). The alarm should sound. Replace the alarm if necessary.
4. Reconnect machine wire harness to alarm.
5. Install and secure power center cover.

Traction Pedal Position Sensor

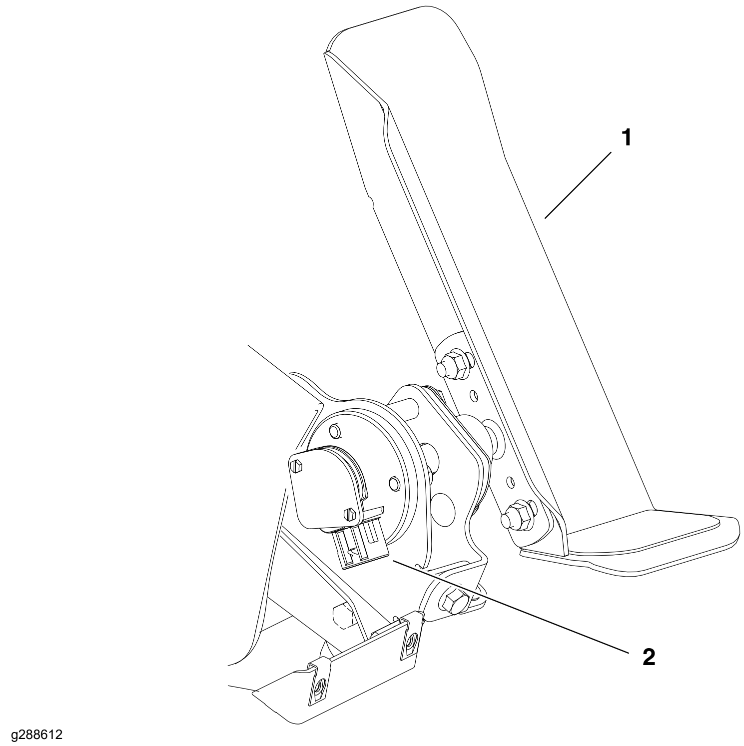


Figure 267

1. Traction pedal
2. Traction pedal position sensor

The traction pedal position sensor is connected to the traction pedal assembly (Figure 267). This sensor determines the neutral band for the traction pedal, the direction of travel desired by the operator and the traction speed. The sensor is a single analog, dual digital signal electronic device. The sensor includes a potentiometer (variable resistor) that provides an analog signal for the primary controller to determine the desired ground speed based on how far the traction pedal is depressed in either direction. The traction pedal position sensor also houses two (2) switches that are used to determine the neutral position (dead−band) and the indicated direction of travel (forward or reverse).

As the traction pedal is depressed, the appropriate position sensor switch closes and sends a digital signal to the primary controller controller to determine machine direction and the internal wiper of the potentiometer moves and sends the analog signal to the primary controller controller to determine machine speed. The traction pedal position sensor must be calibrated with the primary controller to determine the neutral and full speed set points for both the forward and reverse directions.

A properly installed and calibrated traction pedal position sensor is critical to accurate traction response and position sensor life. Use care when installing and calibrating the traction pedal position sensor.

Testing

1. Inspect traction pedal assembly for loose, damaged or worn components (see Traction Pedal (page 7–37)).
2. Calibrate the traction pedal position sensor and test machine operation (see Traction Pedal Position Sensor Calibration (page 6–51)).
3. If the traction pedal position sensor continues to perform poorly, check the wire harness (see Appendix A (page A–1)).
4. Replace position sensor if necessary (see Traction Pedal (page 7–37)).

Piston (Traction) Pump Control Solenoid Coils

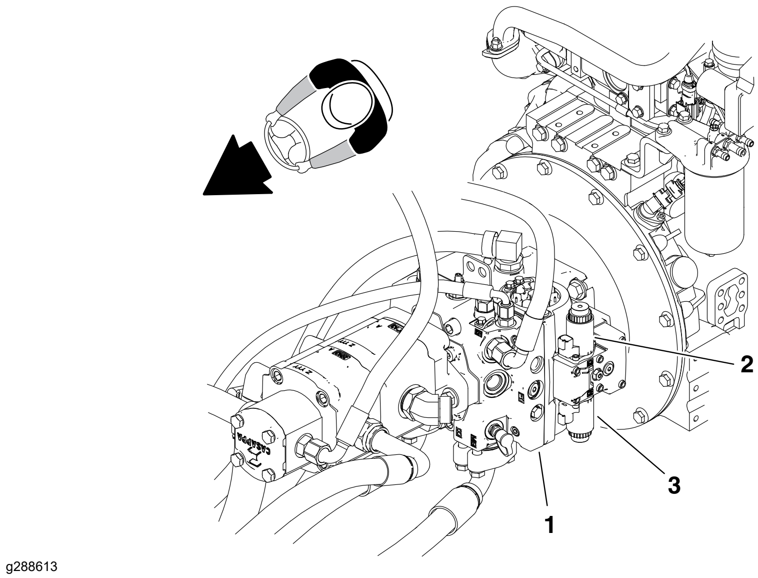


Figure 268

1. Piston pump
2. Forward solenoid coil
3. Reverse solenoid coil

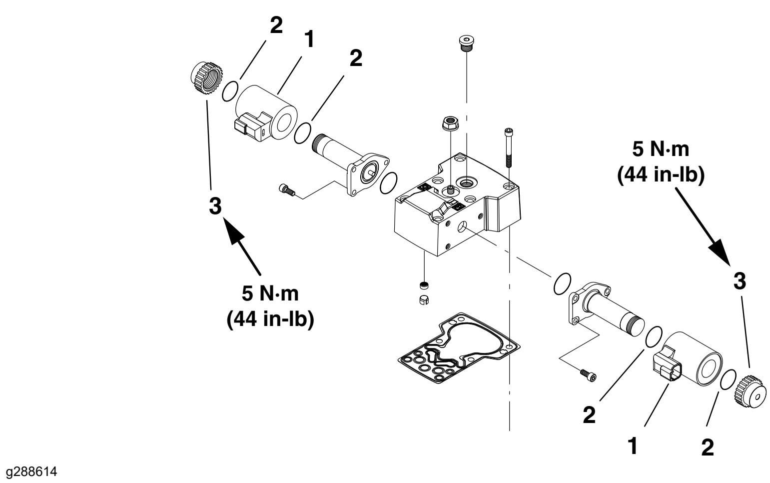


Figure 269

1. Solenoid coil
2. O−ring
3. Coil nut

The piston (traction) pump uses an electronic control assembly to change the position of the swash plate and the pump displacement. Electrical outputs from the machine TEC controller are provided to two (2) solenoid coils for pump control. One solenoid controls the A side pump displacement (forward direction) and the other controls the B side pump displacement (reverse direction) The piston pump control assembly is attached to the left side of the piston pump (Figure 269).

Note: To assist in troubleshooting, the piston pump solenoid coils can be exchanged because they are identical. If the problem follows the exchanged coil, a problem with the coil is likely. If the problem remains unchanged, something other than the solenoid coil is at fault (e.g. traction pedal, traction pedal position sensor, circuit wiring, hydraulic problem).

Solenoid Coil Testing

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the key switch.
2. Turn battery−disconnect switch to the OFF position.
3. Locate piston pump solenoid coil to be tested and disconnect wire harness connector from solenoid coil (Figure 269).

   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.

4. Using a multimeter (ohms setting), measure resistance between the two (2) connector terminals on the solenoid coil. Solenoid coil resistance should be 3.66 ohms.

   Note: Solenoid coil resistance should be measured with solenoid at approximately 20 ºC (68 ºF). Resistance may be slightly different than listed at different temperatures. Typically, a failed solenoid coil will either be shorted (very low or no resistance) or open (infinite resistance).

5. If solenoid coil resistance is incorrect, replace coil as follows:

   A. Use a 12 point, 26 mm socket to loosen and remove the coil nut that secures solenoid coil.

   B. Slide solenoid coil and O−rings from valve stem. Discard the O−rings and clean all corrosion or dirt from the valve.

   C. Lubricate new O−rings with petroleum jelly and slide new coil with O−rings onto the solenoid stem.

   D. Use a 12 point, 26 mm socket to install and tighten coil nut from **5 N·m (44 in−lb)**. Do not over−tighten coil nut.

6. If solenoid coil resistance is correct and a circuit problem still exists, check the wire harness (see Appendix A (page A–1)).
7. After testing is completed, connect wire harness connector to the solenoid coil.
8. Turn the battery−disconnect switch to the ON position before returning the machine to service.

Cutting Deck Position Switches

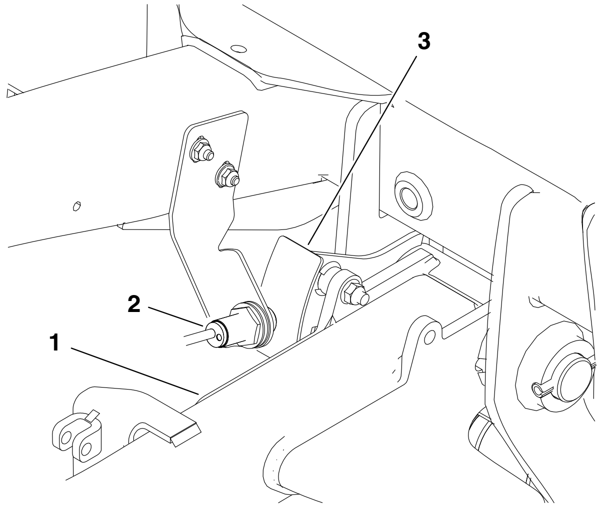


Figure 270

1. Front deck right lift arm
2. Deck position switch
3. Sensing plate

The cutting deck position switches are normally open proximity switches that interact with sensing plates as the cutting deck lift arms raise and lower. When a cutting deck is in the lowered position, the sensing plate will be near the position switch and the switch will be closed. When a cutting deck is raised, the sensing plate is moved away from the position switch and the switch opens.

The cutting deck position switches are attached to brackets on the traction unit frame. The sensing plates are attached to the lift arms.

The secondary controller monitors the position of the cutting deck position switches. Using inputs from the position switches, the engine and coolant temperature senders, the high/low range traction speed switch and the seat switch, the secondary controller energizes hydraulic solenoid valves PRV in the cutting deck control hydraulic manifolds as necessary to engage the cutting blades.

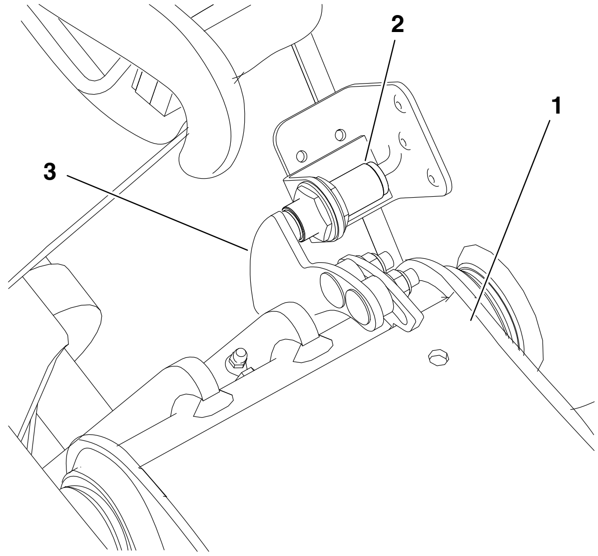


Figure 271

1. Wing deck lift arm
2. Deck position switch
3. Sensing plate

Testing

The cutting deck position switches and their circuit wiring can be tested as TEC inputs using the InfoCenter Display (see InfoCenter Display (page 6–9)). If testing determines that the switch and its circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the key switch.
2. Check to make sure the position switch is adjusted correctly (see Cutting Deck Position Switch Adjustment (page 6–46)). Make sure the sensing plate and switch bracket is not loose or damaged.
3. Disconnect position switch that requires testing from machine wire harness.
4. Check the continuity of the switch by connecting a multimeter (ohms setting) across the switch connector terminals.
5. With the cutting unit in the lowered position, there should be continuity (zero resistance) across the switch terminals.
6. Raise the cutting unit. There should be no continuity (infinite resistance) across the switch terminals.
7. Replace switch as needed. Reconnect switch to machine wire harness.
8. If the switch tests correctly and a circuit problem still exists, check the wire harness (see Appendix A (page A–1)).
9. Check and adjust switch position as necessary (see Cutting Deck Position Switch Adjustment (page 6–46)).

24 Volt Cooling Fans

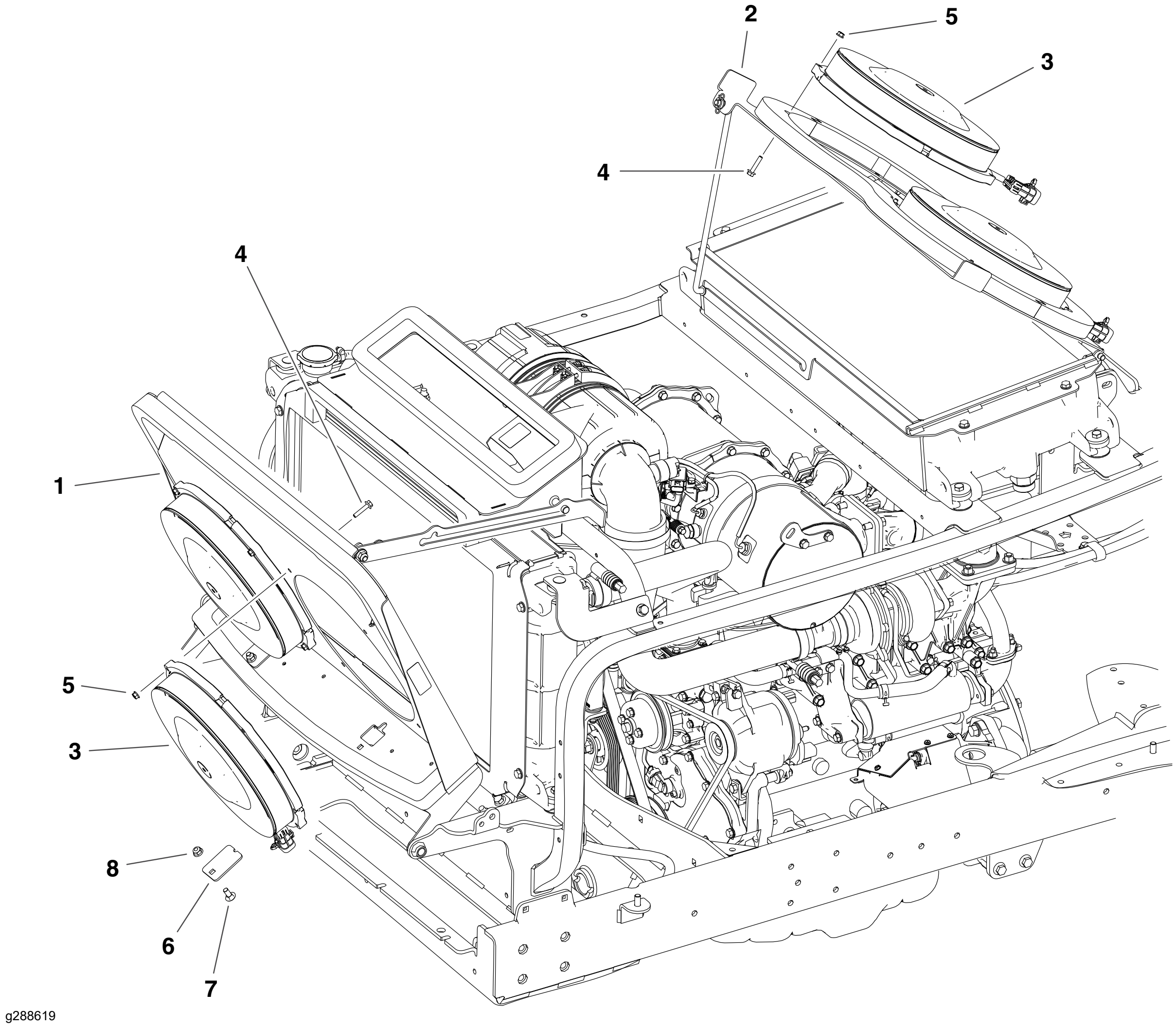


Figure 272

1. Radiator cooling fan panel
2. Hydraulic oil cooler fan panel
3. 24 Volt cooling fan (4)
4. Flange head screw (16)
5. Flange nut (16)
6. Harness cover plate (2)
7. Flange head screw (2)
8. Flange nut (2)

Groundsmaster 5900/5910 machines include two (2) panels of cooling fans. One panel cools the radiator and the other cools the hydraulic oil cooler. Each panel includes two (2) 24 volt cooling fans operating at the same speed and direction. All four cooling fans are identical.

Each of the four (4) fan assemblies include the 24 VDC fan motor and a 12 VDC fan controller. The cooling fan motors receive power from the 24 Volt system contactor. Using inputs from the coolant temperature sender and the hydraulic oil temperature sender, the primary TEC works with the internal fan controllers as necessary to control the fan speed and direction. In return, the fan controllers provide a hard wired fault signal used as an input to the primary TEC as the cooling fans are not on the CAN−bus system (see CAN−bus Communications (page 6–8)).

Note: If a fault code is generated by a cooling fan, both fans in the panel must be tested.

See 24 Volt System (page 6–7) for additional fan operation information.

Testing

⚠ CAUTION ⚠

Be aware of and keep away from rotating parts during test. Do not wear loose clothing while working near rotating parts as these may become entangled and cause personal injury.

---

1. Park machine on a level surface, lower cutting decks, engage the parking brake, leave the engine running and open the hood.

   Note: The engine must be running, no coolant or hydraulic oil temperature warnings can be active and the parking brake needs to be engaged or an operator must be in the seat for fan override or demo modes to be operational.

   Note: The hydraulic oil cooler fans will operate at maximum speed if a hydraulic oil temperature sender fault is active.

2. Use the InfoCenter display to enter either Fan Override Mode or Fan Demo Mode (see SERVICE (page 6–14)).

   If Fan Override Mode is selected, use the InfoCenter to manually control the radiator cooling fans and/or the hydraulic oil cooler fans direction and speed. When operating in the reverse direction, the selected fans will operate for approximately six (6) seconds, pause for approximately nine (9) seconds and repeat.

   If Fan Demo Mode is selected, the following fan operating sequence will begin automatically:

   A. Radiator fans at maximum speed in forward direction and hydraulic oil cooler fans at maximum speed in forward direction for one minute.

   B. Radiator fans at maximum speed in reverse direction and hydraulic oil cooler fans at maximum speed in forward direction for one minute.

   C. Radiator fans at maximum speed in reverse direction and hydraulic oil cooler fans at maximum speed in reverse direction for one minute.

   D. Radiator fans at maximum speed in forward direction and hydraulic oil cooler fans at maximum speed in reverse direction for one minute.

   E. Repeat.

3. Cancel fan override or fan demo mode and return to the previous screen by pressing button 5 or by turning the key switch to OFF.

4. If one fan in the panel is not operating correctly, exchange the fan connections at the machine wire harness and re−enter Demo Fan Mode. If the problem remains unchanged, a problem with the fan is likely. If the problem follows the exchange, or both fans in the panel do not operate correctly, something other than the fan is at fault (e.g. wire harness or connectors).

5. Use a phototach (non−contact tachometer) to compare the RPM of each fan in a panel. The fans speeds should be within 100 RPM of each other when operating at maximum speed.

6. Replace the fan as necessary.

7. Inspect and repair or replace any worn or damaged foam seals on either side of the cooling fan panels.

24 Volt Alternator

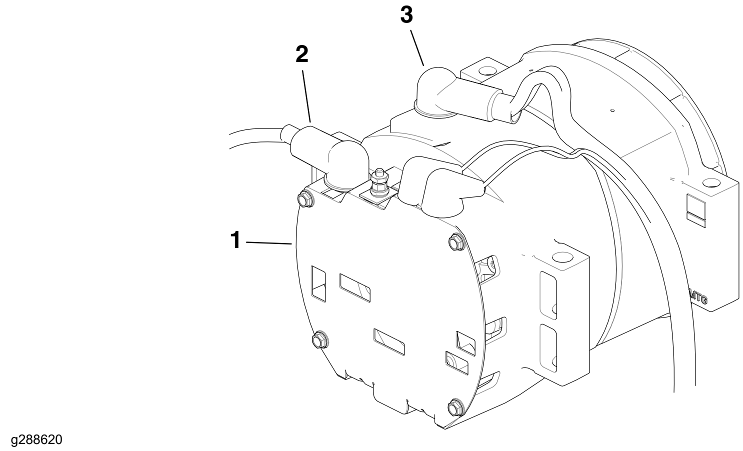


Figure 273

1. 24 Volt alternator
2. Positive (+) terminal
3. Negative (−) terminal (alternator body)

The Groundsmaster 5900/5910 uses two (2) batteries connected together in series to support the 24 Volt cooling fan circuit. The 24 Volt system is charged by an 105 Amp 24 Volt alternator driven by a multi−row V−belt. The 24 Volt alternator is mounted to the machine frame with isolation washers to prevent the alternator body from contacting the frame.

CAUTION

The 24 Volt alternator body must remain isolated from the machine frame. Do not allow metal tools to come in contact with the 24 Volt alternator body and other machine components while the 24 volt system is active.

Be aware of and keep away from rotating parts during test. Do not wear loose clothing while working near rotating parts as these may become entangled and cause personal injury.

A battery−disconnect switch is included on the machine which should be used to disconnect the 12 VDC and 24 VDC system components from the electrical power supply to prevent component damage or unexpected component operation when performing service.

Testing

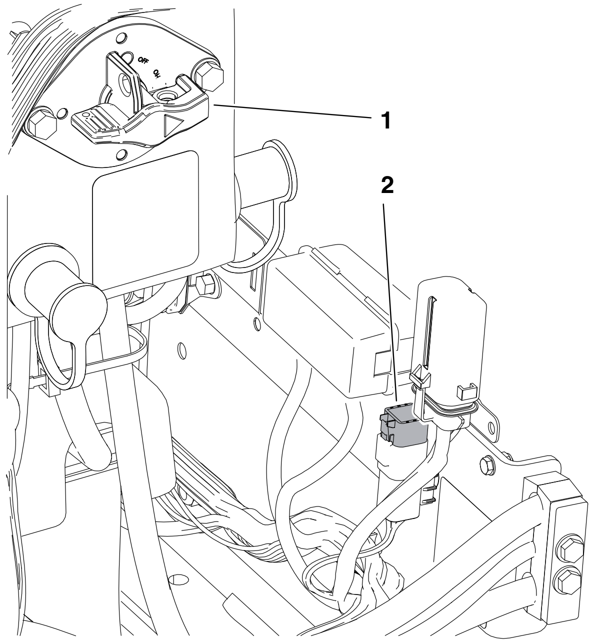
1. Perform the electrical system quick checks (see Electrical System Quick Checks (page 6–42)).
2. Use a battery load tester (carbon pile) and a multimeter (DC voltage setting) to perform a Voltage Drop test on both the positive and negative circuits between the alternator and the battery (see Voltage Drop Test | Delco Remy Tech Tip − YouTube for additional information).

Testing (continued)

The total system loss (both circuits) should not exceed 1.0 Volt. Clean and tighten cable connections and replace damaged cables if the voltage loss is too high.

3. Remove the alternator for additional testing if necessary (see 24 Volt Alternator (page 6–149)).
4. Contact your Authorized Toro Distributor or a Delco Remy authorized Dealer for further assistance.

24 Volt Voltage Divider



g288621

Figure 274

1. Battery−disconnect switch
2. Voltage divider

24 Volt electrical system activity is monitored as an input to the primary TEC. A voltage divider in the circuit reduces the 24 Volt system voltage for the TEC input signal to approximately 4 VDC. The TEC uses the reduced signal voltage to calculate the 24 Volt system voltage. The voltage divider is located in the rear power center in the right rear corner of the engine compartment (Figure 274).

Testing

1. Park the machine on a level surface, lower the cutting units and stop the engine. Remove the key from the key switch.
2. Turn battery−disconnect switch to the OFF position.
3. Locate the voltage divider and unplug it from the rear wire harness for testing.
4. The voltage divider can be tested using a digital multimeter (ohms setting) and the table to the right. Replace the voltage divider if testing determines that it is faulty.

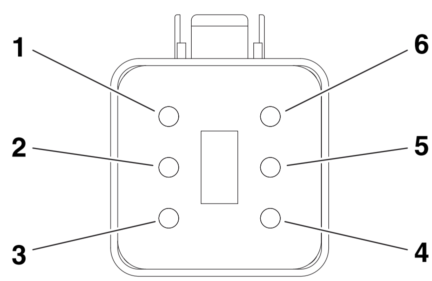


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Figure 275

5. The voltage divider terminals are marked as shown in Figure 275. With the use of a multimeter (ohms setting) the divider may be tested to determine whether each ot the internal resistors in the divider is functioning properly (shown in below table).

   Note: Voltage divider terminals 2 and 5 are not used.

Testing (continued)

Terminals	Resistor
1 + 3	R1 − 12K (12,000) ohms
6 + 3	R2 − 2K (2,000) ohms
4 + 3	R3 − 2K (2,000) ohms

6. After testing is complete, make sure that voltage divider is fully inserted into wire harness connector.
7. If the voltage divider tests correctly and a circuit problem still exists, check the wire harness (see Appendix A (page A–1)).
8. Turn the battery−disconnect switch to the ON position before returning the machine to service.

Fan Speed Switch (Machines with Two−Post ROPS Extension Operator Fan Kit)

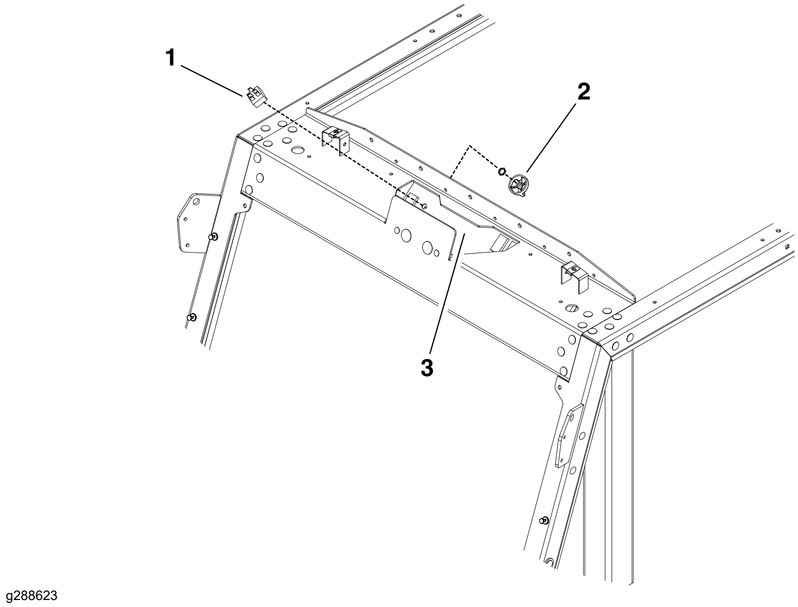

Figure 276

1. Fan speed switch
2. Control knob
3. Control panel

The fan speed switch is attached to the overhead control panel (Figure 276). The switch is used to select the fan speed (off, low, medium, or high).

Testing

1. Park the machine on a level surface, lower the cutting decks, and shut off the engine. Remove the key from the key switch.
2. To access the switch, remove the sunshade from the top of the ROPS extension.
3. Disconnect the machine wire harness from the fan speed switch.

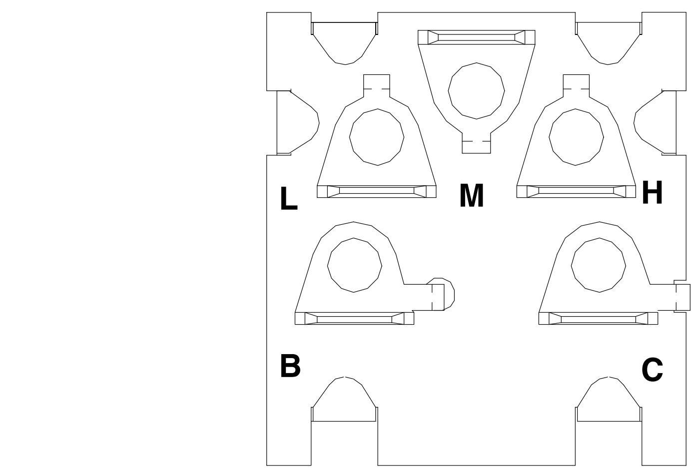

Figure 277
Back of Switch

Testing (continued)

4. The switch terminals are identified in (Figure 277). 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.

Switch Position	Closed Circuits
OFF	L+H
LOW	B+C+L
MEDIUM	B+C+M
HIGH	B+C+H

5. Replace the fan speed switch if testing determines that the switch is damaged.
6. If the fan speed switch testing is correct and a circuit problem still exists, check the wire harness; refer to Electrical Schematics and Wire Harness Drawings in Appendix A (page A–1).
7. After you complete the testing, connect the machine wire harness to the switch and install the sunshade.

Resistor Module (Machines with Two−Post ROPS Extension Operator Fan Kit)

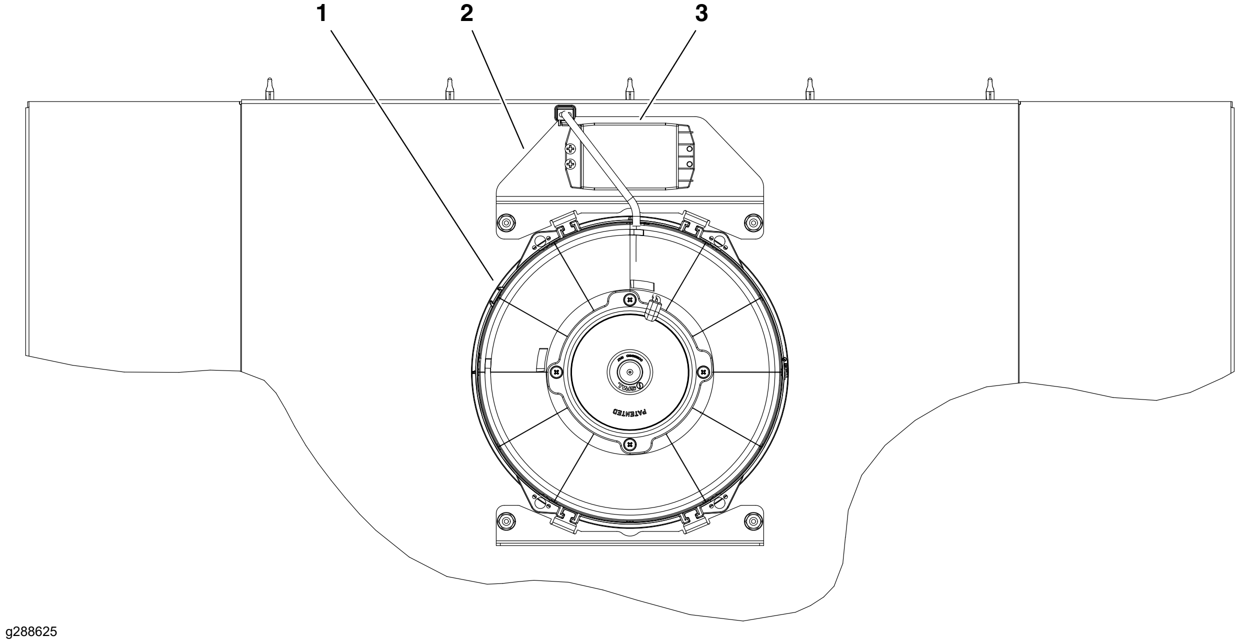

Figure 278

1. Operator's fan
2. Fan mount bracket
3. Resistor module

The resistor module is attached to the rear of the fan mounting bracket (Figure 278). The resistor module is used for operation of the operator's fan.

Testing

1. Park the machine on a level surface, lower the cutting decks, and shut off the engine. Remove the key from the key switch.
2. To access the resistor, remove the sunshade from the top of the ROPS extension.
3. Disconnect the wire harness connectors from the resistor module terminals.

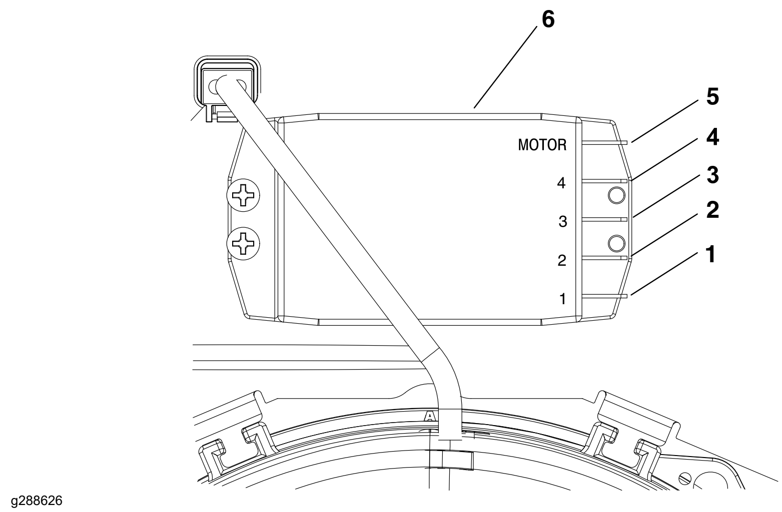

Figure 279

1. Pin 1 (Violet wire)
2. Pin 2 (Brown wire)
3. Pin 3 (Orange wire)
4. Pin 4 (Not used)
5. Motor pin
6. Resistor module

Testing (continued)

4. Use a multimeter to check that the resistance values of the resistor module as below (Figure 279).

Test Point 1	Test Point 2	Expected Reading
Motor Pin	Pin 1	Less than 9 ohms
Motor Pin	Pin 2	Less than 6 ohms
Motor Pin	Pin 3	Less than 3 ohms

5. Replace the resistor module if it fails the test.
6. If the resistor module testing is correct and a circuit problem still exists, check the wire harness; refer to Electrical Schematics and Wire Harness Drawings in Appendix A (page A–1).
7. After you complete the testing, connect the wire harness connectors to the resistor module terminals (Figure 279) and install the sunshade.

Service and Repairs

Batteries

Groundsmaster 5900/5910 machines use two (2) separate electrical systems. Most machine functions operate on a typical 12 VDC system. Two 12 Volt batteries located at the rear of the machine are connected together in parallel to support the 12 Volt electrical system. The second system exists to operate the electric cooling fans and is 24 VDC. Two 12 Volt batteries located at the rear of the machine are connected together in series to support the 24 Volt cooling fan circuit. See Electrical System Operation (page 6–7) for additional information.

Battery Storage

If the machine will be stored for more than 30 days:

1. Remove the batteries and charge them fully (see Battery Service (page 6–139)).
2. Either store batteries on a shelf or on the machine.
3. Leave cables disconnected if the batteries are stored on the machine.
4. Store batteries in a cool atmosphere to avoid quick deterioration of the battery charge.
5. To help prevent the batteries from freezing, make sure they are fully charged (see Battery Service (page 6–139)).

Battery Care

1. 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 temperatures are extremely high, the battery will discharge more rapidly than if the machine is stored in a location where temperatures are cool.

WARNING

Wear safety goggles and rubber gloves when working with electrolyte. Charge battery in a well ventilated place so gasses produced while charging can dissipate. Since the gases are explosive, keep open flames and electrical sparks away from the battery; do not smoke. Nausea may result if the gases are inhaled. Unplug charger from electrical outlet before connecting or disconnecting charger leads to or from battery posts.

2. Check battery condition weekly, after every 50 hours of operation or every 30 days if machine is in storage. Keep terminals and entire battery case clean because a dirty battery will discharge slowly.
   A. Clean battery by washing entire case with a solution of baking soda and water. Rinse with clear water.
   B. Coat battery posts and cable connectors with Battery Terminal Protector (Toro Part No. 107−0392) or petroleum jelly to prevent corrosion.
3. Battery cables must be tight on terminals to provide good electrical contact.

Battery Care (continued)

WARNING

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

4. If corrosion occurs at battery terminals, turn battery− disconnect switch to the OFF position and disconnect cables. Clean clamps and terminals separately. Reconnect cables with positive (+) cables first. Coat battery posts and cable connectors with Battery Terminal Protector (Toro Part No. 107−0392) or petroleum jelly to prevent corrosion.

Battery Service

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

WARNING

When working with batteries, use extreme caution to avoid splashing or spilling electrolyte. Electrolyte can destroy clothing and burn skin or eyes. Always wear safety goggles and a face shield when working with batteries.

12 Volt System Battery Specifications

Quantity: 2	
BCI Group Size 34	
690 CCA at −17.8 ºC (0 ºF)	
Reserve Capacity of 110 minutes at 26.7 ºC (80 ºF)	
Dimensions	
Length	259 mm (10.2 in)
Width	169 mm (6.7 in)
Height (including terminals)	203 mm (8.0 in)
Weight	16.5 Kg (36.5 lb)
Electrolyte Specific Gravity	
Fully charged: 1.265 corrected to 26.7 ºC (80 ºF)	
Discharged: less than 1.240	

24 Volt System Battery Specifications

Quantity: 2	
BCI Group Size UI	
340 CCA at −17.8 ºC (0 ºF)	
Reserve Capacity of 38 minutes at 26.7 ºC (80 ºF)	
Dimensions	
Length	198 mm (7.8 in)
Width	132 mm (5.2 in)
Height (including terminals)	183 mm (7.2 in)
Weight	8.8 Kg (19.5 lb)
Electrolyte Specific Gravity	
Fully charged: 1.265 corrected to 26.7 ºC (80 ºF)	
Discharged: less than 1.240	

Battery Removal

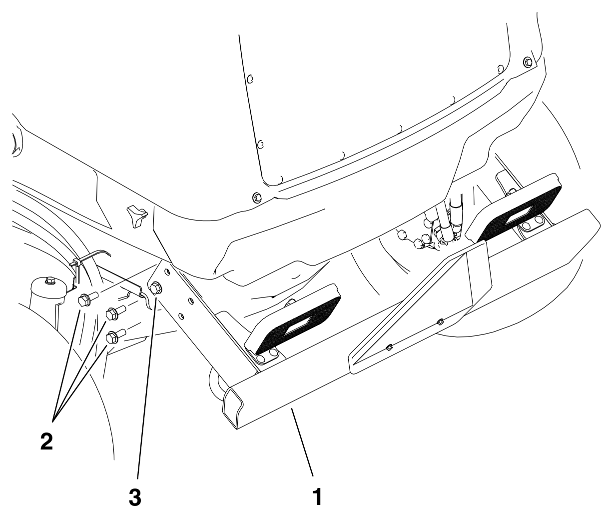

Figure 280

1. Rear bumper
2. Flange head screw (remove 3 per side)
3. Flange head screw (loosen 1 per side)

Battery Removal (continued)

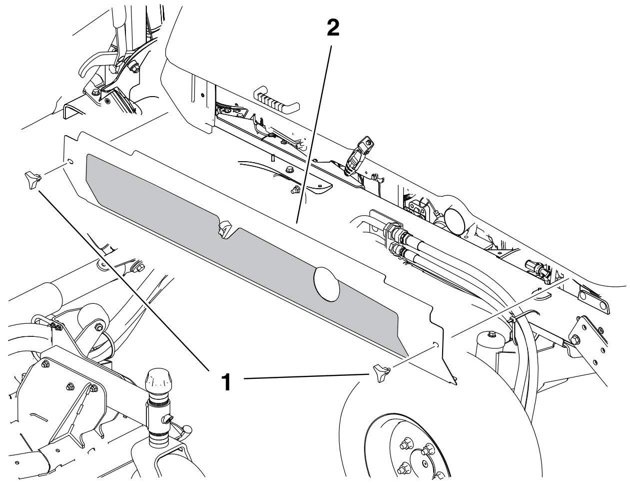

Figure 281

1. Knob (2 per side)
2. Side shroud − LH

1. Open hood and turn battery−disconnect switch to the OFF position.
2. Remove three (3) flange head screws from each side of the rear bumper as shown (Figure 280). Loosen the remaining flange head screws securing the bumper to the frame and pivot the bumper downward.
3. Loosen the knobs and remove both side shrouds (Figure 281).
4. Remove six (6) flange head screws securing rear shroud to frame and remove rear shroud (Figure 282).
5. Remove fasteners that secure battery cover to machine and remove cover (Figure 283).
6. Loosen and remove the battery cables from the batteries.
7. Remove fasteners that secure battery hold downs.
8. Carefully remove batteries from machine.

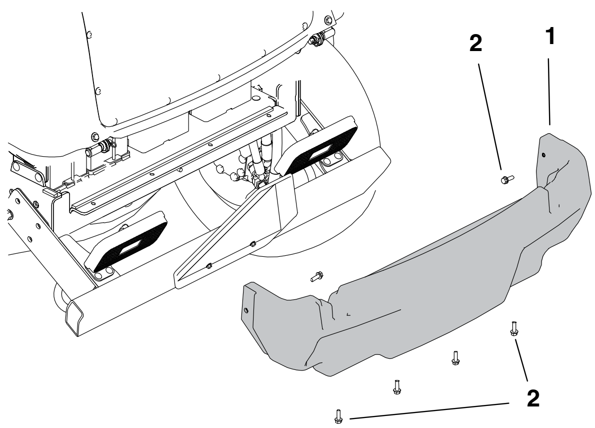

Figure 282

1. Rear shroud
2. Flange head screw (6)

Battery Removal (continued)

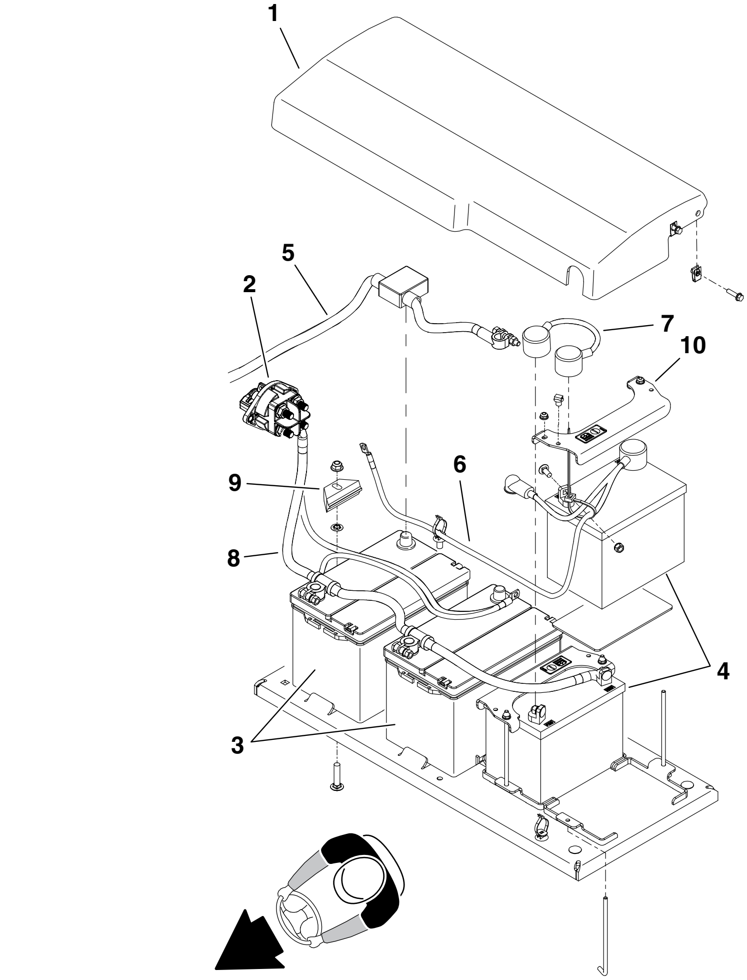

Figure 283

1. Battery cover
2. Battery−disconnect switch
3. Batteries − 12 volt for 12 VDC system) (2)
4. Batteries − 12 volt for 24 VDC system) (2)
5. Positive (+) cable (for 12 VDC system)
6. Cable assembly (for 24 VDC system)
7. Cable − jumper (for 24 VDC system)
8. Ground (−) cable
9. Battery hold down (2)
10. Battery hold down (2)

Battery Installation

1. Secure batteries with hold downs.
2. Install battery cables.
3. Position battery cover in place and secure with removed fasteners.
4. Install rear shroud (Figure 282).
5. Install side shrouds (Figure 281).
6. Raise rear bumper into position and install flange head screws. Tighten all flange head screws securing rear bumper to frame (Figure 280).
7. Turn the battery−disconnect switch to the ON position before returning the machine to service.

Battery Inspection, Maintenance, and Testing

1. Perform following inspections and maintenance:

   A. Check battery case for cracks. Replace battery if cracked or leaking.

   B. Check battery terminal posts for corrosion. Use wire brush to clean corrosion from posts.

IMPORTANT

Before cleaning the battery, tape or block vent holes.

   C. Check for signs of wetness or leakage on the top of the battery which might indicate overcharging or a loose terminal post. Also, check 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. Replace the battery if the seal is broken or leaking.

2. Perform a high−discharge test with an adjustable load tester.

   This is one of the most reliable means of testing a battery as it simulates the cold−cranking test. A commercial battery load tester is required to perform this test.

CAUTION

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

   A. Check the voltage across the battery terminals prior to load testing the battery. If the voltage is less than 12.4 VDC, charge the battery.

   B. If the battery has been charged, apply a 150 amp load for 15 seconds to remove the surface charge. Use a battery load tester following the manufacturer's instructions.

   C. Make sure battery terminals are free of corrosion.

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

   E. Apply a test load equal to one half the Cranking Performance rating of the battery for 15 seconds.

   F. Take a battery voltage reading at 15 seconds, then remove the test load. This reading is the test voltage.

Minimum Voltage	Battery Temperature	
9.6	70 ºF (and up)	21.1 ºC (and up)
9.5	60 ºF	15.6 ºC
9.4	50 ºF	10.0 ºC
9.3	40 ºF	4.4 ºC
9.1	30 ºF	−1.1 ºC
8.9	20 ºF	−6.7 ºC
8.7	10 ºF	−12.2 ºC
8.5	0 ºF	−17.8 ºC

Battery Inspection, Maintenance, and Testing (continued)

G. If the test voltage is below the minimum voltage shown in the chart, replace the battery. If the test voltage is at or above the minimum, return the battery to service.

Battery Charging

To minimize possible damage to the battery and to allow the battery to be fully charged, the slow charging method is presented here. This charging method can be accomplished with a constant current battery charger which is readily available.

CAUTION

Follow the battery charger manufacturer's instructions when using a battery charger.

---

1. Disconnect the battery cables from the battery being charged before charging (see Battery Removal (page 6–140) and Battery Installation (page 6–142)).
2. Determine the battery charge level from its 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

3. Determine the charging time and rate using the battery charger manufacturer's instructions or the following table.

Battery Reserve Capacity (Minutes)	Battery Charge Level (Percent of Fully Charged)			
	75%	50%	25%	0%
80 or less	3.8 hrs @ 3 amps	7.5 hrs @ 3 amps	11.3 hrs @ 3 amps	15 hrs @ 3 amps
81 to 125	5.3 hrs @ 4 amps	10.5 hrs @ 4 amps	15.8 hrs @ 4 amps	21 hrs @ 4 amps
126 to 170	5.5 hrs @ 5 amps	11 hrs @ 5 amps	16.5 hrs @ 5 amps	22 hrs @ 5 amps
171 to 250	5.8 hrs @ 6 amps	11.5 hrs @ 6 amps	17.3 hrs @ 6 amps	23 hrs @ 6 amps
above 250	6 hrs @ 10 amps	12 hrs @ 10 amps	18 hrs @ 10 amps	24 hrs @ 10 amps

⚠ CAUTION ⚠

Do not charge a frozen battery because it can explode and cause injury. Let the battery warm to 16 ºC (60 ºF) before connecting to a charger.

Charge the battery in a well−ventilated place to dissipate gases produced from charging. These gases are explosive; keep open flame and electrical spark away from the battery. Do not smoke. Nausea may result if the gases are inhaled. Unplug the charger from the electrical outlet before connecting or disconnecting the charger leads from the battery posts.

---

4. Following the battery charger manufacturer’s instructions, connect the charger cables to the battery. Make sure a good connection is made.
5. Charge the battery following the battery charger manufacturer’s instructions.
6. Occasionally check the temperature of the battery. If the temperature exceeds 52 ºC (125 ºF) or the electrolyte is violently gassing or venting, the charging rate must be lowered or temporarily stopped.

Hydraulic Solenoid Valve Coils

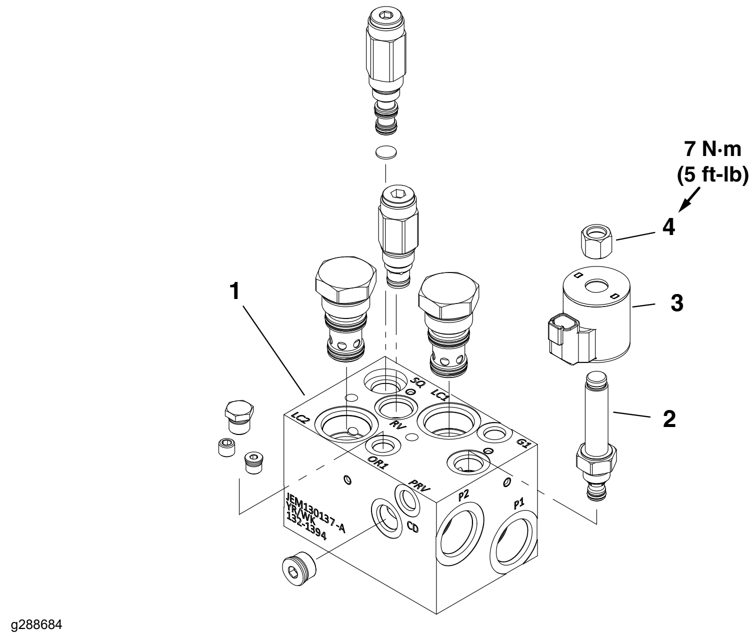

Figure 284

Cutting Deck Control Manifold

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

Most hydraulic solenoid valves used on the Groundsmaster 5900/5910 have replaceable coils. The coils can be replaced without opening the hydraulic system.

The following solenoid valves DO NOT have replaceable solenoid coils and must be replaced as an assembly (see Cartridge Valve Service (page 5–158)):

- Traction control manifold solenoid valve SV.
- Steering/Lift control manifold solenoid valve S10.

Removal (Figure 284)

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from key switch.
2. Locate the solenoid valve coil that is to be replaced.
3. Disconnect the wire harness electrical connector from the solenoid valve coil to be replaced.
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 stem.

Installation (Figure 284)

1. Slide new coil assembly onto the hydraulic valve.
2. Install the nut onto the valve and tighten nut to **7 N·m (5 ft–lb)**.
3. Connect the machine wire harness connector to the solenoid coil.

24 Volt Alternator/Air Conditioning Compressor Drive Belt

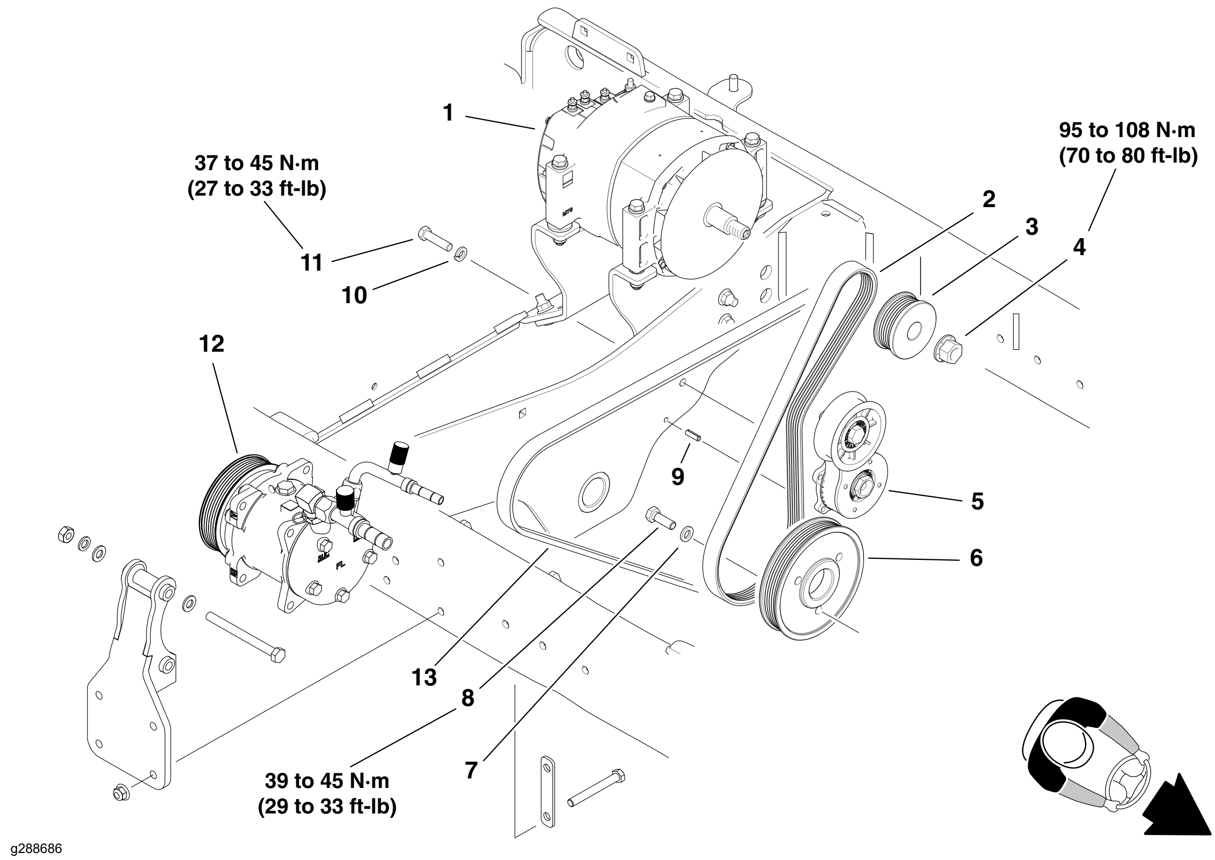

Figure 285

1. 24 Volt alternator
2. Drive belt (GM 5900)
3. Alternator pulley
4. Flange nut
5. Tensioner assembly
6. Engine pulley
7. Lock washer (3)
8. Cap screw (3)
9. Roll pin
10. Lock washer
11. Cap screw
12. Air conditioning compressor (GM 5910)
13. Drive belt (GM 5910)

Removal

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from the key switch.
2. Turn battery−disconnect switch to the OFF position.
3. Loosen the cap screw securing the drive belt tensioner (item 11) to relieve the drive belt tension and remove the drive belt.
4. Inspect drive belt for glazing, cracks or damage. Replace belt if necessary.

Installation

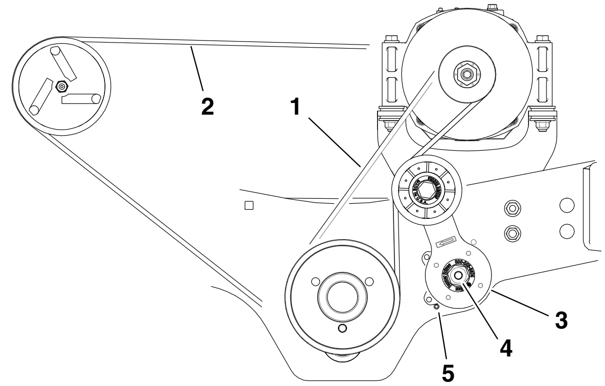

Figure 286

1. Drive belt (GM 5900)
2. Drive belt (GM 5910)
3. Tensioner assembly
4. Large hex (at tensioner base)
5. Roll pin

---

1. Install drive belt over pulleys.
2. Rotate the large hex at the base of the drive belt tensioner until the base contacts the roll pin (Figure 286). Tighten the cap screw securing the drive belt tensioner to the frame (item 11) from **37 to 45 N·m (27 to 33 ft−lb)**.
3. Turn the battery−disconnect switch to the ON position before returning the machine to service.

24 Volt Alternator

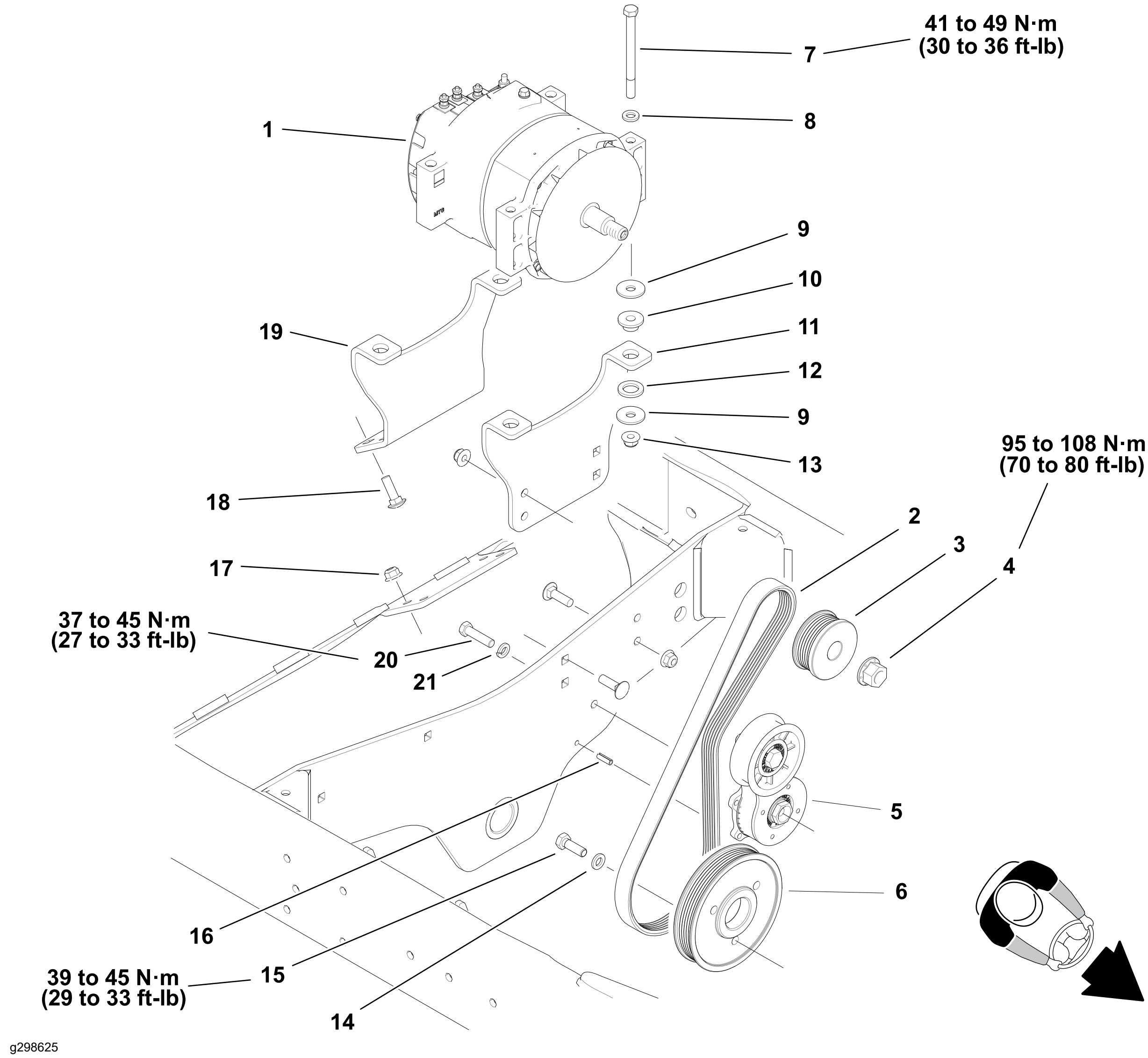

Figure 287

1. 24 Volt alternator
2. Alternator drive belt
3. Alternator pulley
4. Flange nut
5. Tensioner assembly
6. Engine pulley
7. Cap screw (4)
8. Hardened washer (4)
9. Hardened washer (8)
10. Plastic isolator (4)
11. Front mounting bracket
12. Plastic washer (4)
13. Flange nut (4)
14. Lock washer (3)
15. Cap screw (3)
16. Roll pin
17. Flange nut (8)
18. Carriage bolt (8)
19. Rear mounting bracket
20. Cap screw
21. Lock washer

Removal

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the key switch.
2. Turn battery−disconnect switch to the OFF position.
3. Remove the left side lower shroud.

Removal (continued)

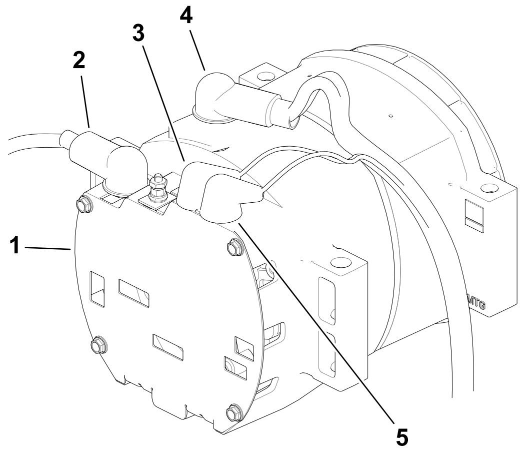

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Figure 288

1. 24 Volt alternator
2. Positive (+) terminal
3. Circuit diode (green)
4. Negative (−) terminal (alternator body)
5. Remote sense relay (violet)

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4. Disconnect the four (4) wire harness connectors from the alternator (Figure 288).
5. Remove the alternator drive belt (see 24 Volt Alternator/Air Conditioning Compressor Drive Belt (page 6–147)).
6. Loosen the four (4) alternator mounting nuts and remove the nuts, hardened washers, plastic washers, plastic isolators and cap screws.
7. Remove the alternator from the machine.

   Contact your Authorized Toro Distributor or a Delco Remy authorized Dealer for 24 Volt alternator service information.
8. Remove the pulley from the alternator shaft only if the alternator is being replaced.
9. Inspect the plastic washers and isolators for wear or damage and replace if necessary.
10. Inspect the rubber boots over each of the wire harness connectors for wear or damage and replace if necessary.

Installation

1. If previously removed, install the alternator pulley and tighten the flange nut from **95 to 108 N·m (70 to 80 ft−lb)**.

IMPORTANT

The alternator body must be isolated from the machine frame.

Installation (continued)

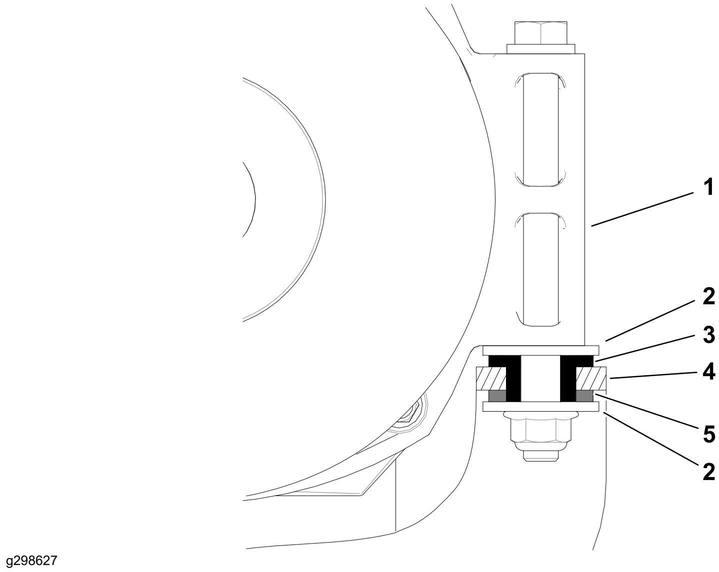

Figure 289

1. 24 Volt alternator
2. Hardened washer (8)
3. Plastic isolator (4)
4. Alternator mounting bracket
5. Plastic washer (4)

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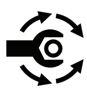
2. Install the alternator to the mounting brackets as shown (Figure 287). Make sure the plastic washers fit over the plastic isolators (Figure 289).



3. Use the clearance in the alternator mounting holes to align the alternator drive pulleys and tighten the four (4) alternator mounting screws from **41 to 49 N·m (30 to 36 ft−lb)**.

4. Install the alternator drive belt (see 24 Volt Alternator/Air Conditioning Compressor Drive Belt (page 6–147)).

5. Connect the four (4) wire harness connectors to the alternator (Figure 288).

6. Turn the battery−disconnect switch to the ON position before returning the machine to service.

Chassis

Table of Contents

General Information

Operator’s Manual

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

Service and Repairs

Wheels

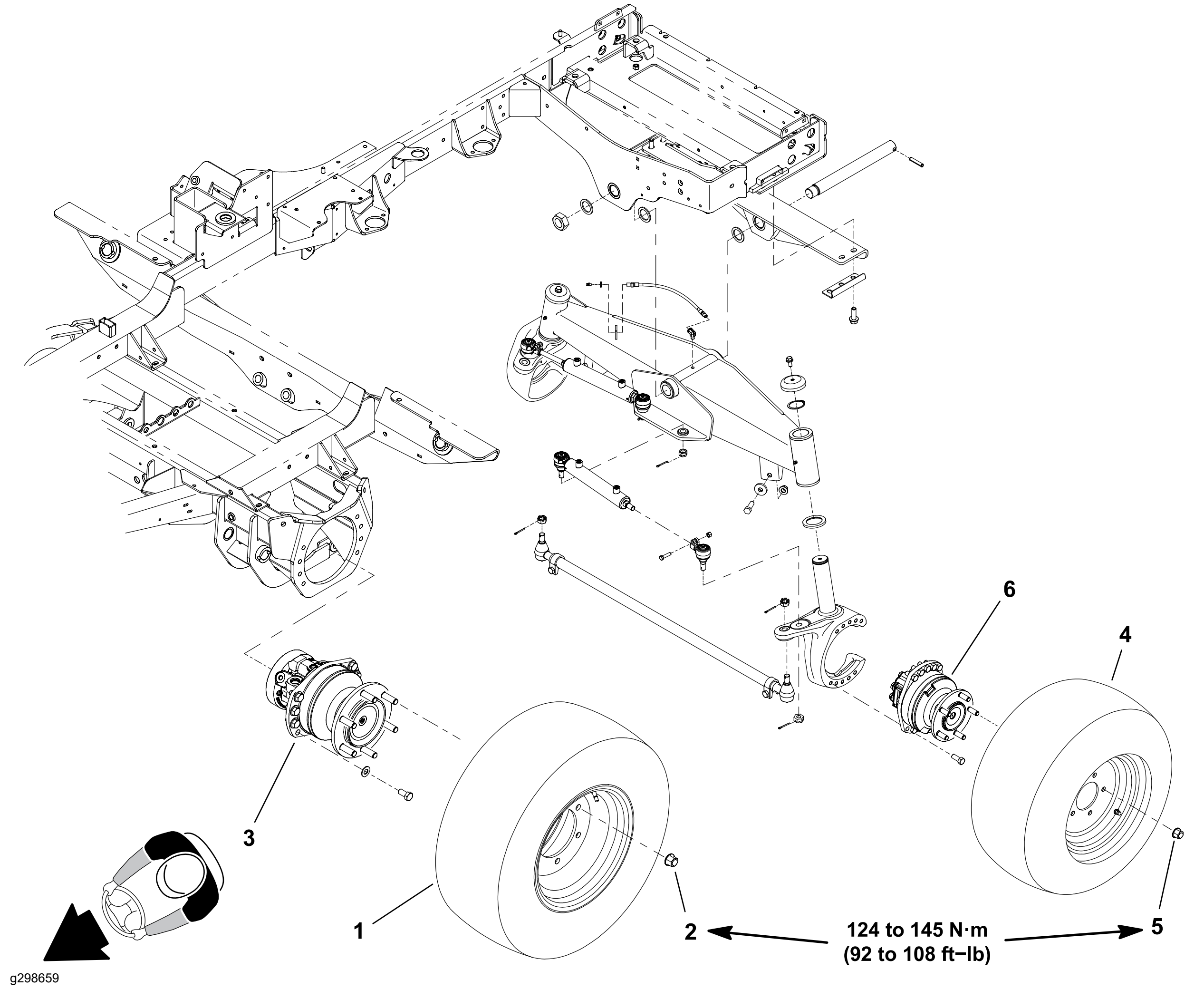


Figure 290

1. Front wheel assembly
2. Lug nut (6 per front wheel)
3. Front wheel motor
4. Rear wheel assembly
5. Lug nut (5 per rear wheel)
6. Rear wheel motor

Wheel Removal (Figure 290)

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the key switch.
2. Chock wheels to prevent machine from shifting.
3. Loosen, but do not remove, lug nuts that secure wheel to machine.

Wheel Removal (Figure 290) (continued)

CAUTION

Make sure machine is parked on a solid level surface such as a concrete floor prior to raising machine. Use appropriate hoists and jacks to raise the machine. Chock or block wheels to prevent the machine from shifting. Use appropriate jack stands to support the machine. If the machine is not properly supported by jack stands, the machine may move or fall, which may result in personal injury.

4. Using a jack, raise machine so wheel to be removed is off ground (see Jacking Instructions (page 1–6)). Support machine with appropriate jack stands.
5. Remove lug nuts and then remove wheel from machine.

Wheel Installation (Figure 290)

Note: The front wheels use six (6) lug nuts. The rear wheels use five (5) lug nuts.

1. Install wheel and secure with lug nuts.
2. Lower machine to ground.

WARNING

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

3. Torque wheel lug nuts evenly in a crossing pattern from **124 to 145 N·m (92 to 108 ft−lb)**.

Steering Column (For machines serial number below 403450000)

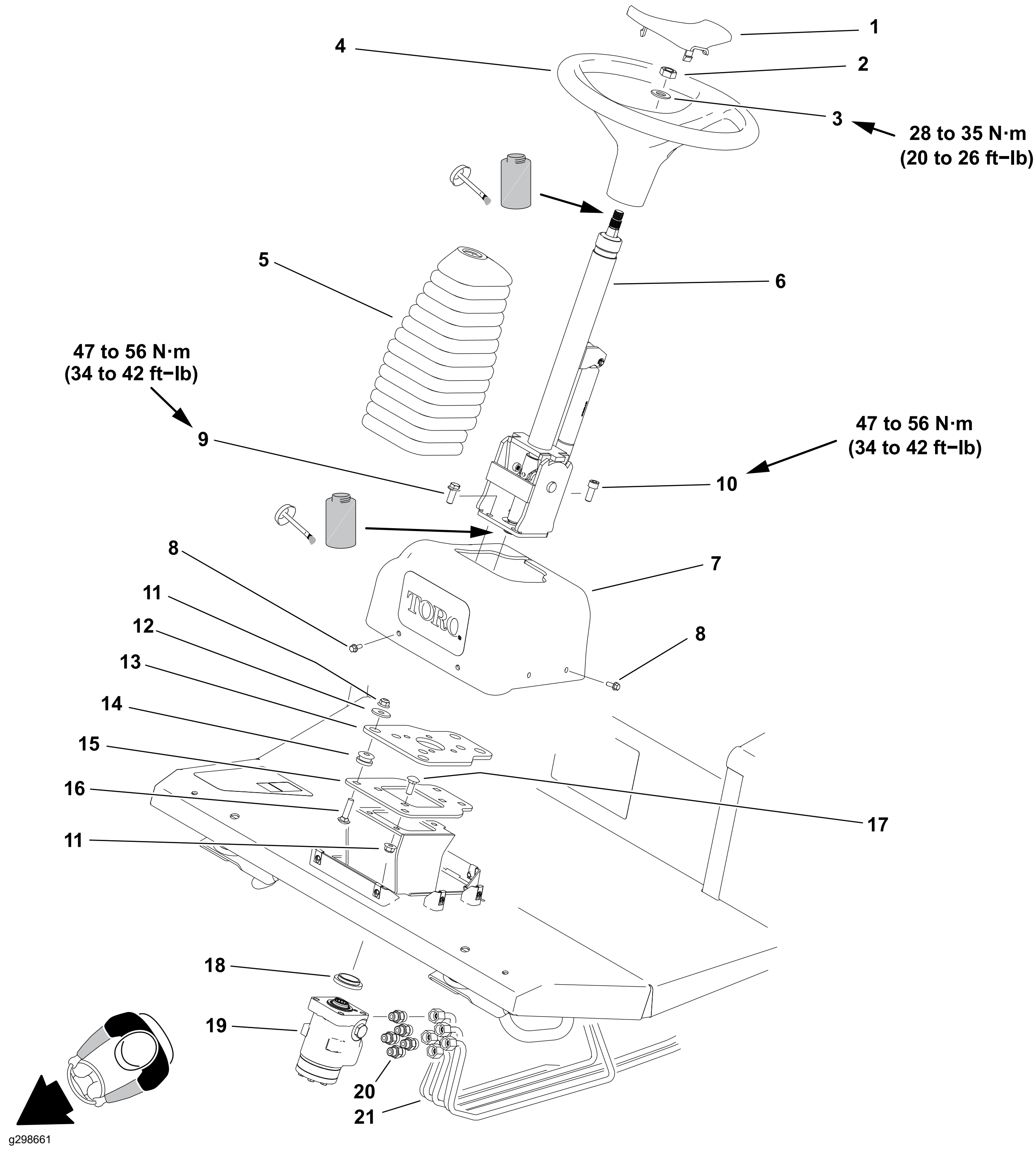


Figure 291

1. Steering wheel cover	8. Flange head screw (7)	15. Lower mounting plate
2. Hex nut	9. Flange head screw (3)	16. Carriage screw (4)
3. Flat washer	10. Socket head screw	17. Carriage screw (3)
4. Steering wheel	11. Flange nut (7)	18. Alignment bushing
5. Steering column boot	12. Flat washer (4)	19. Steering control valve
6. Steering column assembly	13. Upper mounting plate	20. Hydraulic fitting (5)
7. Steering cover	14. Rubber mount (4)	21. Hydraulic tube (5)

Note: See Steering Control Valve Service (For machines serial number below 40345000) (page 5–137).

Steering Column Removal and Disassembly (Figure 291)

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the key switch.
2. Remove the steering wheel cover, hex nut, flat washer and steering wheel.
3. Remove the bearing cover from the steering column.
4. Remove the seven (7) flange head screws and remove the steering cover (item 8).
5. Remove the steering column boot (item 5):
   A. Set the steering column tilt to the fully rearward position.
   B. Gently pull steering column boot over the tilt control lever.
   C. Set the steering column tilt to the fully forward position.
   D. Carefully lift boot up and off steering column.

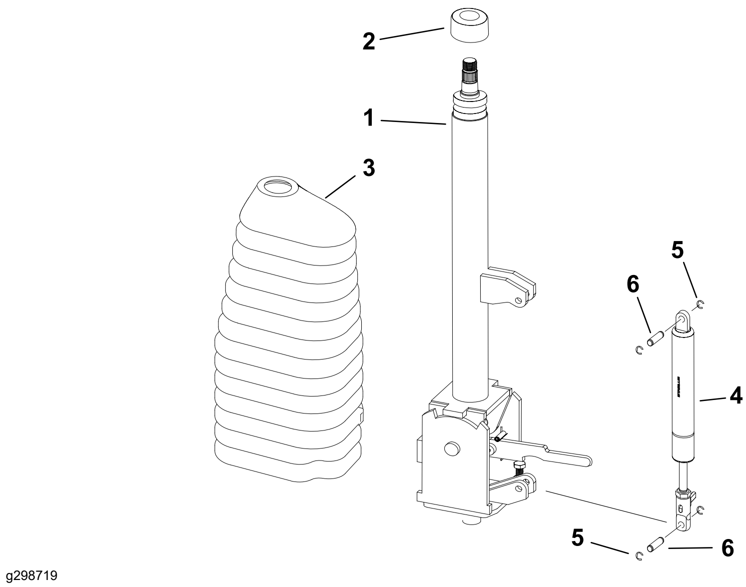


Figure 292

1.	Steering column	4.	Gas spring assembly
2.	Bearing cover	5.	E−Ring (4)
3.	Steering column boot	6.	Pivot pin (2)

6. The steering column gas spring assembly (Figure 292 item 4) controls the steering column tilt position. If gas spring assembly replacement is required, remove the gas spring assembly as follows:
   A. Set the steering column tilt to the fully forward position.
   B. Remove an E−ring (item 5) from an end of each pivot pin.

CAUTION

Be careful when removing or installing the gas spring assembly. The assembly may extend suddenly and cause personal injury.

   C. Drive the pivot pins (item 6) out and replace the gas spring assembly.
7. Support steering control valve and steering column to prevent them from falling.
8. Remove four (4) cap screws that secure steering control valve and steering column to machine. Lift steering column from steering control valve and remove from machine.

Steering Column Assembly and Installation (Figure 291)

1. Apply anti−seize lubricant to upper and lower splines of steering column shaft.
2. Hold steering column in position on machine and slide steering control valve onto lower end of steering column. Secure steering column and steering control valve to machine with four (4) cap screws. Tighten cap screws from **47 to 56 N·m (34 to 42 ft−lb)**.
3. Install the steering column boot (item 5):
   A. Carefully pull the boot down over the steering column.
   B. Set the steering column tilt to the fully rearward position.
   C. Gently pull steering column boot over the tilt control lever.
   D. Set the steering column tilt to the fully forward position.
   E. Pull the front of the boot down over the base of the steering column.
4. Install steering cover and secure with seven (7) flange head screws.
5. Install the bearing cover over the top of the steering column.
6. Install steering wheel, flat washer and hex hut. Tighten hex nut (item 2) from **28 to 35 N·m (20 to 26 ft−lb)**. Install steering wheel cover.

Steering Column (For machines serial number above 403450001)

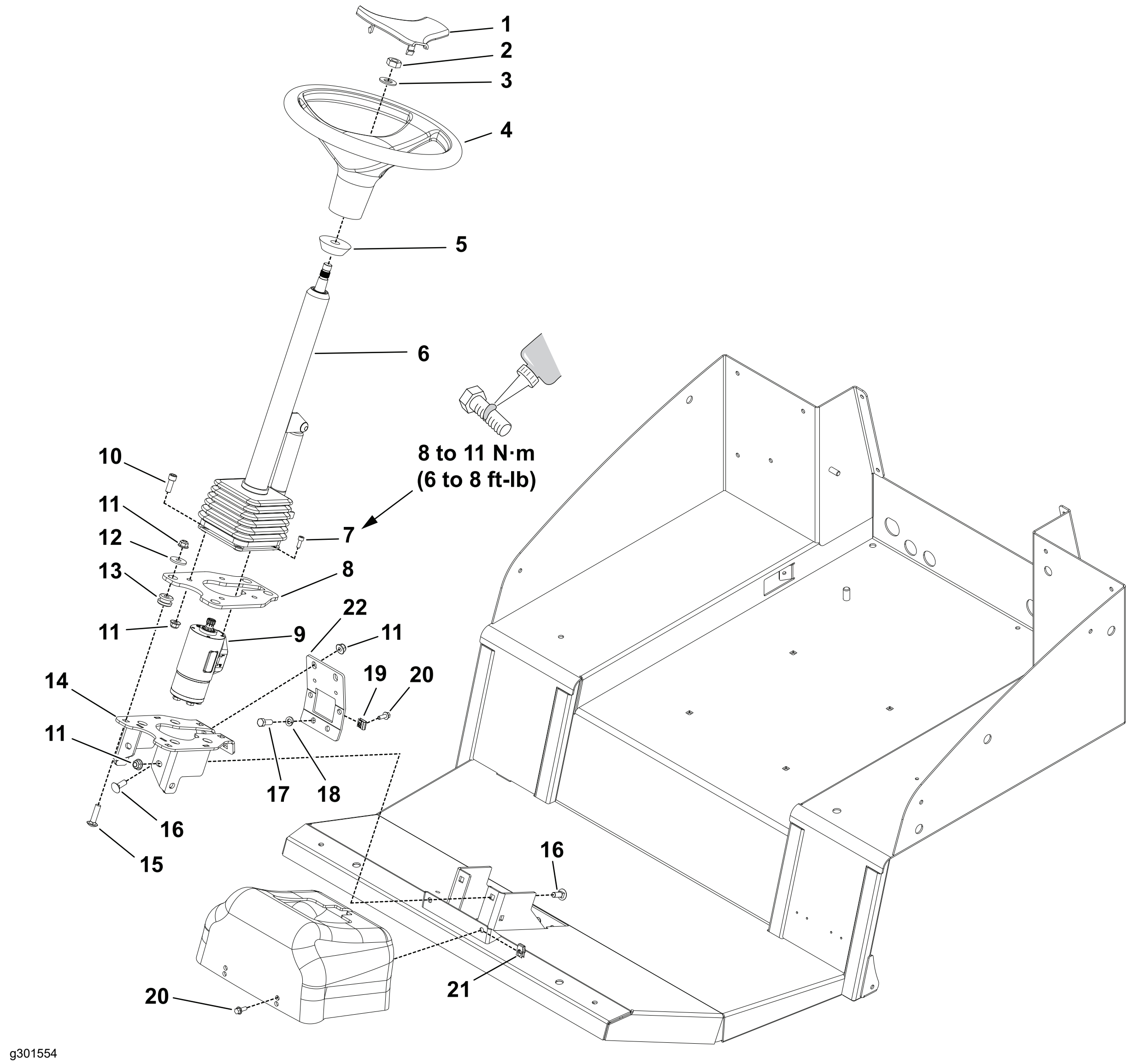


Figure 293

1. Steering wheel cover
2. Hex nut
3. Flat washer
4. Steering wheel
5. Foam collar
6. Steering shaft
7. Bolt (4 each)
8. Steering mount plate
9. Steering control valve
10. Bolt (4 each)
11. Nut (14 each)
12. Washer (4 each)
13. Mount (4 each)
14. Mount assembly
15. Carriage bolt (4 each)
16. Carriage bolt (6 each)
17. Bolt (2 each)
18. Lock washer (2 each)
19. Speed nut (2 each)
20. Bolt (4 each)
21. Clip (2 each)
22. Column support

Removal (Figure 293)

1. Park the machine on the level surface, set the parking brake, lower the cutting units, shut off the engine, and remove the key from the key switch.
2. Remove the steering cover to access the steering tower components.
3. Remove the locknut and flat washer that secures the steering wheel to the steering tower.

Removal (Figure 293) (continued)

4. Use a suitable puller to remove the steering tower to get access to the fasteners that secure the steering tower to the machine.
5. Slide the rubber bellows up the steering tower to get access to the fasteners that secure the steering tower to the machine.
6. Support the steering control valve to prevent it from falling during the steering tower removal.

   Note: Do not allow the steering control valve to hang from the hydraulic lines.
7. Remove the steering tower as needed using the Figure 293 as a guide.

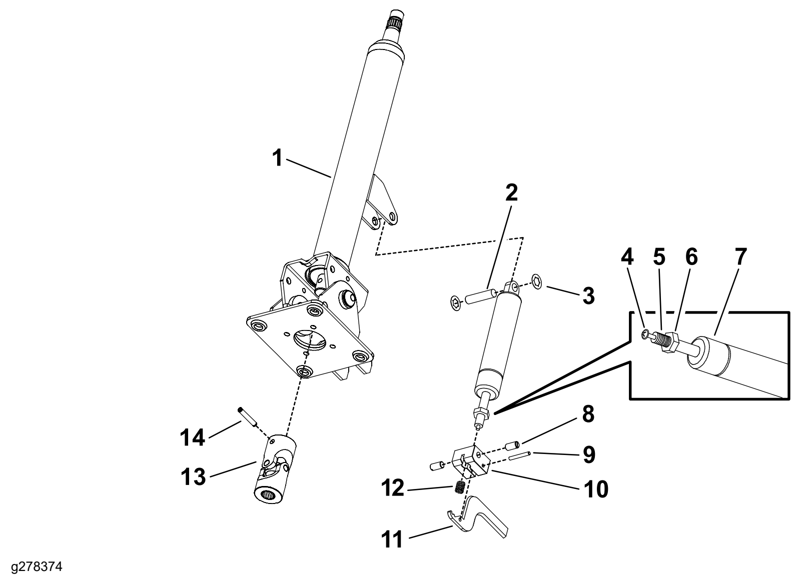


Figure 294

1.	Steering tower	8.	Bolt (2 each)
2.	Pin	9.	Pin
3.	Lock washer (2 each)	10.	Pedal block
4.	Release pin	11.	Pedal
5.	Cylinder shaft	12.	Spring
6.	Jam nut	13.	Universal joint
7.	Cylinder	14.	Pin

8. Disassemble the steering tower assembly as necessary; refer to Figure 294.

Installation (Figure 293)

1. Assemble the steering tower; refer to Figure 294.
2. After assembly, ensure that the release pin on the end of the cylinder shaft is positioned against the pedal. The jam nut on the cylinder shaft can be used to adjust the location of the release pin.
3. Install the steering tower using the Figure 293 as a guide.
4. Secure the steering wheel to the steering column assembly with the flat washer and locknut.
5. Install the steering wheel cover onto the steering wheel.

Rear Axle

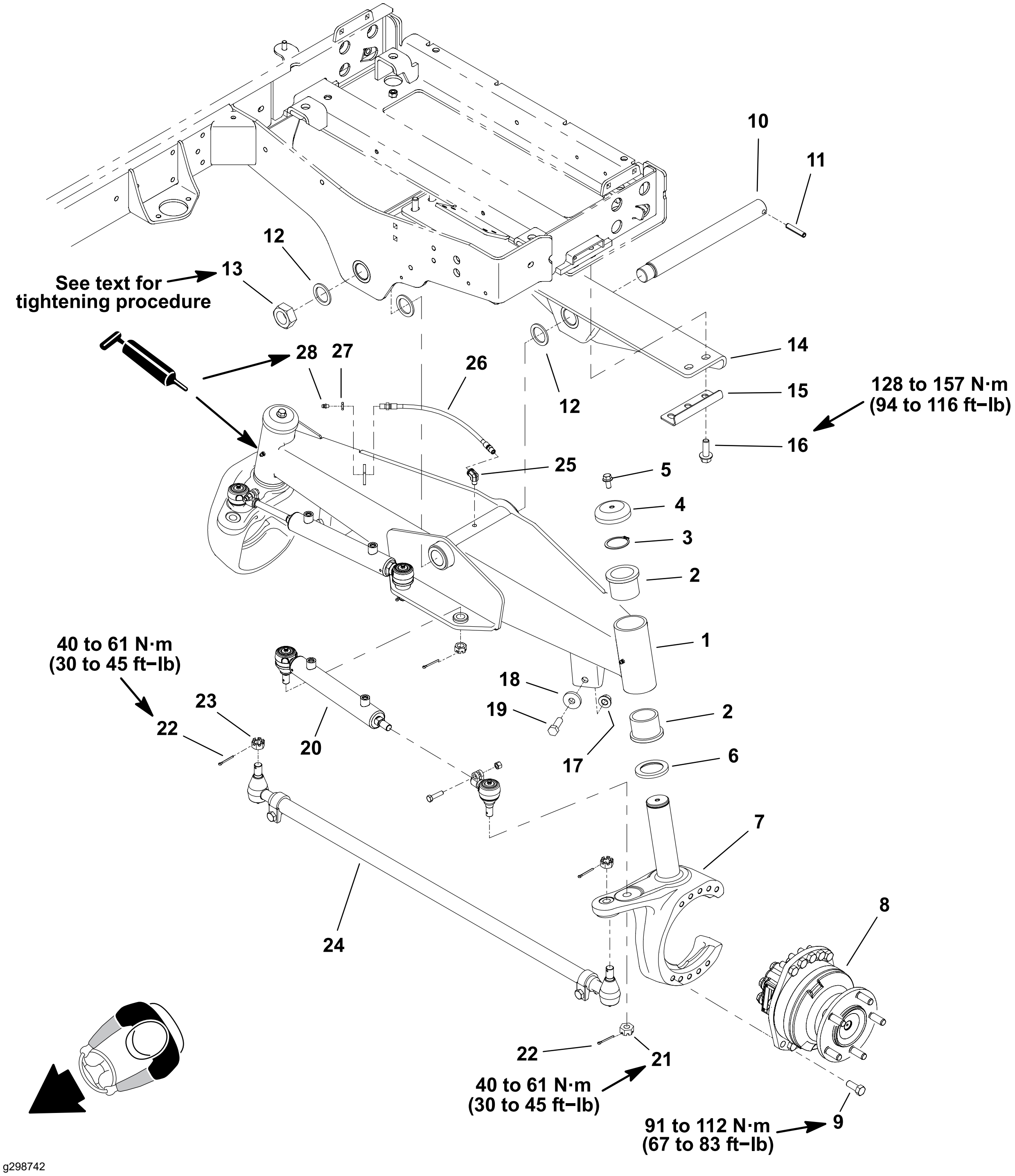


Figure 295

1. Rear axle
2. Flange bushing (4)
3. Retaining ring (2)
4. Spindle cap (2)
5. Flange head screw (2)
6. Thrust washer (2)
7. Spindle − LH
8. Wheel motor − LH
9. Cap screw (10 per motor)
10. Pivot shaft
11. Roll pin
12. Thrust washer (3)
13. Lock nut
14. Axle support
15. Hose guard(2)
16. Flange head screw (4)
17. Lock nut (2)
18. Washer (2)
19. Cap screw (2)
20. Steering cylinder (2)
21. Castle nut (4)
22. Cotter pin (6)
23. Castle nut (2)
24. Tie rod assembly
25. Elbow
26. Grease hose
27. Nut
28. Grease fitting

Rear Axle Removal (Figure 295)

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the key switch.
2. Chock front wheels to prevent machine from shifting.
3. Safely raise the machine and remove rear wheels (see Wheels (page 7–3)).
4. Thoroughly clean hydraulic hose ends at fittings on steering cylinders and the hydraulic hose ends at the frame hard lines for the rear wheel motors to prevent hydraulic system contamination.

   Note: To ease assembly, label hydraulic hoses to indicate their correct locations.

5. Disconnect the hydraulic hoses from the steering cylinders and the hydraulic hoses at the frame hard lines for the rear wheel motors. Put caps and plugs on all fittings and hoses to prevent contamination.
6. Remove the lock nut (item 13) and thrust washer that secures the axle pivot shaft to the frame.

⚠ CAUTION ⚠

The rear axle assembly weighs approximately 136 kg (300 lbs). Use an appropriate lifting device to safely lift the rear axle assembly.

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7. Support rear axle to prevent it from falling.
8. Pull the axle pivot shaft (item 10) from frame and rear axle. Carefully lower the entire axle assembly and remove it from under the machine. Locate and retrieve the two (2) thrust washers (item 12) from between the machine frame and rear axle.

   Note: If service to the rear wheel motors or steering cylinders is required, see Chapter 5: Hydraulic System (page 5–1).

Rear Axle Installation (Figure 295)

1. Thoroughly clean the rear axle pivot shaft. Inspect the shaft for wear or damage and replace if necessary.
2. Position the rear axle assembly to the frame. Install a thrust washer (item 12) between each side of the axle assembly and the machine frame. Raise axle assembly to frame and slide pivot shaft through frame, thrust washers and axle. Make sure that roll pin on pivot shaft is in good condition and positioned in frame reliefs.
3. Install thrust washer and lock nut (item 13) onto pivot shaft. Tighten lock nut to eliminate any axial (front to back) movement of rear axle. Make sure that axle can still pivot freely after lock nut is tightened.
4. Install the hydraulic hoses to the steering cylinders and the rear wheel motors.

⚠ WARNING ⚠

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

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5. Install rear wheels. Tighten wheel lug nuts evenly in a crossing pattern from **124 to 145 N·m (92 to 108 ft–lb)**.
6. Lower the machine to the ground.

Rear Axle Installation (Figure 295) (continued)

7. Check oil level in hydraulic reservoir and add if necessary (see machine *Operator's Manual*).
8. Lubricate the rear axle pivot bushings and spindle pivot bushings through the grease fittings provided.
9. Check rear wheel toe−in and adjust as necessary (see machine *Operator's Manual*).
10. Check to make sure that no contact is made between any machine components (including hydraulic hoses) as the rear wheels are moved from steering lock to steering lock. Correct any interference as necessary.
11. Operate machine and check hydraulic connections at steering cylinders and wheel motors for leaks.

Rear Axle Service

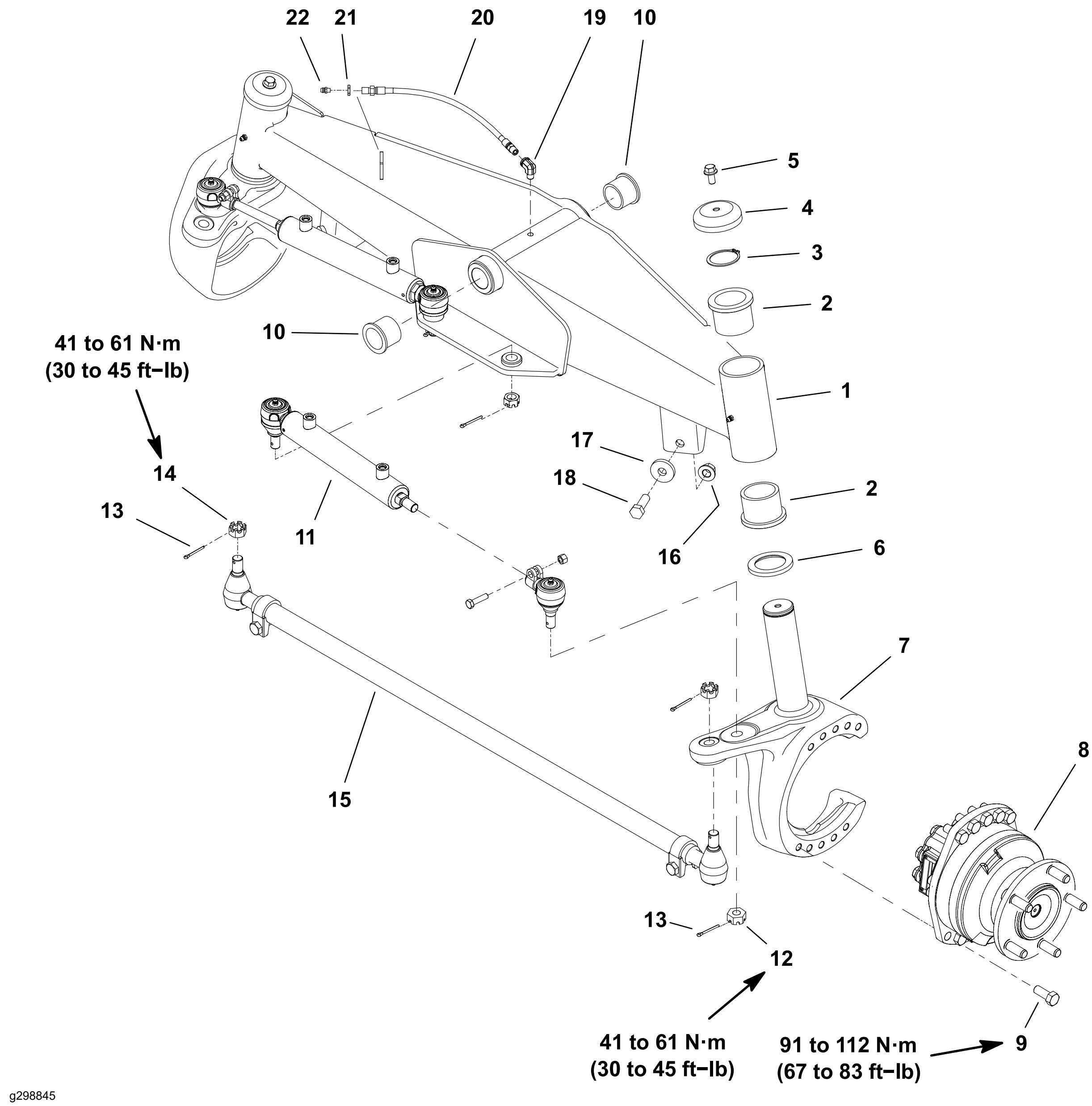

Figure 296

1. Rear axle
2. Flange bushing (4)
3. Retaining ring (2)
4. Spindle cap (2)
5. Flange head screw (2)
6. Thrust washer (2)
7. Spindle – LH
8. Wheel motor – LH
9. Cap screw (10 per motor)
10. Flange bushing (2)
11. Steering cylinder (2)
12. Castle nut (4)
13. Cotter pin (6)
14. Castle nut (2)
15. Tie rod assembly
16. Lock nut (2)
17. Washer (2)
18. Cap screw (2)
19. Elbow
20. Grease hose
21. Nut
22. Grease fitting

Note: If service to the rear wheel motors or steering cylinders is required, see Chapter 5: Hydraulic System (page 5–1).

Tie Rod Disassembly and Assembly

1. Remove cotter pins and slotted hex nuts from tie rod ends. Discard cotter pins.
2. Use a suitable puller (pickle fork) to separate tie rod ends from the steering spindles.

   Note: One of the tie rod ball joints has left hand threads.

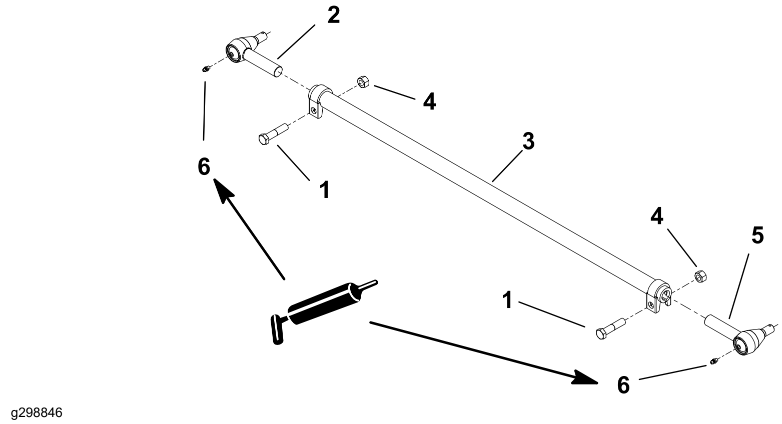

Figure 297

1. Cap screw (2)
2. Tie rod end − LH thread
3. Tie rod tube
4. Lock nut (2)
5. Tie rod end − RH thread
6. Grease fitting (2)

3. Loosen the clamp cap screws and lock nuts then unscrew ball joints from tie rod (Figure 297).

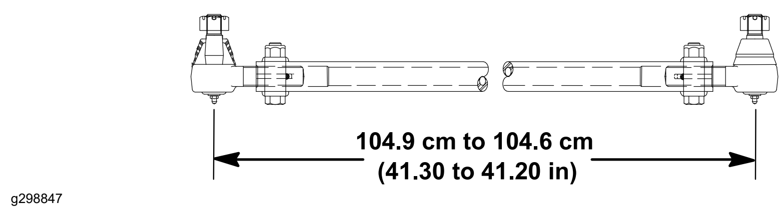

Figure 298

4. Thread ball joints equally into tie rod so that center to center length is from 104.9 to 104.6 cm (41.30 to 41.20 in) (Figure 298).
5. Thoroughly clean the tapered surfaces of the tie rod ball joints and steering spindles.
6. Connect the tie rod ends to the steering spindles with slotted hex nuts. Torque nut from **40 to 61 N·m (30 to 45 ft−lb)**. Install cotter pin.
7. Check and adjust rear wheel toe−in (see machine *Operator's Manual*).
8. Lubricate the tie rod ball joints.
9. Check to make sure that no contact is made between any machine components (including hydraulic hoses) as the rear wheels are moved from steering lock to steering lock. Correct any interference as necessary.

Rear Axle Spindle Bushing Replacement

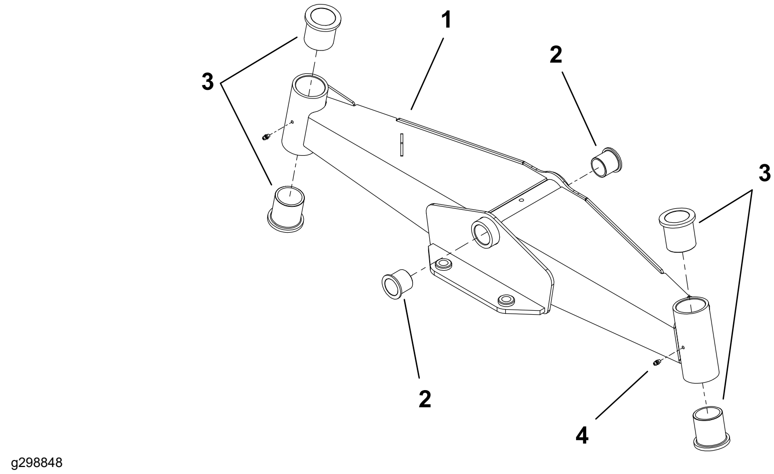

Figure 299

1. Rear axle
2. Pivot bushing (2)
3. Spindle bushing (4)
4. Grease fitting (2)

The rear wheel steering spindles must fit snugly in the rear axle. Excessive movement of the spindle in the axle might indicate that the steering spindle bushings are worn and should be replaced.

1. Remove rear axle from machine (see Rear Axle (page 7–10)).
2. Remove the tie rod assembly (see Tie Rod Disassembly and Assembly (page 7–14)).
3. Remove the steering cylinder ball joint at the steering spindle (see Steering Cylinders (page 5–139)).
4. If necessary, remove the ten (10) cap screws securing the rear wheel motor to the steering spindle and remove the rear wheel motor.
5. Remove the flange head screw, spindle cap and retaining ring that secure the steering spindle into the axle. Remove the spindle from the axle. Locate and retrieve thrust washer from steering spindle shaft.
6. Remove both spindle bushings from the axle. Take care to not damage the bore of the axle spindle tube. Clean the inside of the axle tube to remove any dirt or foreign material.
7. Apply grease to the inside and outside of the new bushings. Press the bushings into the top and bottom of the axle. Press bushings into axle until bushing flange contacts axle.
8. Thoroughly clean the steering spindle shaft. Inspect the spindle for wear and replace if worn or damaged.
9. Install thrust washer onto the spindle shaft and slide the shaft up through the axle. Hold the spindle shaft assembly in place and install the retaining ring into the groove in the spindle shaft.
10. Install the spindle cap and flange head screw.
11. Install the steering cylinder ball joint at the steering spindle (see Steering Cylinders (page 5–139)).

Rear Axle Spindle Bushing Replacement (continued)

12. Install the tie rod assembly (see Tie Rod Disassembly and Assembly (page 7–14)).
13. If removed, install the rear wheel motor to the steering spindle. Tighten the cap screws from **91 to 112 N·m (67 to 83 ft−lb)**.
14. Install rear axle to machine (see Rear Axle (page 7–10)).
15. Lubricate the steering spindles through the grease fittings on the rear axle.
16. Check rear wheel toe−in and adjust if necessary (see machine *Operator's Manual*).
17. Operate machine and check hydraulic connections at steering cylinders and wheel motors for leaks.
18. Check to make sure that no contact is made between any machine components (including hydraulic hoses) as the rear wheels are moved from steering lock to steering lock. Correct any interference as necessary.

Axle Pivot Bushing Replacement

The rear axle must be held in place snugly by the axle pivot shaft. Excessive twisting in the machine frame or side−to−side movement of the axle, which is often characterized by erratic steering, might indicate worn axle pivot bushings. To correct the problem, replace the rear axle pivot bushings (Figure 299).

1. Remove rear axle from machine (see Rear Axle (page 7–10)).
2. Remove both pivot bushings from the axle. Take care to not damage the bore of the axle pivot tube. Clean the inside of the pivot tube to remove any dirt or foreign material.
3. Apply grease to the inside and outside of the new bushings. Press the bushings into the front and back of the axle. Press bushings into axle until bushing flange contacts axle.
4. Thoroughly clean the steering spindle shaft. Inspect the spindle for wear and replace if worn or damaged.
5. Install rear axle to machine (see Rear Axle (page 7–10)).
6. Lubricate the axle pivot through the grease fitting on the rear axle.

Front Deck Lift Arms

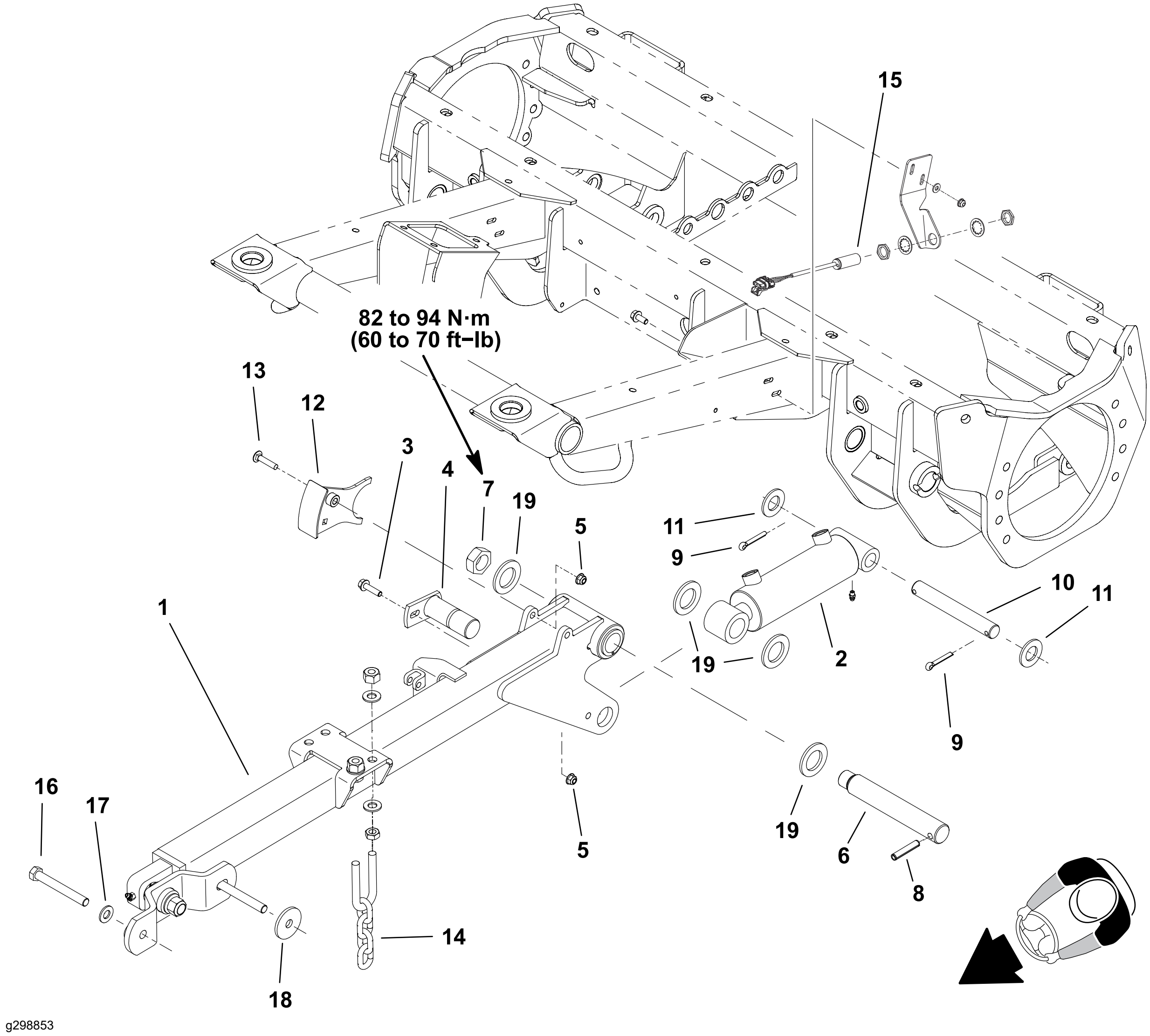

Figure 300

1.	Lift arm (left shown)	8.	Roll pin	15.	Front deck position switch (machine serial numbers above 316000200 shown)
2.	Lift cylinder	9.	Cotter pin	16.	Switch bracket
3.	Flange head screw	10.	Cylinder pin	17.	Cap screw
4.	Pivot pin	11.	Flat washer (2 per cylinder)	18.	Flat washer
5.	Flange nut	12.	Sensing plate	19.	Thrust washer
6.	Lift arm pin	13.	Carriage bolt (2)	20.	Washer (4 per cylinder)
7.	Lock nut	14.	HOC Chain		

Note: See Front Cutting Deck Lift Cylinders (page 5–143).

Front Deck Lift Arm Removal (Figure 300)

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the key switch.
2. Remove front cutting deck (see Front Cutting Deck (page 8–3)).

Front Deck Lift Arm Removal (Figure 300) (continued)

CAUTION

Make sure machine is parked on a solid level surface such as a concrete floor prior to raising machine. Use appropriate hoists and jacks to raise the machine. Chock or block wheels to prevent the machine from shifting. Use appropriate jack stands to support the machine. If the machine is not properly supported by jack stands, the machine may move or fall, which may result in personal injury.

3. Chock rear wheels and jack up front of machine. Support machine on jack stands. Remove front wheel next to lift arm that is being removed (see Wheels (page 7–3)).
4. Remove flange head screw and flange nut that secure lift cylinder pin (item 4) to lift arm. Remove pin and washers and separate lift cylinder from lift arm.
5. Remove lock nut (item 7) that secures lift arm pin.
6. Support lift arm and slide pin and washers from frame and lift arm. Remove lift arm from frame.

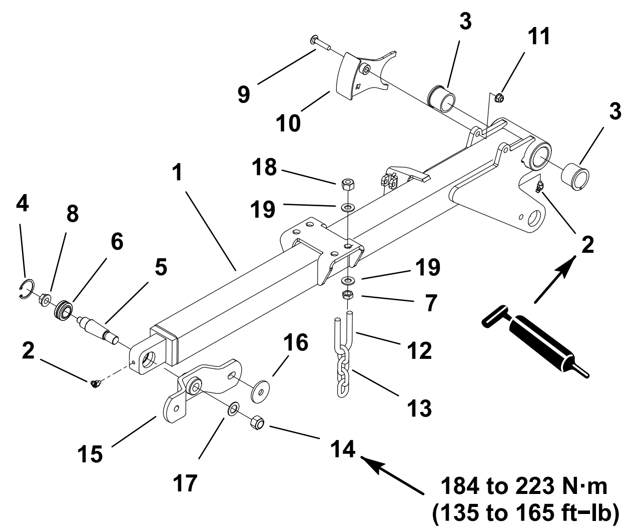

Figure 301

1. Lift arm (LH shown)
2. Grease fitting
3. Flange bushing (2)
4. Retaining ring
5. Tapered stud
6. Spherical bearing
7. Jam nut (2)
8. Flange nut
9. Carriage screw
10. Sensing plate
11. Flange nut
12. U−bolt
13. HOC chain
14. Lock nut
15. Support hub
16. Thrust washer
17. Flat washer
18. Lock nut (2)
19. Flat washer (4)

7. As needed, disassemble lift arm (Figure 301):

   A. Remove height−of−cut chain.

   B. Remove lock nut, flat washer and support hub from tapered stud in lift arm.

Front Deck Lift Arm Removal (Figure 300) (continued)

C. Remove retaining ring that secures spherical bearing in lift arm. Remove tapered stud with spherical bearing from lift arm. Separate flange nut and spherical bearing from stud.

D. Press flange bushings from lift arm. Thoroughly clean lift arm bore.

Front Deck Lift Arm Installation (Figure 300)

1. If removed, install components to lift arm (Figure 301):

   A. Assemble height−of−cut chain u−bolt so that there is 46 mm (1.8 in) between the inside loop of the u−bolt and the bottom of the mounting plate.

   B. Lightly lubricate new flange bushings and press bushings into lift arm. Make sure that bushing flange is pressed fully to lift arm surface.

   C. Install spherical bearing on tapered stud and secure with flange nut. Install stud with spherical bearing into lift arm and secure with retaining ring.

   D. Thoroughly clean tapered surfaces of stud and mounting boss of support hub. Secure support hub (position slotted hole in hub toward rear of deck) to tapered stud with flat washer and lock nut. Tighten lock nut from **184 to 223 N·m (135 to 165 ft−lb)**.

2. Position lift arm and washers to frame and insert lift arm pin. Engage roll pin into frame slots and install lock nut on pin. Tighten lock nut from **82 to 94 N·m (60 to 70 ft−lb)**.

3. Align lift cylinder and washers with lift arm. Slide lift cylinder pin through lift arm, washers and cylinder end. Secure pin with flange head screw and flange nut.

4. Install front wheel assembly (see Wheels (page 7–3)). Lower machine to the ground.

WARNING

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

5. Tighten wheel lug nuts evenly in a crossing pattern from **124 to 146 N·m (92 to 108 ft−lb)**.

6. Install front cutting deck (see Front Cutting Deck (page 8–3)).

7. Lubricate lift arm grease fittings.

8. After assembly is completed, raise and lower the cutting deck to verify that hydraulic hoses and fittings do not contact other components.

Front Deck Lift Arm Installation (Figure 300) (continued)

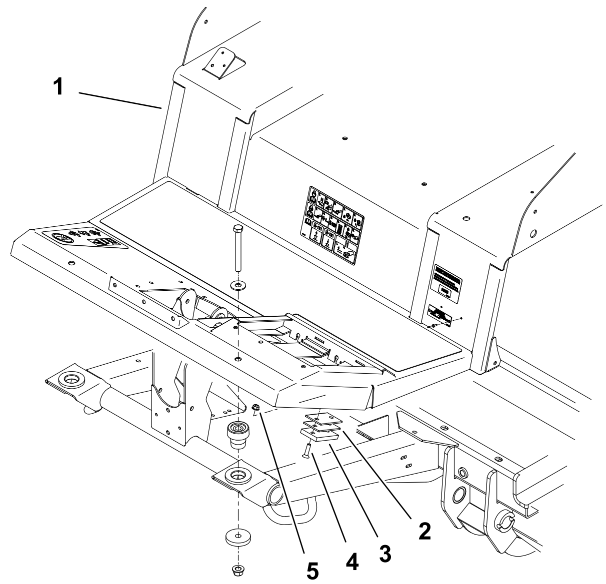

Figure 302

1. Operator platform
2. Shim pad
3. Bumper pad
4. Flange head screw
5. Flange nut

---

9. When lift arms are fully raised, check that gap between lift arms and bumper pads on bottom of operator platform is no greater than 1.5 mm (0.06 in) (Figure 302). If necessary, add or remove shim pads so that gap is correct.
10. Verify correct operation of front deck position switch and adjust as necessary (see Cutting Deck Position Switch Adjustment (page 6–46)).
11. Check blade rake and adjust rear chains as necessary (see machine *Operator's Manual* − Front Deck Leveling).
12. Check height−of−cut adjustment and adjust if necessary (see machine *Operator's Manual*).

Wing Deck Lift Arms

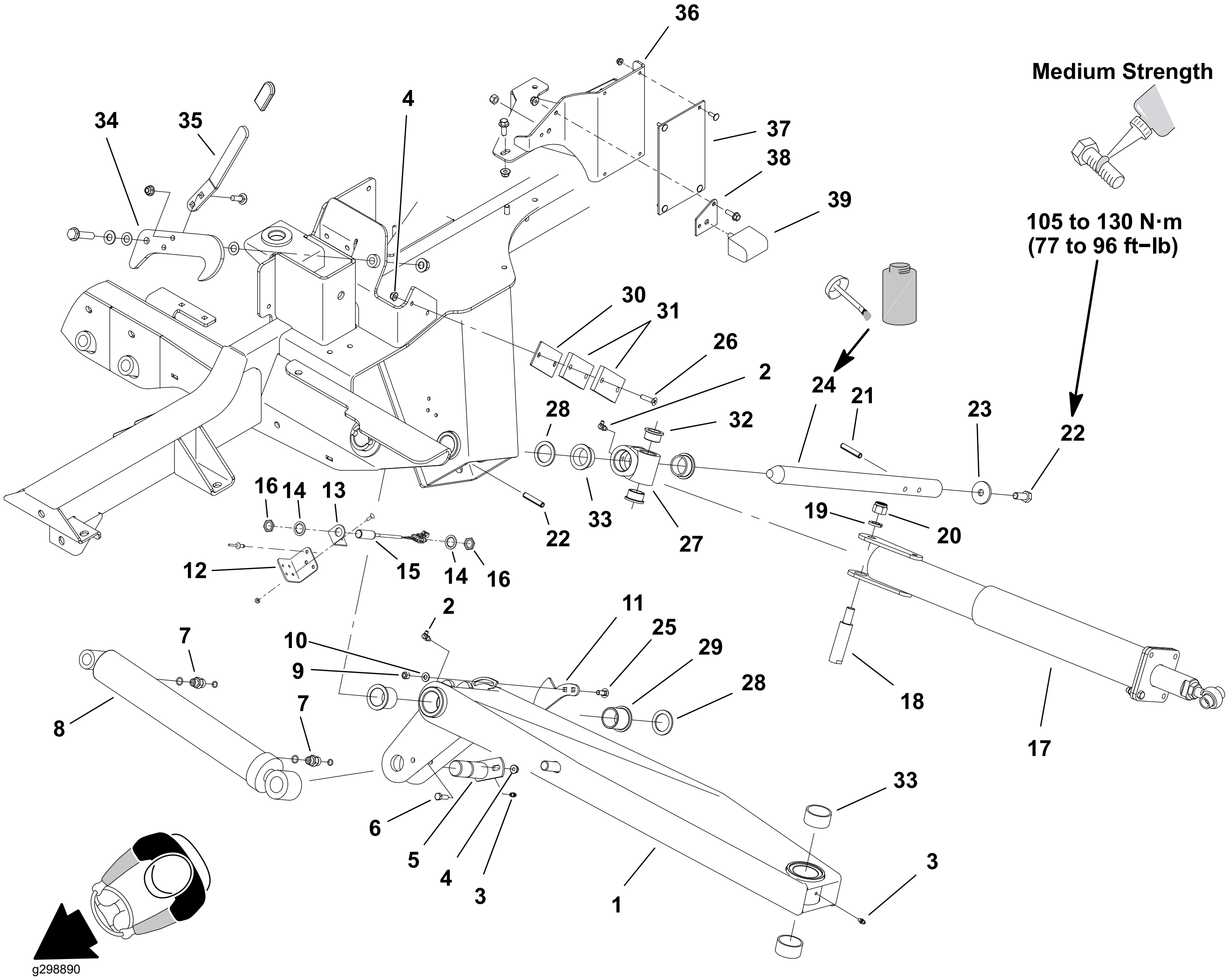

Figure 303

1. Lift arm (LH shown)
2. Grease fitting
3. Grease fitting
4. Flange nut
5. Cylinder pin
6. Cap screw
7. Hydraulic fitting
8. Lift cylinder
9. Lock nut (2 per plate)
10. Flat washer (2 per plate)
11. Sensing plate
12. Bracket
13. Sensor mount
14. Lock washer (2)
15. Wing deck position switch (machine serial numbers above 316000200 shown)
16. Lock nut (2)
17. Impact arm assembly
18. Pivot shaft
19. Lock washer
20. Lock nut
21. Roll pin (2)
22. Cap screw
23. Thrust washer
24. Lift arm pivot shaft
25. Carriage screw (2 per plate)
26. Screw (2)
27. Pivot hub assembly
28. Thrust washer (2)
29. Flange bushing (2)
30. Shim
31. Bumper pad (2)
32. Bushing (2)
33. Flange bushing (2)
34. Latch
35. Latch handle
36. Transport pad
37. Roller pad
38. Shim
39. Bumper

Note: For wing deck lift cylinder removal and installation information, see Wing Cutting Deck Lift Cylinders (page 5–148).

Wing Deck Lift Arm Removal (Figure 303)

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the key switch.
2. Remove wing deck from lift arm (see Wing Cutting Decks (page 8–9)).
3. Remove wing deck impact arm assembly from pivot hub (see Wing Deck Impact Arm Assembly (page 7–31)).
4. Remove joint yoke and cutting deck connection from lift arm (Figure 306 and Figure 307):
   A. Support cutting deck connection to prevent it from falling.
   B. Remove cotter pin, slotted hex nut, hardened washer and thrust washers from joint yoke shaft.
   C. Lower joint yoke, cutting deck connection and wing deck impact arm assembly from lift arm.
5. Remove cap screw and flange nut that secure lift cylinder pin (item 5) to lift arm. Slide cylinder pin from lift cylinder and lift arm. Separate lift cylinder from lift arm.
6. Remove cap screw (item 23) and flat washer from lift arm pivot shaft.
7. Slide wing deck impact arm pivot hub and thrust washer (item 29) from lift arm pivot shaft.
8. Drive out roll pins (item 22) that retain lift arm pivot shaft to frame. Discard roll pins.

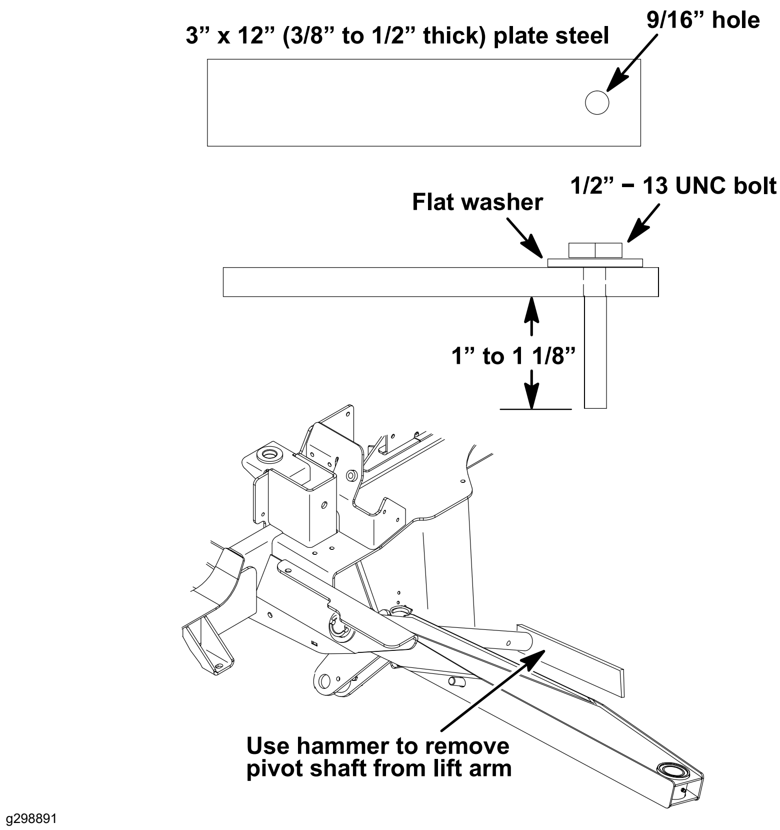

Figure 304

Wing Deck Lift Arm Removal (Figure 303) (continued)

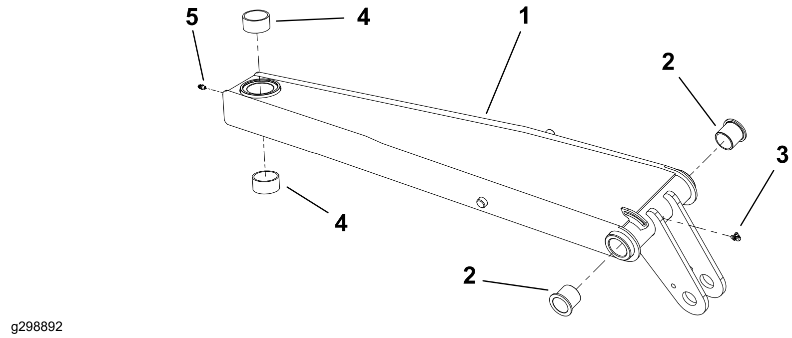

Figure 305

1. Lift arm (LH shown)
2. Flange bushing (2)
3. Grease fitting
4. Straight bushing (2)
5. Grease fitting

---

9. Support lift arm to prevent it from shifting or falling. Remove lift arm pivot shaft and lift arm from machine. Locate and remove thrust washer (item 29) during pivot shaft removal.

   Note: If pivot shaft is difficult to remove, fabricate a puller (Figure 304). Attach puller to end of pivot shaft with a bolt and flat washer. Drive pivot shaft from lift arm and frame with hammer.

10. If necessary, press bushings from lift arm (Figure 305). Thoroughly clean lift arm bores.

Wing Deck Lift Arm Installation (Figure 303)

1. If bushings were removed from lift arm, press new bushings into lift arm bores. Make sure that bushings are pressed fully to lift arm surface.
2. Apply anti−seize lubricant to lift arm pivot shaft.
3. Position lift arm to frame with thrust washer (item 29) positioned between rear of lift arm and frame. Slide pivot shaft into position and install new roll pins (item 22) to secure lift arm pivot shaft to frame.
4. Slide thrust washer (item 29) and impact arm pivot hub onto pivot shaft. Make sure that thrust washer is between frame and pivot hub.
5. Apply medium strength thread locker to threads of cap screw (item 23). Secure pivot hub to pivot shaft with washer (item 24) and cap screw. Torque cap screw from **105 to 130 N·m (77 to 96 ft−lb)**.
6. Position lift cylinder in lift arm. Slide cylinder pin into lift arm and lift cylinder. Secure cylinder pin with cap screw (item 6) and flange nut.

Wing Deck Lift Arm Installation (Figure 303) (continued)

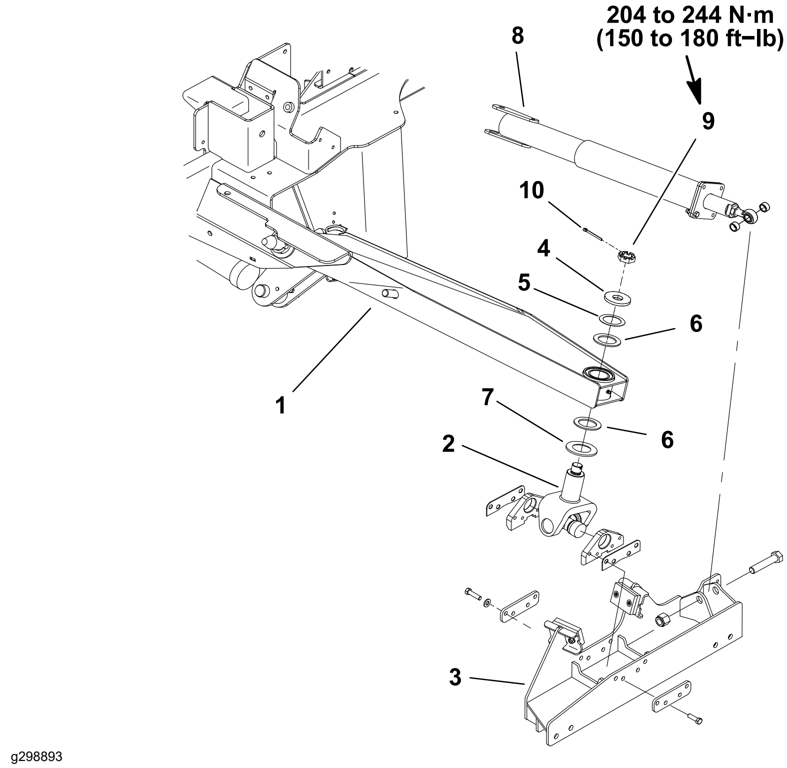

Figure 306

(For machines serial number below 403450000)

1. Lift arm (LH shown)
2. Joint yoke
3. Deck connection
4. Hardened washer
5. Thrust washer
6. Thrust washer
7. Spacer
8. Impact arm
9. Slotted hex nut
10. Cotter pin

Wing Deck Lift Arm Installation (Figure 303) (continued)

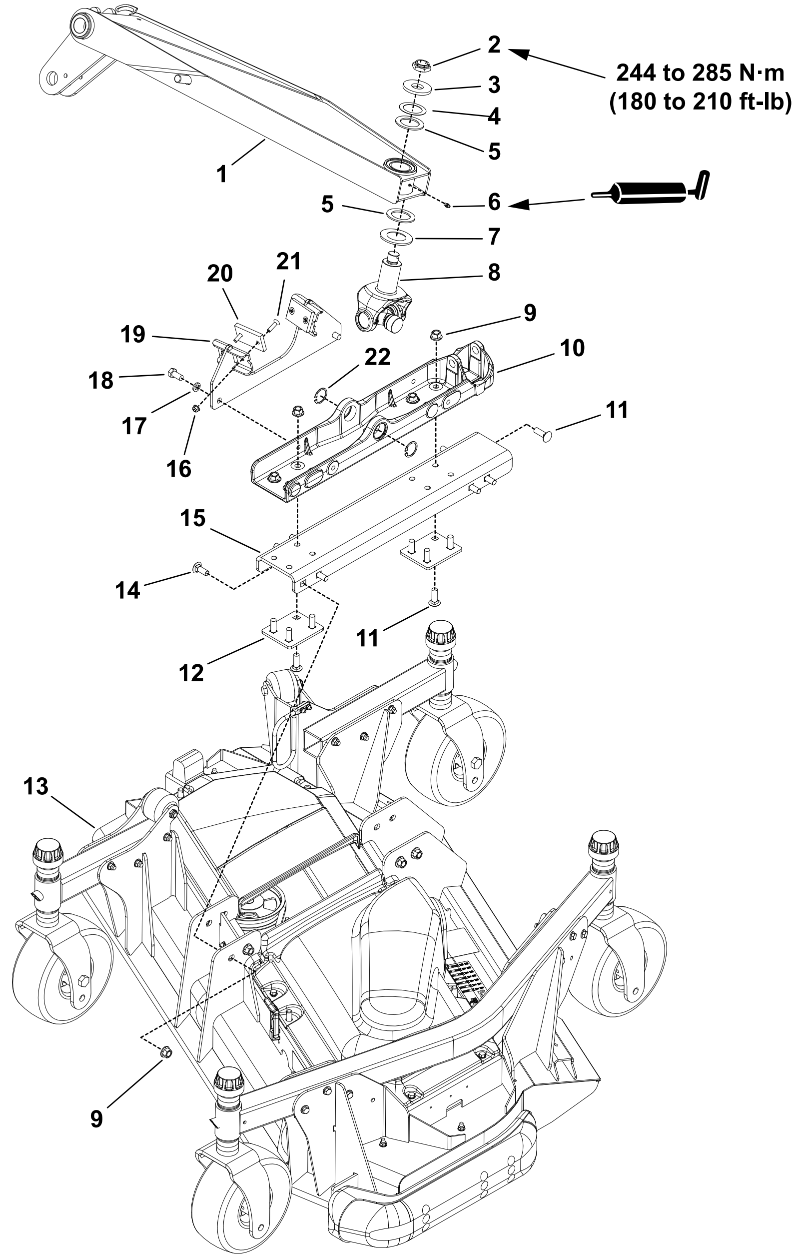

Figure 307

(For machines serial number above 403450001)

1.	Lift arm (LH shown)	8.	Yoke joint	15.	LH channel assembly
2.	Lock nut	9.	Nut (16 each)	16.	Nut (4 each)
3.	Hardened washer	10.	Deck mount	17.	Lock washer (2 each)
4.	Thrust washer	11.	Carriage bolt (10 each)	18.	Bolt (2 each)
5.	Thrust washer	12.	Spacer plate	19.	Deck stop
6.	Grease fitting	13.	Left cutting deck	20.	Bumper pad (2 each)
7.	Spacer	14.	Carriage bolt (6 each)	21.	Screw (4 each)

7. Install joint yoke and cutting deck connection to lift arm (Figure 306 and Figure 307):

   A. Make sure that spacer and thrust washer are installed on joint yoke.

Wing Deck Lift Arm Installation (Figure 303) (continued)

B. Raise joint yoke, cutting deck connection and wing deck impact arm assembly to lift arm. Slide joint yoke into lift arm bore.

C. Place second thrust washer onto joint yoke shaft and then place washer(s) (item 5) as needed to remove as much clearance as possible between thrust washer and hardened washer (item 4) location.

D. Install slotted hex nut to secure joint yoke to lift arm. Torque hex nut from **204 to 244 N·m (150 to 180 ft−lb)**. Make sure that joint yoke rotates in lift arm without binding and that excessive clearance does not exist in yoke assembly.

8. Secure wing deck impact arm assembly to pivot hub (see Wing Deck Impact Arm Assembly (page 7–31)).
9. Position and install wing cutting deck to machine (see Wing Cutting Decks (page 8–9)).
10. Lubricate lift arm grease fittings after assembly is complete.
11. After assembly is completed, raise and lower the cutting deck to verify that hydraulic hoses and fittings do not contact anything throughout the full range of movement.
12. When lift arm is fully raised, check that light contact exists between the lift arm and bumper pad (item 32). The bumper pad should not compress more than 4 mm (0.15 in). If necessary, add or remove shims (item 31) so that contact is correct.
13. When lift arm is fully raised, check that light contact exists between the lift arm and the transport pad bumper (item 39). The bumper should not compress more than 3 mm (0.12 in). If necessary, add or remove shims (item 38) so that contact is correct.
14. Verify correct operation of wing deck proximity sensor.

Wing Deck Lift Arm Joint Yoke

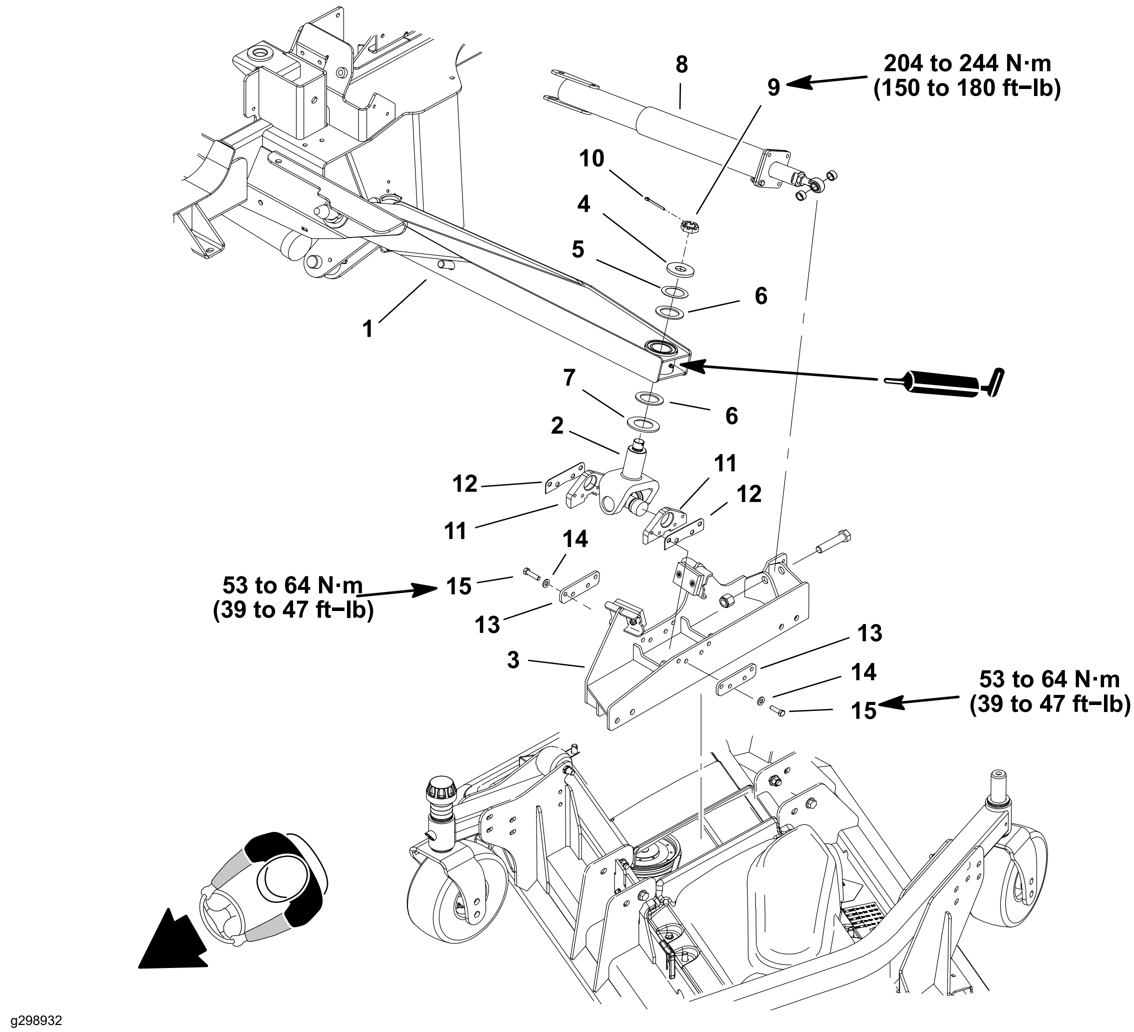

Figure 308

(For machines serial number below 403450000)

1. Lift arm (LH shown)	6. Thrust washer	11. Base mount (2)
2. Joint yoke	7. Spacer	12. Shim (2)
3. Deck connection	8. Impact arm	13. Bolt plate (2)
4. Hardened washer	9. Slotted hex nut	14. Hardened washer (8)
5. Thrust washer	10. Cotter pin	15. Cap screw (8)

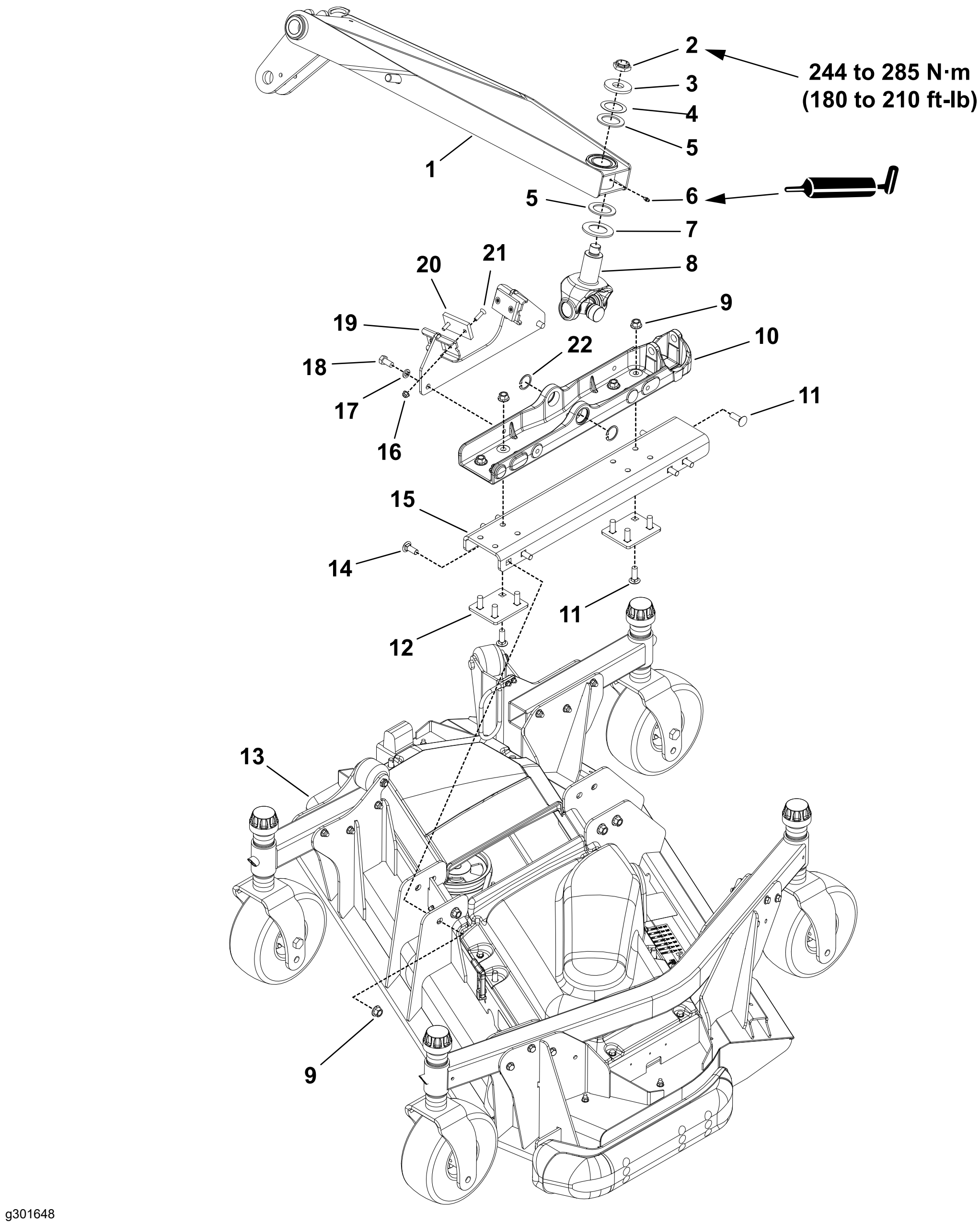

Figure 309

(For machines serial number above 403450001)

1. Lift arm (LH shown)
2. Lock nut
3. Hardened washer
4. Thrust washer
5. Thrust washer
6. Grease fitting
7. Spacer
8. Yoke joint
9. Nut (16 each)
10. Deck mount
11. Carriage bolt (10 each)
12. Spacer plate
13. Left cutting deck
14. Carriage bolt (6 each)
15. LH channel assembly
16. Nut (4 each)
17. Lock washer (2 each)
18. Bolt (2 each)
19. Deck stop
20. Bumper pad (2 each)
21. Screw (4 each)

Joint Yoke Removal (Figure 308 and Figure 309)

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the key switch.
2. Remove cotter pin and slotted hex nut (item 9) from joint yoke shaft. Remove hardened washer and thrust washers (if equipped) from joint yoke shaft.

Joint Yoke Removal (Figure 308 and Figure 309) (continued)

3. Remove eight (8) cap screws (item 15), hardened washers and two (2) bolt plates that secure base mounts (item 11) to cutting deck connection.
4. Raise lift arm enough to free joint yoke and base mounts from lift arm and deck connection. Remove thrust washer and spacer (item 7) from yoke shaft.
5. Locate and retrieve shim (item 12) from between each base mount and deck connection.

Joint Yoke Disassembly

1. Remove snap rings from yoke.

IMPORTANT

Support yoke when removing cross and bearings to prevent yoke damage.

2. Press base mounts from joint yoke. Slide base mount bearings from cross.
3. Use a press to remove cross and remaining bearings from yoke:
   A. Place a small socket against one bearing and a large socket against the yoke on the opposite side.
   B. While supporting the large socket, apply pressure on small socket to partially push the opposite bearing into the large socket.
   C. Remove yoke from press, grasp partially removed bearing and tap on yoke to completely remove the bearing.
   D. Repeat process for remaining bearing.
   E. Thoroughly clean and inspect all components.

Joint Yoke Assembly

1. Apply a coating of grease to bearing bores of yoke. Also, apply grease to bearings and seals of cross assembly.
2. Press one bearing partially into yoke.

IMPORTANT

Take care when installing cross into bearing to avoid damaging bearing seal.

3. Carefully insert cross into bearing and yoke.
4. Hold cross in alignment and press bearing in until it hits the yoke.
5. Carefully place second bearing into yoke bore and onto cross shaft. Press bearing into yoke.
6. Install snap rings to bearings to secure bearings in place.
7. Install remaining bearings on cross.

Joint Yoke Assembly (continued)

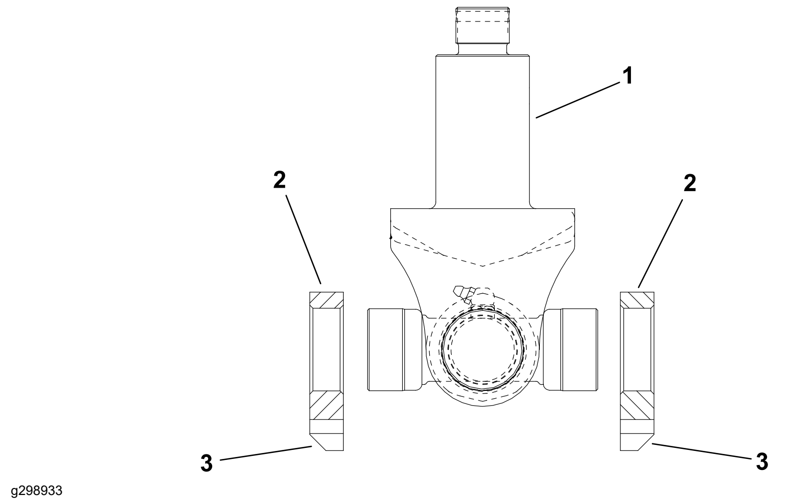

Figure 310

1. Joint yoke
2. Base mount
3. Angled edge

---

8. Press base mounts onto bearing caps with the angled edge of the mounts away from the joint (Figure 310). The outside of the cross bearing cups should be flush with the base mount surfaces.
9. Make sure that assembled joint yoke moves without binding. Slight binding can usually be eliminated by lightly rapping the yoke lugs with a soft faced hammer. If binding continues, disassemble joint yoke to identify and eliminate source of binding.

Joint Yoke Installation (Figure 308 and Figure 309)

1. Install joint yoke to lift arm:
   A. Place spacer (item 7) and then thrust washer onto joint yoke shaft.
   B. Insert yoke shaft up through lift arm bushings.
   C. Place thrust washer (item 6) onto joint yoke shaft and then place washer(s) (item 5) as needed to remove as much clearance as possible between the thrust washer and the hardened washer (item 4).
   D. Install slotted hex nut to secure joint yoke to lift arm. Torque nut from **204 to 244 N·m (150 to 180 ft−lb)**. Make sure that joint yoke rotates in lift arm without binding and that excessive clearance does not exist in yoke assembly.
2. Carefully lower lift arm to position base mounts to deck connection.
3. Install shims between deck connection and base mounts. Secure base mounts with eight (8) cap screws, hardened washers and two (2) bolt plates. Tighten cap screws from **53 to 64 N·m (39 to 47 ft−lb)**.
4. Grease joint yoke and lift arm bushing after installation on machine.
5. After assembly is completed, raise and lower the cutting deck to verify that hydraulic hoses and fittings do not contact anything throughout the full range of movement.

Wing Deck Impact Arm Assembly

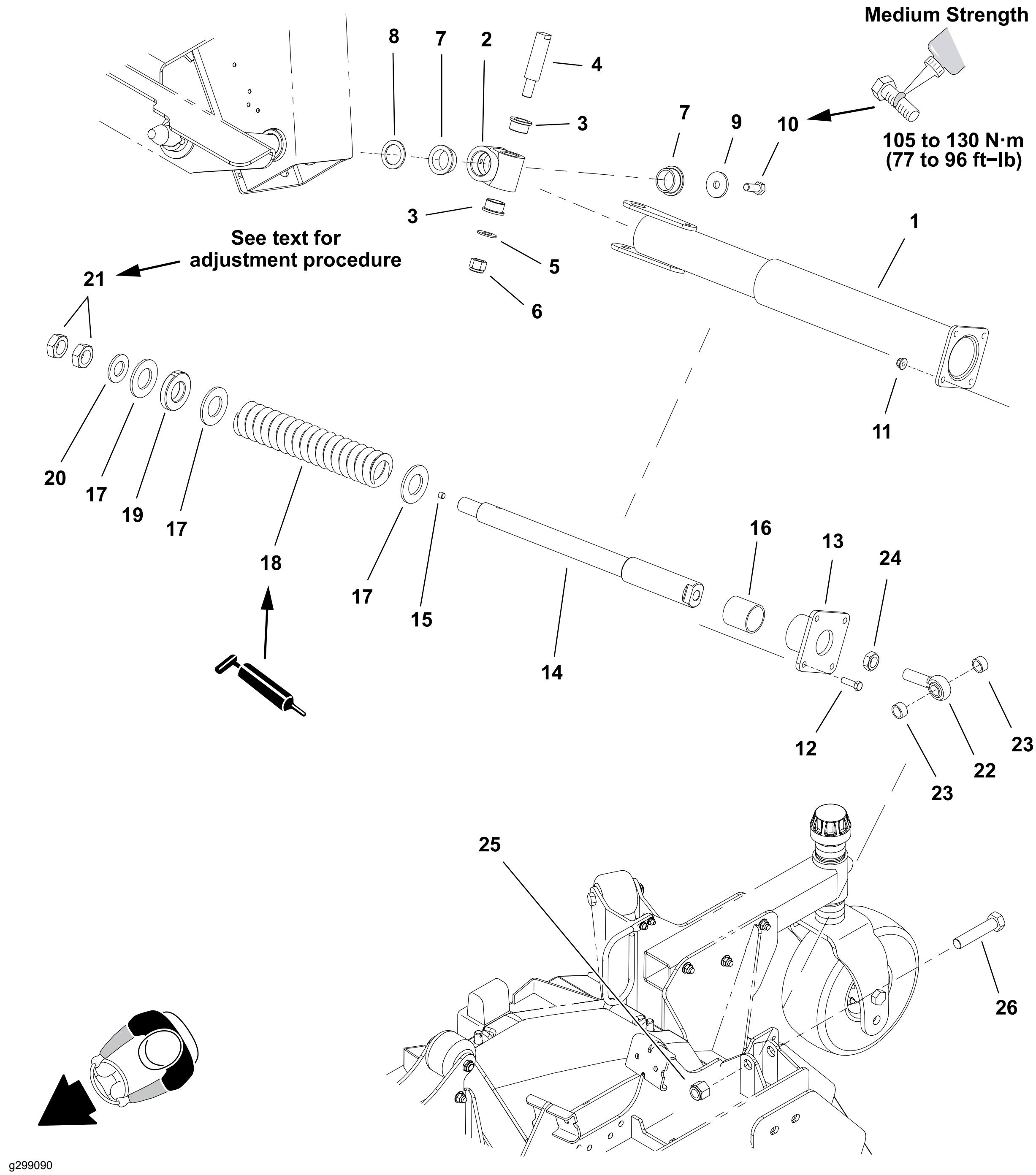

Figure 311

(For machines serial number below 403450000)

1. Impact arm housing
2. Pivot hub
3. Flange bushing (2)
4. Pivot shaft
5. Flat washer
6. Lock nut
7. Flange bushing
8. Thrust washer
9. Thrust washer
10. Cap screw
11. Flange nut (4)
12. Cap screw (4)
13. Housing
14. Spring shaft
15. Pipe plug
16. Bushing
17. Washer
18. Spring
19. Plastic bearing
20. Flat washer
21. Jam nut (2)
22. Rod end
23. Spacer (2)
24. Jam nut
25. Lock nut
26. Cap screw

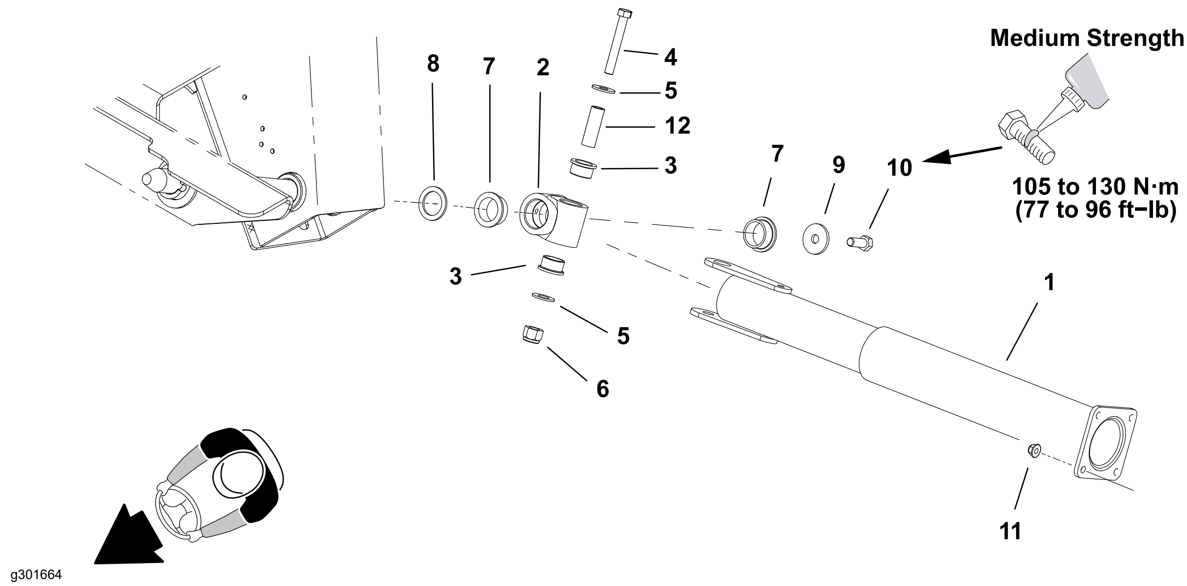

Figure 312

(For machines serial number above 403450001)

1. Impact arm housing
2. Pivot hub
3. Flange bushing (2)
4. Bolt
5. Flat washer
6. Lock nut
7. Flange bushing
8. Thrust washer
9. Thrust washer
10. Cap screw
11. Flange nut (4)
12. Spacer

Impact Arm Removal (Figure 311 and Figure 312)

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the key switch.
2. Remove cap screw (item 26) and lock nut that secures rod end of impact arm to cutting deck connection. Locate and remove spacers from each side of rod end.
3. Remove lock nut (item 6) and flat washer from pivot shaft. Slide pivot shaft from pivot hub and impact arm housing, and remove impact arm assembly from machine.

Impact Arm Disassembly (Figure 311)

1. Disassemble wing deck impact arm assembly as necessary.
2. Thoroughly clean impact arm components and inspect for worn parts. Replace components as needed.

Impact Arm Assembly (Figure 311)

1. Slide washer (item 17), compression spring (item 18), second washer (item 17), plastic bearing (item 19), third washer (item 17), flat washer (item 20) and one jam nut (item 21) onto spring shaft. Tighten jam nut so that spring length is 30.4 cm (12 in).
2. Fit housing (item 13) over rod end of assembled spring shaft assembly and insert assembly into impact arm housing.
3. Temporarily secure housing (item 13) to impact arm housing with two (2) cap screws and lock nuts.

Impact Arm Assembly (Figure 311) (continued)

IMPORTANT

All endplay must be removed from spring shaft assembly to allow proper operation and ensure long life.

4. Grasp end of spring shaft. Push inward and pull outward on shaft to determine if endplay exists between spring shaft assembly and impact arm housing assembly.
5. If endplay in spring shaft assembly exists, insert a 3/4” socket onto jam nut (item 21) on spring shaft. Access to jam nut can be obtained through the open end of impact arm housing. Loosen jam nut until all endplay in shaft is removed.
6. When no endplay exists in spring shaft assembly, remove two (2) cap screws and nuts securing housing to impact arm housing and remove spring shaft assembly from housing.
7. Thread second jam nut (item 21) onto end of spring shaft. While holding first jam nut with a wrench to prevent it from turning, tighten second jam nut from **184 to 223 N·m (135 to 165 ft−lb)** to secure spring adjustment.
8. Thoroughly pack spring with grease. Apply approximately 1.1 kg (40 oz) of grease to a clean spring.
9. Install spring shaft assembly into impact arm housing and secure housing (item 13) with four (4) cap screws and lock nuts.

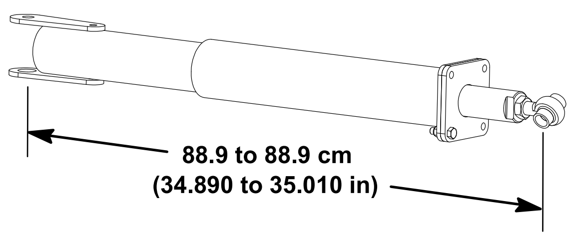

Figure 313

10. Thread rod end (item 22) with jam nut into end of spring shaft so that distance from center of rod end to center of impact housing mounting hole is from 88.6 to 88.9 cm (34.89 to 35.01 in) (Figure 313). Do not tighten jam nut until impact arm is installed to deck.

Impact Arm Installation (Figure 311 and Figure 312)

1. Position impact arm assembly to cutting deck connection and frame.
2. Slide pivot shaft (item 4) through impact arm housing and hub. Secure pivot shaft with flat washer and lock nut.
3. Position a spacer on each side of impact arm rod end. Secure rod end to deck connection with cap screw (item 26) and lock nut.
4. Tighten rod end jam nut (item 24).
5. Lubricate impact arm pivot hub grease fitting.
6. After installation is completed, raise and lower the cutting deck to verify that hydraulic hoses and fittings do not contact anything throughout the entire range of movement.

Impact Arm Installation (Figure 311 and Figure 312) (continued)

Note: Due to changes in the counterbalance setting of the traction unit, it is recommended to test cut grass and check the after−cut appearance before returning the machine to regular service. Refer to machine *Operator's Manual* for correcting cutting deck mismatch procedures if necessary.

Console Arm

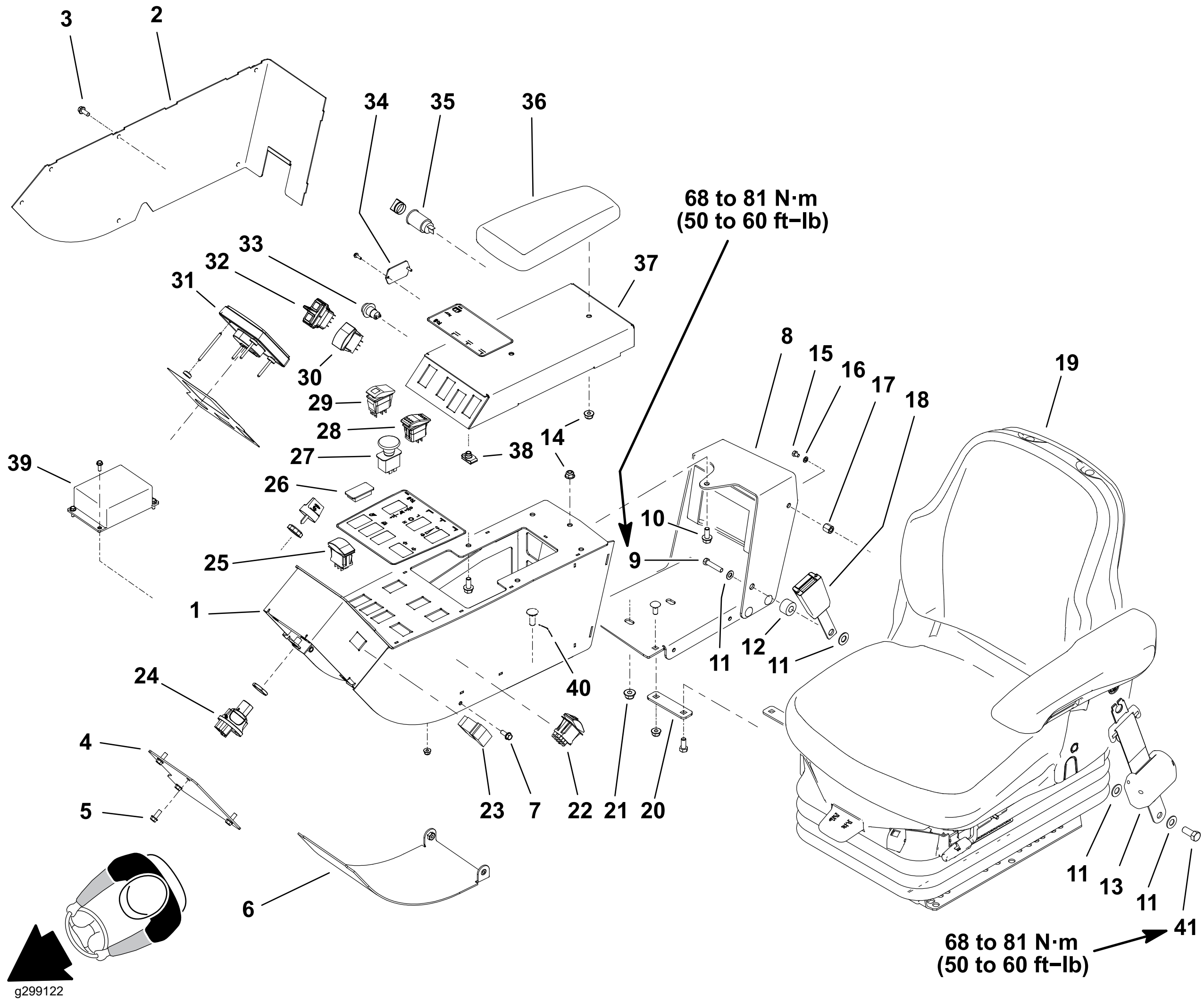

Figure 314

1. Console arm
2. Side cover
3. Flange head screw (6)
4. Front cover
5. Flange head screw (4)
6. Console gate
7. Flange head screw (2)
8. Console support
9. Cap screw
10. Flange head screw
11. Flat washer (4)
12. Spacer
13. Retractable seat belt
14. Flange nut (3)
15. Cap screw
16. Lock washer
17. Coupling nut
18. Seat belt receptacle
19. Seat assembly
20. Support strap
21. Flange nut (2)
22. Switch − parking brake
23. Switch − headlight
24. Switch − ignition
25. Switch − turn signal
26. Plug − switch
27. Switch − PTO
28. Switch − throttle
29. Switch − high/low range
30. Switch − lift (3)
31. InfoCenter display
32. Switch − cruise control
33. Button − horn
34. Cover plate
35. Power port
36. Arm rest
37. Control panel
38. Nut − U (4)
39. Flasher
40. Carriage screw (2)
41. Cap screw

Console Arm Disassembly (Figure 314)

1. Park machine on a level surface, lower cutting units, and stop engine. Remove key from key switch.
2. Remove six (6) flange head screws and side cover (item 2) from outside of console arm.
3. Remove four (4) flange head screws that secure front cover (item 4) to console arm panel.
4. Loosen two (2) flange head screws (item 7) to open console gate (item 6).
5. Remove electrical components from console arm as needed.
6. If necessary, remove console arm and supports from machine.

Console Arm Assembly (Figure 314)

1. If removed, install console arm and supports to machine. Tighten cap screw (item 9) securing console support and seat belt receptacle to seat from **68 to 81 N·m (50 to 60 ft−lb)**.
2. Install all removed electrical and console arm components.
3. Close console gate and tighten two (2) flange head screws (item 7).
4. Secure front cover (item 4) to console arm with four (4) flange head screws.
5. Secure side cover to console arm (item 2) with six (6) flange head screws.

Traction Pedal

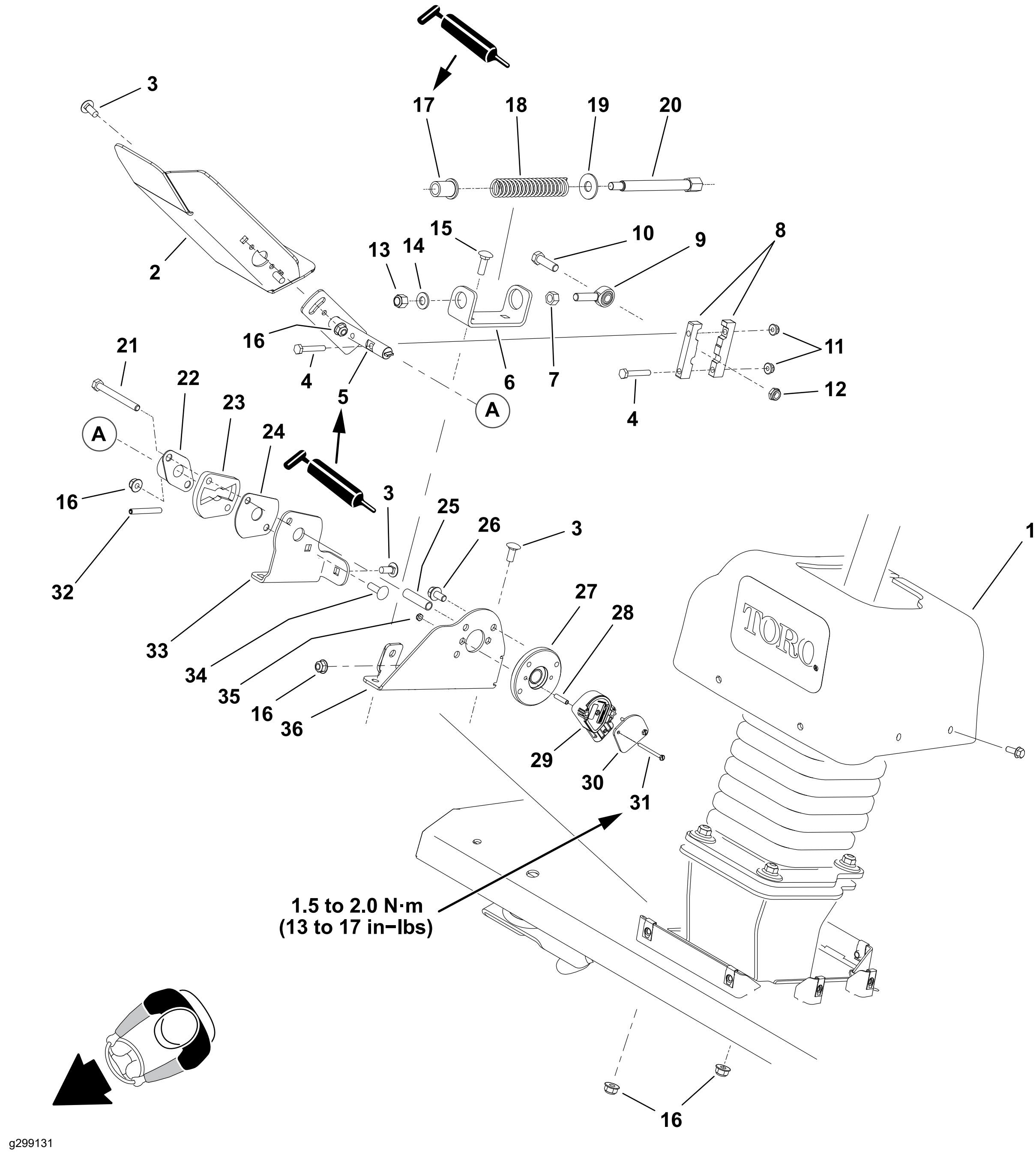

Figure 315

1. Steering cover	13. Lock nut	25. Spacer
2. Traction pedal	14. Flat washer	26. Flange head screw (2)
3. Carriage screw (6)	15. Carriage screw (2)	27. Hub and bushing assembly
4. Cap screw (2)	16. Flange nut (7)	28. Standoff (2)
5. Pedal shaft	17. Flange bushing	29. Position sensor
6. Spring bracket	18. Spring	30. Cover plate
7. Hex nut	19. Flat washer	31. Socket head screw (2)
8. Clamp block (2)	20. Spring shaft	32. Roll pin
9. Rod end	21. Cap screw	33. Butterfly bracket
10. Cap screw	22. Bearing	34. Carriage screw
11. Flange nut (2)	23. Butterfly plate	35. Lock nut (2)
12. Lock nut	24. Cover plate	36. Sensor bracket

IMPORTANT

A properly installed and calibrated traction pedal position sensor is critical to accurate traction system response and for reliable sensor life. Use care when removing, installing and calibrating the traction pedal position sensor.

Traction Pedal Disassembly (Figure 315)

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the key switch.
2. Remove screws securing steering cover (item 1) and move steering cover up steering column to access traction pedal assembly.
3. Disconnect machine wire harness connector from throttle position sensor (item 29).
4. If the traction pedal is to be removed from the traction pedal shaft (item 5), use a marker or paint pen on pedal and shaft to identify location of pedal for assembly purposes.
5. Disassemble traction pedal as needed. When removing roll pin (item 32), make sure to support shaft to prevent component damage.

Traction Pedal Assembly (Figure 315)

1. Assemble traction pedal as necessary noting the following items:
   A. Apply grease to inside and outside of flange bushing (item 17). Do not allow grease to get on threads of spring shaft (item 20) during installation.
   B. Apply grease to traction pedal shaft (item 5) where the shaft contacts bearing (item 22) and bushing (item 27).
   C. Use a press to install roll pin (item 32). DO NOT distort roll pin during assembly.
   D. Make sure that roll pin (item 32) is fully inside the butterfly plate (item 23). The roll pin should not contact the shim plate or bearing throughout the operating range.
   E. To install the traction pedal position sensor (item 29), press and hold the traction pedal in the reverse direction slightly. Align the slot on the end of the pedal shaft with the slot in the position sensor. Hold the position sensor against the hub and bushing assembly and install the two (2) standoffs (item 28) through the sensor body. Install the cover plate (item 30), socket head screws and lock nuts. Tighten socket head screws (item 31) from **1.5 to 2.0 N·m (13 to 17 in−lb)**.

Traction Pedal Assembly (Figure 315) (continued)

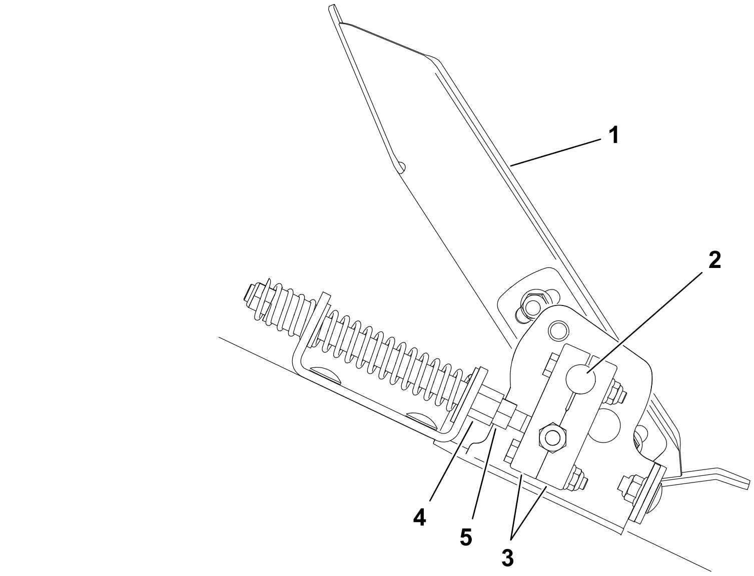

Figure 316

1. Traction pedal
2. Traction pedal shaft
3. Clamp blocks
4. Spring shaft
5. Lock nut

F. Clamp blocks (Figure 316 item 3) must be square (at 90º angles) to traction pedal shaft after tightening.

2. Plug machine wire harness connector into traction pedal position sensor.
3. After assembling the traction pedal, calibrate the traction pedal position sensor (see Traction Pedal Position Sensor Calibration (page 6–51)).
4. Make sure that hex nut (item 7) is tightened after throttle position sensor adjustment.
5. Install steering cover (item 1).

Operator Seat

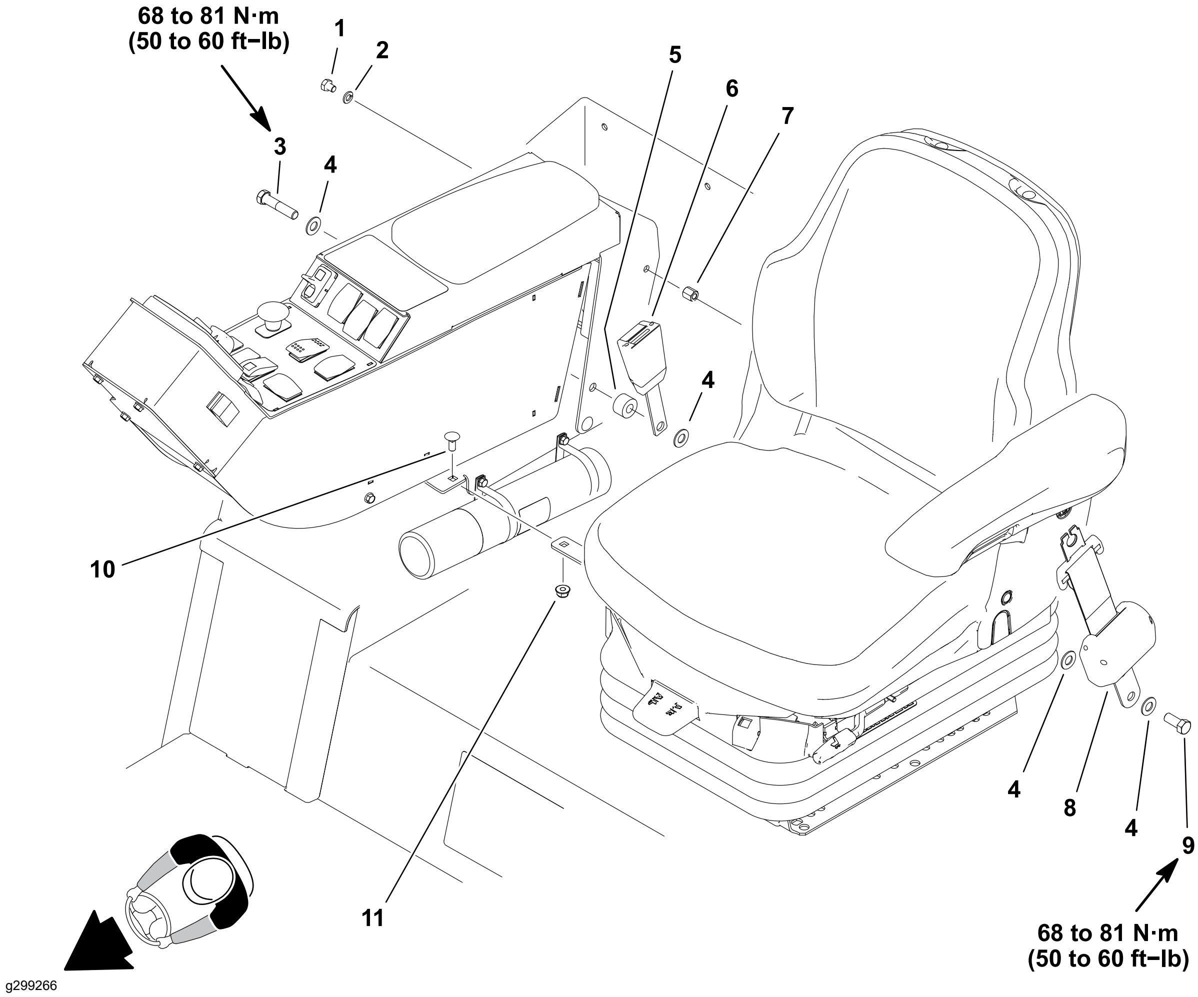

Figure 317

1. Cap screw
2. Lock washer
3. Cap screw
4. Flat washer (4)
5. Spacer
6. Seat belt receptacle
7. Coupling nut
8. Retractable seat belt
9. Cap screw
10. Carriage screw
11. Flange nut

Operator Seat Removal (Figure 317)

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the key switch.
2. Disconnect seat electrical connector from machine wire harness.
3. Remove flange nut and carriage screw (item 10) that secure support bracket at front right corner of seat to console support.
4. Remove cap screw (item 1) and lock washer that secure coupling nut (item 7) to console support.
5. Remove cap screw (item 3) and flat washer that secure seat to console support. Remove spacer, seat belt receptacle (item 6) and flat washer from between seat and console support.
6. Remove four (4) Torx head screws (Figure 318) that secure seat to seat suspension. Note that the screw near the seat adjustment handle is longer than the other three screws.
7. Lift seat from seat suspension and remove from machine.

Operator Seat Installation (Figure 317)

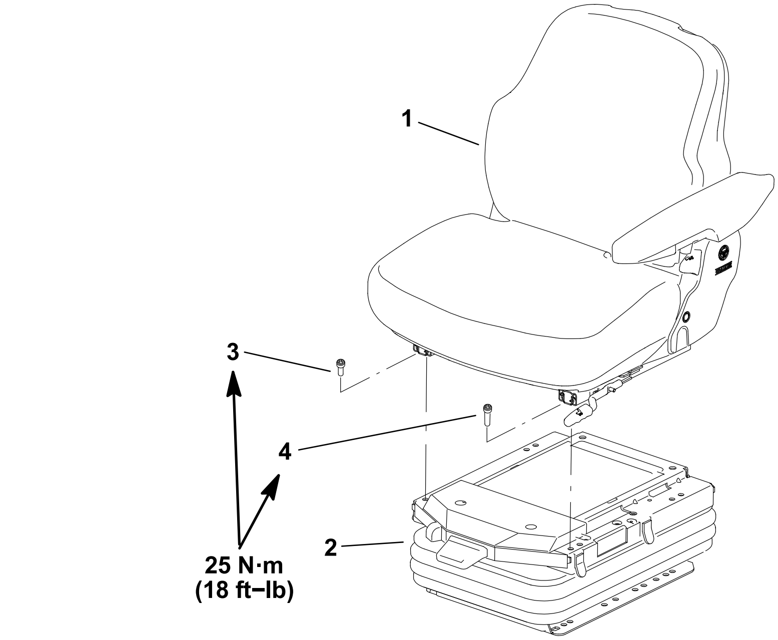

Figure 318

1. Seat
2. Suspension assembly
3. Torx head screw – 12mm (3)
4. Torx head screw – 16mm

1. Carefully position seat to seat suspension.
2. Secure seat to seat suspension with four (4) Torx head screws (Figure 318). Make sure that longer screw is positioned near the seat adjustment handle. Tighten screws from **25 N·m (18 ft–lb)**.
3. Position and secure console arm assembly to seat. Install all fasteners before fully tightening them.
   A. Secure support bracket at front right corner of seat to support channel with flange nut and carriage screw (item 10).
   B. Secure console support to coupling nut with cap screw (item 1) and lock washer.
   C. Place flat washer, seat belt receptacle (item 6) and spacer between seat and console and secure with flat washer and cap screw (item 3). Tighten cap screw from **68 to 81 N·m (50 to 60 ft–lb)**.
   D. Fully tighten all fasteners to secure console support to seat assembly.
4. Connect seat electrical connector to machine wire harness.

Operator Seat Service

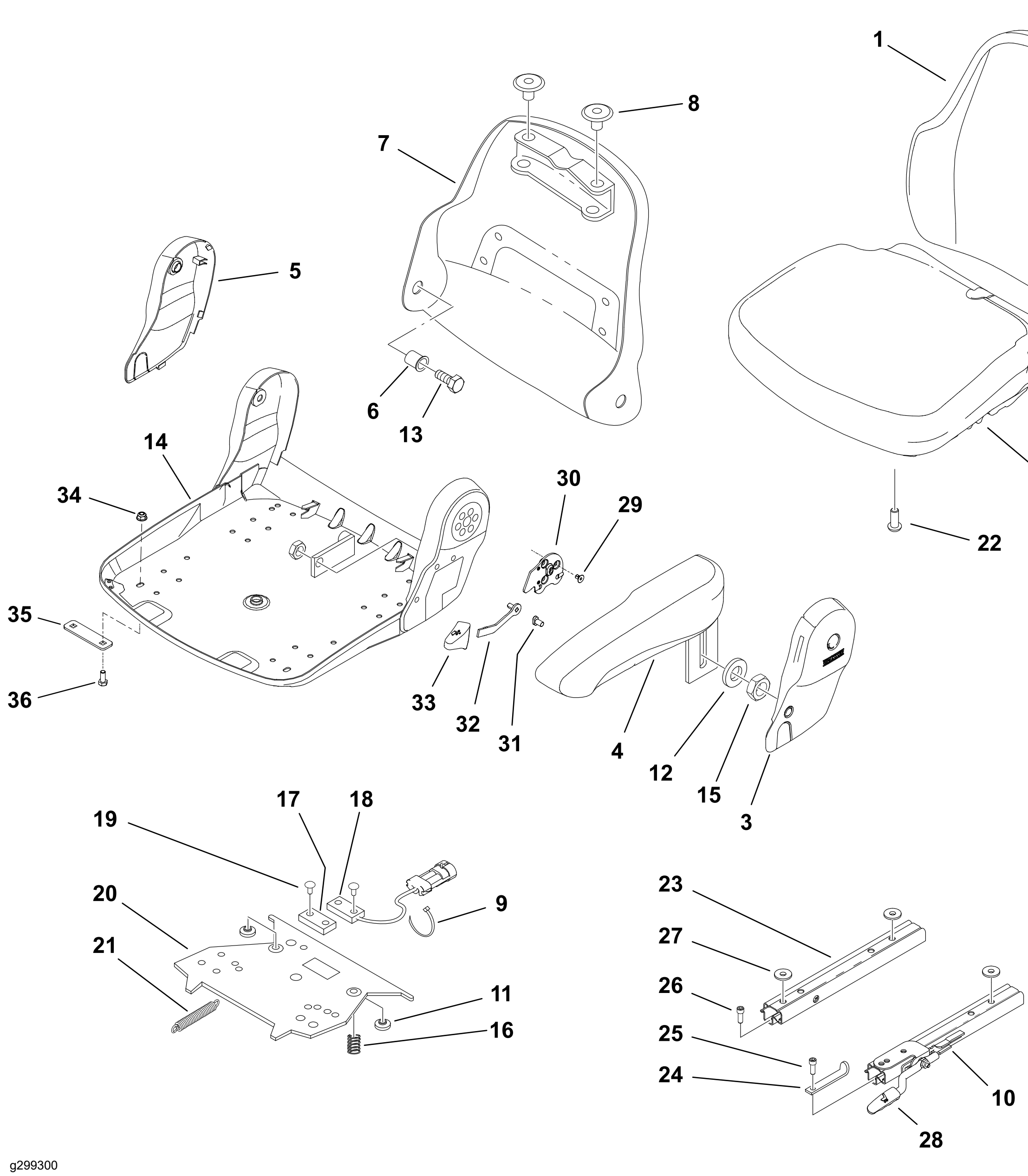

Figure 319

1. Backrest cushion
2. Seat cushion
3. RH support cover
4. LH armrest
5. RH support cover
6. Bushing (2)
7. Backrest
8. Plug (2)
9. Cable tie (3)
10. LH adjustment rail
11. Bumper (2)
12. Washer
13. Cap screw (2)
14. Seat frame
15. Nut
16. Spring (2)
17. Magnet
18. Seat switch
19. Rivet (4)
20. Mounting plate
21. Return spring
22. Torx screw (5)
23. RH adjustment rail
24. Rail stop
25. Torx screw
26. Torx screw (3)
27. Washer (3)
28. Handle
29. Flat head screw (3)
30. Adaptor plate
31. Screw
32. Lever
33. Handle
34. Nut
35. Support bracket
36. Cap screw

Operator Seat Disassembly (Figure 319)

1. Remove seat from machine for service (see Operator Seat (page 7–40)).
2. Disassemble operator seat as necessary.

Operator Seat Assembly (Figure 319)

1. Assemble operator seat as needed.
2. Install seat to machine (see Operator Seat (page 7–40)).

Operator Seat Suspension

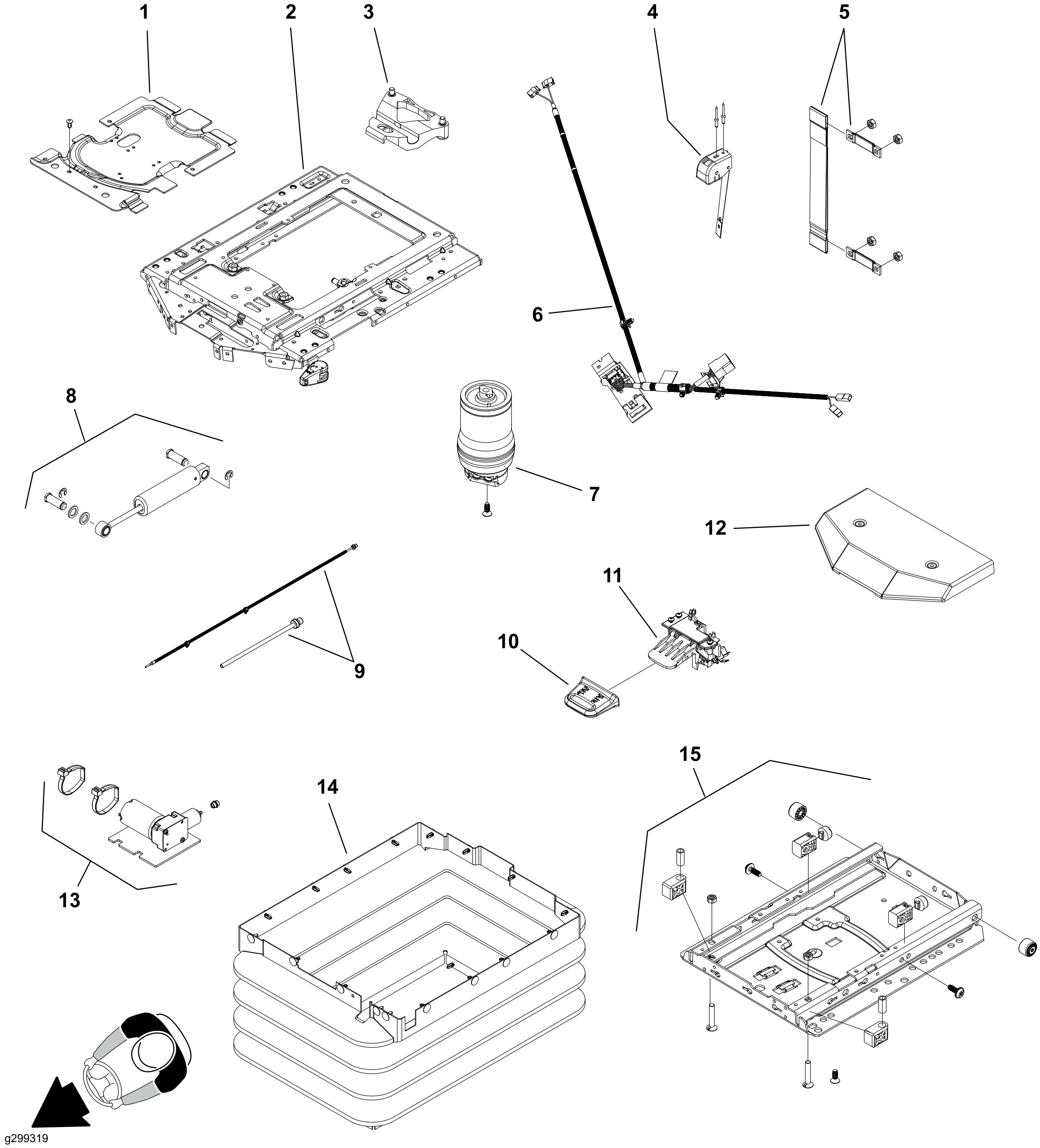

Figure 320

1. Cover assembly
2. Upper suspension
3. Thrust limiter
4. Control lever
5. Tether
6. Wire harness
7. Air spring
8. Shock absorber
9. Air tube assembly
10. Handle
11. Air control valve
12. Cover
13. Compressor
14. Bellows
15. Lower suspension

Operator Seat Suspension Disassembly (Figure 320)

Note: Most of the seat suspension components can be serviced with the lower seat suspension (item 15) mounted to the frame platform. If the air spring assembly (item 7) requires removal, the lower seat suspension will have to be removed from the seat platform.

Operator Seat Suspension Disassembly (Figure 320) (continued)

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the key switch.
2. Remove operator seat from seat suspension (see Operator Seat (page 7–40)).
3. Disconnect seat suspension electrical connector from machine wire harness.
4. Remove seat suspension components as needed.

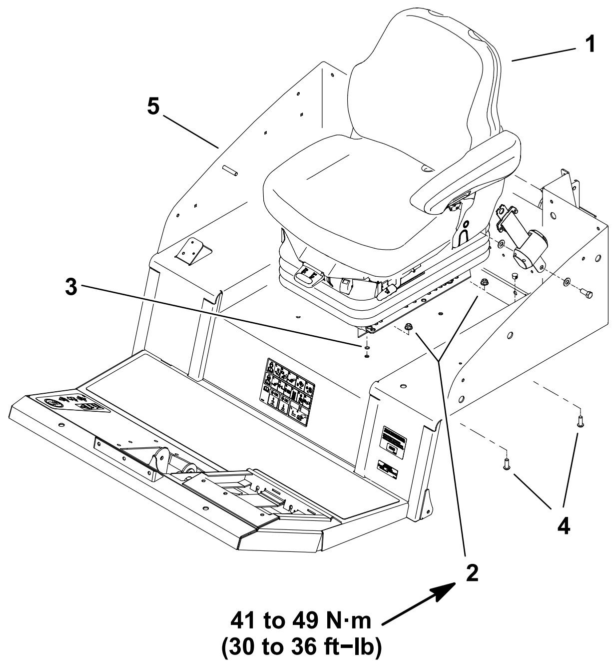

Figure 321

1. Operator seat assembly
2. Flange nut (4)
3. Screw (4)
4. Retaining washer (4)
5. Seat platform

---

5. Remove the lower seat suspension from seat platform as follows (Figure 321):

   A. To gain access to lower seat suspension mounting screws, slide fuel tank toward left side of machine (see Fuel Tank Removal (page 4–18)). Support tank to prevent it from shifting.

   B. Remove four (4) flange nuts that secure the lower seat suspension to seat platform and lift the lower seat suspension from machine. The four (4) mounting screws and their retaining washers can be removed if necessary.

Operator Seat Suspension Assembly (Figure 320)

1. If previously removed, install lower seat suspension to seat platform as follows (Figure 321):

   A. If removed, install mounting screws and secure with retaining washers.

   B. Position seat suspension onto seat platform.

   C. Secure lower seat suspension to seat platform with four (4) screws and flange nuts. Tighten flange nuts from **41 to 49 N·m (30 to 36 ft−lb)**.

   D. Move fuel tank back into position and install (see Fuel Tank Installation (page 4–19)). Make sure that fuel tank and front wheel are properly secured.

2. Install all removed seat suspension components.
3. Install operator seat to seat suspension (see Operator Seat (page 7–40)).
4. Make sure that seat electrical connectors are secured to machine wire harness.

Hood and Lower Shrouds

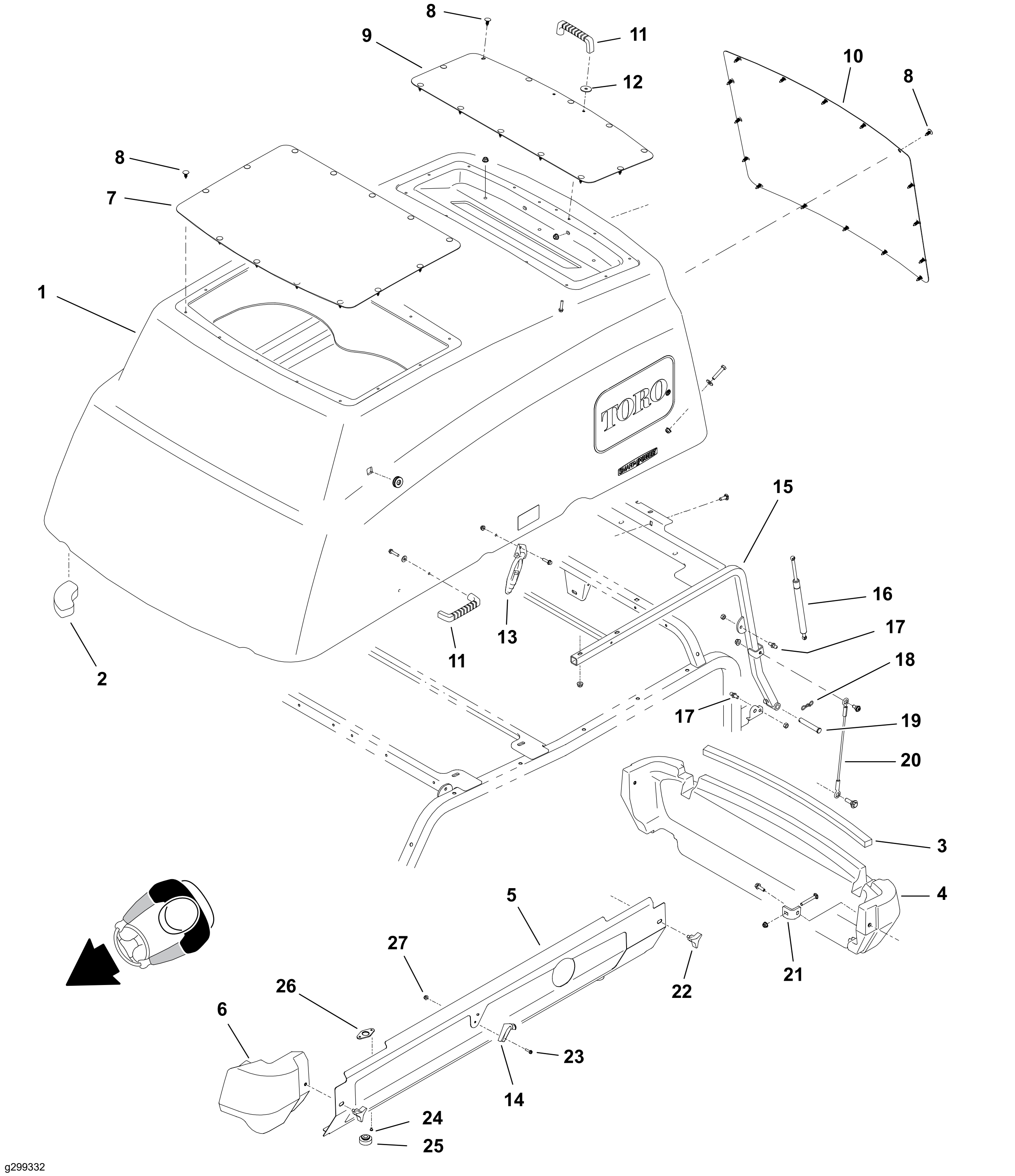

Figure 322

1.	Hood	8.	Panel fastener (42)	15.	Hood frame	22.	Knob (4)
2.	Foam pad (2)	9.	Intake screen	16.	Gas spring (2)	23.	Washer head screw (4)
3.	Foam strip	10.	Radiator screen	17.	Ball stud (4)	24.	Pop rivet (8)
4.	Rear shroud	11.	Handle (2)	18.	Hair pin (2)	25.	Grommet (4)
5.	Side shroud − LH	12.	Flat washer (2)	19.	Clevis pin (2)	26.	Grommet plate (4)
6.	Front shroud − LH	13.	Latch rubber (2)	20.	Lanyard (2)	27.	Flange nut (4)
7.	Cooler screen	14.	Latch catch (2)	21.	Rear shroud bracket (2)		

⚠ CAUTION ⚠

Due to the size and weight of the hood assembly, two people are required to remove and install the hood assembly.

Hood Removal (Figure 322)

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the key switch.
2. Unlatch and raise hood.
3. Have one person support the rear of the raised hood.
4. Have a second person remove the flange head cap screw and flange nut at the machine frame end of each lanyard (item 20) and disconnect the lanyards from the machine frame.
5. Disengage gas springs (item 16) from ball studs. Lift up on flat clip until ball is released from the gas spring socket.
6. Slowly lower the hood to its closed position.
7. Remove the two (2) hair pins (item 18) that secure the clevis pins to the frame.
8. Remove two (2) clevis pins (item 19) that secure hood to machine. Lift hood and remove from rear of machine.
9. Inspect hood foam seals for damage. Also, make sure that machine foam seals show evidence of effective sealing with hood. Remove and replace foam seals if necessary.
10. If necessary, remove additional hood components.

Hood Installation (Figure 322)

1. Replace all removed hood components.
2. Position hood to align clevis pin holes in hood and machine frames. Install two (2) clevis pins and hair pins to secure hood to machine.
3. Have one person support the rear of the raised hood.
4. Have a second person secure the gas springs (item 16) to the ball studs. Align ball stud and socket and press together to engage.
5. Install the flange head cap screw and flange nut securing the machine frame end of each lanyard (item 20).
6. Lower and secure hood.

Cutting Decks

Table of Contents

General Information

CAUTION

Never install or work on the cutting deck or lift arms with the engine running. Always stop engine and remove ignition key first.

Operator's Manual

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

Blade Stopping Time

The blades of the cutting deck should come to a complete stop in approximately five (5) seconds after the PTO switch is shut off.

Note: Make sure the decks are lowered onto a clean section of turf or hard surface to avoid dust and debris.

To verify blade stopping time, have a second person stand back from the deck at least twenty (20) feet (6.1 meters) and watch one of the cutting deck pulleys. Have the operator shut the cutting deck off and record the time it takes for the pulleys to come to a complete stop. If this stopping time is greater than seven (7) seconds, the braking valve (RV) in the cutting deck control hydraulic manifold may need adjustment (see Chapter 5: Hydraulic System (page 5–1)).

Service and Repairs

⚠ CAUTION ⚠

Never install or work on a cutting deck or lift arm with the engine running. Always stop engine and remove ignition key first.

Front Cutting Deck

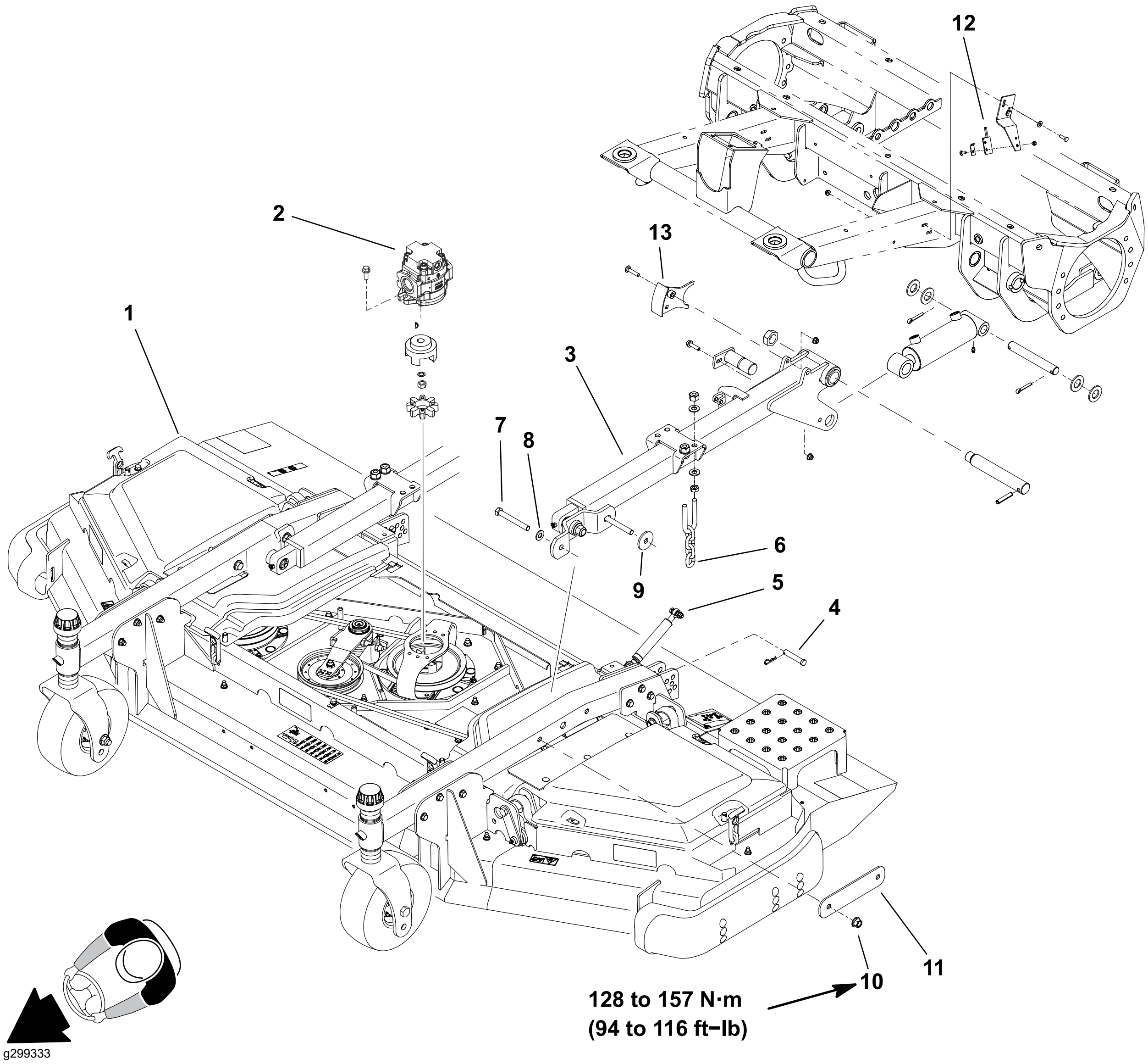

Figure 323

1. Front cutting deck
2. Hydraulic motor
3. Lift arm assembly − LH
4. Clevis pin (1 per lift arm)
5. Damper assembly
6. HOC chain (1 per lift arm)
7. Cap screw (2 per lift arm)
8. Flat washer (2 per lift arm)
9. Thrust washer (1 per lift arm)
10. Lock nut (2 per lift arm)
11. Plate (1 per lift arm)
12. Front cutting deck position switch

See Front Deck Lift Arms (page 7–17) for lift arm removal, installation and service information.

See Drive Belt Idler Assemblies (page 8–11), Blade Spindles (page 8–14), Castor Forks and Wheels (page 8–21) and Deck Skids and Front Deck Roller (Figure 340 and Figure 341) (page 8–23) in this chapter for removal, installation and service information.

Front Cutting Deck Removal (Figure 323)

1. Position machine on a clean, level surface. Lower cutting decks, stop engine and remove key from the key switch.
2. Remove center deck cover to access hydraulic deck motor.
3. Remove hydraulic motor from cutting deck (see Cutting Deck Motor (page 5–118)). Position and support motor away from cutting deck. DO NOT allow cutting deck motor to hang from hydraulic hoses.
4. Start engine and raise deck slightly. Stop engine and remove key from the key switch.
5. Remove hairpins and clevis pins (item 12) that secure the height−of−cut chains to the rear of the cutting deck.

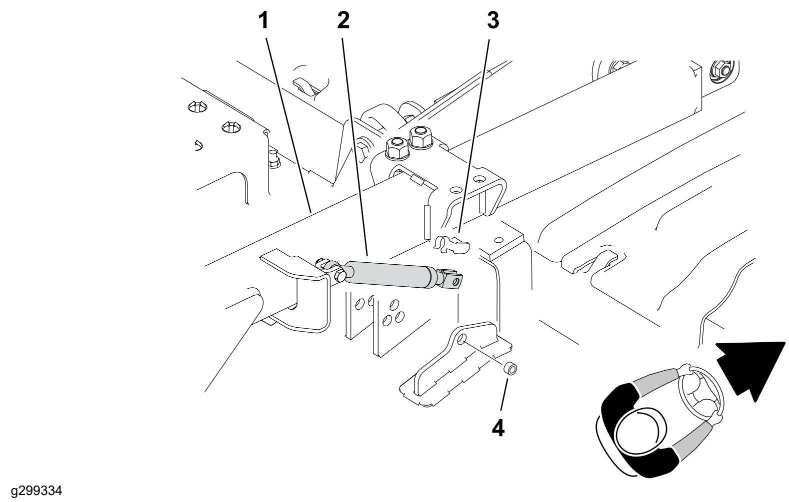

Figure 324

1. Lift arm − LH
2. Damper
3. Spring pin
4. Spacer

6. Remove spring pin and spacer that secure damper to cutting deck (Figure 324). Position damper away from cutting deck.
7. Start engine and lower deck to ground. Stop engine and remove key from the key switch.
8. Remove cap screws, flat washers, lock nuts and plate (item 15) that secure lift arm support hubs to cutting deck. Remove thrust washer (item 9) from between the lift arm and the rear support hub mounting hole.
9. Slide the cutting deck away from the traction unit.

Front Cutting Deck Installation (Figure 323)

1. Position machine on a clean, level surface. Lower front lift arms, stop engine and remove key from the key switch.
2. Position the cutting deck to the lift arms.
3. Align lift arm support hub to cutting deck. Make sure that slotted hole in the support hub is toward the rear of the deck.
4. Position thrust washer (item 9) between the lift arm and the rear, slotted hole of the support hub and secure lift arm support hub to deck with cap screws (item 7), flat washers, plate and lock nuts. Tighten fasteners from **128 to 157 N·m (94 to 116 ft−lb)**.
5. Start engine and raise deck slightly. Stop engine and remove key from the key switch.
6. Install clevis pins and hairpins that secure the height−of−cut chains to the rear of the cutting deck.
7. Position damper to mount on cutting deck. Install spacer and spring pin to secure damper to deck (Figure 324).
8. Start engine and lower deck to ground. Stop engine and remove key from the key switch.
9. Install hydraulic motor to cutting deck (see Cutting Deck Motor (page 5–118)).
10. Install all removed cutting deck covers.
11. Lubricate grease fittings on cutting deck and lift arm assemblies (see *Operator's Manual*).

Front Cutting Deck Winglets

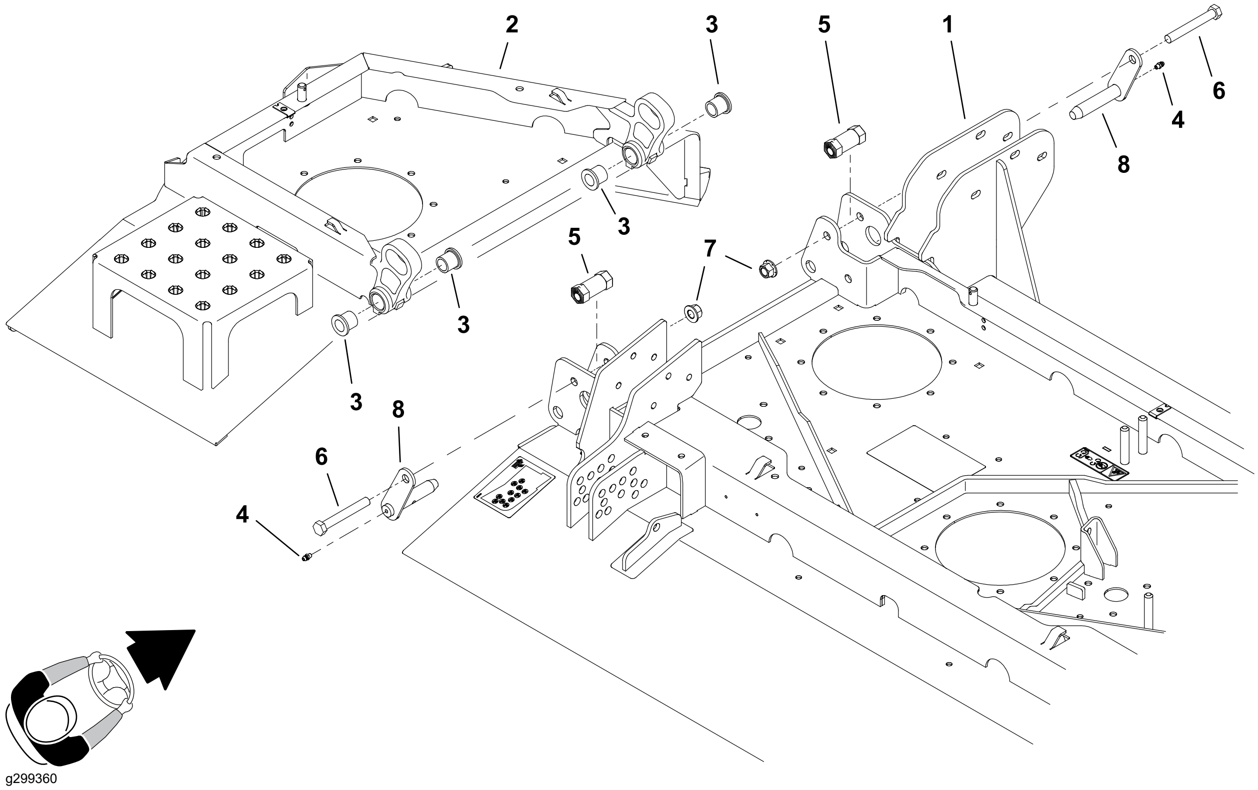

Figure 325

1. Center deck
2. LH deck winglet
3. Flange bushing (4 per winglet)
4. Grease fitting
5. Eccentric (2 per winglet)
6. Cap screw (2 per winglet)
7. Lock nut (2 per winglet)
8. Hinge pin (2 per winglet)

Front Cutting Deck Winglet Disassembly (Figure 325)

1. Park machine on a level surface, lower front cutting deck, stop engine and remove key from the key switch.
2. Remove covers from front cutting deck.
3. Use a ⅜” or ½” drive ratchet or breaker bar to relieve idler pulley tension and remove upper (winglet) drive belt.
4. For assembly and alignment purposes, record the position of the front winglet deck eccentric spacers:
   A. Use a marker or paint pen to record the location of each eccentric spacer directly on the spacer (right front, right rear, etc).
   B. Use a marker or paint pen to record the position of each eccentric spacer by drawing a line across each eccentric spacer and the deck bracket (Figure 326).
5. Remove lock nut, cap screw, eccentric spacer and hinge pin from front and rear winglet hinges. Use access hole in deck brackets to remove eccentric spacers from deck. Slide winglet away from front deck.
6. Inspect hinge pin, eccentric spacers and flange bushings in deck winglet. Replace worn or damaged components as necessary.

Front Cutting Deck Winglet Assembly (Figure 325)

1. Position winglet to front deck.

   Note: Install previously used eccentric spacers in their original locations.

2. Install eccentric spacers in winglet and center frame brackets. Secure front deck winglet to center deck with hinge pins, cap screws and lock nuts. Do not fully tighten fasteners.

3. Use a ⅜” or ½” drive ratchet or breaker bar to relieve idler pulley tension and install upper (winglet) drive belt. Make sure that idler pulley applies tension against the back side of the belt.

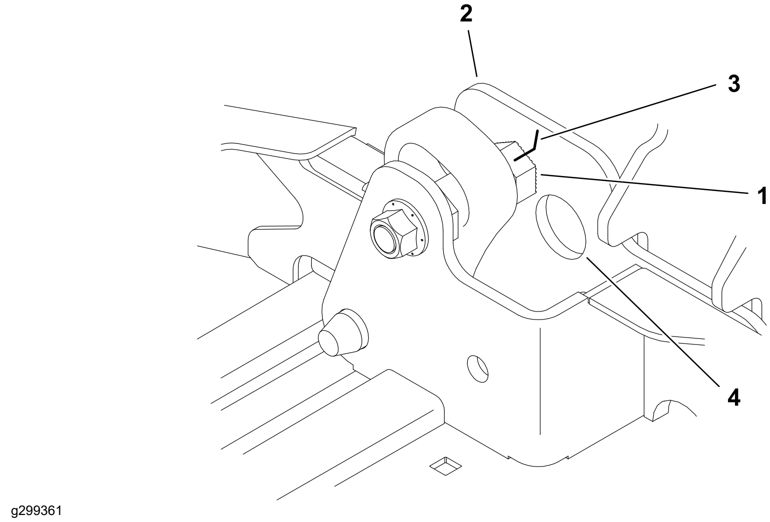

Figure 326

1. Eccentric
2. Deck bracket
3. Marker/paint line
4. Eccentric access hole

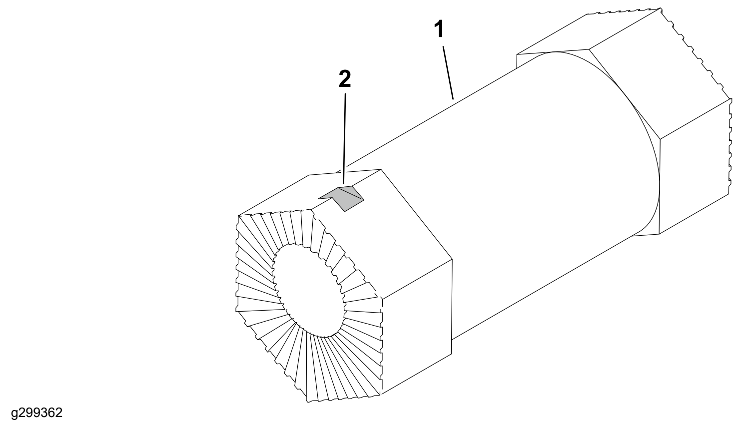

Figure 327

1. Eccentric spacer
2. Notch across hex point

4. Set the eccentric spacers:

   A. If previously removed eccentric spacers are being used, align the marker or paint pen lines made during disassembly to position the eccentric spacers (Figure 326).

Front Cutting Deck Winglet Assembly (Figure 325) (continued)

B. If new eccentric spacers are being used, initially orient the eccentric spacers with the eccentric lobe downward (notch across hex point upward − Figure 327). Level the front winglet deck to the front center deck (see machine *Operator’s Manual*).

5. Tighten cap screws and lock nuts securing eccentric spacers from **56 to 75 N·m (41 to 55 ft−lb)**.
6. Check front cutting deck pitch and adjust as needed (see machine *Operator’s Manual*).
7. Lubricate hinge pin grease fittings.
8. Install and secure all removed covers to front cutting deck.

Wing Cutting Decks

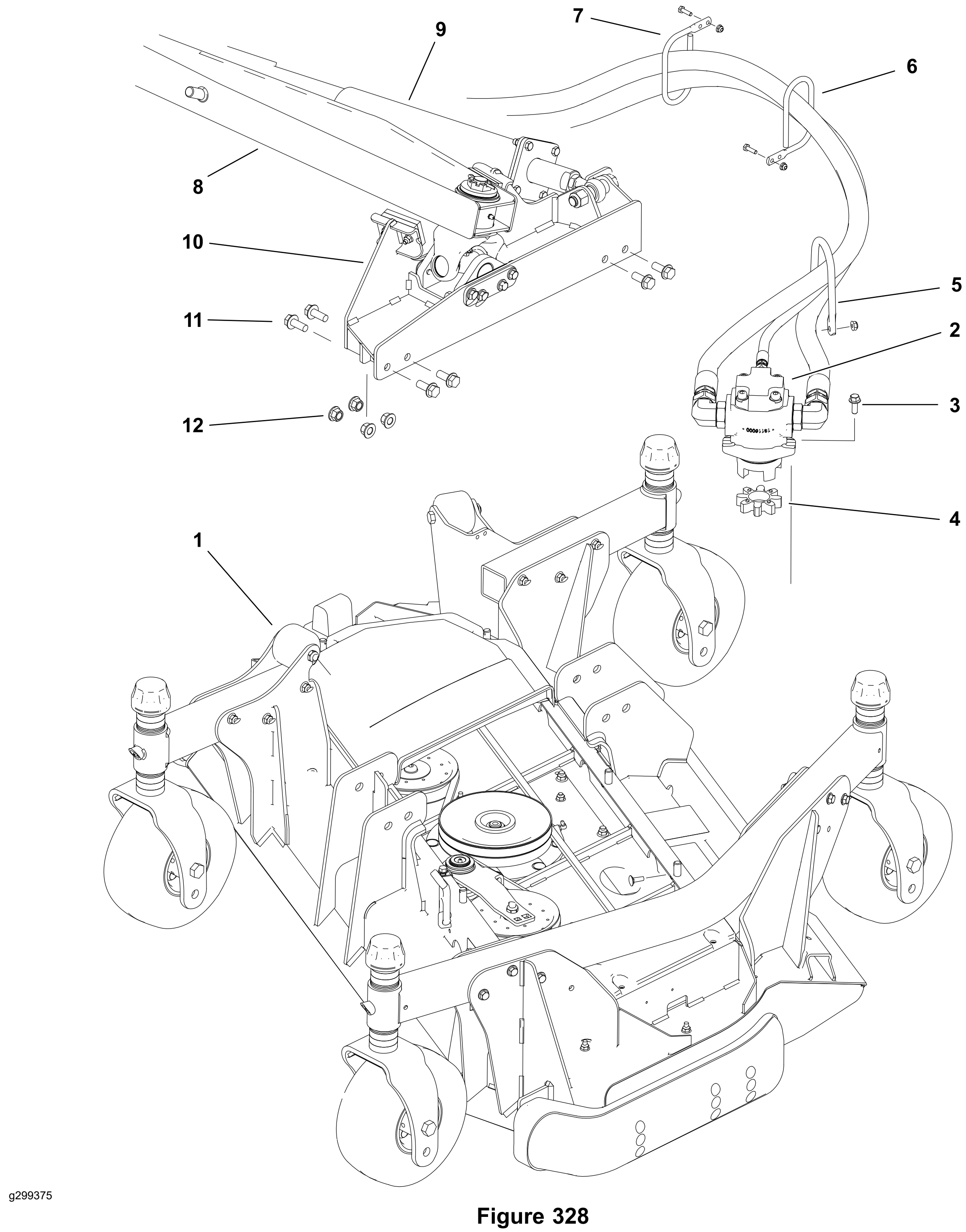

Figure 328

1. Wing cutting deck (LH)
2. Hydraulic motor
3. Flange head screw (2)
4. Drive spider
5. Hose guide − open
6. Hose guide − loop (on deck connection)
7. Hose guide − loop (on deck)
8. Lift arm (LH)
9. Impact arm assembly (LH)
10. Deck connection (LH)
11. Flange head screw (8)
12. Lock nut (8)

See Wing Deck Lift Arms (page 7–21) and Wing Deck Impact Arm Assembly (page 7–31) for lift arm and impact arm removal, installation and service information.

See Drive Belt Idler Assemblies (page 8–11), Blade Spindles (page 8–14), Castor Forks and Wheels (page 8–21) and Deck Skids and Front Deck Roller (Figure 340 and Figure 341) (page 8–23) for removal, installation and service information.

Wing Cutting Deck Removal (Figure 328)

1. Position machine on a clean, level surface. Lower cutting decks, stop engine and remove key from the key switch.
2. Remove cutting deck outer cover to access hydraulic deck motor.
3. Remove three (3) hose guides from cutting deck. Leave two (2) loop guides (item 6 and 7) on hydraulic hoses.
4. Remove hydraulic motor from cutting deck (see Cutting Deck Motor (page 5–118)). Position and support motor away from cutting deck. DO NOT allow cutting deck motor to hang from hydraulic hoses.
5. Remove eight (8) flange head screws (item 11) and lock nuts that secure deck connection (item 10) to cutting deck.
6. Start engine and raise lift arm slightly. Stop engine and remove key from the key switch.
7. Slide the cutting deck away from the traction unit.

Wing Cutting Deck Installation (Figure 328)

1. Position machine on a clean, level surface. Lower wing deck lift arm, stop engine and remove key from the key switch.
2. Position the wing cutting deck to a partially raised lift arm.
3. Start engine and lower lift arm while aligning deck connection to cutting deck. Stop engine and remove key from the key switch.
4. Install deck connection to cutting deck with eight (8) flange head screws (item 11) and lock nuts and tighten fasteners.
5. Install hydraulic motor to cutting deck (see Cutting Deck Motor (page 5–118)).
6. Position and secure three (3) hose guides to cutting deck.
7. Install all removed cutting deck covers.
8. Lubricate grease fittings on cutting deck and lift arm assemblies (see machine *Operator's Manual*).

Drive Belt Idler Assemblies

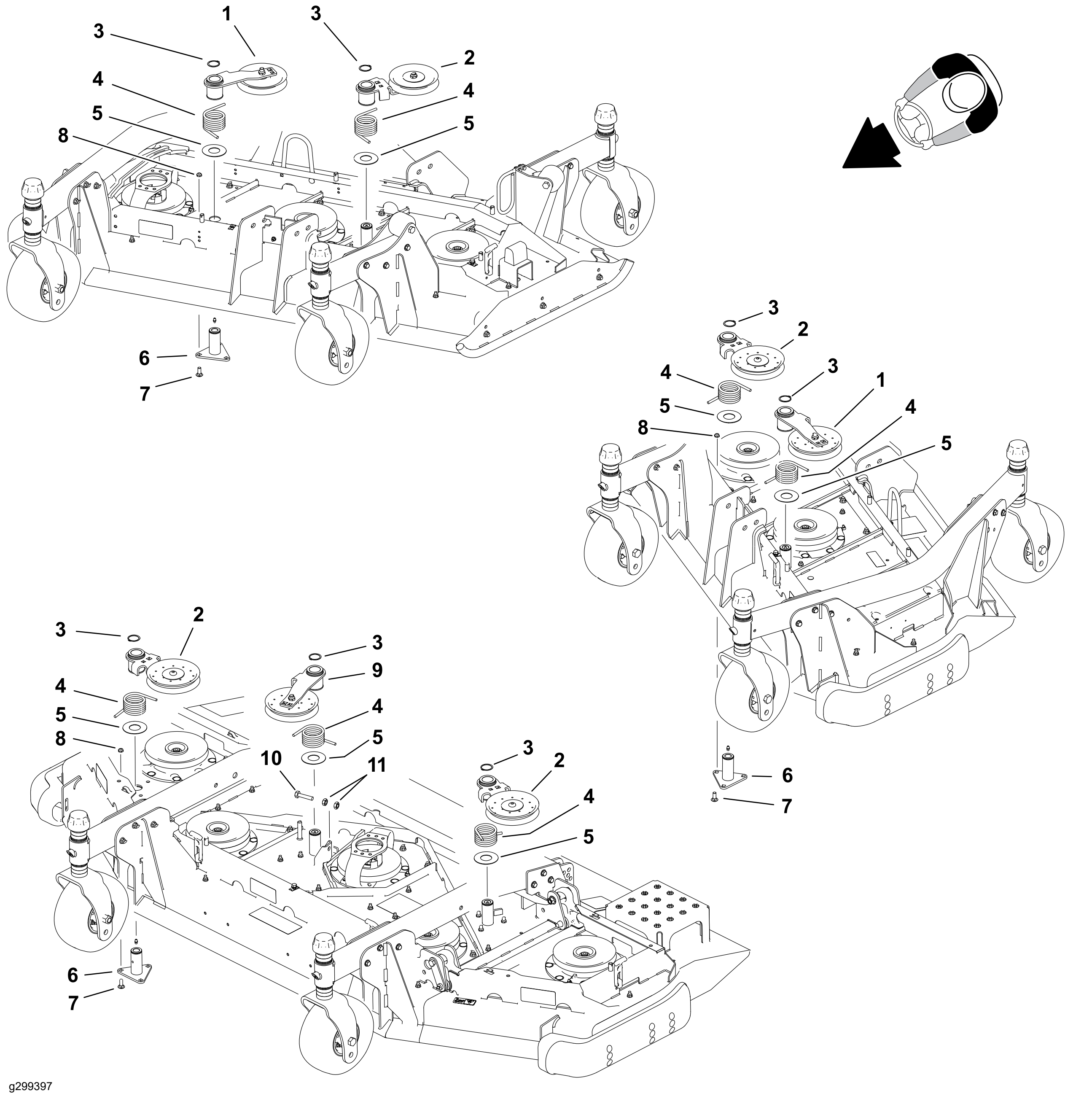

Figure 329

1. Lower belt Idler assy − wing deck (2)
2. Upper belt idler assembly (4)
3. Retaining ring (1 per idler)
4. Torsion spring (1 per idler)
5. Washer (1 per idler)
6. Idler pivot (1 per idler)
7. Carriage screw (3 per pivot)
8. Lock nut (3 per pivot)
9. Low belt Idler assy − front deck
10. Idler stop bolt
11. Jam nut (2)

Drive Belt Idler Assembly Removal (Figure 329)

1. Park machine on a level surface with cutting deck lowered. Stop engine and remove key from the key switch.
2. Remove deck covers from top of cutting deck.
3. If removing lower belt (center) idler assembly on front deck, loosen jam nuts that secure idler stop bolt (item 10) to cutting deck to increase clearance between the idler arm and the stop bolt.

Drive Belt Idler Assembly Removal (Figure 329) (continued)

4. Use a ⅜" or ½" drive ratchet or breaker bar to relieve idler pulley tension and remove drive belt.
5. Remove the retaining ring that secures the idler assembly to the idler pivot.

⚠ CAUTION ⚠

Be careful when removing the idler arm assembly. The idler torsion spring is under heavy load and may cause personal injury.

6. For additional leverage, slide a nut driver or small piece of pipe onto either end of the idler arm torsion spring. Apply enough load against the torsion spring to release it from the spring stop or idler arm and carefully lift the idler assembly from the idler pivot. Release the torsion spring slowly.
7. Check condition of idler pivot (item 6) and replace as needed.

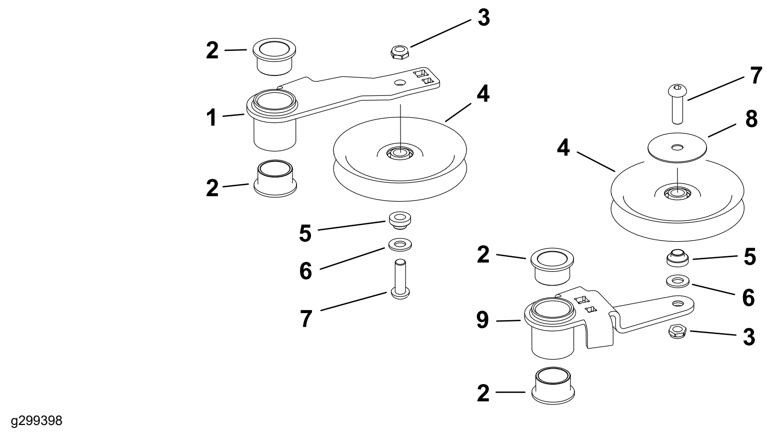

Figure 330

1. Lower belt idler arm	6. Flat washer
2. Flange bushing (2 ea)	7. Screw
3. Lock nut	8. Washer
4. Idler pulley	9. Upper belt idler arm
5. Spacer	

8. Replace worn or damaged idler components as needed (Figure 330).

Drive Belt Idler Assembly Installation (Figure 329)

⚠ CAUTION ⚠

Be careful when installing the idler arm assembly. The idler arm torsion spring is under heavy load and may cause personal injury.

1. If previously removed, fit the large washer over the idler pivot.
2. For additional leverage, slide nut driver or small piece of pipe onto either end of the idler arm torsion spring to. Apply enough load against the torsion spring to release it from the spring stop or the idler arm and carefully lower the idler assembly all the way onto the idler pivot. Slowly release the torsion spring against the spring stop and idler arm.
3. Secure idler assembly to idler pivot with retaining ring.

Drive Belt Idler Assembly Installation (Figure 329) (continued)

4. Use a ⅜” or ½” drive ratchet or breaker bar to relieve idler pulley tension and install drive belt. Make sure that idler pulley applies tension against the back side of the belt.

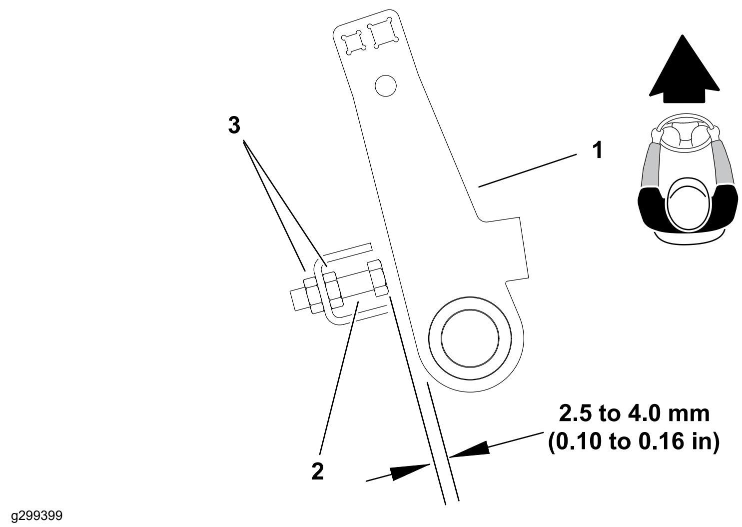

Figure 331

1. High idler arm
2. Stop bolt
3. Jam nut

5. On front deck, make sure that clearance between lower belt (center) idler arm and stop bolt head is 2.5 to 4.0 mm (0.10 to 0.16 in) (Figure 331). Adjust as necessary.
6. Install all deck covers to cutting deck.

Blade Spindles

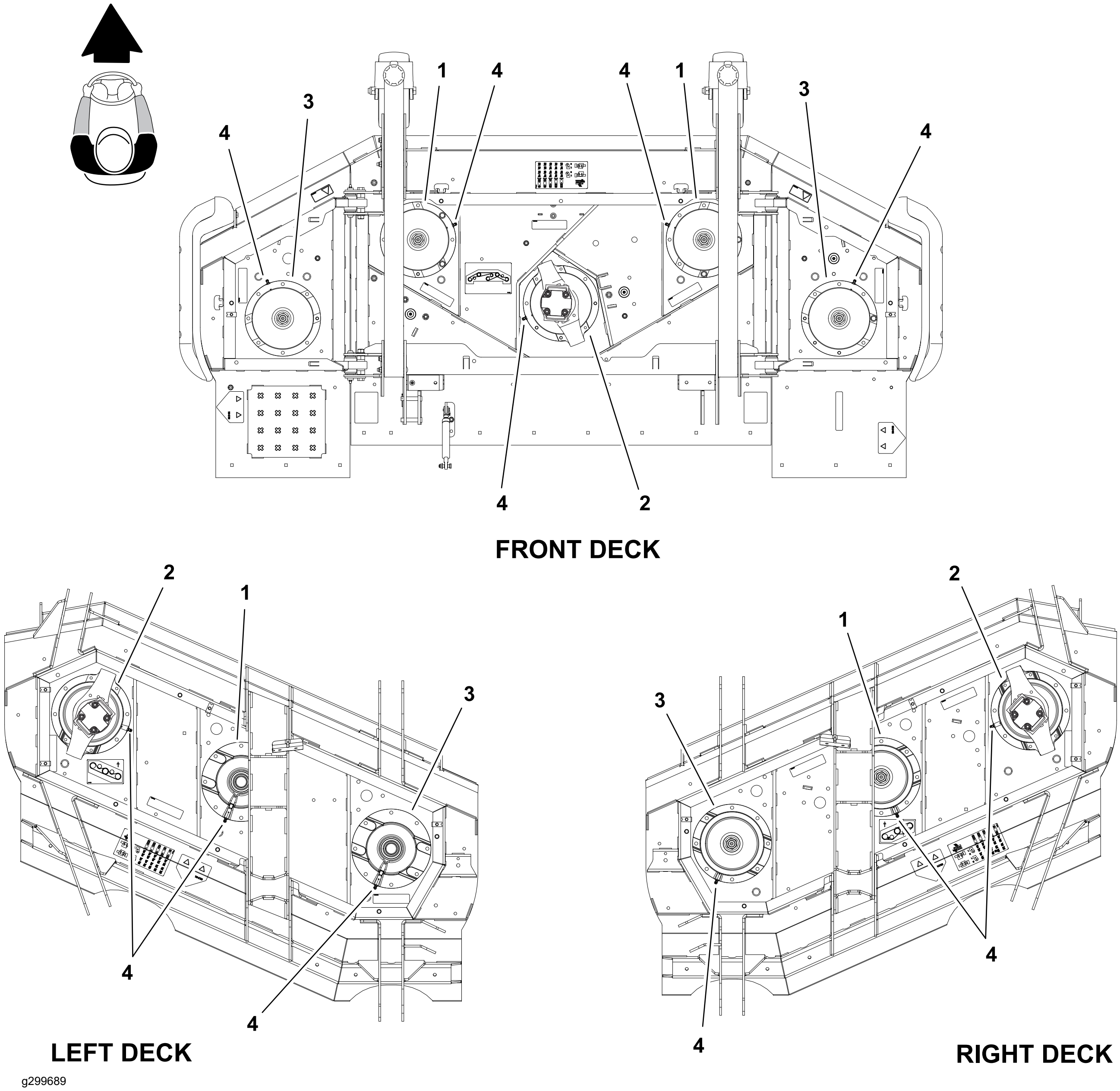

Figure 332

1. Driven spindle (double pulley)
2. Drive spindle
3. Driven spindle (high pulley)
4. Grease fitting

Blade Spindle Removal

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the key switch.
2. Remove covers from cutting deck to allow access to blade spindle.
3. If drive spindle is to be serviced, record motor orientation and remove hydraulic motor from cutting deck. See Cutting Deck Motor (page 5–118) for additional information. Position motor away from spindle.
4. Use a ⅜” or ½” drive ratchet or breaker bar to relieve idler pulley tension and remove drive belt(s) from spindle to be serviced.

5. Start the engine and raise the cutting deck. Stop engine and remove key from the key switch. Latch or block up the cutting deck so it cannot lower accidentally.

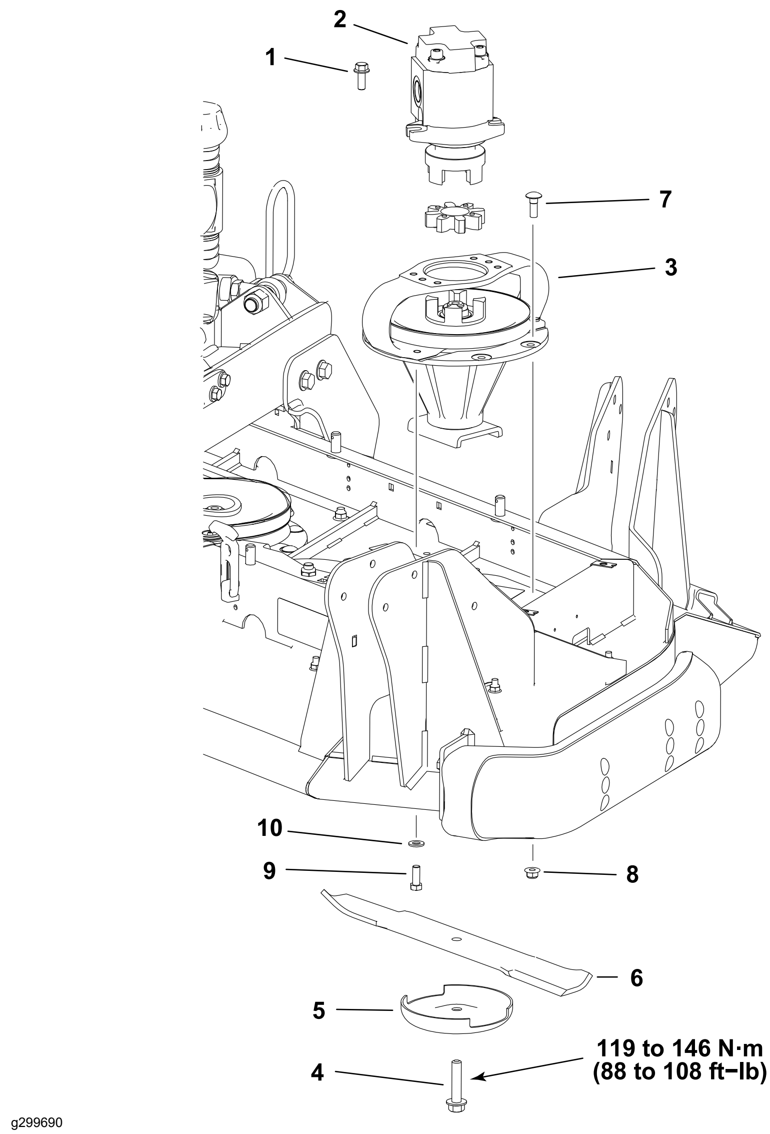

Figure 333

1. Flange screw
2. Hydraulic motor
3. Drive spindle
4. Blade bolt
5. Anti−scalp cup
6. Blade
7. Carriage bolt
8. Flange nut
9. Cap screw
10. Flat washer

6. Remove cutting blade, anti−scalp cup and blade bolt from spindle to be serviced (Figure 333).
7. Remove spindle housing assembly from deck.
   A. For driven spindle assemblies, remove eight (8) flange nuts that secure spindle to deck.
   B. For drive spindle assemblies, record spindle orientation and loosen and remove four (4) flange nuts that secure spindle to deck. Then, remove four (4) cap screws and flat washers that secure spindle and hydraulic motor mount to deck.

Blade Spindle Removal (continued)

8. Lift spindle assembly from deck. See Blade Spindle Service (page 8–17) for additional spindle service information.

Blade Spindle Installation

1. Position spindle on cutting deck noting orientation of grease fitting (Figure 332). Secure spindle assembly to deck with correct fasteners (Figure 333).

2. Install cutting blade, anti−scalp cup and blade bolt to spindle. Tighten blade bolt from **119 to 146 N·m (88 to 108 ft−lb)**.

3. Slowly rotate cutting blades to verify that blades do not contact any deck components.

4. Use a ⅜” or ½” drive ratchet or breaker bar to relieve idler pulley tension and install drive belt(s).

5. If drive spindle was removed, install hydraulic motor to cutting deck. See Cutting Deck Motor (page 5–118) for additional information.

6. Install all cutting deck covers.

Blade Spindle Service

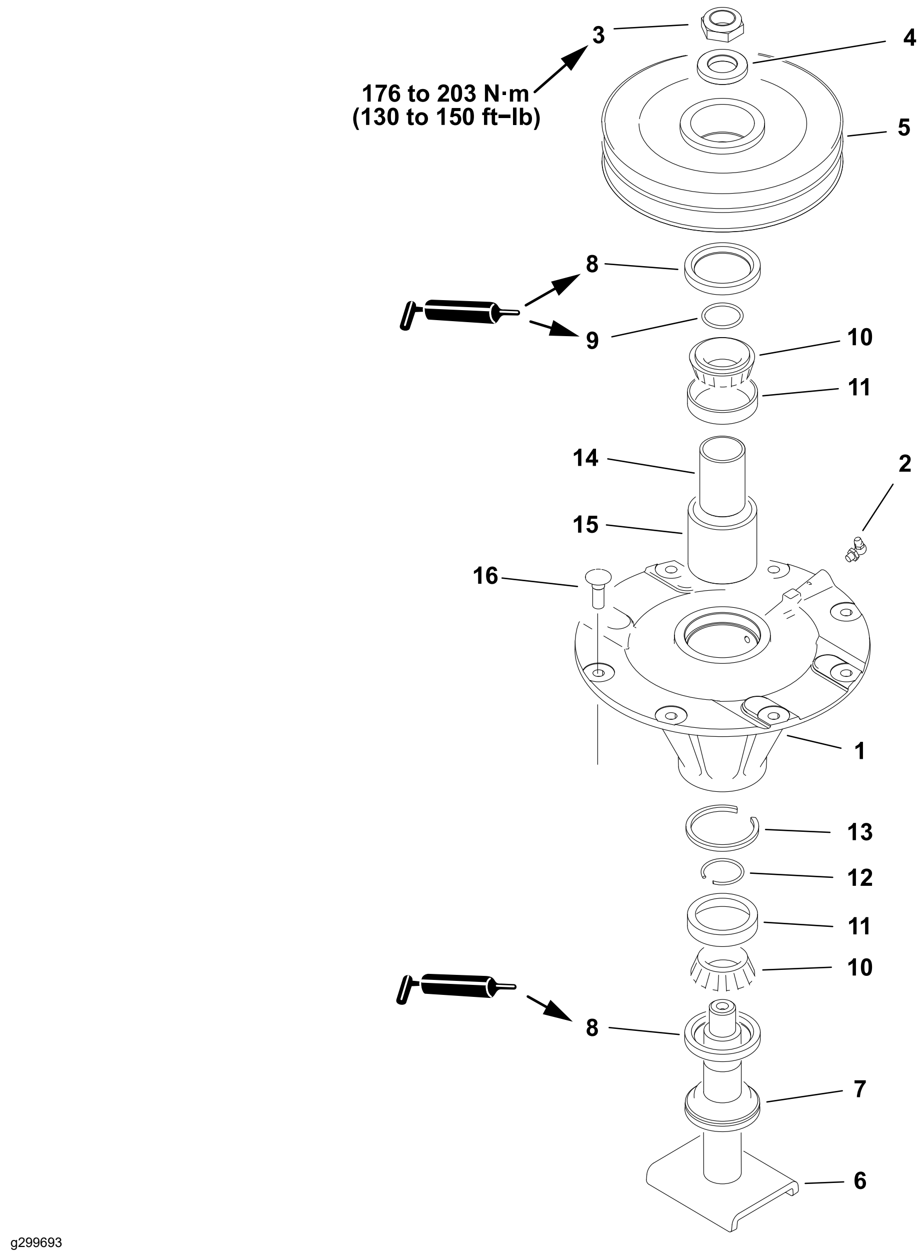

Figure 334

1. Spindle housing
2. Grease fitting
3. Lock nut
4. Hardened washer
5. Pulley
6. Spindle shaft
7. Spindle spacer
8. Seal (2)
9. O−ring
10. Bearing cone (2)
11. Bearing cup (2)
12. Spacer ring
13. Large snap ring
14. Inner bearing spacer
15. Outer bearing spacer
16. Drive Stud

Blade Spindle Disassembly (Figure 334)

1. Loosen and remove lock nut from top of spindle shaft. Remove hardened washer and pulley from spindle. For drive spindle, remove hydraulic motor mount.
2. Remove the spindle shaft from the spindle housing which may require the use of an arbor press. The shaft spacer (item 7) should remain on the spindle shaft.

Blade Spindle Disassembly (Figure 334) (continued)

3. Remove and discard the oil seals from spindle housing.
4. Remove the bearing cones, inner bearing spacer, spacer ring and spindle shaft O− ring from the spindle housing. Discard the spindle shaft O−ring.
5. Using an arbor press, remove both of the bearing cups and the outer bearing spacer from the housing.
6. The large snap ring (item 13) can remain inside the spindle housing. Removal of this snap ring can be very difficult.
7. Remove damaged drive studs (item 16) as needed.

Blade Spindle Assembly (Figure 334)

Note: A replacement spindle bearing set contains two (2) complete bearings (cups and cones), a spacer ring and a large snap ring (Figure 335). These parts cannot be purchased separately. Do Not mix bearing set components from one deck spindle to another.

Note: A replacement bearing spacer set includes the inner spacer and outer spacer (Figure 335). These parts cannot be purchased separately. Do Not mix bearing spacers from one deck spindle to another.

IMPORTANT

If new bearings are installed into a used spindle housing, it may not be necessary to replace the original large snap ring (item 13). If the original snap ring is in good condition with no evidence 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 found to be damaged, replace the snap ring.

1. Use an arbor press to install any drive studs previously removed.

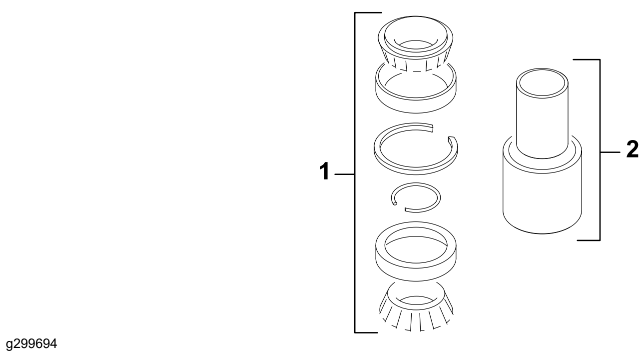

Figure 335

1. Bearing set
2. Spacer set

2. If large snap ring (item 13) was removed from the spindle housing, install the snap ring into the housing groove. Make sure the snap ring is fully seated in the housing groove.
3. Install outer bearing spacer into top of spindle housing. The spacer should contact the large snap ring.

Blade Spindle Assembly (Figure 334) (continued)

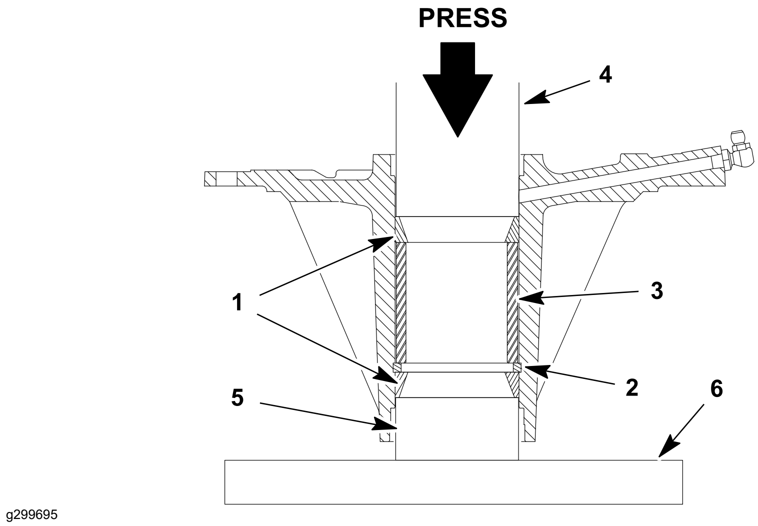

Figure 336

1. Bearing cups	4. Arbor press
2. Large snap ring	5. Support
3. Large outer spacer	6. Arbor press base

4. Using an arbor press, push the bearing cups into the top and bottom of the spindle housing. The top bearing cup must contact the outer bearing spacer previously installed, and the bottom bearing cup must contact the large snap ring. Make sure that the assembly is correct by supporting the first bearing cup and pressing the second cup against it (Figure 336).
5. Pack the bearing cones with grease. Apply a film of grease on lips of oil seals and O−ring.

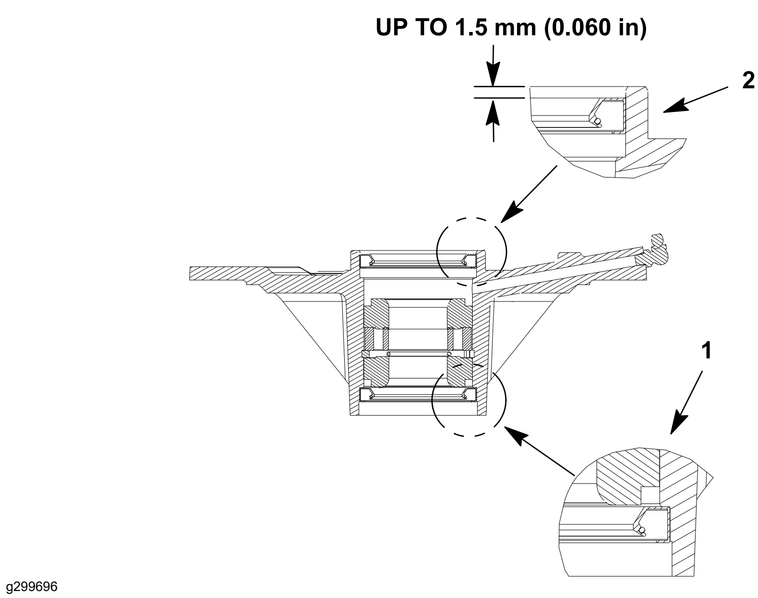

Figure 337

1. Bottom seal installation	2. Upper seal installation

6. Install lower bearing cone and greased oil seal into bottom of spindle housing. Note: The bottom seal must have the lip facing out (down) (Figure 337). This seal installation allows grease to purge from the spindle during the lubrication process.

IMPORTANT

If bearings are being replaced, make sure to use the spacer ring that is included with new bearing set (Figure 335).

7. Slide spacer ring and inner bearing spacer into spindle housing, then install upper bearing cone and greased oil seal into top of housing. Note: The upper seal must have the lip facing in (down) (Figure 337). Make sure upper seal is flush to 1.5 mm (0.060 in) below the housing surface.
8. Inspect the spindle shaft and shaft spacer to make sure there are no burrs or nicks that could possibly damage the oil seals. Lubricate the shaft and spacer with grease.
9. Install spindle shaft spacer onto shaft. Place thin sleeve or tape on spindle shaft splines to prevent seal damage during shaft installation.
10. Carefully slide spindle shaft with spacer up through spindle housing. The bottom oil seal and spindle spacer fit together when the spindle is fully installed.
11. Install greased O−ring to top of spindle shaft.
12. Install pulley (hub down), hardened washer and lock nut to spindle shaft. Tighten lock nut from **176 to 203 N·m (130 to 150 ft−lb)**.

IMPORTANT

Pneumatic grease guns can produce high pressure inside spindle housing that can damage spindle seals. Pneumatic grease guns, therefore, are not recommended to be used for greasing of spindle housings.

13. Attach a hand pump grease gun to grease fitting on housing and fill housing cavity with grease until grease starts to come out of lower seal.
14. Rotate spindle shaft to make sure that it turns freely.

Castor Forks and Wheels

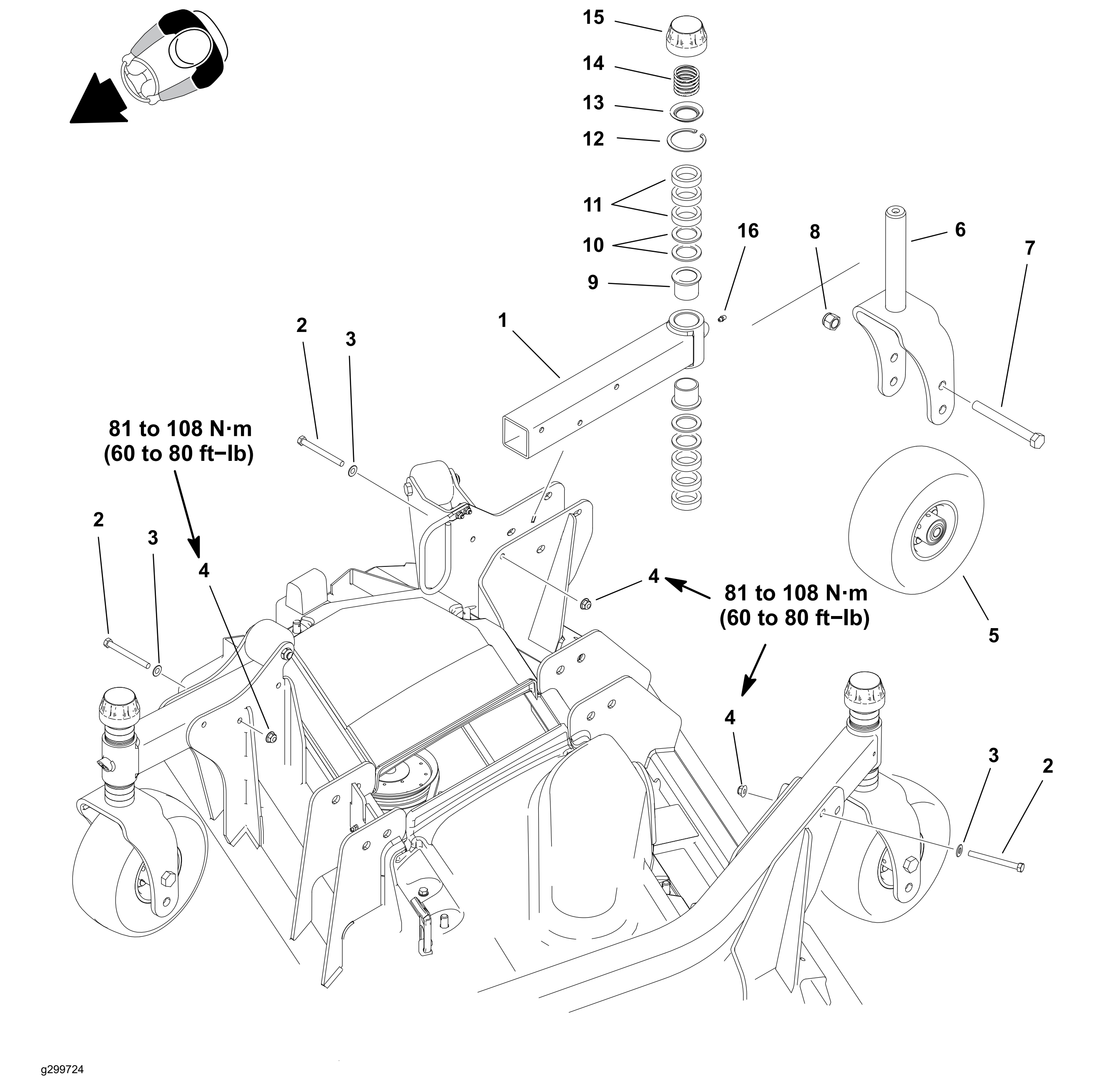

Figure 338

Wing Deck (LH shown)

1. Castor arm
2. Cap screw (12)
3. Flat washer (12)
4. Flange nut (12)
5. Castor wheel (4)
6. Castor fork (4)
7. Cap screw (4)
8. Lock nut (4)
9. Flange bushing (2 per castor arm)
10. Thrust washer (4 per castor)
11. Spacer (6 per castor)
12. Retaining ring (1 per cap)
13. Spring seat (1 per cap)
14. Spring (1 per cap)
15. Cap (1 per cap)
16. Grease fitting (1 per castor arm)

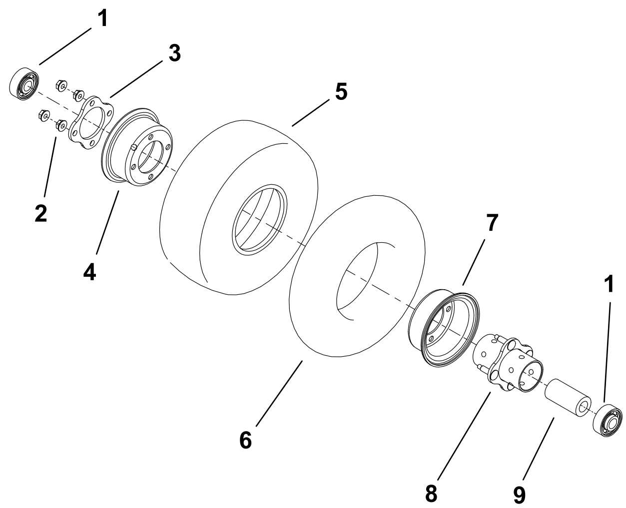

Figure 339

1. Bearing (2)
2. Flange nut (4)
3. Plate
4. Rim half
5. Tire
6. Inner tube
7. Rim half
8. Hub
9. Bearing spacer

Castor Wheel Disassembly (Figure 338 and Figure 339)

Disassemble castor forks and wheels as needed.

Castor Wheel Assembly

1. If the caster arm was removed form cutting deck, insert castor arm bolts with bolt head toward the outside of the cutting deck.
2. Assemble castor forks and wheels as needed.
   A. Make sure to install all the castor wheels on all the cutting decks in the same mounting hole height position (lower, or upper).
   B. Install castor wheels so that valve stem extends toward the outside of the machine.
   C. Insert castor wheel bolts with bolt head toward the outside of the machine. Tighten castor wheel lock nut from **81 to 108 N·m (60 to 80 ft−lb)**.
3. Castor tire pressure should be 345 kPa (50 PSI).
4. Lubricate castor fork grease fitting.
5. Check height−of−cut setting and adjust if necessary.

Deck Skids and Front Deck Roller (Figure 340 and Figure 341)

Deck Skids and Front Deck Roller Removal

1. Remove skids from cutting decks as needed.
2. Remove roller from front cutting deck as needed.

Deck Skids and Front Deck Roller Installation

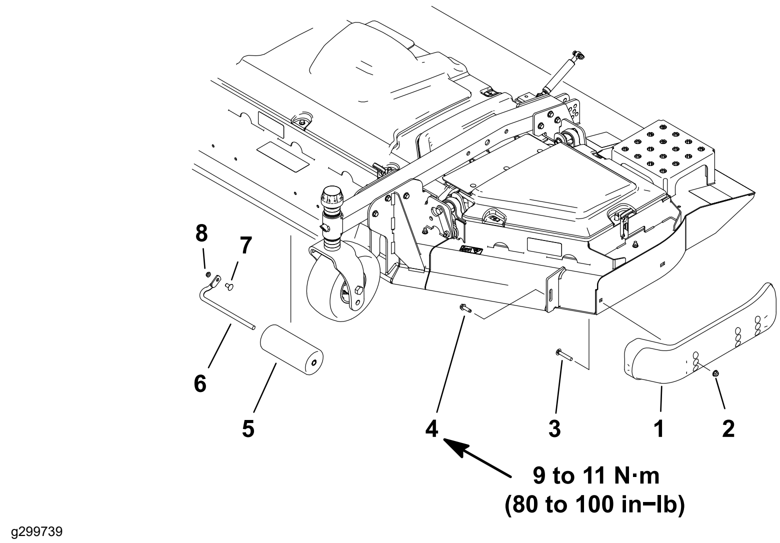

Figure 340

1. Skid/Bumper
2. Flange nut (4)
3. Carriage bolt (4)
4. Flange head screw (2)
5. Roller
6. Roller shaft
7. Carriage screw
8. Lock nut

Deck Skids and Front Deck Roller Installation (continued)

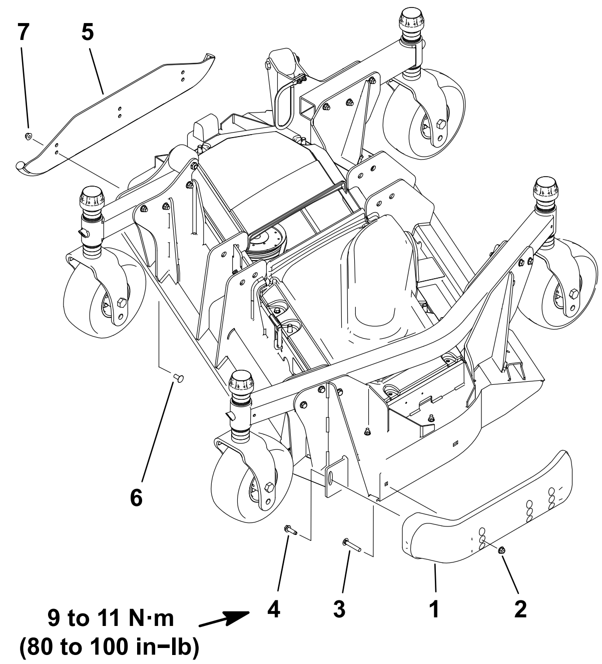

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Figure 341

1. Skid/Bumper
2. Flange nut (2)
3. Carriage bolt (2)
4. Flange head screw
5. Inner skid
6. Carriage bolt (3)
7. Lock nut (3)

---

1. Install skids and rollers to deck.

   A. Make sure to install all the skid/bumpers on all the cutting decks in the same mounting hole height position (lower, middle or upper).

   B. The flange head screw at the front of each deck skid/bumper threads into the skid/bumper. Tighten the flange head screws (item 4) from **9 to 11 N·m (80 to 100 in−lb)**.

   C. Make sure to install the inner skids on the wing decks in the same mounting hole height position (lower, or upper).

   D. Install front deck roller in correct mounting hole based on desired height−of−cut.

Chapter 9

Operator Cab

Table of Contents

Additional Reference Materials

Sanden SD Compressor Service Guide

General Information

The information in this chapter pertains to the operator cab on the Groundsmaster 5910.

Operator's Manual

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

Electrical Components, Schematics and Wire Harness Drawings

Information regarding Groundsmaster 5910 electrical cab components (switches and relays) is included in Chapter 6: Electrical System (page 6–1). The electrical schematic and wire harness drawings for the operator cab are included in Appendix A (page A–1).

Air Conditioning System

The air conditioning system used on the Groundsmaster 5910 consists of the following components:

1. A compressor mounted on the right side of the engine and driven by a poly v−belt.
2. A condenser assembly and two (2) condenser fans located at the rear of the cab roof assembly.
3. An evaporator core, a drier−receiver and an expansion valve mounted in the headliner of the cab.
4. The necessary hoses and tubes that connect the A/C system components.
5. A blower fan motor that provides air movement through the evaporator and into the cab. The fan motor is a component of the mixing box located in the cab headliner. The fan motor is also used for the cab heating system.
6. Operator controls to turn the air conditioning on, to adjust the fan speed and to control the cab air temperature.

Cab Heater System

The cab heater system used on the Groundsmaster 5910 consists of the following components:

1. A heater core mounted in the headliner of the cab.
2. 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. The fan motor is also used for the air conditioning system.
4. Operator controls to adjust the fan speed and to control the cab air temperature.

Air Conditioning System Performance

There are a number of factors that can affect the performance of the Groundsmaster 5910 air conditioning system. To ensure the best system operation, inspect the following components.

1. Make sure that the heater control fully closes the heater valve in the cab headliner.
2. Make sure that the condenser and evaporator fins are clean.
3. Verify that refrigerant charge quantity and system operating pressures are correct.
4. Make sure that exposed metal surfaces inside cab are insulated.
5. If ambient temperatures exceeds 43 ºC (110 ºF), apply additional window tinting to lower solar heat load to cab.

Service and Repairs

General Precautions for Removing and Installing Air Conditioning System Components

CAUTION

The air conditioning system is under high pressure. Do not loosen any system fitting or component until after the system has been completely discharged by a certified A/C service technician.

WARNING

Always wear safety goggles or a face shield when working with air conditioning system components. Also, do not allow refrigerant contact with your skin or eyes as there would be the possibility of serious injury.

CAUTION

Never use compressed air to leak test or pressure test the air conditioning system. Under certain conditions, pressurized mixtures of refrigerant and air can be combustible.

1. Before servicing any air conditioning system components, park machine on a level surface, lower cutting decks or attachments and stop engine. Remove key from the key switch.
2. Clean machine before disconnecting, removing or disassembling any air conditioning system components. Thorough cleaning will prevent system contamination while performing service procedures.
3. Before loosening or removing any air conditioning system hose or other component, have a certified air conditioning service technician recover the system refrigerant and then evacuate the air conditioning system completely. It is illegal to vent refrigerant to the atmosphere.
4. Put caps or plugs on any air conditioning system lines, fittings or components left open or exposed to prevent moisture and contaminants from entering the system.
5. Put labels on disconnected lines and hoses for proper installation after repairs are completed.
6. If compressor is removed from machine, keep compressor in the same orientation as the installed position. This will prevent compressor oil from filling the compressor cylinders.
7. Note the position of fittings (especially elbow fittings) before removal. Mark parts if necessary to make sure they will be aligned properly when reinstalling hoses and tubes.
8. Always use a DOT approved tank for storing used and recycled refrigerants.

General Precautions for Removing and Installing Air Conditioning System Components (continued)

9. The Groundsmaster 5910 air conditioning system uses R134a refrigerant. DO NOT use other refrigerants in the system. A/C system capacity is 3.43 lb of R134a refrigerant.
10. Refrigerant containers (either full or empty) are under pressure that will increase if the containers are heated. DO NOT expose refrigerant containers to high heat sources or flame.
11. Be sure the work area is properly ventilated to prevent any accumulation of refrigerant or other fumes.
12. Make sure that caps are always placed on the pressure hose ports. These caps prevent refrigerant leakage from the system.
13. The A/C drier−receiver component is used to collect moisture that will reduce air conditioning performance. If the air conditioning system is opened for component repair or replacement, make sure that the drier−receiver ports are plugged to prevent damage to the drier−receiver. If either the compressor or A/C expansion valve is replaced, replacement of the drier−receiver is also recommended.
14. After installing air conditioning components, have a certified air conditioning service technician evacuate the air conditioning system completely, properly recharge the system with R134a refrigerant and then leak test the system.

Air Conditioning Compressor

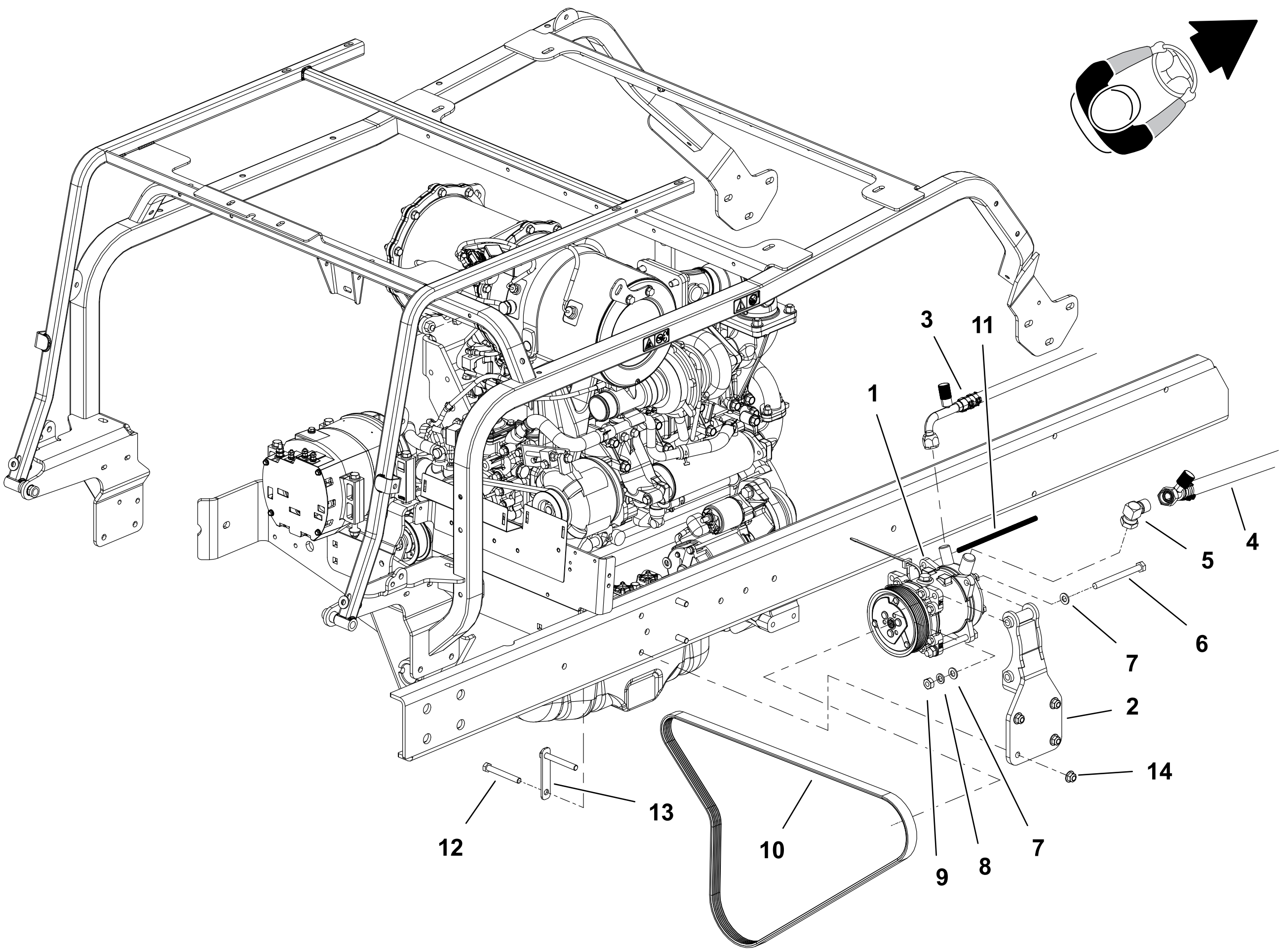

Figure 342

1. Air conditioning compressor
2. Compressor mount
3. AC hose
4. AC hose
5. Elbow fitting
6. Cap screw (2)
7. Flat washer (4)
8. Lock washer (2)
9. Hex nut (2)
10. Drive belt
11. Tubing
12. Cap screw (4)
13. Mount strap (2)
14. Flange nut (4)

Removal (Figure 342)

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from the key switch.
2. Raise hood to allow access to engine and air conditioning compressor.
3. Remove drive belt from A/C compressor pulley (see 24 Volt Alternator/Air Conditioning Compressor Drive Belt (page 6–147)).
4. Disconnect compressor electrical connector from machine wire harness.
5. Read the General Precautions for Removing and Installing Air Conditioning System Components (page 9–4).

Removal (Figure 342) (continued)

CAUTION

The air conditioning system is under high pressure. Do not loosen any system fitting or component until after the system has been completely discharged by a certified A/C service technician.

6. Have refrigerant evacuated from air conditioning system by a certified A/C service technician.
7. Label and remove hoses from compressor. Immediately cap hoses and fittings to prevent moisture and contaminants from entering the system.
8. Support compressor to prevent it from shifting or falling.

   Note: There may be shims mounted between the compressor mounting flanges and the compressor mount. When removing compressor, note shim location and quantity for assembly purposes.
9. Remove cap screws, lock washers, flat washers and hex nuts that secure compressor to compressor mount.

IMPORTANT

To prevent compressor oil from filling the compressor cylinders, keep compressor in the same orientation as the installed position.

10. Carefully remove compressor from engine and machine.

    Note: The replacement of the A/C drier−receiver is recommended whenever A/C compressor is serviced or replaced.

    Note: The air conditioning compressor used on the Groundsmaster 5910 is a Sanden model SD5H09. For air conditioning compressor repair procedures, see the Sanden SD Compressor Service Guide.

Installation (Figure 342)

1. Position compressor to compressor mount on machine frame.
2. The clearance between the compressor mounting flanges and the compressor mount must be less than 0.10 mm (0.004 in). If necessary, install shims between compressor flanges and mount to adjust clearance.
3. Secure compressor to compressor mount with removed cap screws, washers and hex nuts.

IMPORTANT

After the compressor has been installed, make sure to rotate the compressor drive shaft several times to properly distribute oil in the compressor. Compressor damage due to oil slugging can occur if this procedure is not performed.

4. Manually rotate the compressor drive shaft at least ten (10) revolutions to make sure that no compressor oil is in the compressor cylinders.
5. Install drive belt to A/C compressor pulley (see 24 Volt Alternator/Air Conditioning Compressor Drive Belt (page 6–147)).

Installation (Figure 342) (continued)

6. Remove caps that were placed on hoses and fittings during the removal process. Using labels placed during removal, properly secure hoses to compressor.
7. Connect compressor electrical connector to machine wire harness.
8. Have a certified air conditioning service technician evacuate the air conditioning system completely, properly recharge the system with R134a refrigerant and then leak test the system. A/C system capacity is 3.43 lb of R134a refrigerant.
9. Lower and secure hood.

Roof Assembly

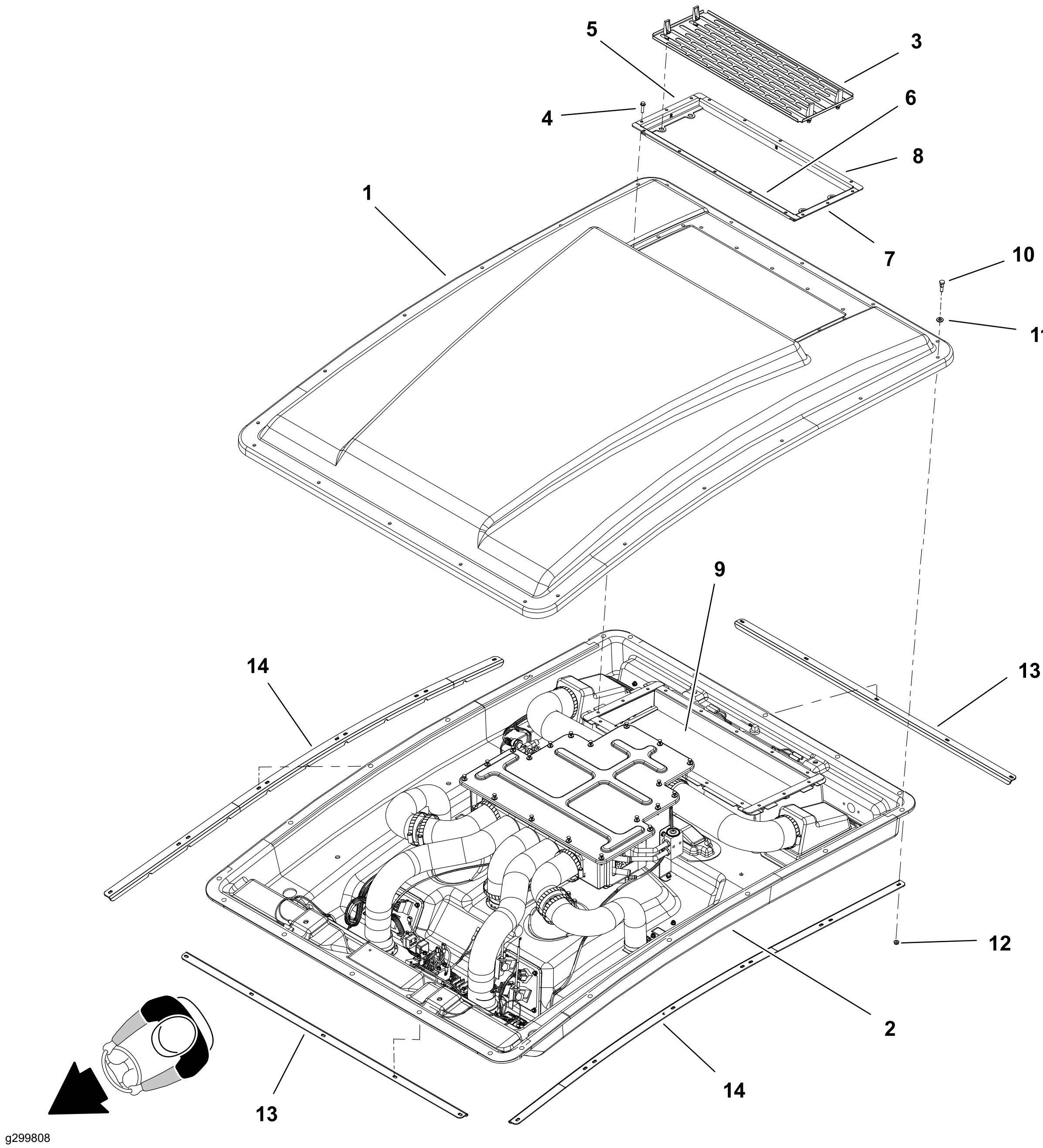

Figure 343

1. Roof panel
2. Headliner assembly
3. Condenser screen
4. Flange head screw (16)
5. RH condenser seal
6. Front condenser seal
7. LH condenser seal
8. Rear condenser seal
9. Condenser assembly
10. Shoulder screw (22)
11. Flat washer (22)
12. Flange nut (22)
13. Front/rear cab strap (2)
14. Side cab strap (2)

To gain access to heater and air conditioning components, the roof panel needs to be removed.

Removal (Figure 343)

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from the key switch.
2. Release swell latches and lift condenser screen (item 3) from roof assembly.
3. Remove flange head screws that secure condenser seals (items 5, 6, 7 and 8) to roof and A/C condenser assembly.
4. Remove shoulder screws, washers and flange nuts that secure the roof and cab straps to the headliner.
5. Carefully lift roof from headliner and cab.

Installation (Figure 343)

1. Make sure that all components in headliner are installed and secure.
2. Position roof onto headliner. Make sure that all roof mounting holes are properly aligned with headliner and A/C condenser assembly.
3. Secure roof to headliner with removed shoulder screws, flat washers, cab straps and flange nuts.
4. Secure condenser seals to roof and A/C condenser assembly with removed flange head screws.
5. Install and secure A/C screen to roof assembly with swell latches.

Heating and Air Conditioning Components

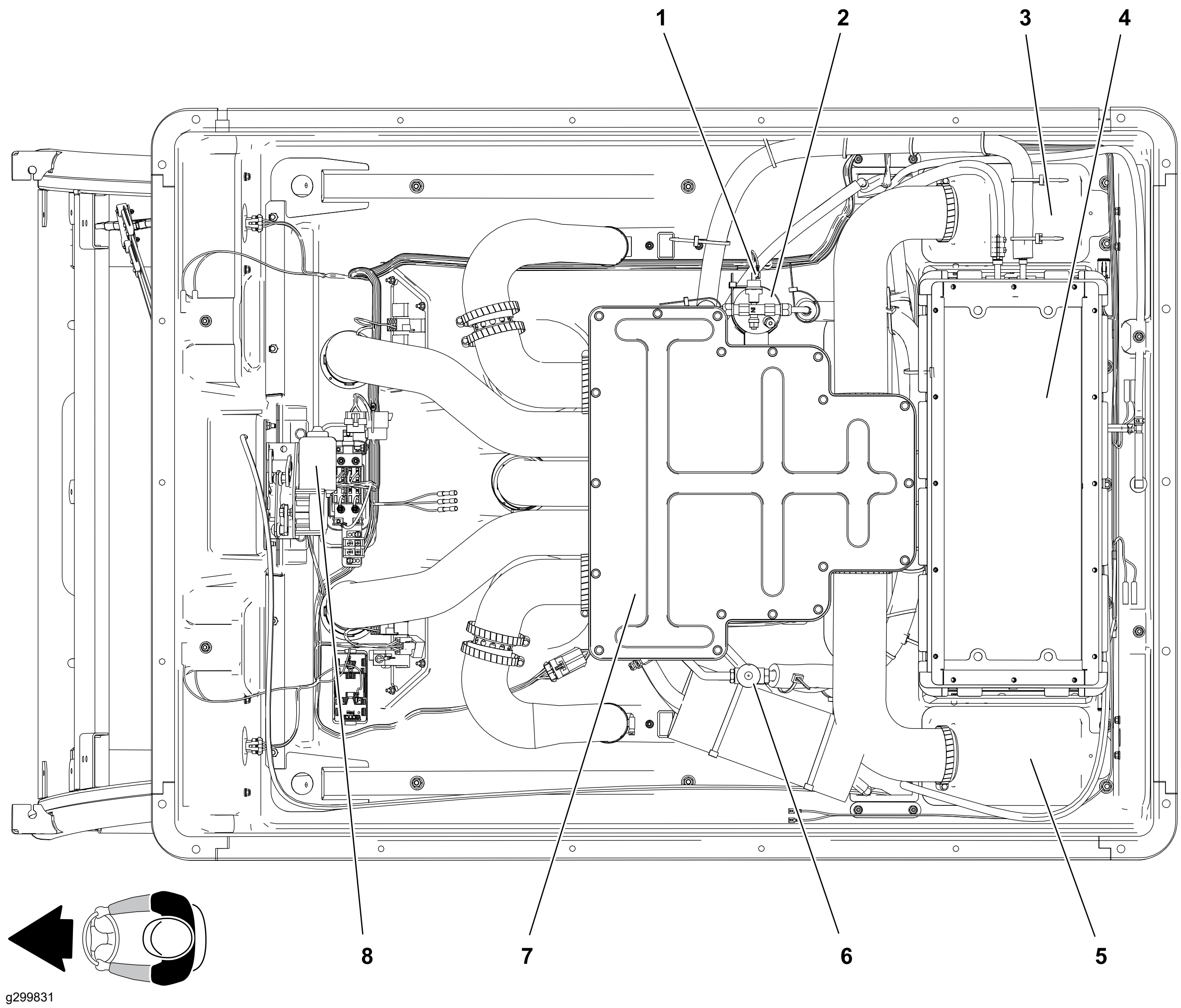

Figure 344

1. A/C binary switch
2. A/C drier−receiver
3. RH intake air filter
4. A/C condenser assembly
5. LH intake air filter
6. A/C expansion valve
7. Heat and A/C mixing box assembly
8. Wiper motor assembly

Heating and Air Conditioning Components (continued)

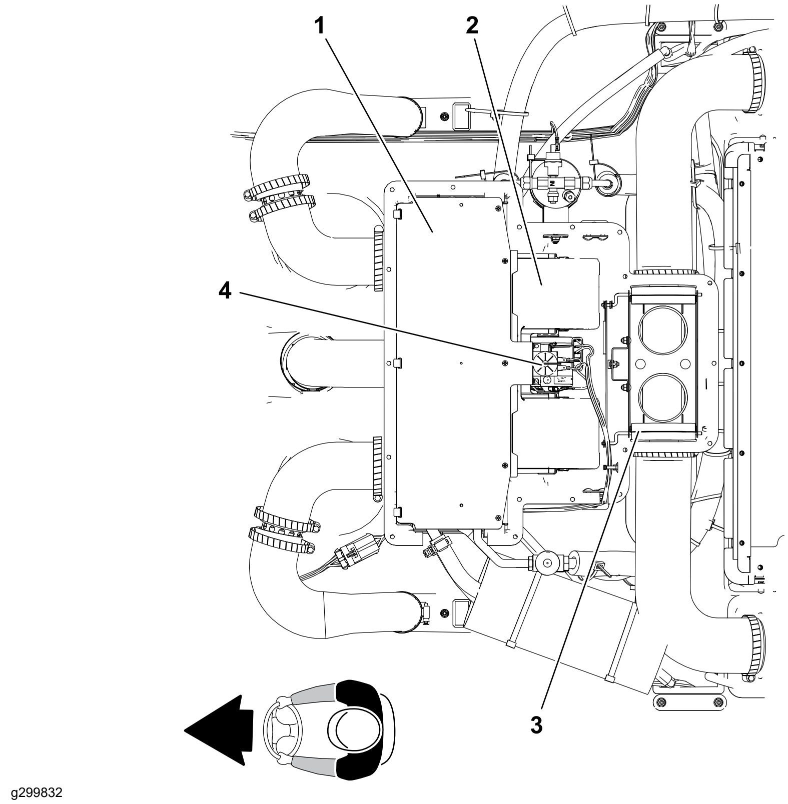

Figure 345

1. Evaporator/heater cores
2. Blower fan
3. Air diverter assembly
4. A/C freeze switch

Access to cab heating and air conditioning components can be obtained by removing the cab roof. Once the cab roof is removed, the illustrations in Figure 344 and Figure 345 can be used to identify the components used for heating and cooling the operator cab.

Note: Figure 345 shows the heat and A/C mixing box assembly with the mixing box cover removed.

Note: A/C system capacity is 3.43 lb of R134a refrigerant.

A/C Condenser Fan Assembly

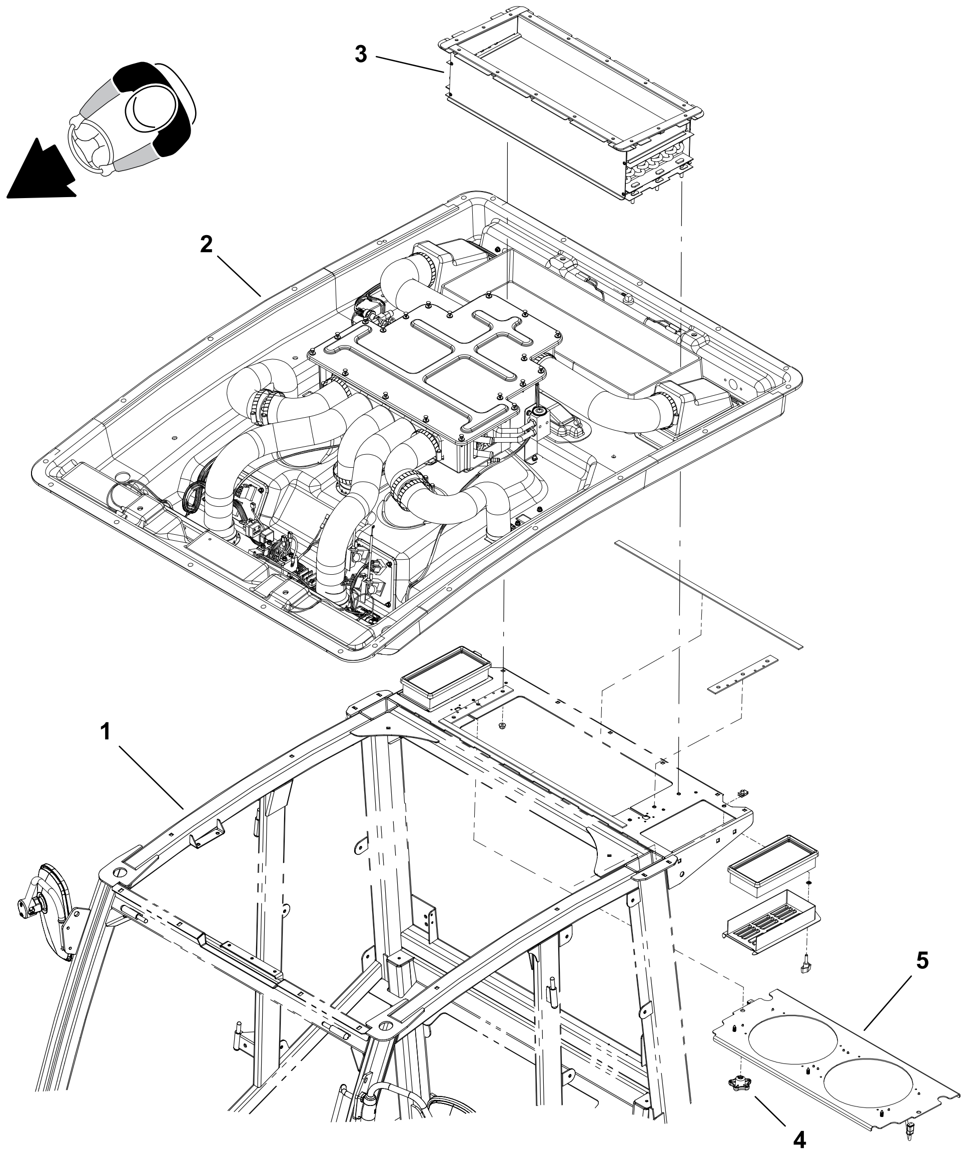

Figure 346

1. Cab frame
2. Cab headliner assembly
3. A/C condenser assembly
4. Knob (2)
5. Condenser fan assembly

Removal (Figure 346)

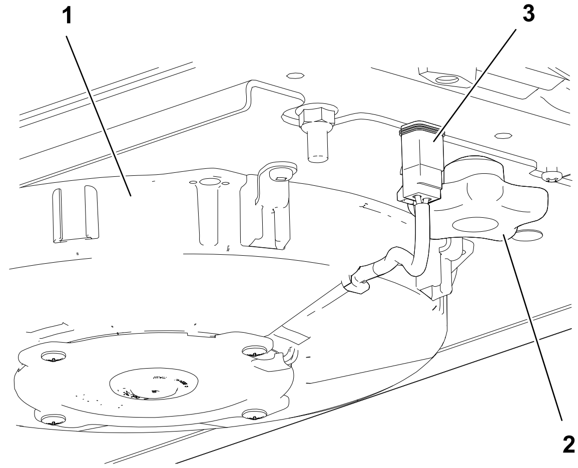

Figure 347

1. Condenser fan (2)
2. Knob (2)
3. Fan plug (2)

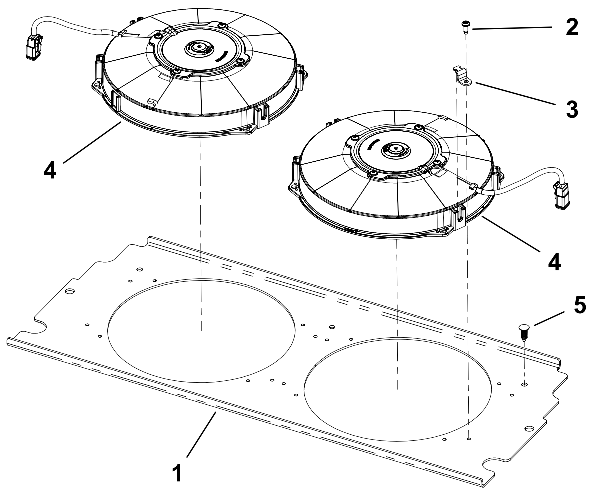

Figure 348

1. Fan mount plate
2. Screw (4 per fan)
3. Fan tab (4 per fan)
4. Condenser fan (2)
5. Plastic plug (3)

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from the key switch.
2. Locate A/C condenser fan assembly which is secured to the frame under the rear of the cab headliner.
3. Disconnect the two (2) condenser fan plugs from the wire harness connectors attached to the cab frame (Figure 347).
4. Support the condenser fan assembly to prevent it from falling.
5. Remove two (2) knobs that secure condenser fan assembly to machine (Figure 347).
6. Lower condenser fan assembly from machine.
7. If necessary, disassemble condenser fan assembly using Figure 348 as a guide.

Installation (Figure 346)

1. If condenser fan assembly was disassembled, use Figure 348 as a guide to secure fans to fan mount plate.
2. Raise and support fan assembly to cab frame.
3. Secure fan assembly to machine with two (2) knobs.
4. Connect the two (2) condenser fan plugs to the wire harness connectors attached to the cab frame.

A/C Condenser Assembly

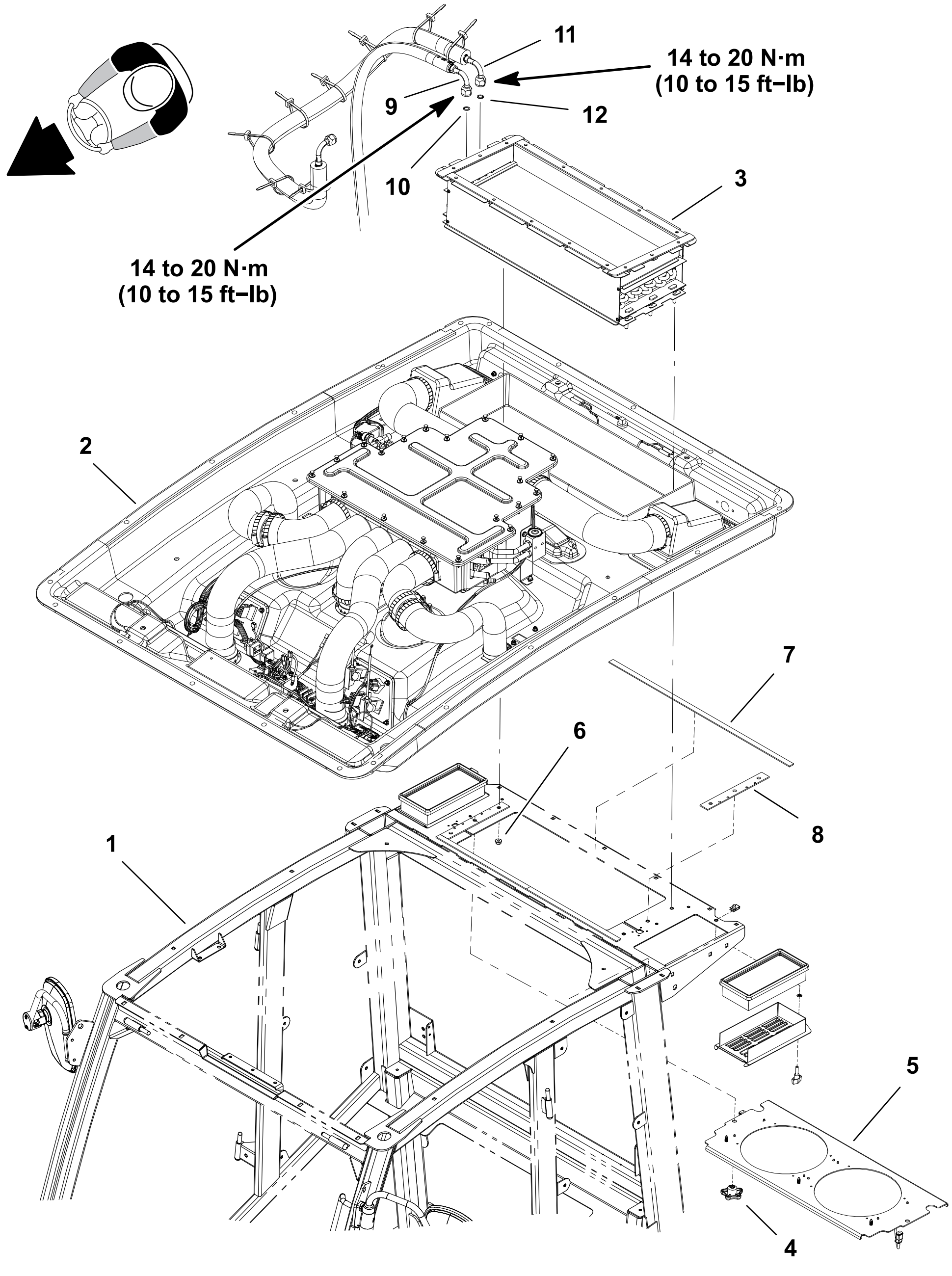

Figure 349

1. Cab frame
2. Cab headliner assembly
3. A/C condenser assembly
4. Knob (2)
5. Condenser fan assembly
6. Flange nut (4)
7. Strip seal (2)
8. Edge seal (2)
9. AC hose (from compressor)
10. O−ring
11. AC hose (to drier−receiver)
12. O−ring

Removal (Figure 349)

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from the key switch.
2. To access A/C condenser assembly, remove roof panel from top of cab (see Roof Assembly (page 9–9)).
3. Remove condenser fan assembly from machine (see A/C Condenser Fan Assembly (page 9–13)).

Removal (Figure 349) (continued)

4. Read the General Precautions for Removing and Installing Air Conditioning System Components (page 9–4).

CAUTION

The air conditioning system is under high pressure. Do not loosen any system fitting or component until after the system has been completely discharged by a certified A/C service technician.

5. Have refrigerant evacuated from air conditioning system by a certified A/C service technician.
6. Label and disconnect hoses from condenser core. Immediately cap hoses and fittings to prevent moisture and contaminants from entering the system.
7. Remove four (4) flange nuts that secure A/C condenser assembly to cab frame.
8. Carefully raise condenser assembly from headliner and remove from machine.

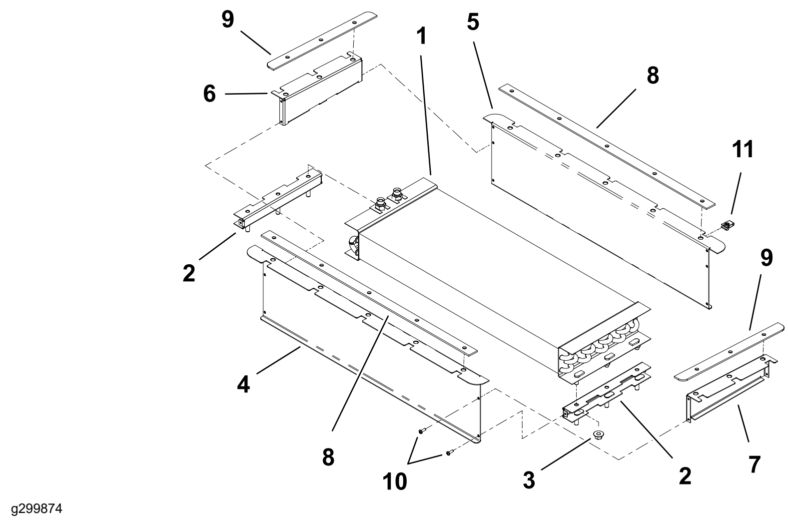

Figure 350

1. Condenser core
2. Lower leg (2)
3. Hex nut (6)
4. Front wall
5. Back wall
6. Right side wall
7. Left side wall
8. Strip seal (2)
9. Edge seal (2)
10. Screw (12)
11. Clip (16)

9. Inspect seals (items 7 and 8 in Figure 349) on top of cab frame for wear or damage and replace if needed.
10. If necessary, disassemble condenser assembly using Figure 350 as a guide. Inspect seals on top of condenser assembly walls (items 8 and 9 in Figure 350) for wear or damage and replace if needed.

Installation (Figure 349)

1. If condenser assembly was disassembled:

   A. To properly seal condenser core, apply RTV sealant to all mating surfaces of walls, lower legs and condenser core before assembly.

   B. Assemble all condenser assembly components using Figure 350 as a guide. Make sure that strip and edge seals are in good condition after assembly.

2. Carefully lower the A/C condenser assembly through headliner and onto cab frame.

3. Secure A/C condenser assembly to cab frame with four (4) flange nuts.

4. Remove caps that were placed on hoses and fittings during the removal process. Using labels placed during removal, properly secure hoses to condenser core. While holding condenser fittings with a second wrench, torque hose swivels from **14 to 20 N·m (10 to 15 ft−lb)**.

5. Secure condenser fan assembly to machine (see A/C Condenser Fan Assembly (page 9–13)).

6. Make sure that all machine air conditioning components are installed and secure.

7. Have a certified air conditioning service technician evacuate the air conditioning system completely, properly recharge the system with R134a refrigerant and then leak test the system. A/C system capacity is 3.43 lb of R134a refrigerant.

8. When all service in cab headliner is completed, secure roof panel to top of cab (see Roof Assembly (page 9–9)).

Mixing Box Assembly

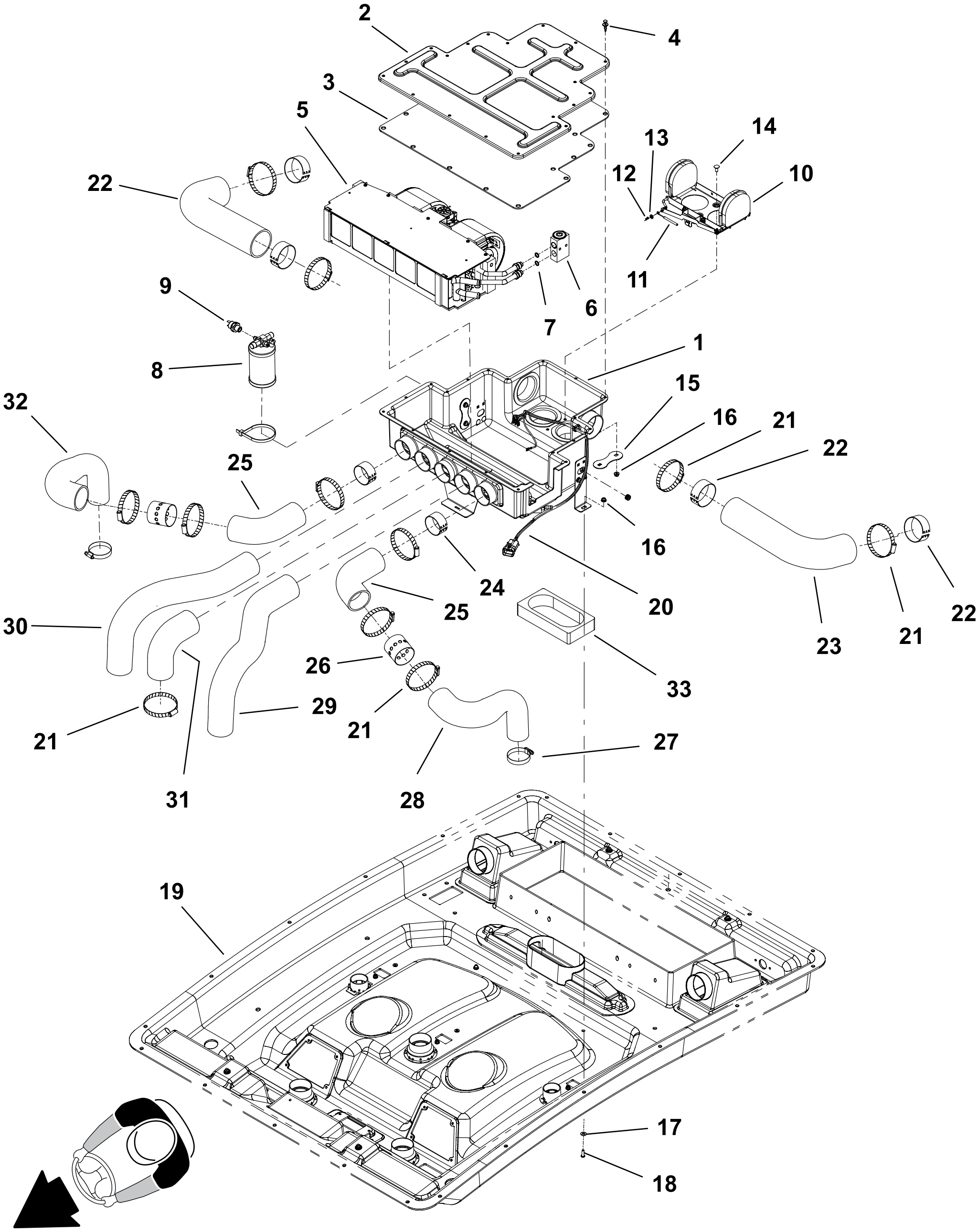

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Figure 351

1. Mixing box
2. Mixing box cover
3. Cover insulation
4. Rivet (19)
5. Heater core A/C evaporator/fan assy
6. Expansion valve
7. O−ring (2)
8. A/C drier−receiver
9. Binary switch
10. Air diverter assembly
11. Control cable
12. Hairpin
13. Flat washer
14. Carriage screw (2)
15. Support plate
16. Flange nut (4)
17. Flat washer (2)
18. Button head screw (2)
19. Cab headliner
20. Mixing box wire harness
21. Hose clamp (11)
22. Tube support (4)
23. Vent hose (2)
24. Tube support (2)
25. Vent hose (2)
26. Adapter (2)
27. Hose clamp (2)
28. Vent hose
29. Vent hose
30. Vent hose
31. Vent hose
32. Vent hose
33. Mixing box inlet foam

Removal (Figure 351)

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from the key switch.
2. To access mixing box assembly, remove roof panel from top of cab (see Roof Assembly (page 9–9)).
3. Remove cover from mixing box assembly:

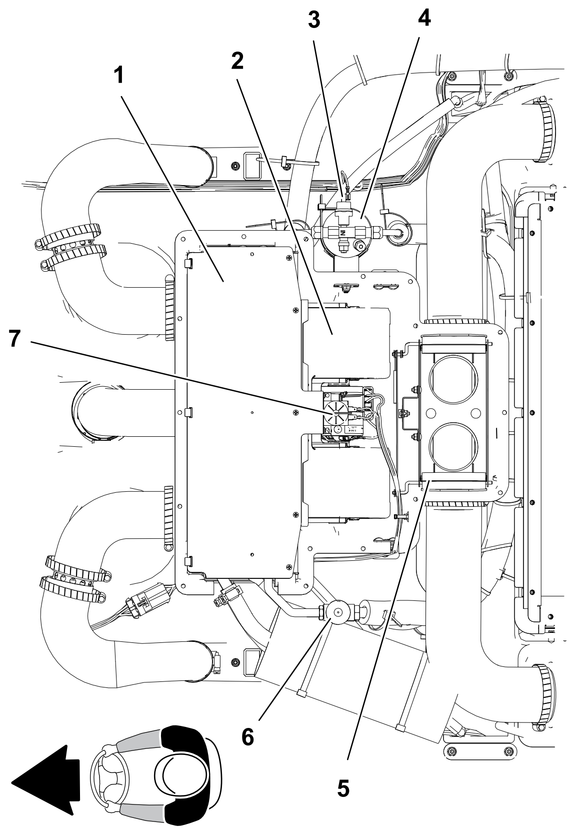
   A. Carefully use a small pry−bar to raise head of pin in center of each rivet that secures mixing box cover.

   B. Lift rivets from cover and mixing box.

   C. Remove mixing box cover.

   Note: If heater core, AC evaporator core or blower fan need to be removed from mixing box, the box does not have to be removed from the cab headliner. See Heater and A/C Evaporator Cores (page 9–23) or Blower Fan (page 9–26) for information on removing and installing these components.

4. Disconnect electrical connectors from mixing box wire harness and binary switch on drier−receiver.
5. Read the General Precautions for Removing and Installing Hydraulic System Components (page 5–73). Make sure that these instructions are followed if any air conditioning hoses are loosened or if any air conditioning components are to be removed from cab headliner.



g299906

Figure 352

1. Evaporator & heater core
2. Blower fan
3. A/C binary switch
4. A/C drier−receiver
5. Air diverter assembly
6. A/C expansion valve
7. A/C freeze switch

Removal (Figure 351) (continued)

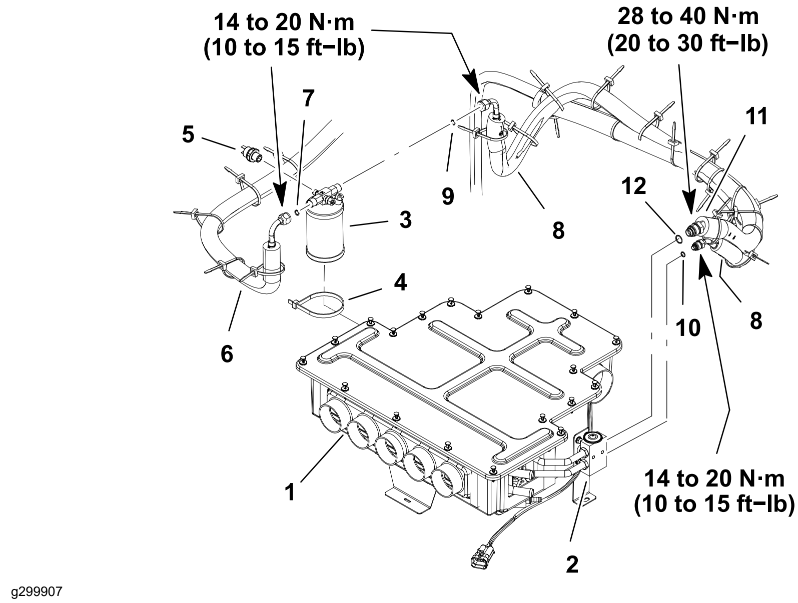


Figure 353

1. Mixing box assembly
2. A/C expansion valve
3. A/C drier−receiver
4. Cable tie (2)
5. A/C binary switch
6. Hose (from condenser)
7. O−ring
8. Hose (from drier)
9. O−ring
10. O−ring
11. Hose (to compressor)
12. O−ring

CAUTION

The air conditioning system is under high pressure. Do not loosen any system fitting or component until after the system has been completely discharged by a certified A/C service technician.

6. Remove mixing box components as necessary using Figure 351, Figure 352 and Figure 353 as guides.

   Note: The replacement of the A/C drier−receiver is recommended if the expansion valve is replaced.

Installation (Figure 351)

1. Install all removed mixing box components using Figure 351, Figure 352 and Figure 353 as guides. Make sure that expansion valve is covered with insulating tape to prevent condensation issues. Also, use torque specifications shown in Figure 353 to properly tighten hoses connected to the expansion valve and drier−receiver.
2. Make sure that condensation hoses are secured to the drain fittings on the bottom of mixing box assembly. Also, route hoses to cab frame for proper draining of condensate.
3. Make sure to connect electrical connectors from mixing box wire harness and binary switch on A/C drier−receiver.
4. If any A/C system components were removed from cab headliner, make sure that all machine air conditioning components are installed and secure.

Installation (Figure 351) (continued)

Then, have a certified air conditioning service technician evacuate the air conditioning system completely, properly recharge the system with R134a refrigerant and then leak test the system. A/C system capacity is 3.43 lb of R134a refrigerant.

5. Secure cover to mixing box assembly:
   A. Position mixing box cover to mixing box. Make sure that wire harness is routed through recess in side of mixing box.
   B. With the rivet pin in a raised position, insert rivets through cover and into hole in mixing box. Press pin into rivet to secure rivet in place.
6. Operate the heater system to make sure that no coolant leaks in cab headliner exist.
7. When all service in cab headliner is completed, secure roof panel to top of cab (see Roof Assembly (page 9–9)).

Heater and A/C Evaporator Cores

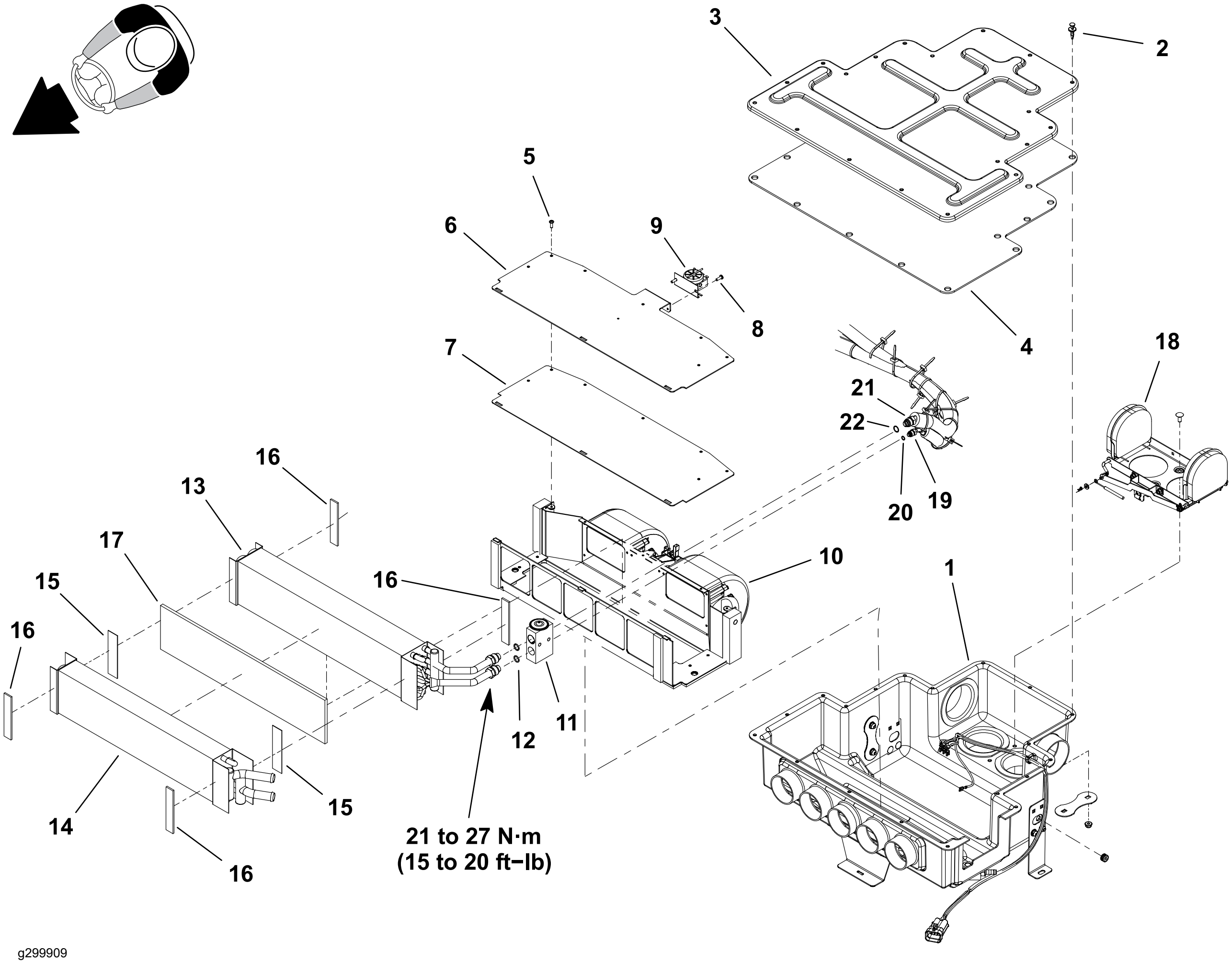


Figure 354

1. Mixing box
2. Rivet (19)
3. Mixing box cover
4. Cover insulation
5. Screw (5)
6. Mount bracket cover
7. Cover gasket
8. Screw (2)
9. Freeze switch
10. Mount bracket (shown with fan)
11. Expansion valve
12. O−ring (2)
13. A/C evaporator core
14. Heater core
15. Double sided tape (2)
16. Gasket (4)
17. Condensation catch foam
18. Air diverter assembly
19. A/C hose (from drier−receiver)
20. O−ring
21. A/C hose (to A/C compressor)
22. O−ring

Note: The heater and evaporator cores can be removed and installed with the mixing box (item 1 in Figure 354) attached to the cab headliner.

Removal (Figure 354)

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from the key switch.
2. To access heater and A/C evaporator cores, remove roof panel from top of cab (see Roof Assembly (page 9–9)).
3. Read the General Precautions for Removing and Installing Air Conditioning System Components (page 9–4).

Removal (Figure 354) (continued)

CAUTION

The air conditioning system is under high pressure. Do not loosen any system fitting or component until after the system has been completely discharged by a certified A/C service technician.

4. Have refrigerant evacuated from air conditioning system by a certified A/C service technician.
5. Disconnect both evaporator core swivel fittings from front ports of expansion valve. Immediately cap tubes and expansion valve ports to prevent moisture and contaminants from entering the system. Position expansion valve with attached hoses away from the mixing box.
6. Label heater hoses for assembly purposes. Loosen hose clamps and disconnect both heater hoses from tubes on heater core.
7. Remove mixing box cover:
   A. Carefully use a small pry−bar to raise head of pin in center of each rivet that secures mixing box cover.
   B. Lift rivets from cover and mixing box.
   C. Remove mixing box cover.
8. Locate wire from freeze switch that is inserted into A/C evaporator core through mount bracket cover. Carefully pull wire from cover and position it away from cover.
9. Remove screws (item 5) that secure mount bracket cover to mount bracket. Lift cover and position it away from mount bracket taking care to not damage freeze switch or wires connected to the switch.
10. Carefully lift heater and A/C evaporator core assembly from frame.
11. Separate heater and A/C evaporator cores as needed using Figure 354 as a guide. The cores are secured to each other with double sided tape (item 10).
12. Inspect seals, gaskets and insulation in mixing box assembly for tears or other damage. Replace all damaged sealing components.

Installation (Figure 354)

1. Assemble heater and A/C evaporator cores using Figure 354 as a guide.
2. Carefully install heater and A/C evaporator core assembly into frame in mixing box.
3. Position mount bracket cover to mount bracket taking care to not damage freeze switch or wires connected to the switch. Secure cover to mount bracket with removed screws (item 5).
4. Insert wire from freeze switch into A/C evaporator core through mount bracket cover. The wire should be inserted 51 mm (2 in) past the cover.
5. Secure cover to mixing box assembly:
   A. Position mixing box cover to mixing box. Make sure that wire harness is routed through recess in side of mixing box.
   B. With the rivet pin in a raised position, insert rivets through cover and into hole in mixing box. Press pin into rivet to secure rivet in place.
6. Using labels placed during disassembly, connect both heater hoses to tubes on heater core and secure with hose clamps.

Installation (Figure 354) (continued)

7. Remove caps that were placed on evaporator core tubes and expansion valve ports during the removal process. Position expansion valve with attached hoses to the evaporator core tubes. Properly secure evaporator core swivel fittings to front ports of expansion valve. Torque fittings from **21 to 27 N·m (15 to 20 ft−lb)**.

8. Make sure that all machine air conditioning components are installed and secure.

9. Make sure that expansion valve is covered with insulating tape to prevent condensation issues.

10. Have a certified air conditioning service technician evacuate the air conditioning system completely, properly recharge the system with R134a refrigerant and then leak test the system. A/C system capacity is 3.43 lb of R134a refrigerant.

11. Operate the heater system to make sure that no coolant leaks in headliner exist.

12. Secure roof panel to top of cab (see Roof Assembly (page 9–9)).

Blower Fan

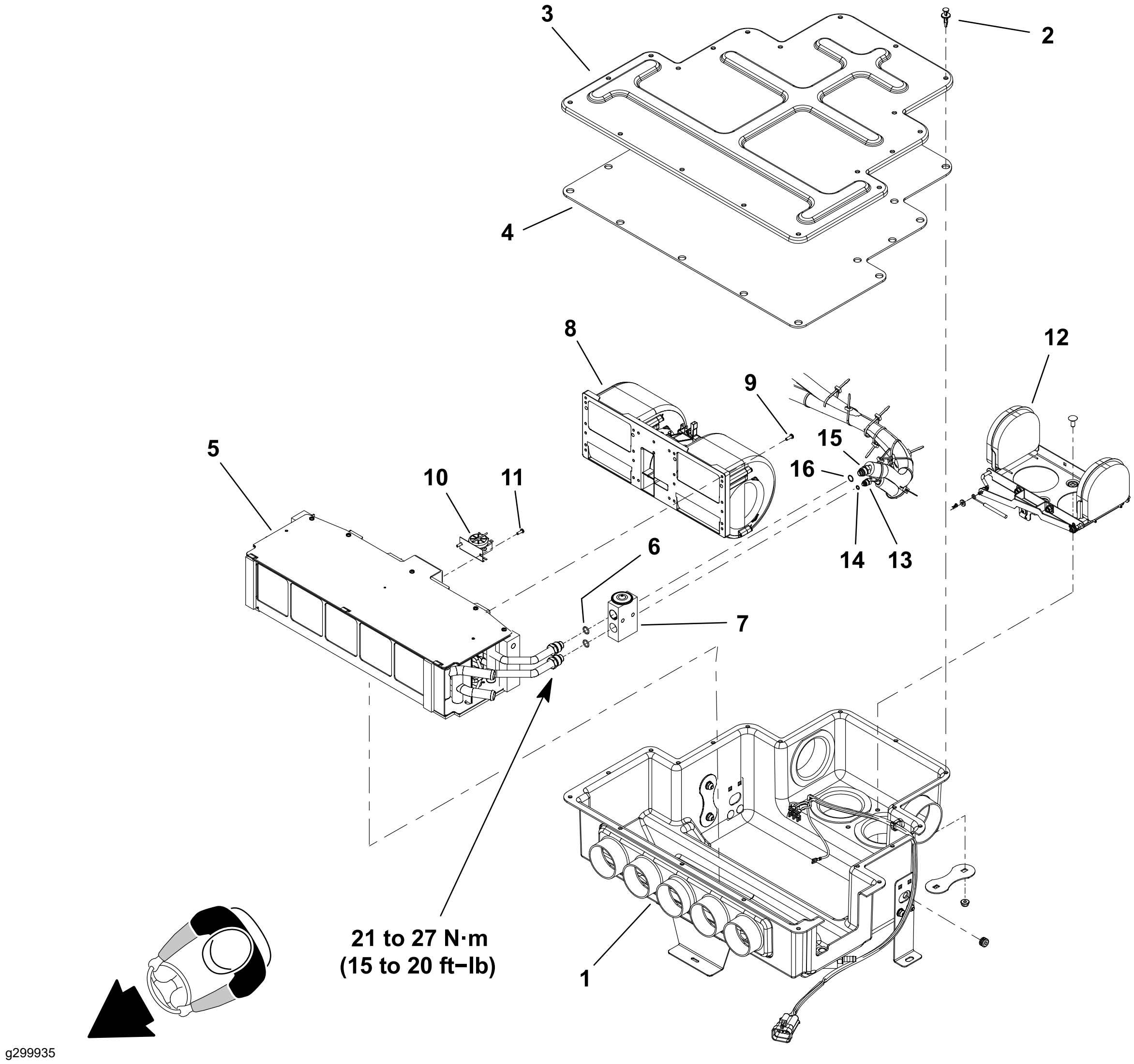


Figure 355

1. Mixing box
2. Rivet (19)
3. Mixing box cover
4. Cover insulation
5. Heater core A/C evaporator assembly
6. O−ring (2)
7. Expansion valve
8. Blower fan
9. Screw (6)
10. Freeze switch
11. Screw (2)
12. Air diverter assembly
13. A/C hose (from drier−receiver)
14. O−ring
15. A/C hose (to AC compressor)
16. O−ring

Note: The blower fan can be removed and installed with the mixing box (item 1 in Figure 355) attached to the cab headliner.

Removal (Figure 355)

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from the key switch.
2. To access blower fan, remove roof panel from top of cab (see Roof Assembly (page 9–9)).
3. Read the General Precautions for Removing and Installing Air Conditioning System Components (page 9–4).

Removal (Figure 355) (continued)

CAUTION

The air conditioning system is under high pressure. Do not loosen any system fitting or component until after the system has been completely discharged by a certified A/C service technician.

4. Have refrigerant evacuated from air conditioning system by a certified A/C service technician.
5. Disconnect both evaporator core swivel fittings from front ports of expansion valve. Immediately cap tubes and expansion valve ports to prevent moisture and contaminants from entering the system. Position expansion valve with attached hoses away from the mixing box.
6. Label heater hoses for assembly purposes. Loosen hose clamps and disconnect both heater hoses from tubes on heater core.
7. Remove mixing box cover:
   A. Carefully use a small pry−bar to raise head of pin in center of each rivet that secures mixing box cover.
   B. Lift rivets from cover and mixing box.
   C. Remove mixing box cover.

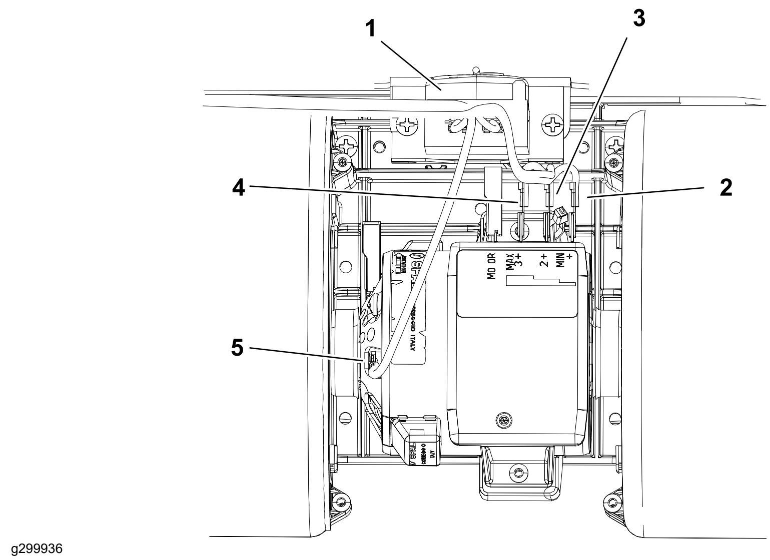


Figure 356

1. Freeze switch
2. MIN terminal (violet)
3. Terminal 2 (brown)
4. Terminal 3 (orange)
5. Ground terminal (black)

8. Note location of wire harness connectors on freeze switch and blower fan assembly (Figure 356). Disconnect wire harness connectors from switch and fan.
9. Carefully raise heater core/AC evaporator assembly with attached blower fan from mixing box.
10. Remove six (6) screws that secure blower fan to heater core/AC evaporator assembly. Remove blower fan.

Installation (Figure 355)

1. Position blower fan to heater core/AC evaporator assembly and secure with six (6) screws.
2. Carefully lower heater core/AC evaporator assembly with attached blower fan into mixing box.
3. Connect wire harness connectors to freeze switch and blower fan assembly (Figure 356).
4. Secure mixing box cover:
   A. Position mixing box cover to mixing box. Make sure that wire harness is routed through recess in side of mixing box.

   B. With the rivet pin in a raised position, insert rivets through cover and into hole in mixing box. Press pin into rivet to secure rivet in place.
5. Using labels placed during disassembly, connect both heater hoses to tubes on heater core and secure with hose clamps.
6. Remove caps that were placed on evaporator core tubes and expansion valve ports during the removal process. Position expansion valve with attached hoses to the evaporator core tubes. Properly secure evaporator core swivel fittings to front ports of expansion valve. Torque fittings from **21 to 27 N·m (15 to 20 ft−lb)**.
7. Make sure that all machine air conditioning components are installed and secure.
8. Have a certified air conditioning service technician evacuate the air conditioning system completely, properly recharge the system with R134a refrigerant and then leak test the system. A/C system capacity is 3.43 lb of R134a refrigerant.
9. Operate the heater system to make sure that no coolant leaks in headliner exist.
10. Secure roof panel to top of cab (see Roof Assembly (page 9–9)).

Windshield Wiper Assembly

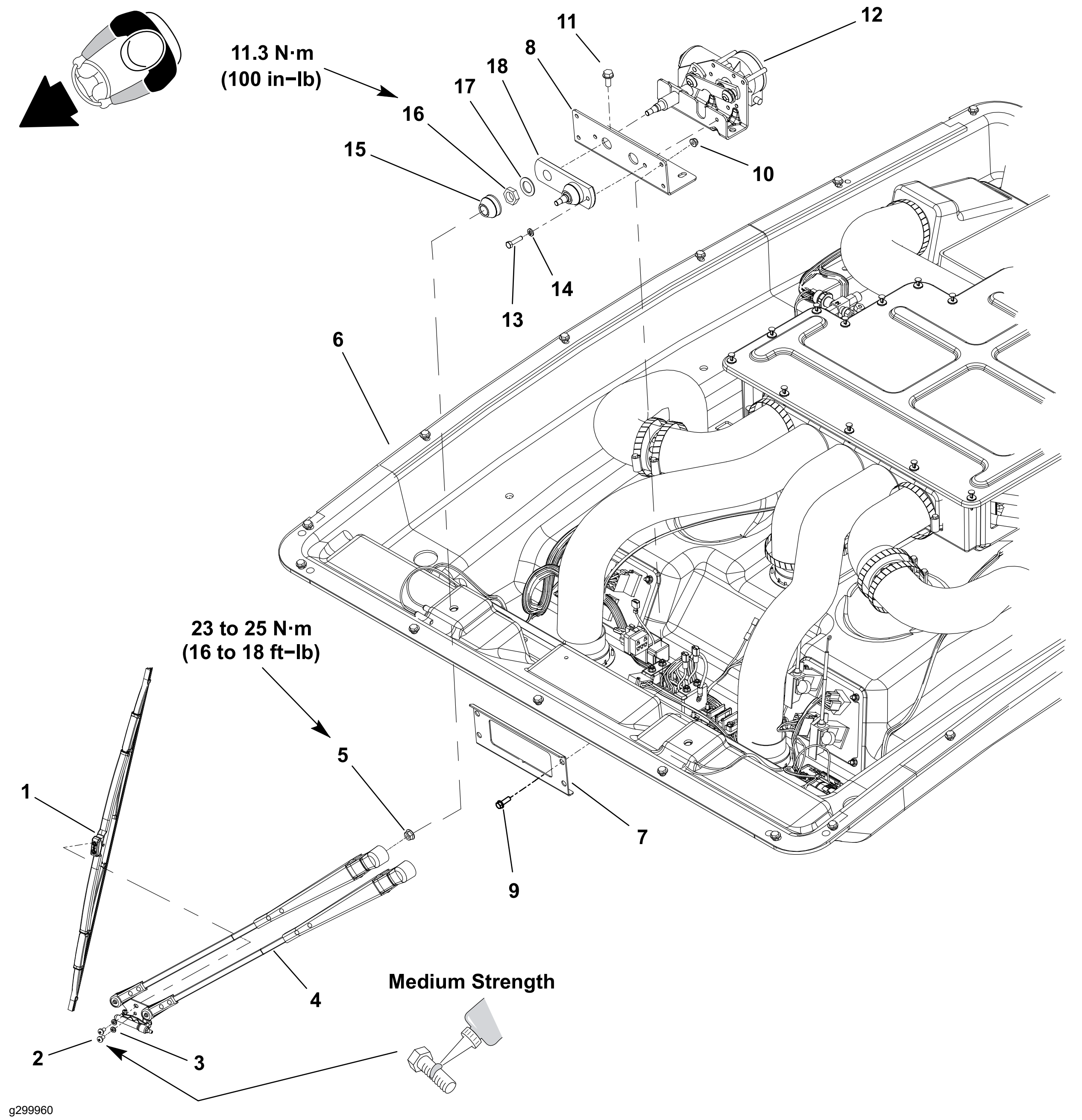


Figure 357

1. Wiper blade
2. Cap screw (2)
3. Lock washer (2)
4. Wiper arm assembly
5. Flange nut (2)
6. Cab headliner
7. Washer plate
8. Wiper bracket
9. Washer head screw (4)
10. Flange nut (4)
11. Washer head screw (3)
12. Wiper motor
13. Cap screw
14. Lock washer
15. Cover
16. Jam nut
17. Star washer
18. Wiper motor plate

Disassembly (Figure 357)

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from the key switch.
2. To remove wiper blade, remove two (2) cap screws and lock washers that secure wiper blade to wiper arm assembly.

Disassembly (Figure 357) (continued)

3. If necessary, remove wiper arm assembly:

   A. Disconnect washer hose from wiper assembly.

   B. Lift caps at top of wiper arms and remove flange nuts that secure wiper arms to wiper motor.

   C. Use suitable puller to remove tapered wiper arm sockets from wiper motor shafts.

4. If access to wiper motor is necessary, remove roof panel from top of cab to allow access to wiper motor assembly (see Roof Assembly (page 9–9)). Remove wiper motor components using Figure 357 as a guide.

Assembly (Figure 357)

1. If required, install removed wiper motor components using Figure 357 as a guide.

   A. If wiper bracket (item 8) was removed, apply bead of RTV sealant around wiper opening on inside of headliner before installing bracket.

   B. If jam nut (item 16) was removed, torque jam nut to **11.3 N·m (100 in−lb)** during assembly.

   C. Make sure that wiper motor electrical connector is secured to cab wire harness.

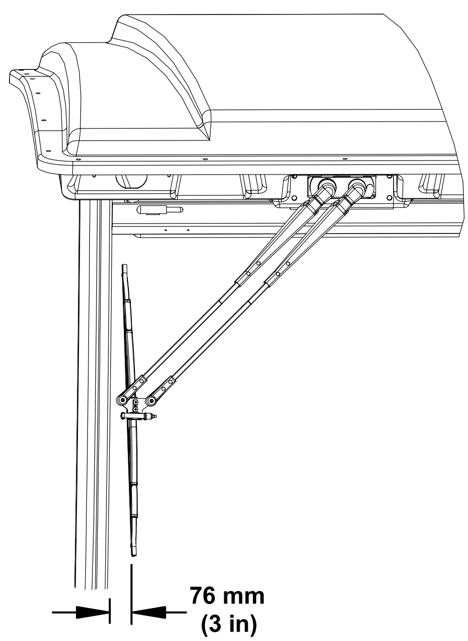
   D. Secure roof panel to top of cab (see Roof Assembly (page 9–9)).

2. If wiper blade was removed, apply medium strength thread locker to threads of cap screws (item 2). Secure blade to wiper arm assembly with two (2) cap screws and lock washers.

3. If wiper arm assembly was removed:

   A. Clean tapered wiper arm sockets and wiper motor shafts.

   B. Run the wiper motor for one (1) cycle to allow the motor to return to the normal OFF position.



g299961

Figure 358

Assembly (Figure 357) (continued)

C. Slide wiper arm sockets onto wiper motor shafts so that the bottom of the wiper blade is 76 mm (3 in) from the right side window trim (Figure 358).

D. Secure wiper arm sockets to motor shafts with flange nuts. Torque nuts from **23 to 25 N·m (16 to 18 ft−lb)**.

E. Install wiper arm caps over flange nuts.

F. Connect washer hose to wiper assembly.

Foldout Drawings

Table of Contents

Electrical Drawing Designations

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

Wire Color

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

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

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

Wire Size

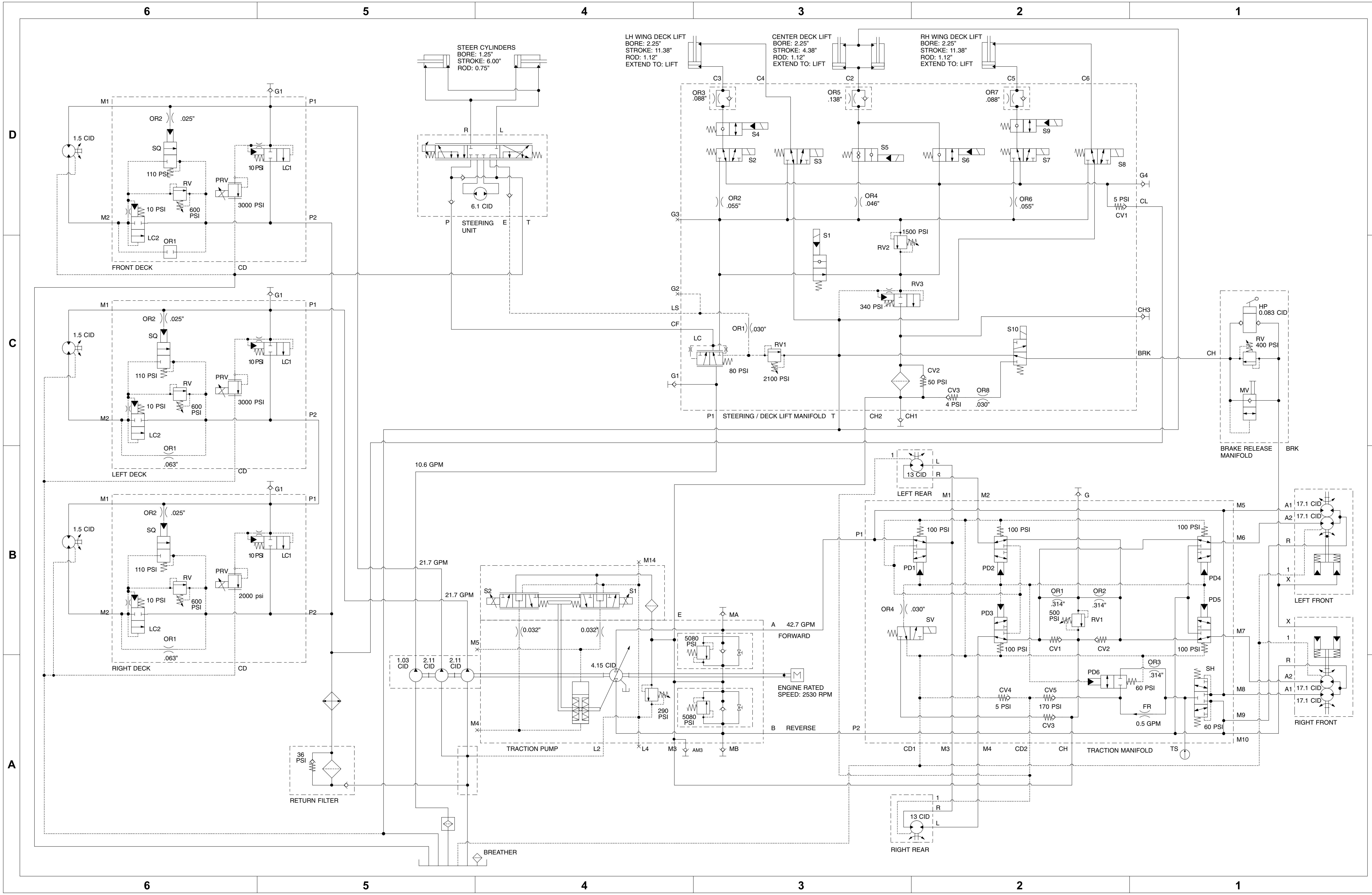
The individual wires of the electrical harness diagrams in this chapter identify both the wire color and the wire size.

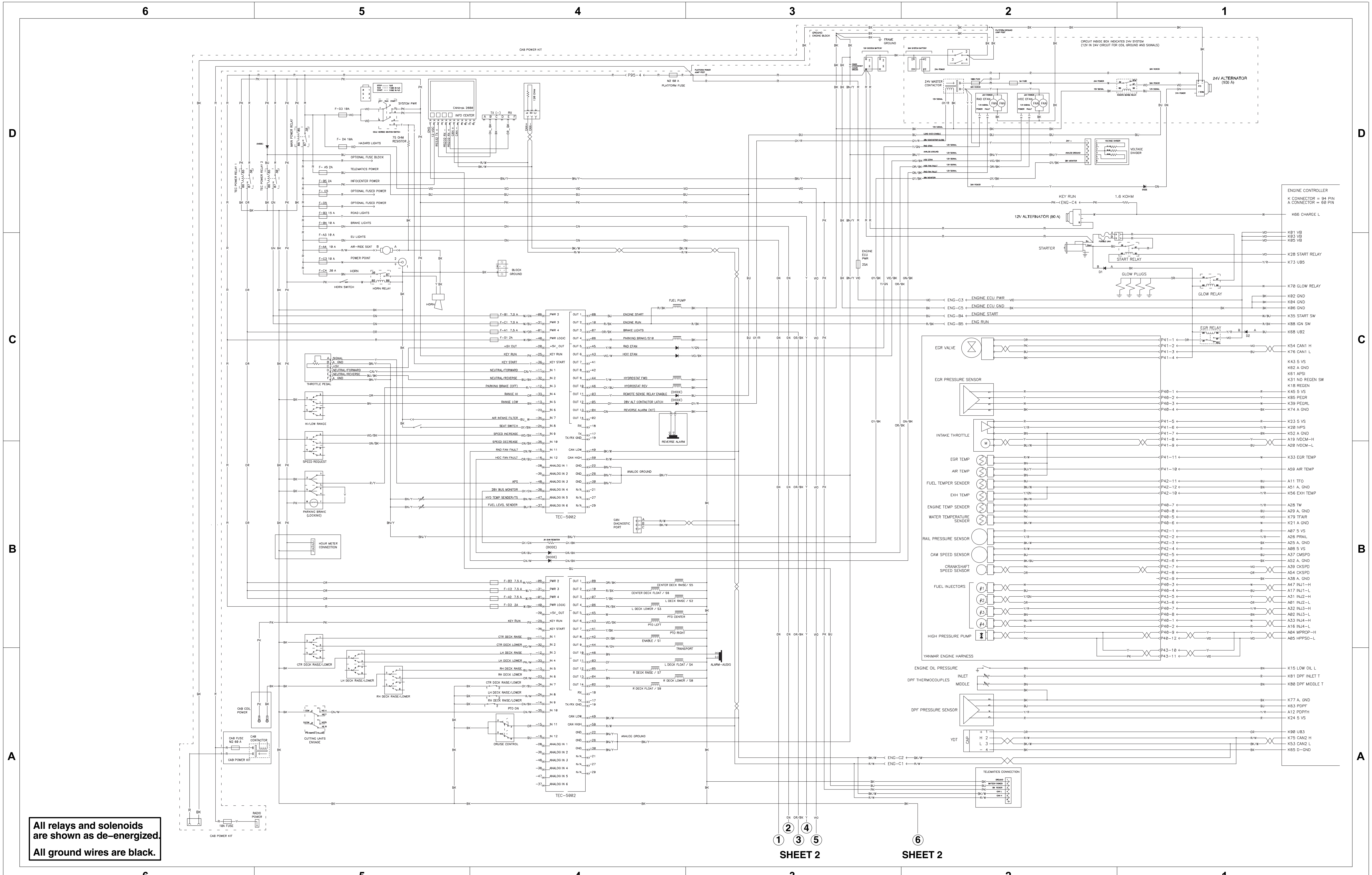
Examples:

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

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

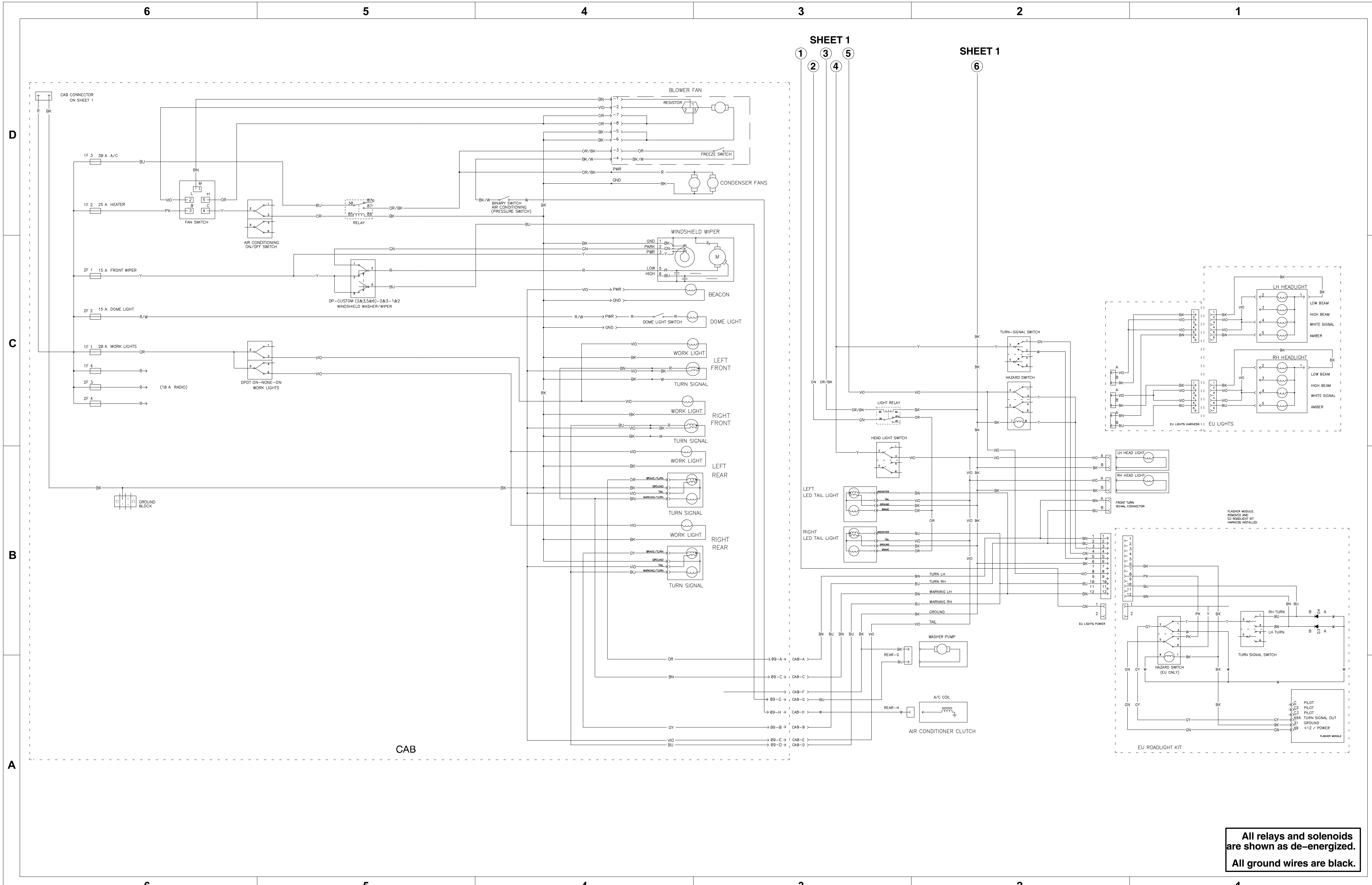
Hydraulic Schematic




6
5
4
3
2
1
D
C
B
A
24V ALTERNATOR (100 A)
12V ALTERNATOR (80 A)
ENGINE CONTROLLER
STARTER
START RELAY
GLOW PLUGS
GLOW RELAY
EGR RELAY
EGR VALVE
EGR PRESSURE SENSOR
INTAKE THROTTLE
FUEL INJECTORS
HIGH PRESSURE PUMP
YANMAR ENGINE HARNESS
DPF PRESSURE SENSOR
TELEMATICS CONNECTION
TEC-5002
TEC-5002
REVERSE ALARM
THROTTLE PEDAL
HI/LOW RANGE
SPEED REQUEST
PARKING BRAKE (LOCKING)
HOUR METER CONNECTION
CTR DECK RAISE/LOWER
LH DECK RAISE/LOWER
RH DECK RAISE/LOWER
CUTTING UNITS ENGAGE
CRUISE CONTROL
CAB POWER KIT
All relays and solenoids are shown as de–energized.
All ground wires are black.
1
2
3
4
5
SHEET 2
6
SHEET 2

g299964

Electrical Schematic (machine serial numbers below 316000200)

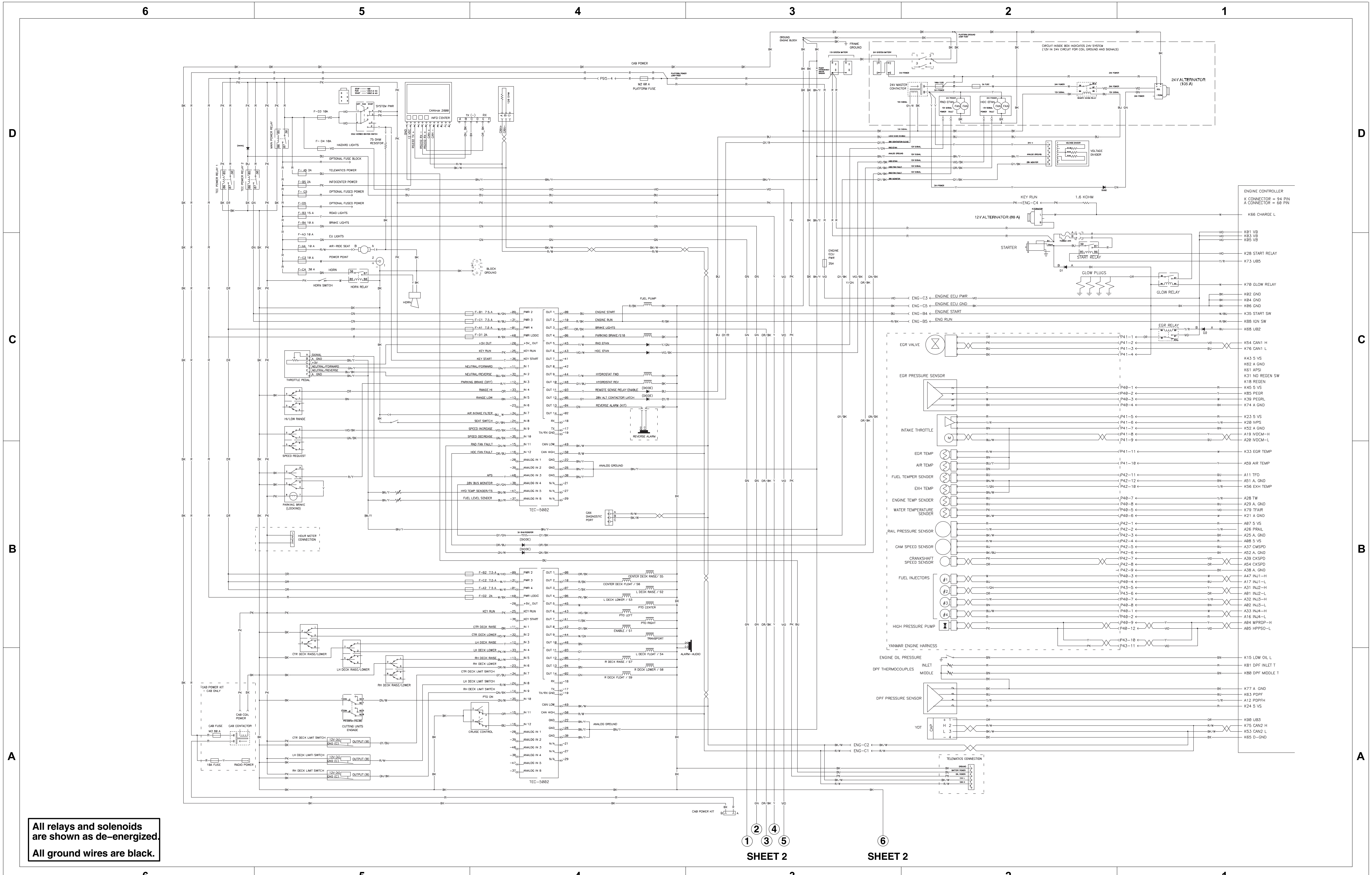


All relays and solenoids are shown as de-energized.

All ground wires are black.

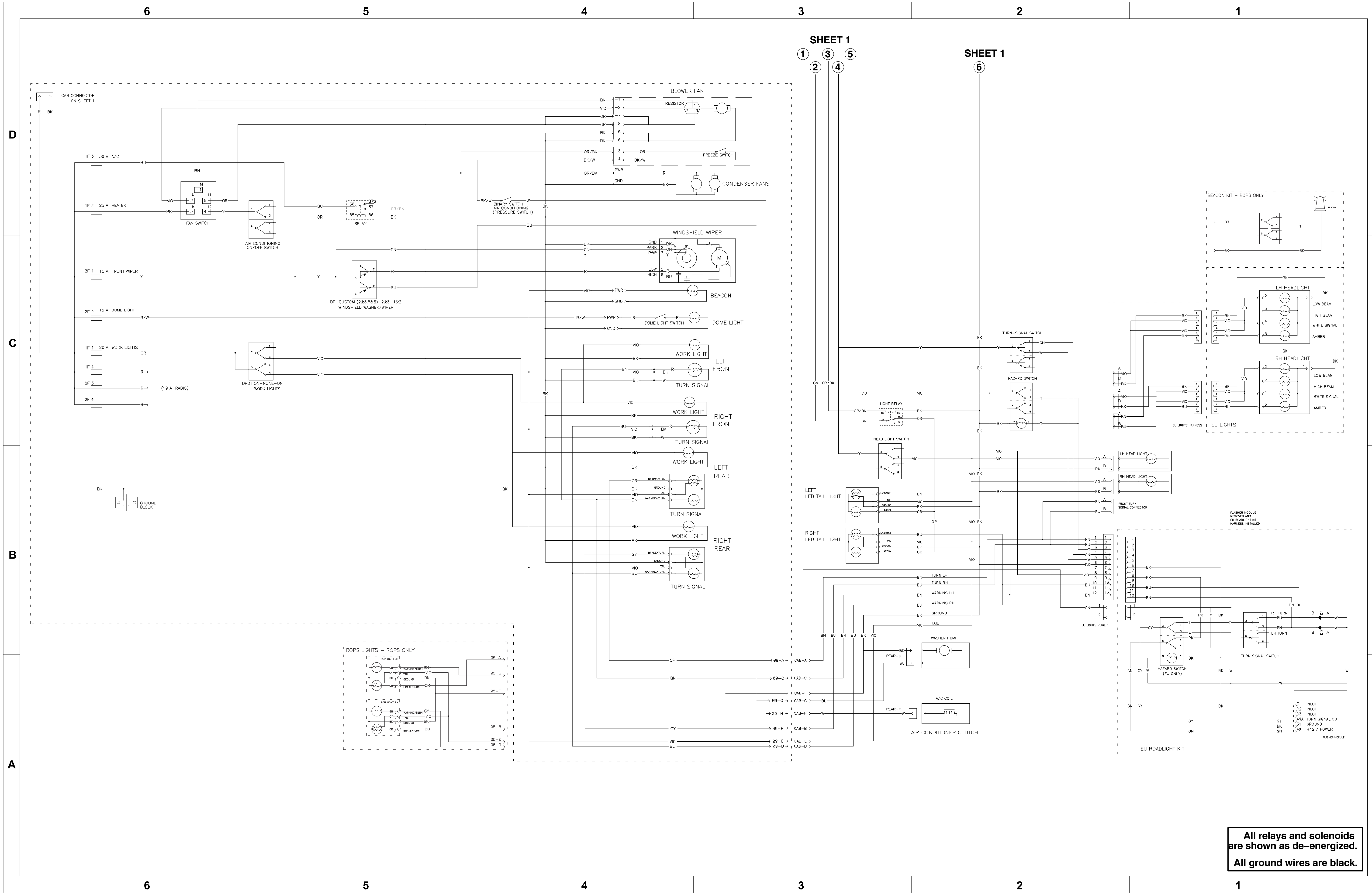
g299965

Electrical Schematic (machine serial numbers 316000201 to 399999999)



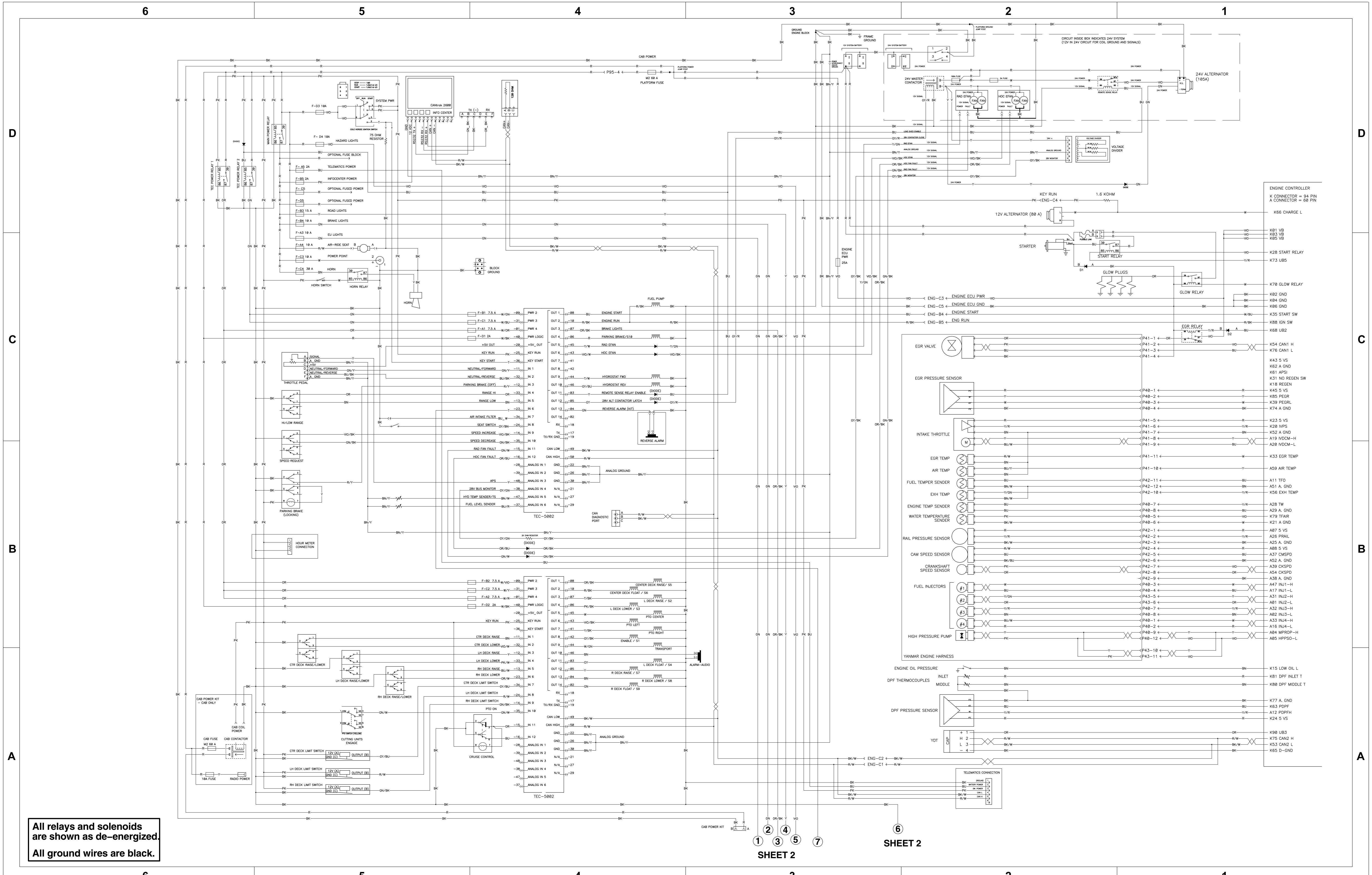
g299966

Electrical Schematic (machine serial numbers 316000201 to 399999999)



g299967

Electrical Schematic (machine serial numbers 400000000 to 403450000)

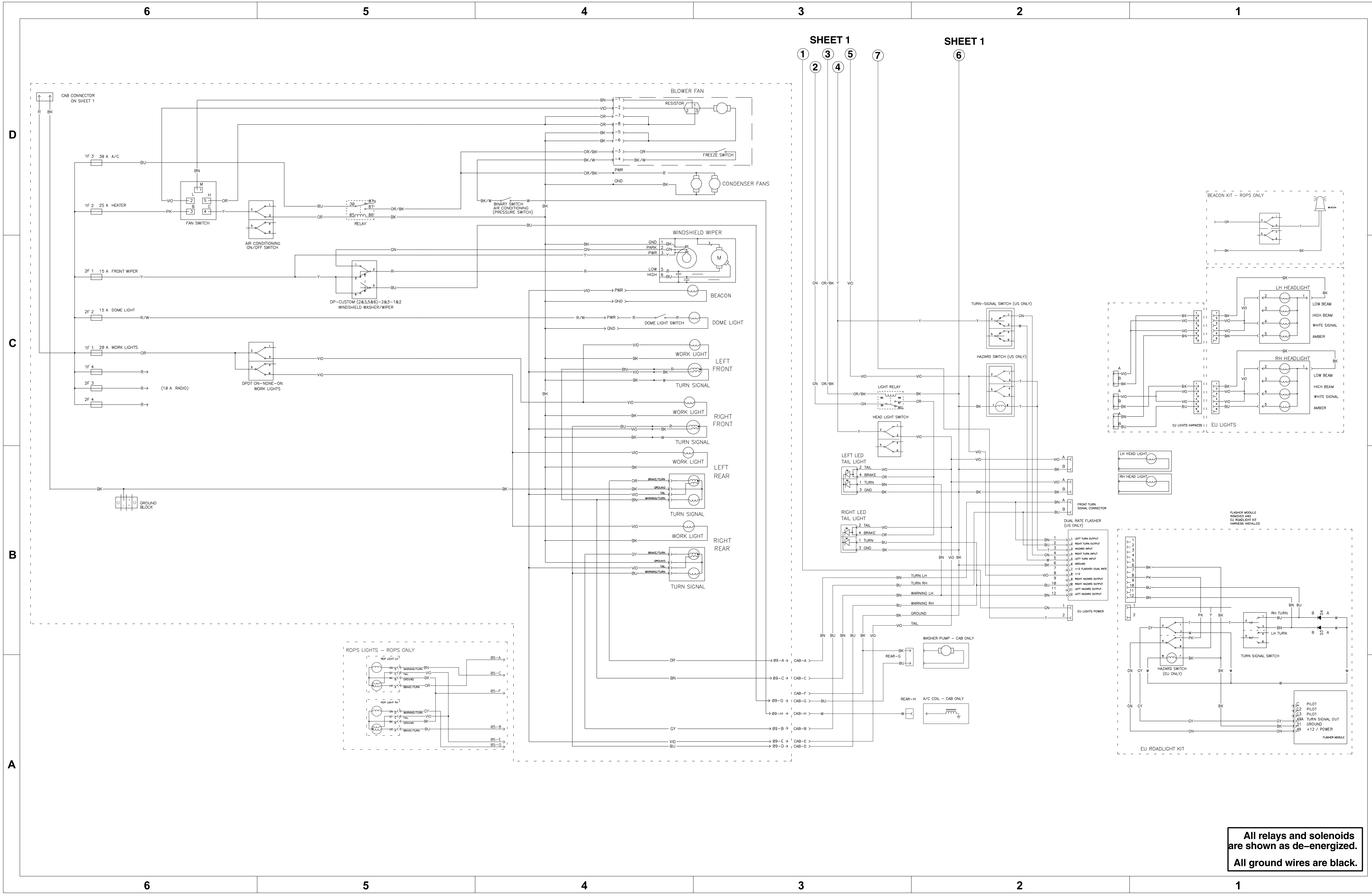


All relays and solenoids are shown as de-energized.

All ground wires are black.

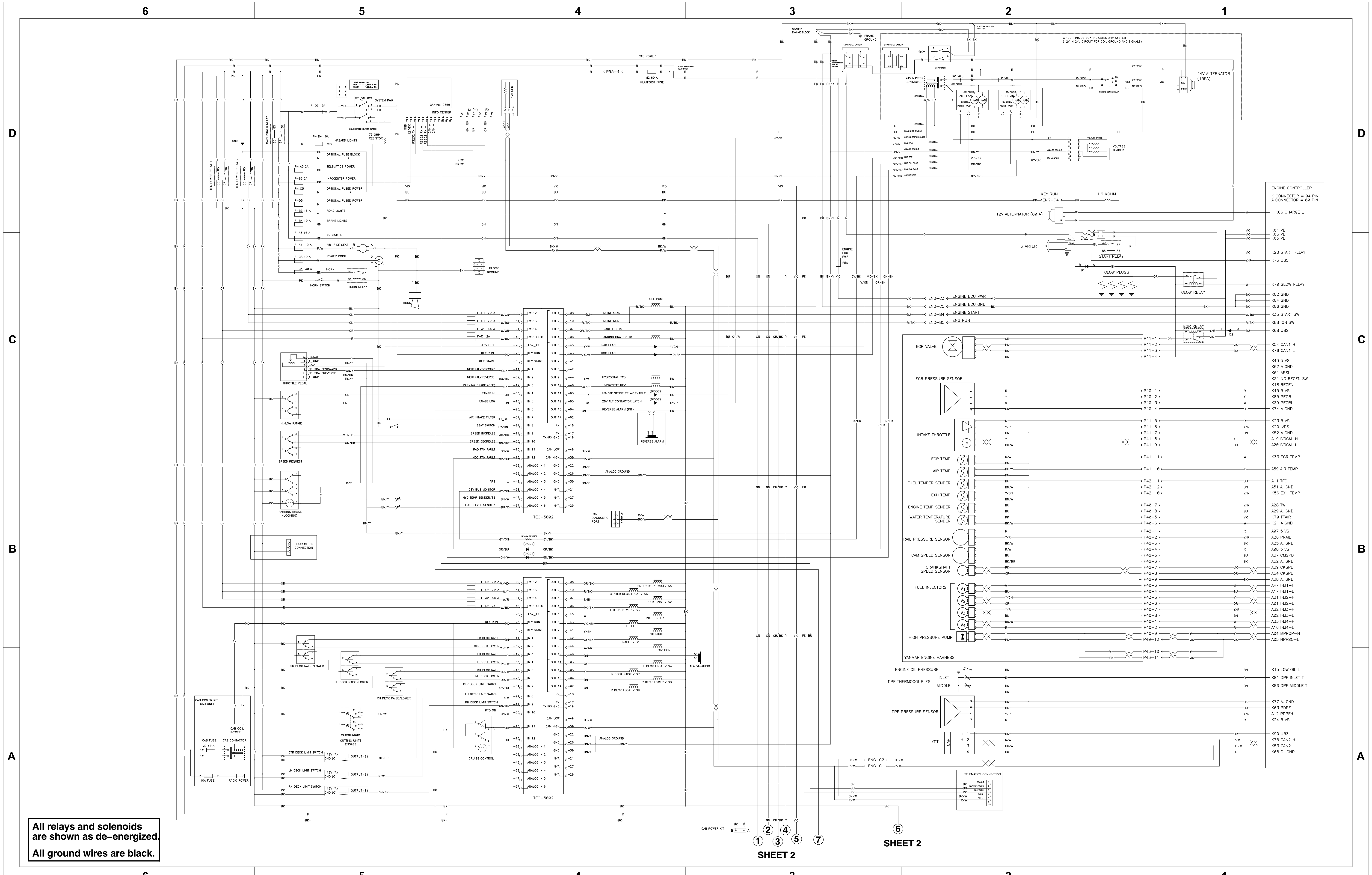
g302045

Electrical Schematic (machine serial numbers 400000000 to 403450000)



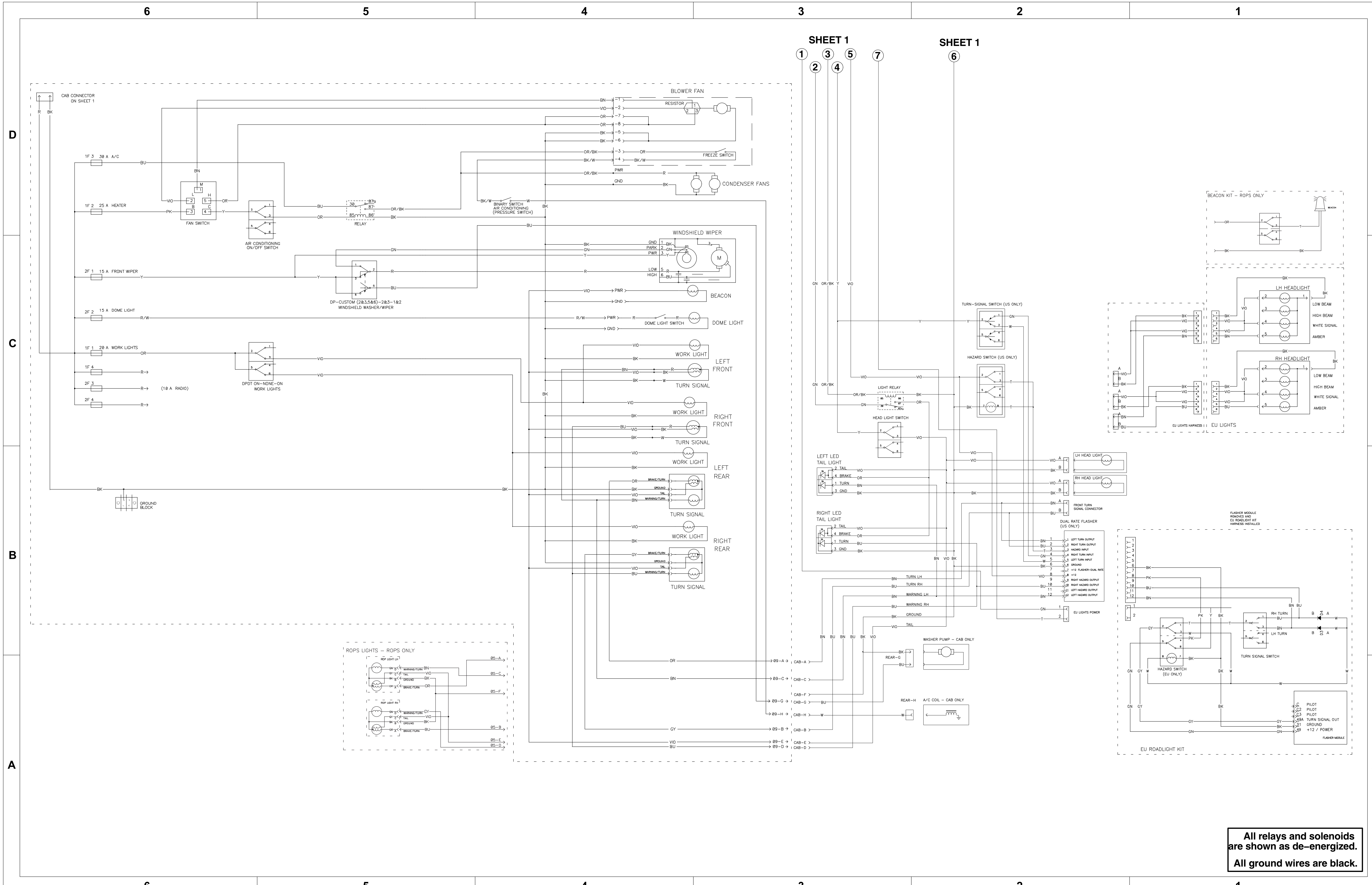
g302046

Electrical Schematic (machine serial numbers 403450001 to 405600000)



g302047

Electrical Schematic (machine serial numbers 403450001 to 405600000)

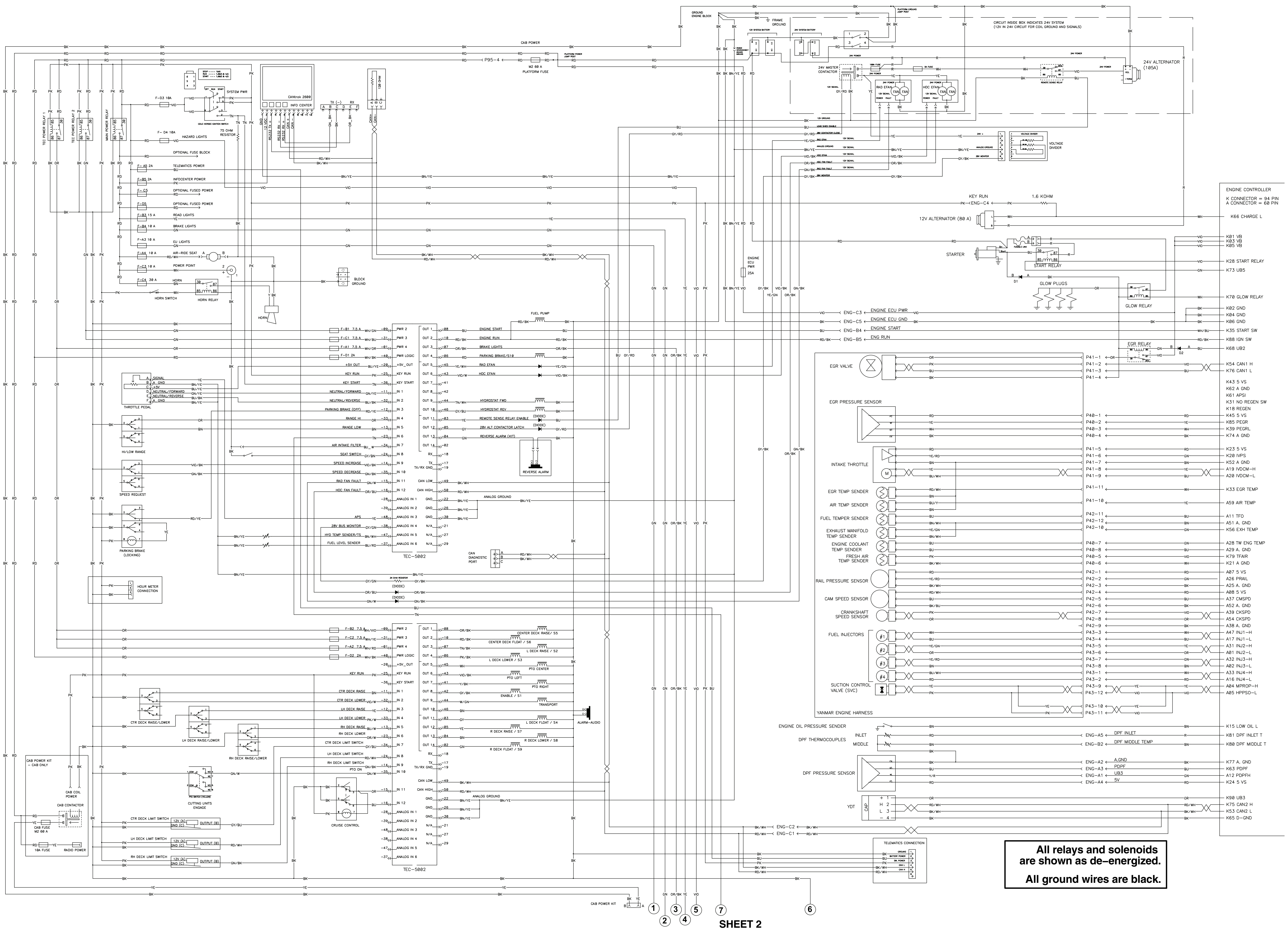


All relays and solenoids are shown as de–energized.

All ground wires are black.

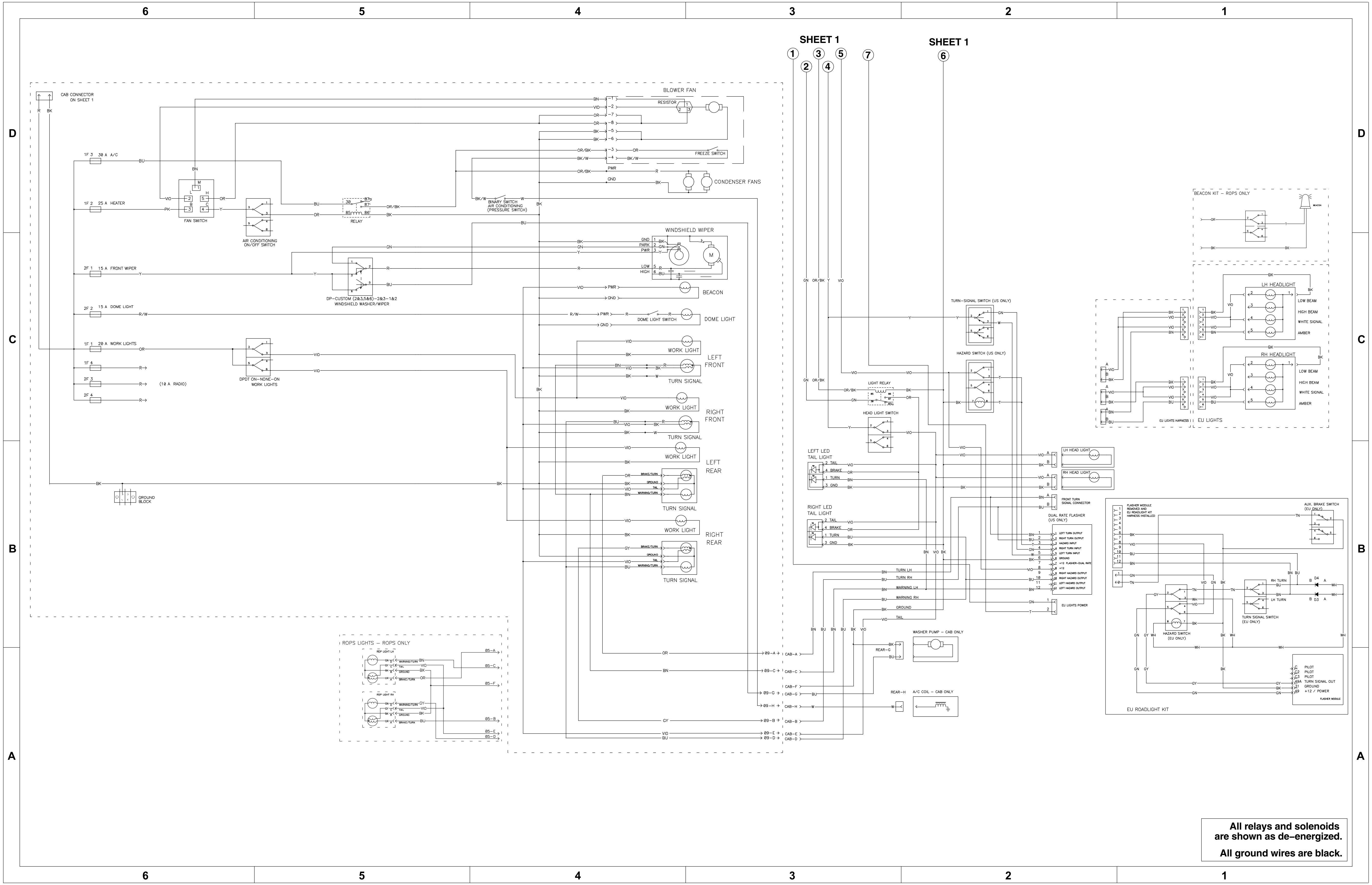
g302048

Electrical Schematic (machine serial numbers 405600001 to 408000000)



g329178

Electrical Schematic (machine serial numbers 405600001 to 408000000)

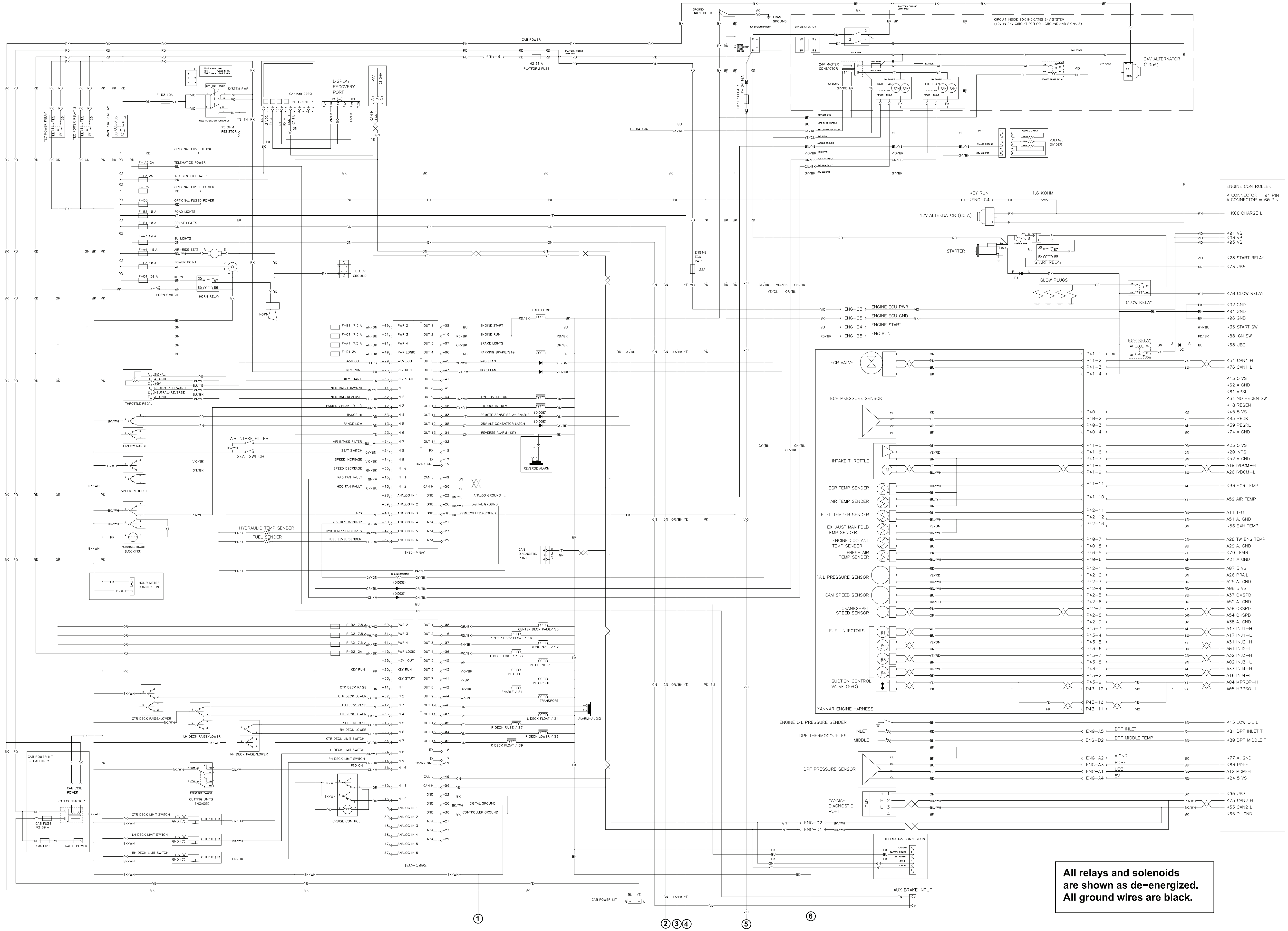


All relays and solenoids are shown as de-energized.

All ground wires are black.

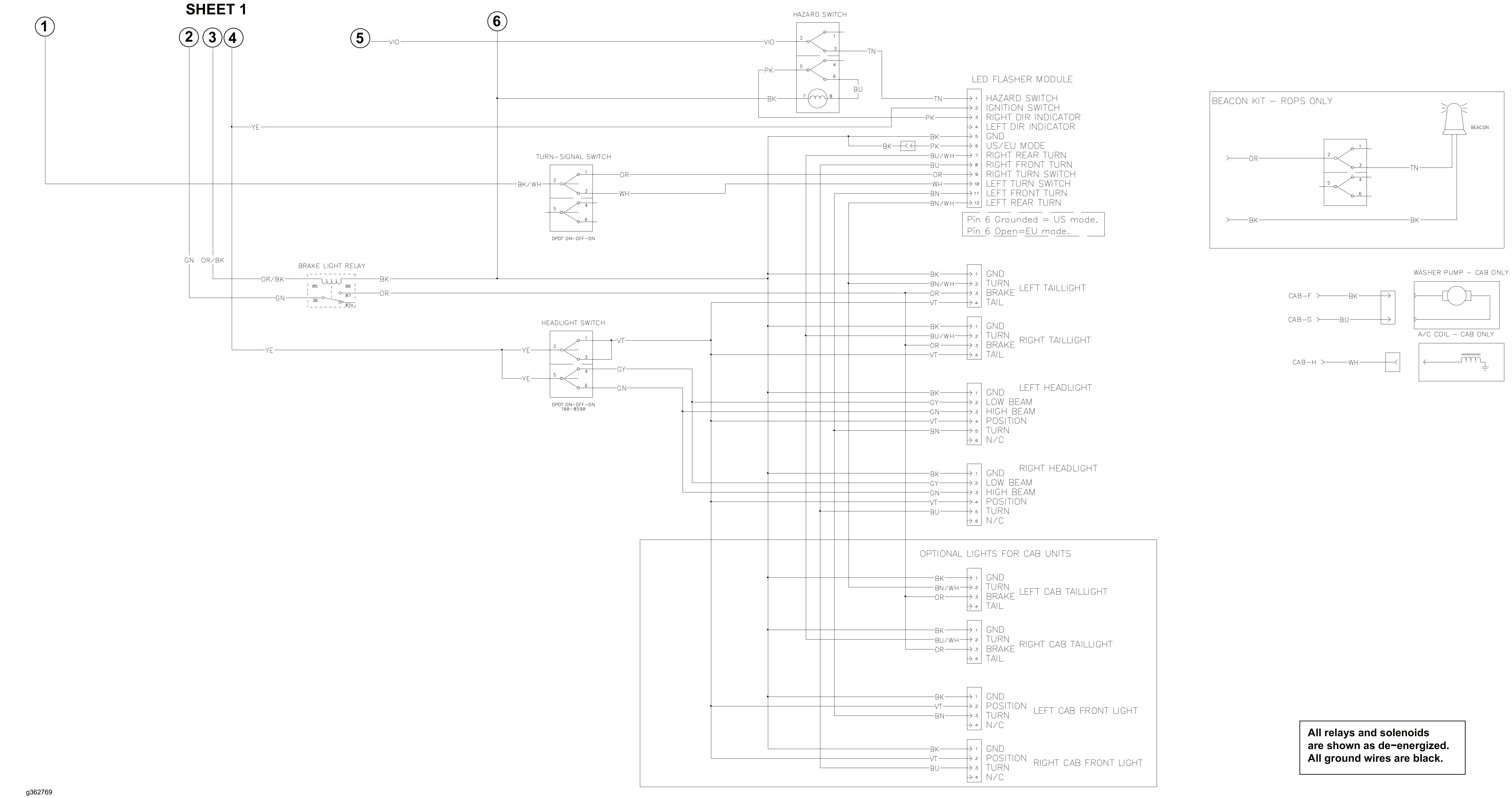
g329179

Electrical Schematic (machine serial numbers above 408000000)

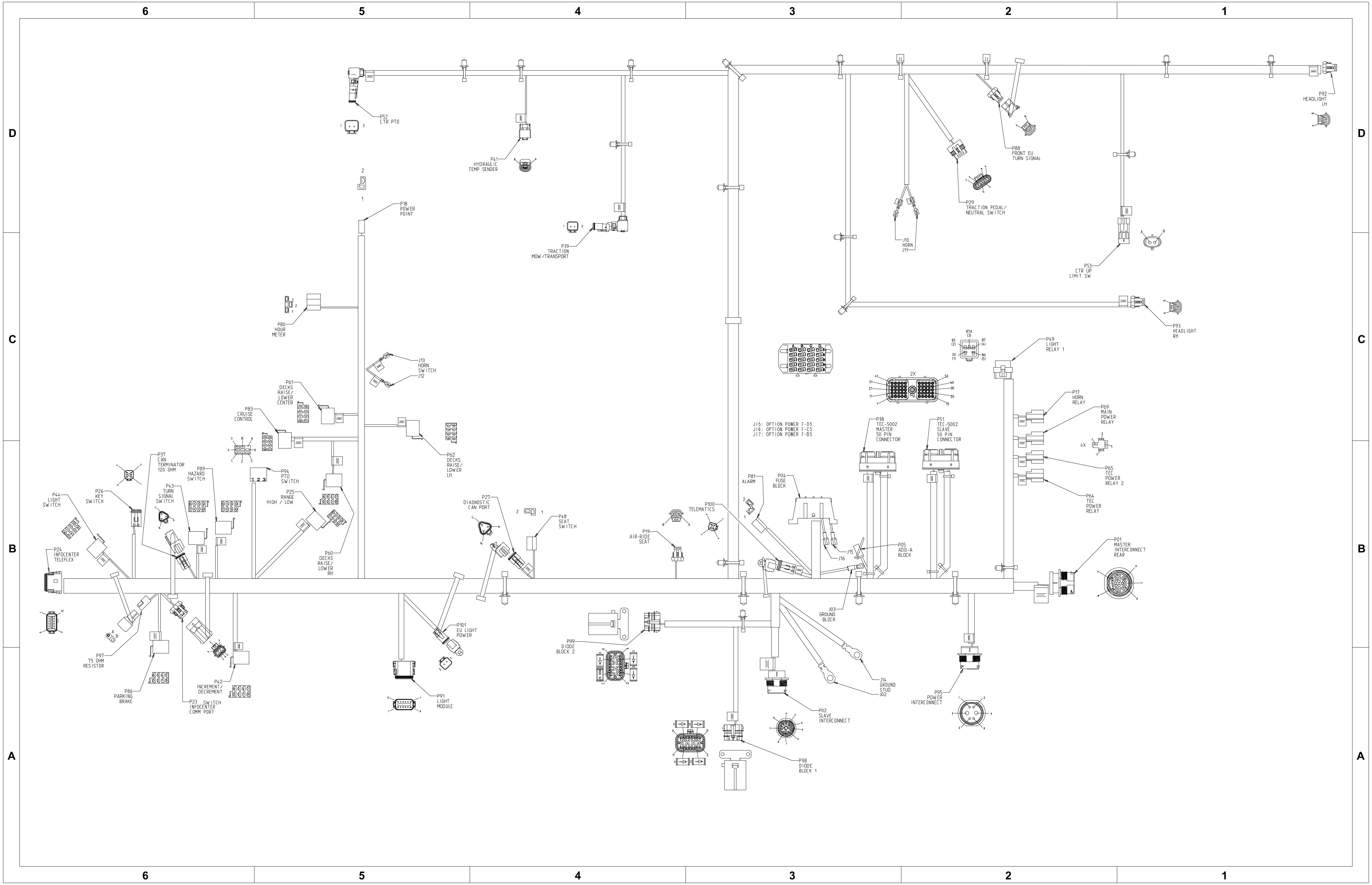


g362768

Electrical Schematic (machine serial numbers above 408000000)

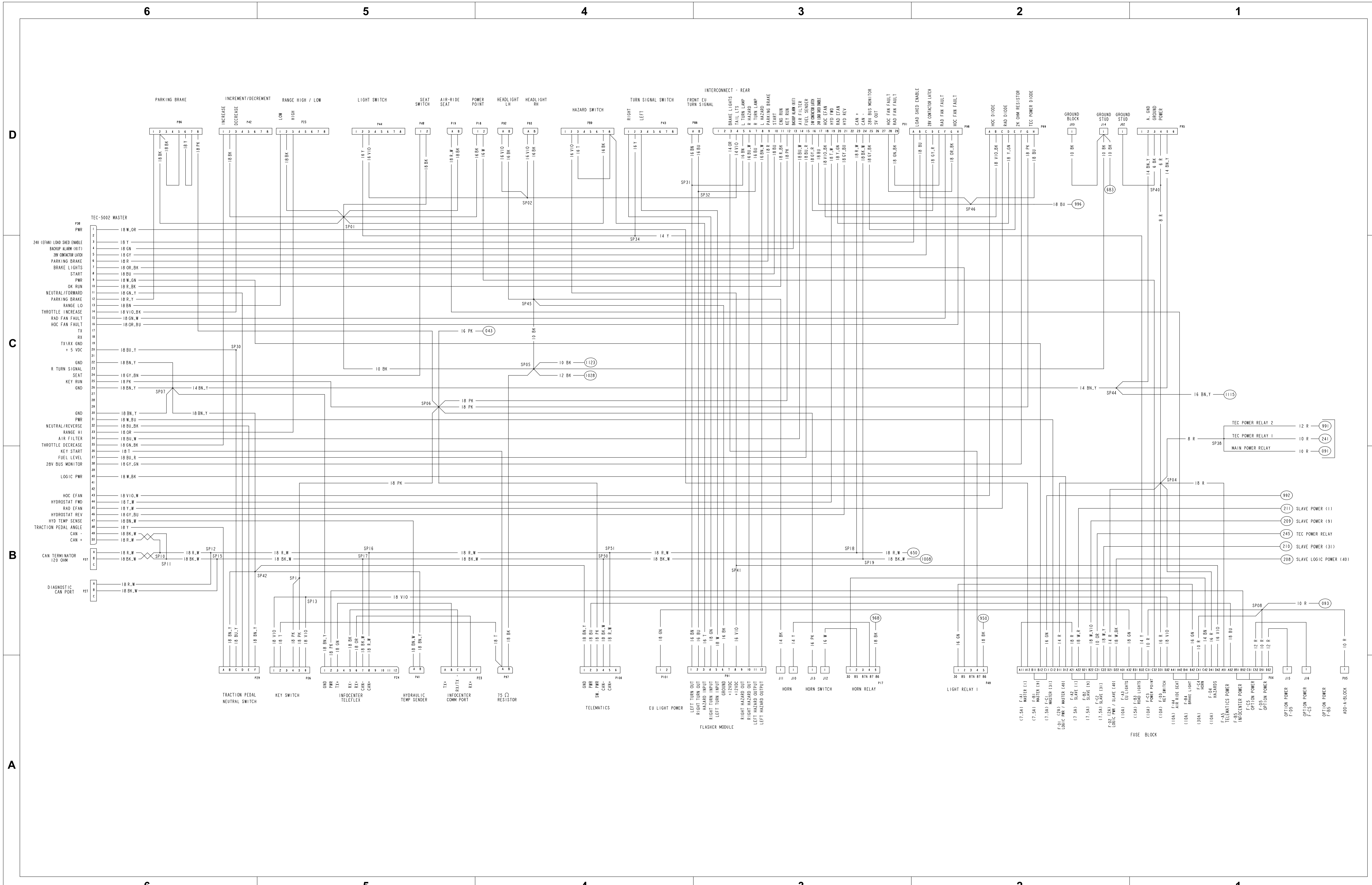


Operator Platform Wire Harness Drawing (machine serial numbers below 316000200)



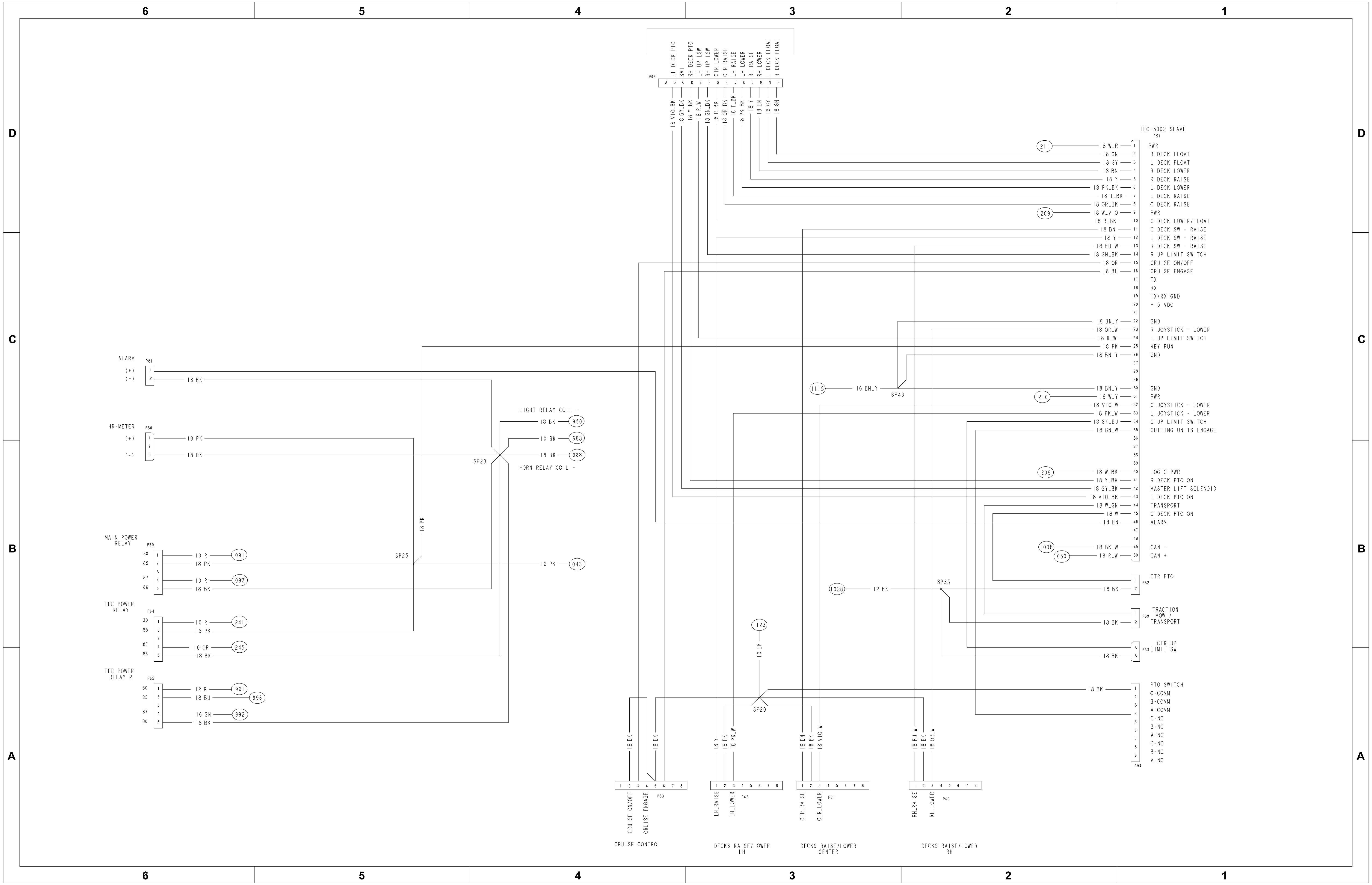
g299976

Operator Platform Wire Harness Diagram (machine serial numbers below 316000200)



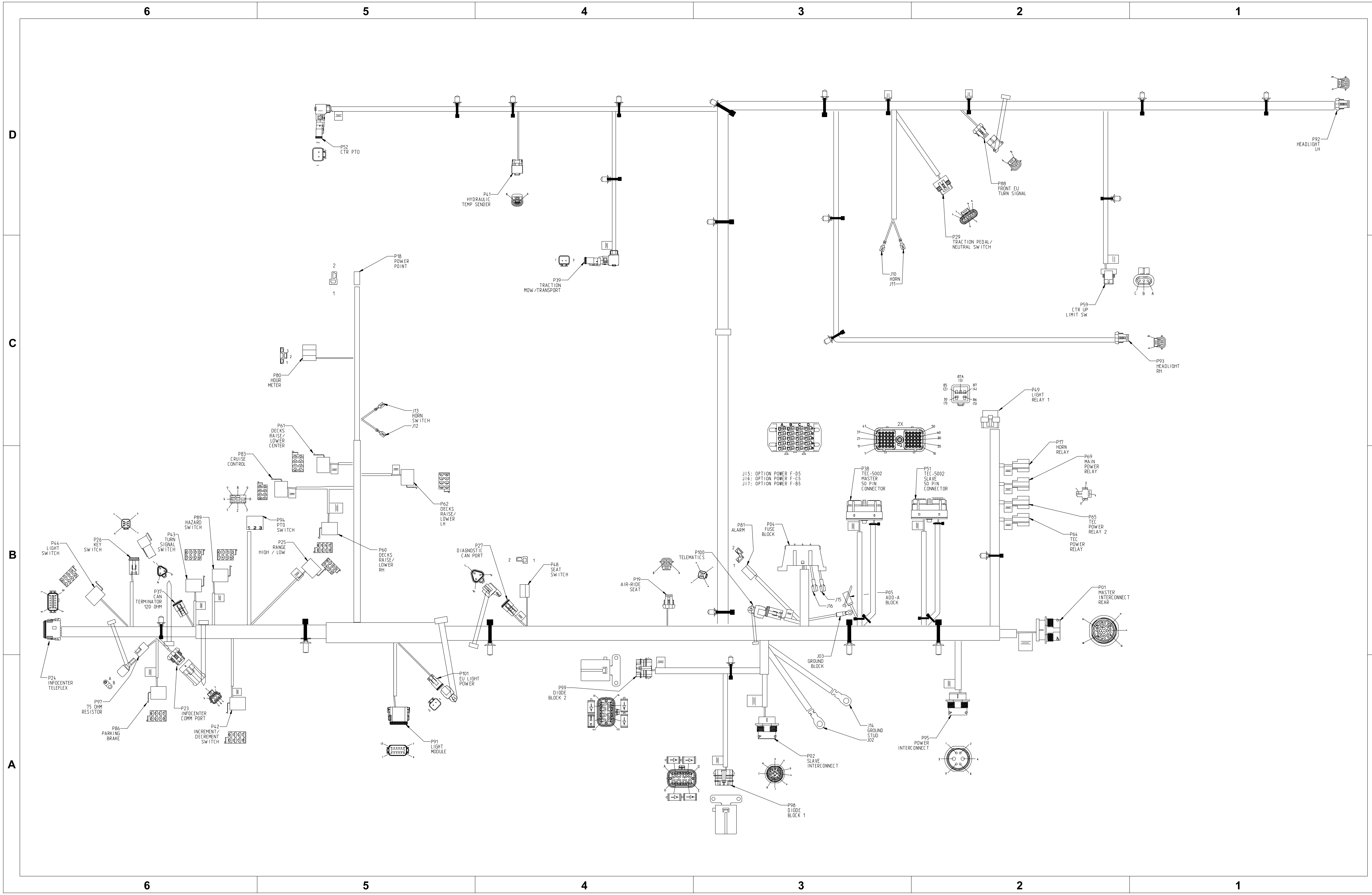
g299969

Operator Platform Wire Harness Diagram (machine serial numbers below 316000200)



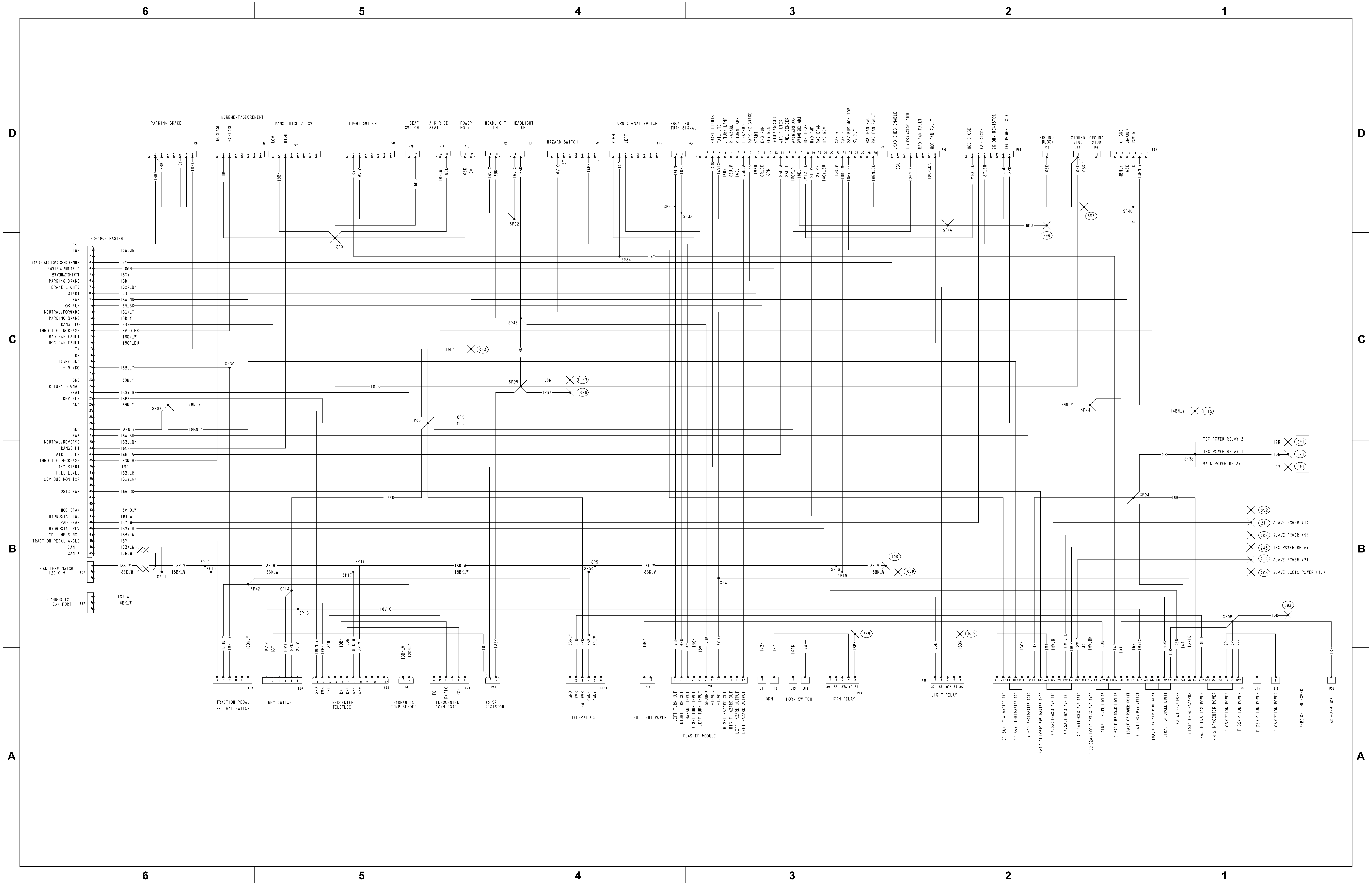
g299970

Operator Platform Wire Harness Drawing (machine serial numbers 316000201 to 316999999)



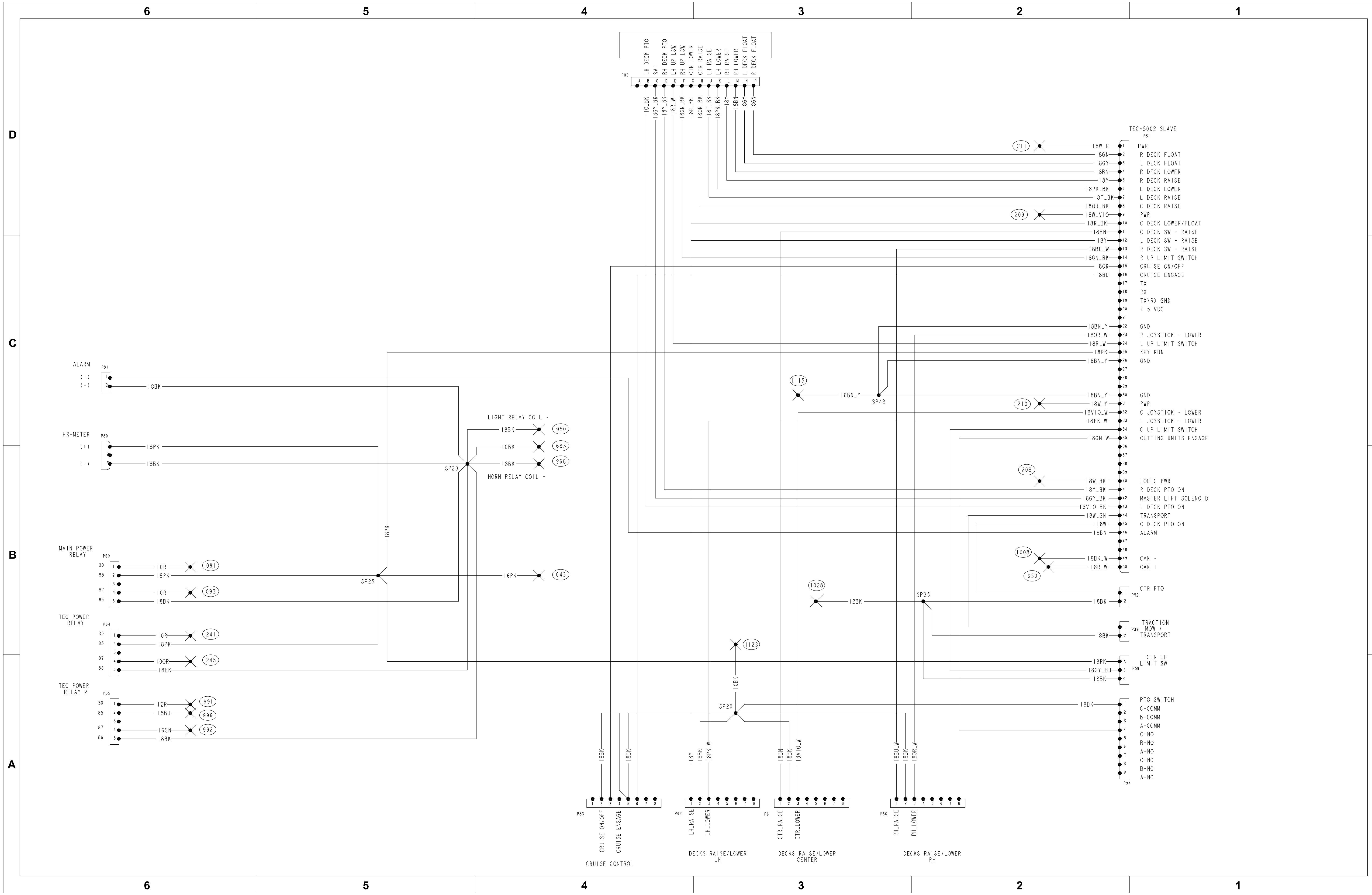
g299971

Operator Platform Wire Harness Diagram (machine serial numbers 316000201 to 316999999)



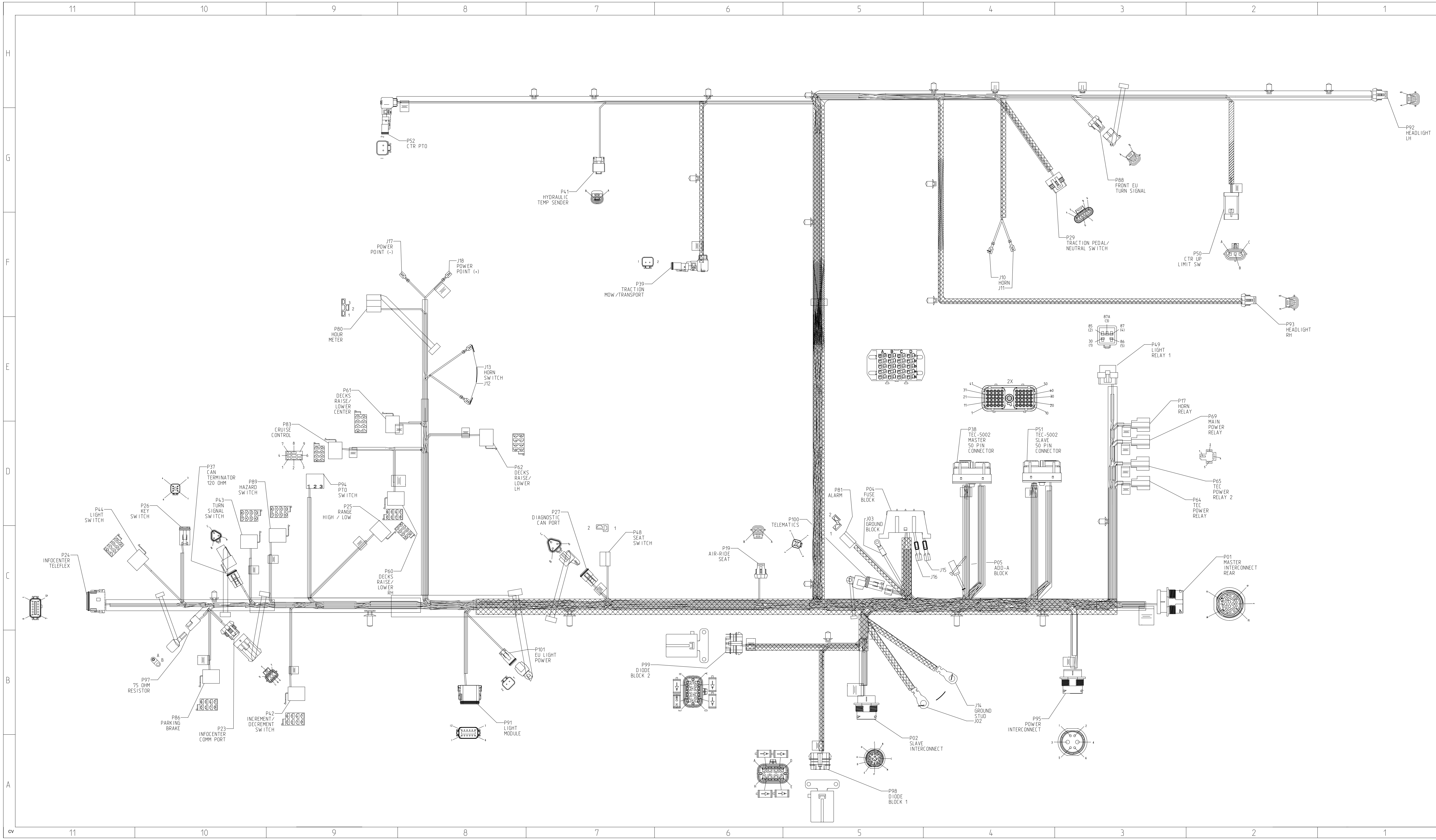
g299972

Operator Platform Wire Harness Diagram (machine serial numbers 316000201 to 316999999)



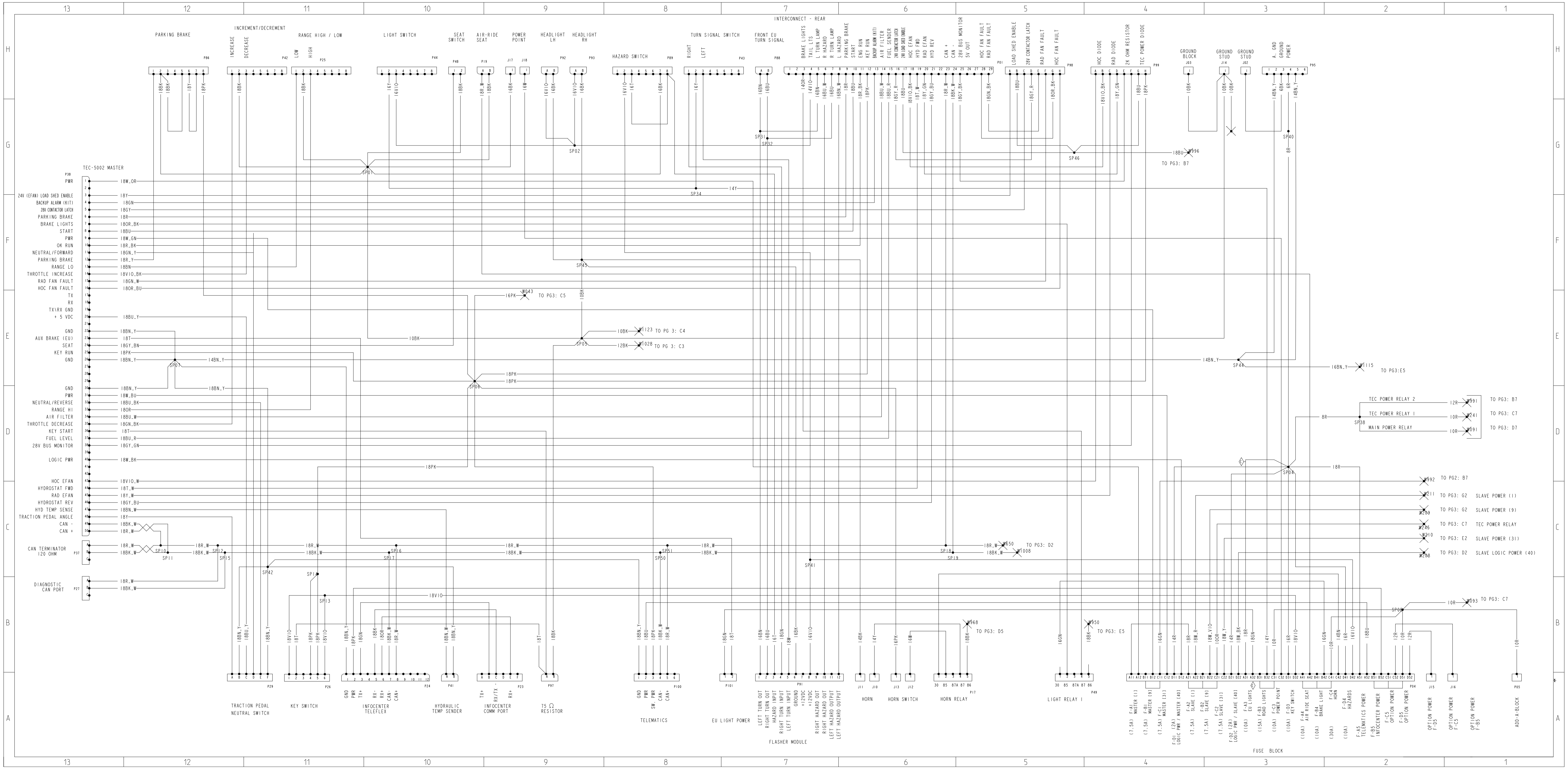
g299973

Operator Platform Wire Harness Diagram (machine serial numbers 400000000 to 403450000)



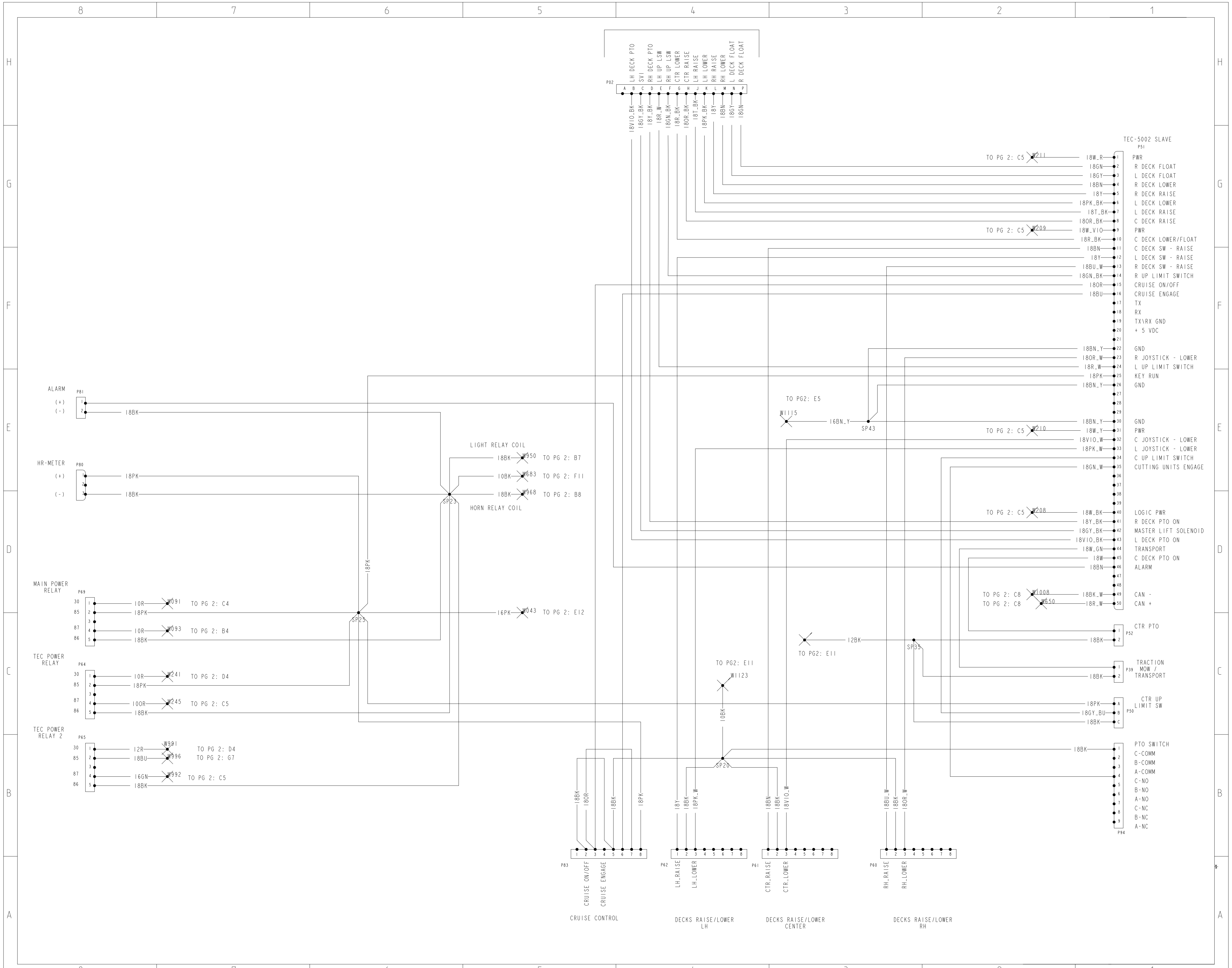
g302224

Operator Platform Wire Harness Diagram (machine serial numbers 400000000 to 403450000)

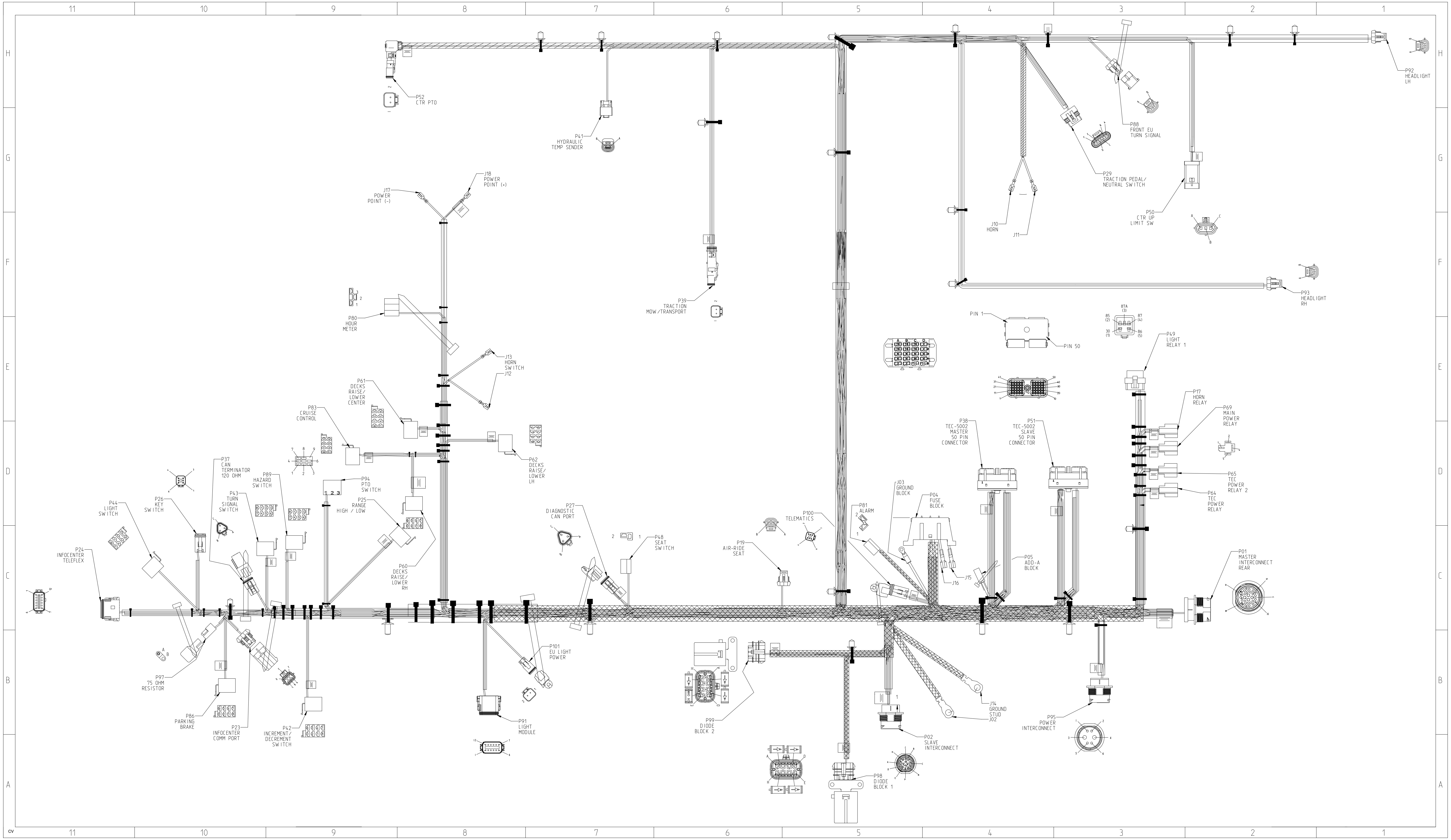


g302225

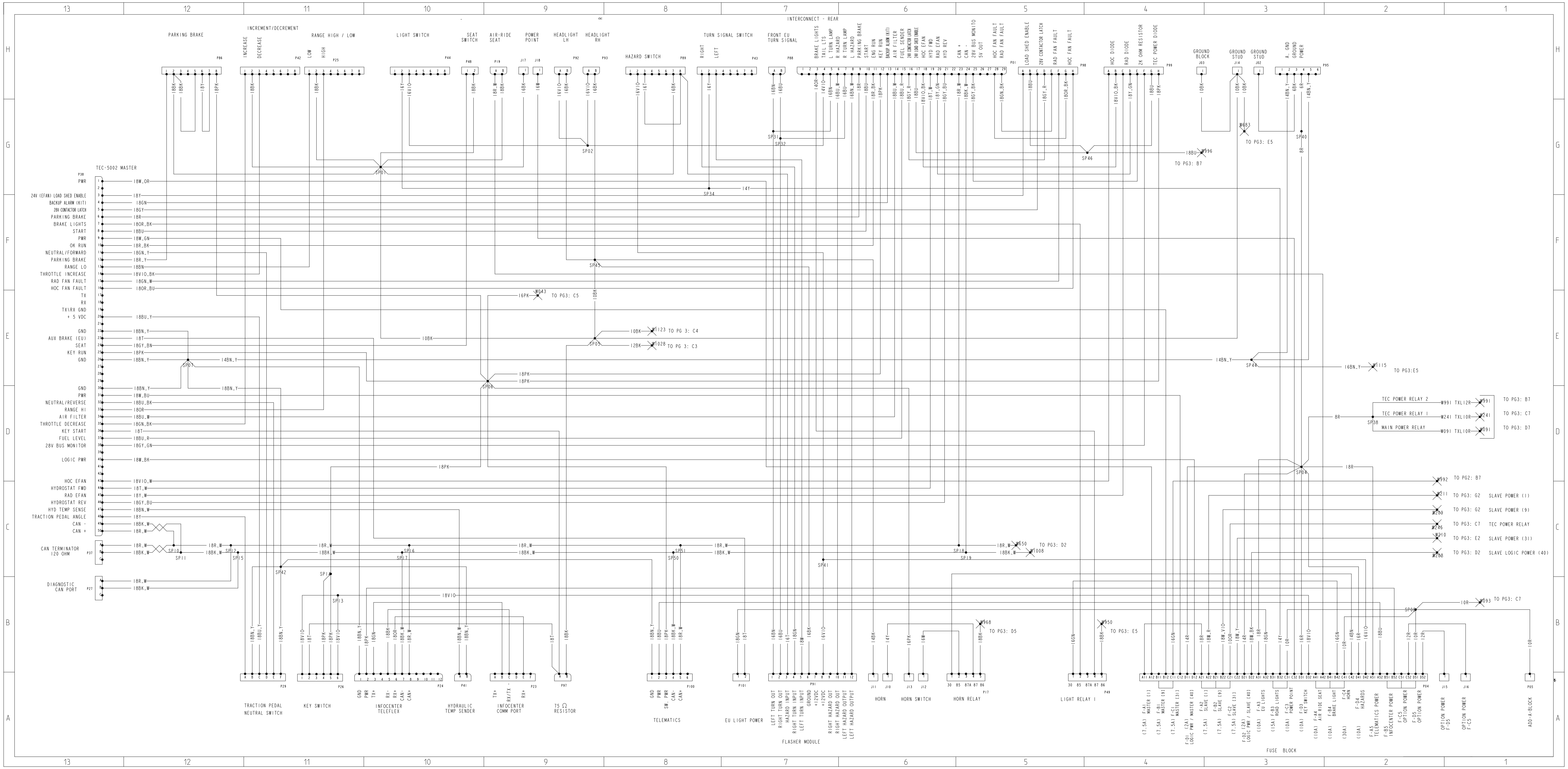
Operator Platform Wire Harness Diagram (machine serial numbers 400000000 to 403450000)



Operator Platform Wire Harness Diagram (machine serial numbers 403450001 to 405600000)

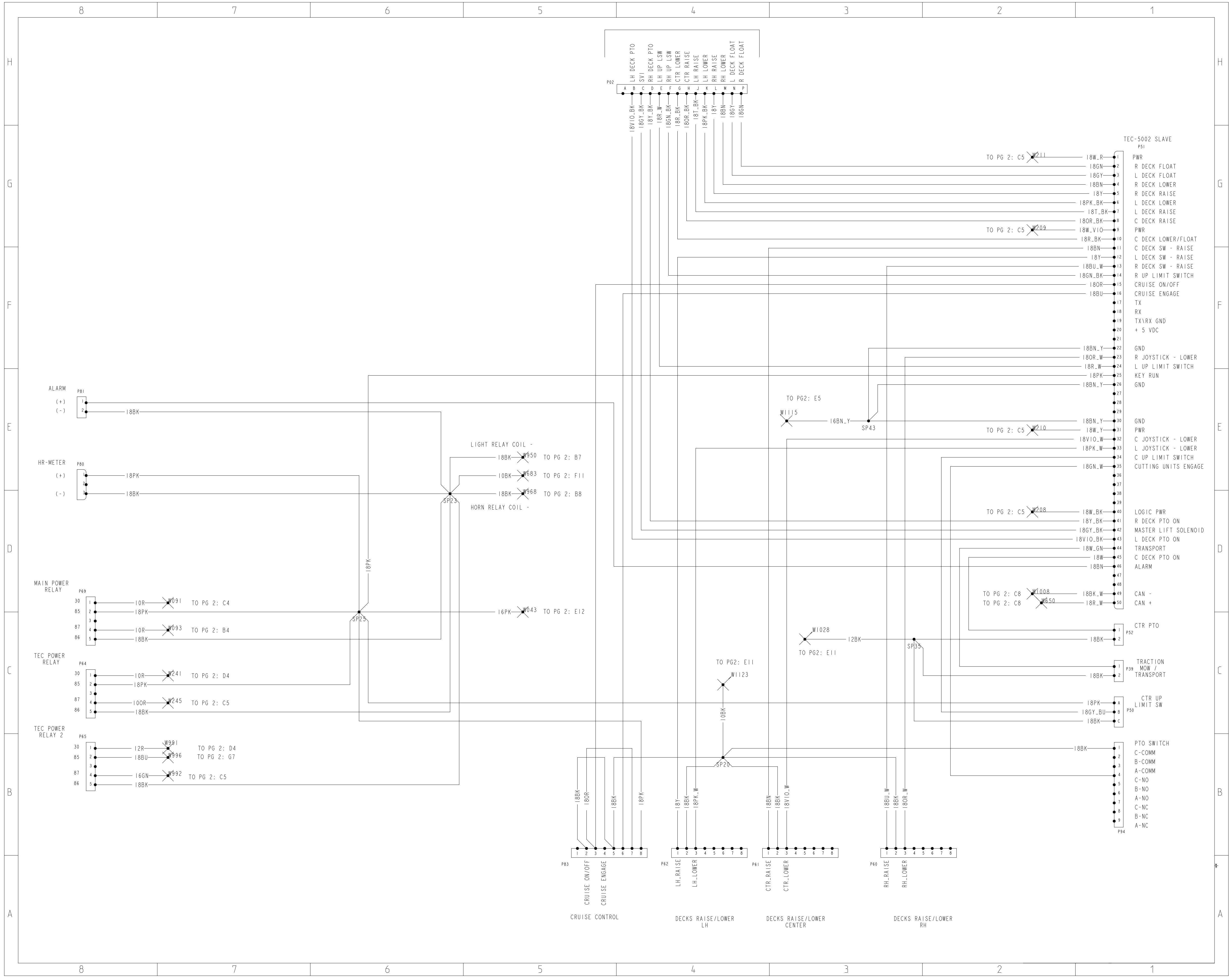


Operator Platform Wire Harness Diagram (machine serial numbers 403450001 to 405600000)



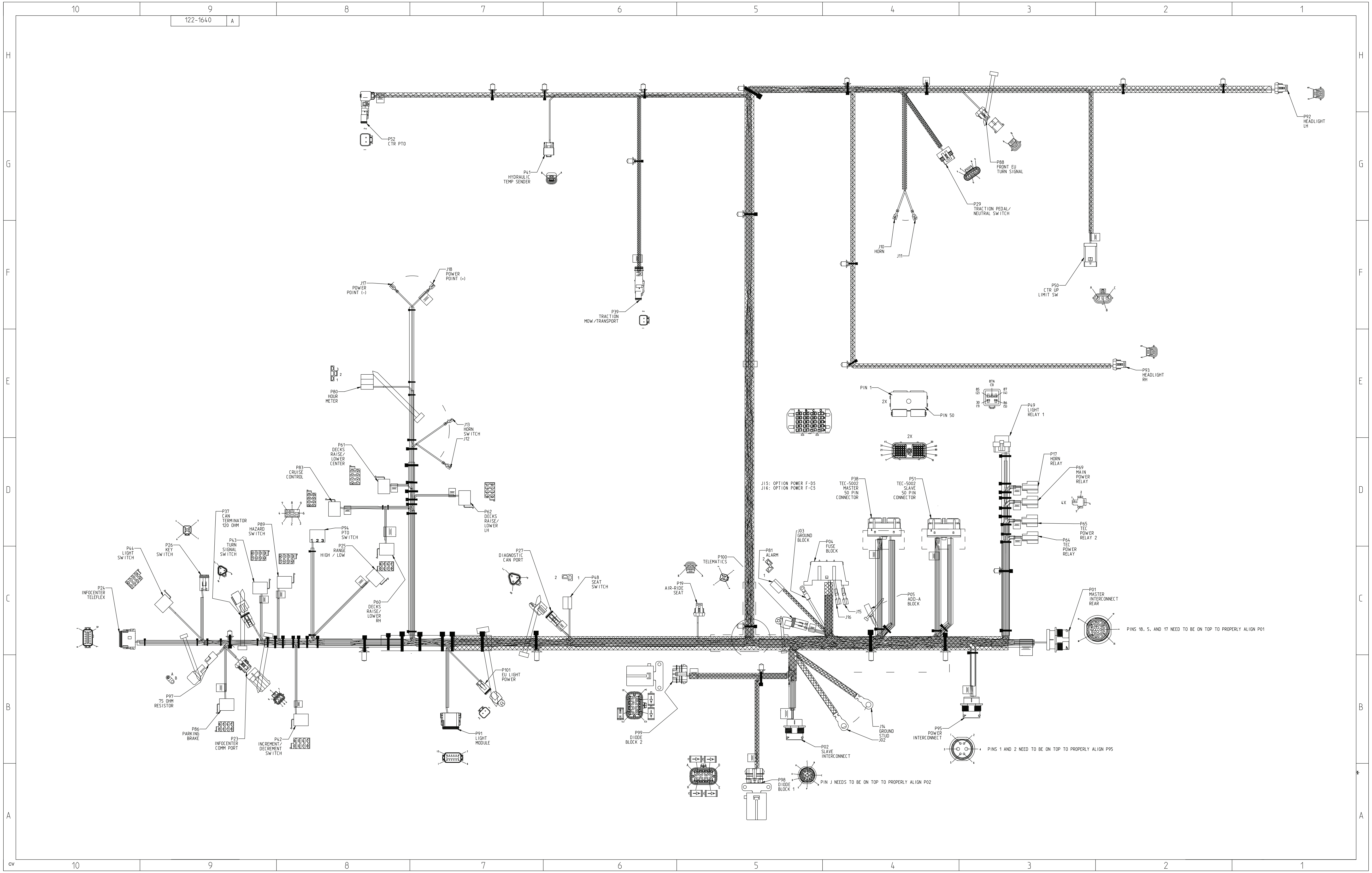
g302255

Operator Platform Wire Harness Diagram (machine serial numbers 403450001 to 405600000)



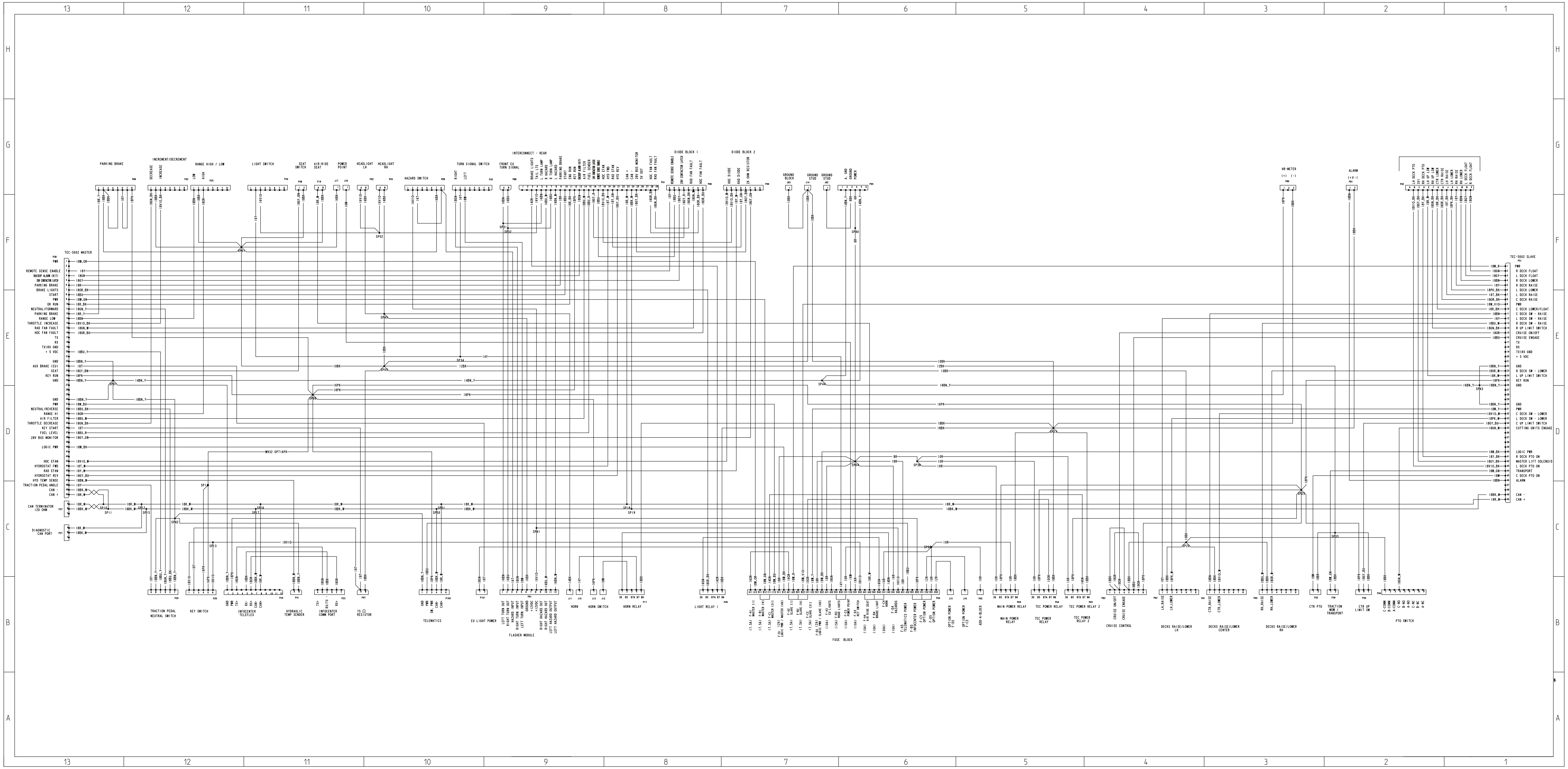
g302256

Operator Platform Wire Harness Drawing (machine serial numbers 405600001 to 408000000)



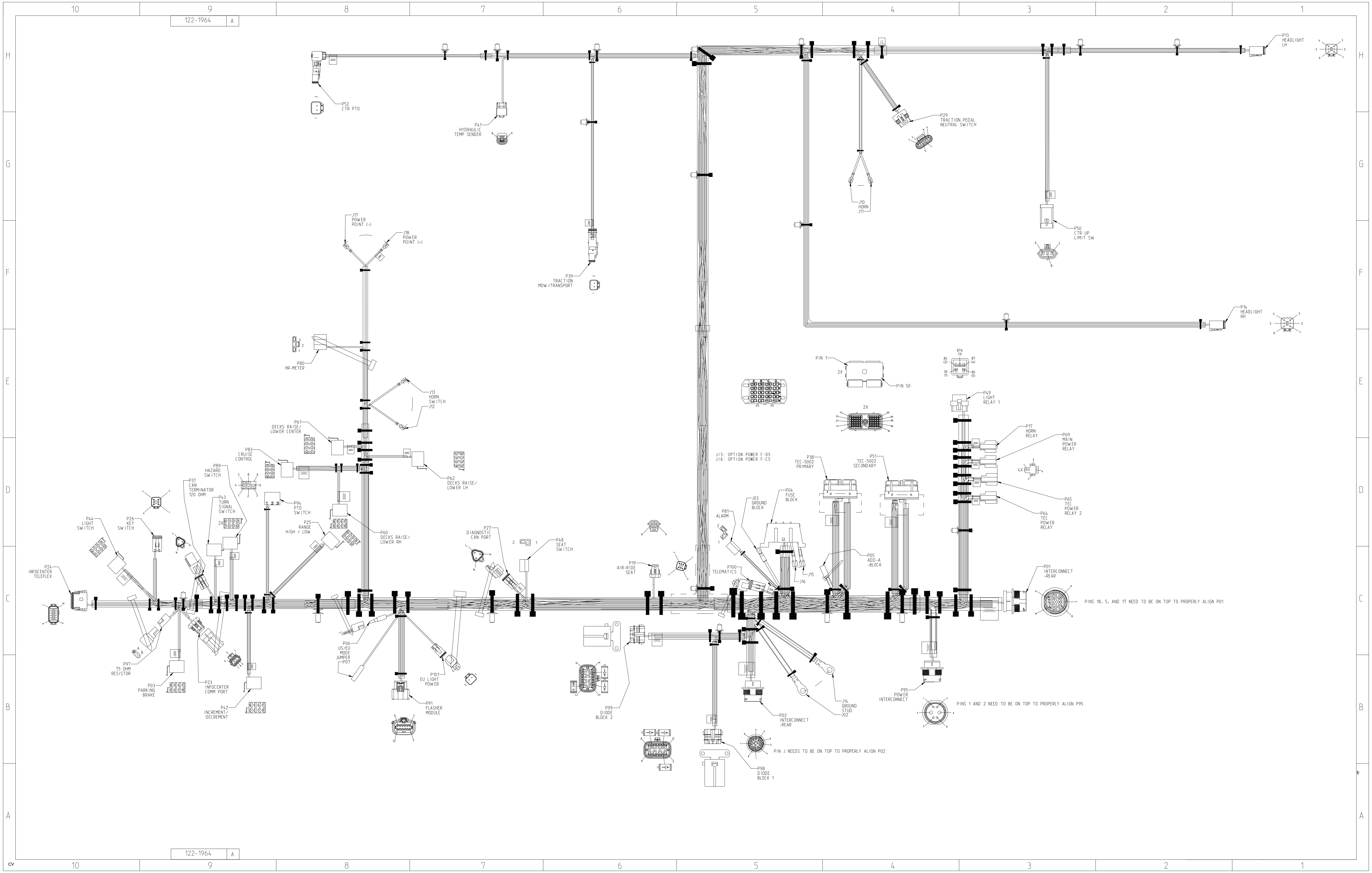
g329182

Operator Platform Wire Harness Diagram (machine serial numbers 405600001 to 408000000)



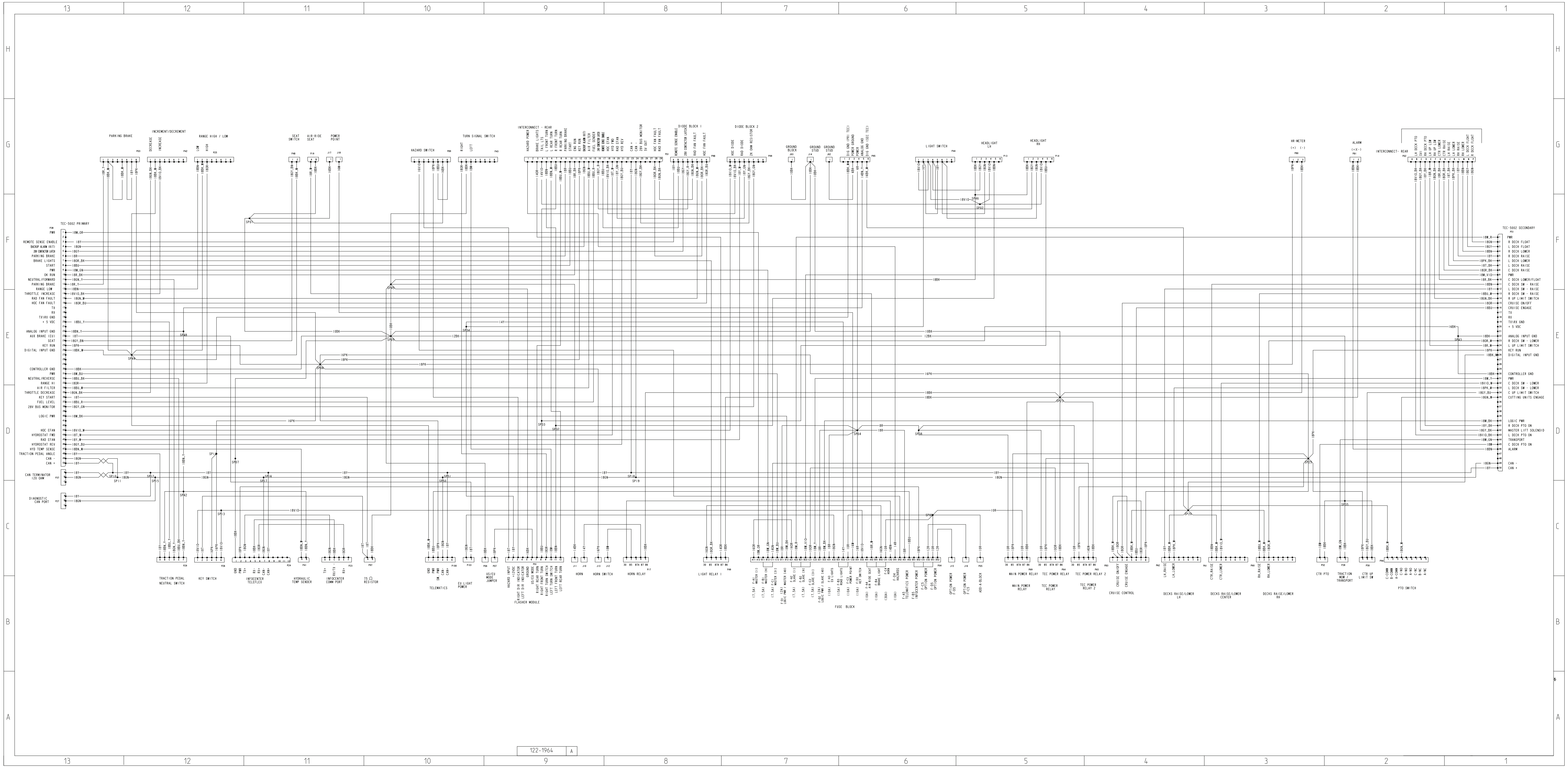
g329183

Operator Platform Wire Harness Drawing (machine serial numbers above 408000000)

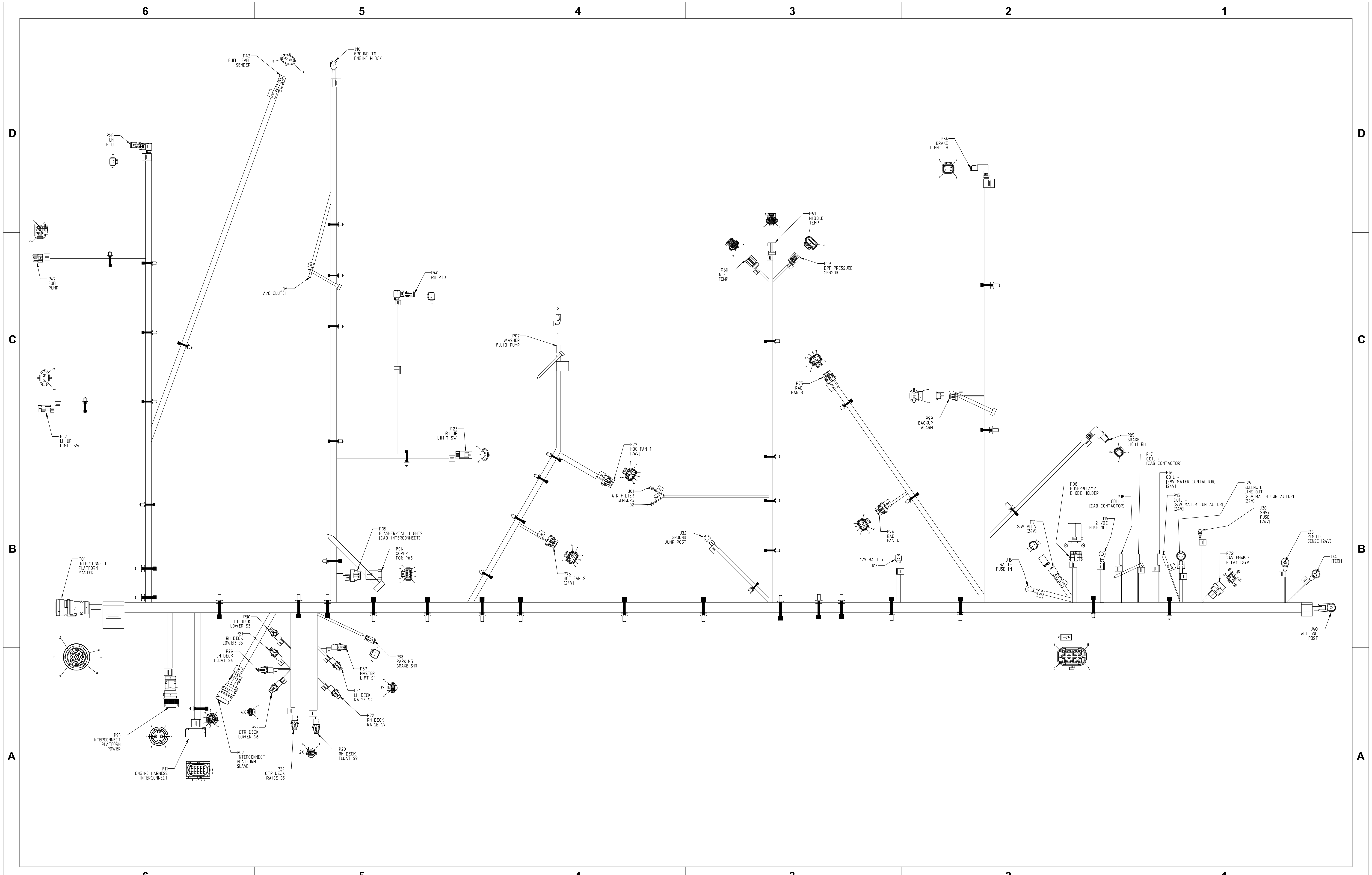


g362772

Operator Platform Wire Harness Diagram (machine serial numbers above 408000000)



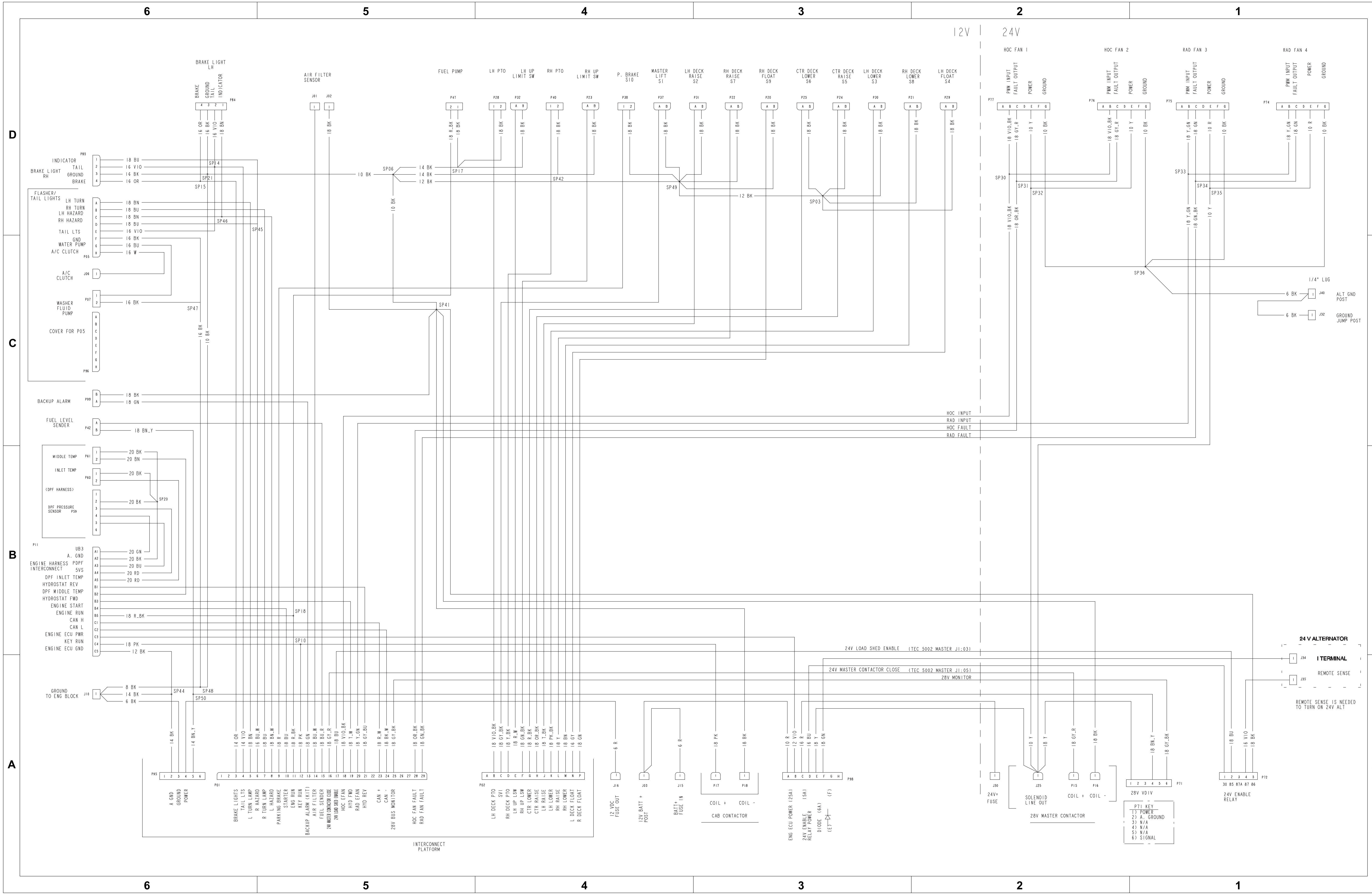
g362773



6
5
4
3
2
1
D
C
B
A
P42 FUEL LEVEL SENDER
J10 GROUND TO ENGINE BLOCK
P28 LH PTO
P47 FUEL PUMP
J06 A/C CLUTCH
P40 RH PTO
P32 LH UP LIMIT SW
P23 RH UP LIMIT SW
P07 WASHER FLUID PUMP
P77 HOC FAN 1 [24V]
J01 AIR FILTER SENSORS J02
P76 HOC FAN 2 [24V]
P61 MIDDLE TEMP
P60 INLET TEMP
P59 DPF PRESSURE SENSOR
P75 RAD FAN 3
J32 GROUND JUMP POST
P74 RAD FAN 4
12V BATT + J03
P84 BRAKE LIGHT LH
P99 BACKUP ALARM
P85 BRAKE LIGHT RH
P17 COIL + [CAB CONTACTOR]
P16 COIL - [28V MATER CONTACTOR] [24V]
P98 FUSE/RELAY/ DIODE HOLDER
P18 COIL - [CAB CONTACTOR]
P15 COIL + [28V MATER CONTACTOR] [24V]
J25 SOLENOID LINE OUT [28V MATER CONTACTOR] [24V]
J30 28V+ FUSE [24V]
P71 28V VDIV [24V]
J16 12 VDC FUSE OUT
J15 BATT+ FUSE IN
P72 24V ENABLE RELAY [24V]
J35 REMOTE SENSE [24V]
J34 ITERM
J40 ALT GND POST
P01 INTERCONNECT PLATFORM MASTER
P05 FLASHER/TAIL LIGHTS [CAB INTERCONNECT]
P96 COVER FOR P05
P30 LH DECK LOWER S3
P21 RH DECK LOWER S8
P29 LH DECK FLOAT S4
P38 PARKING BRAKE S10
P37 MASTER LIFT S1
P31 LH DECK RAISE S2
3X
P22 RH DECK RAISE S7
4X
P25 CTR DECK LOWER S6
P95 INTERCONNECT PLATFORM POWER
P02 INTERCONNECT PLATFORM SLAVE
2X
P20 RH DECK FLOAT S9
P11 ENGINE HARNESS INTERCONNECT
P24 CTR DECK RAISE S5
6
5
4
3
2
1

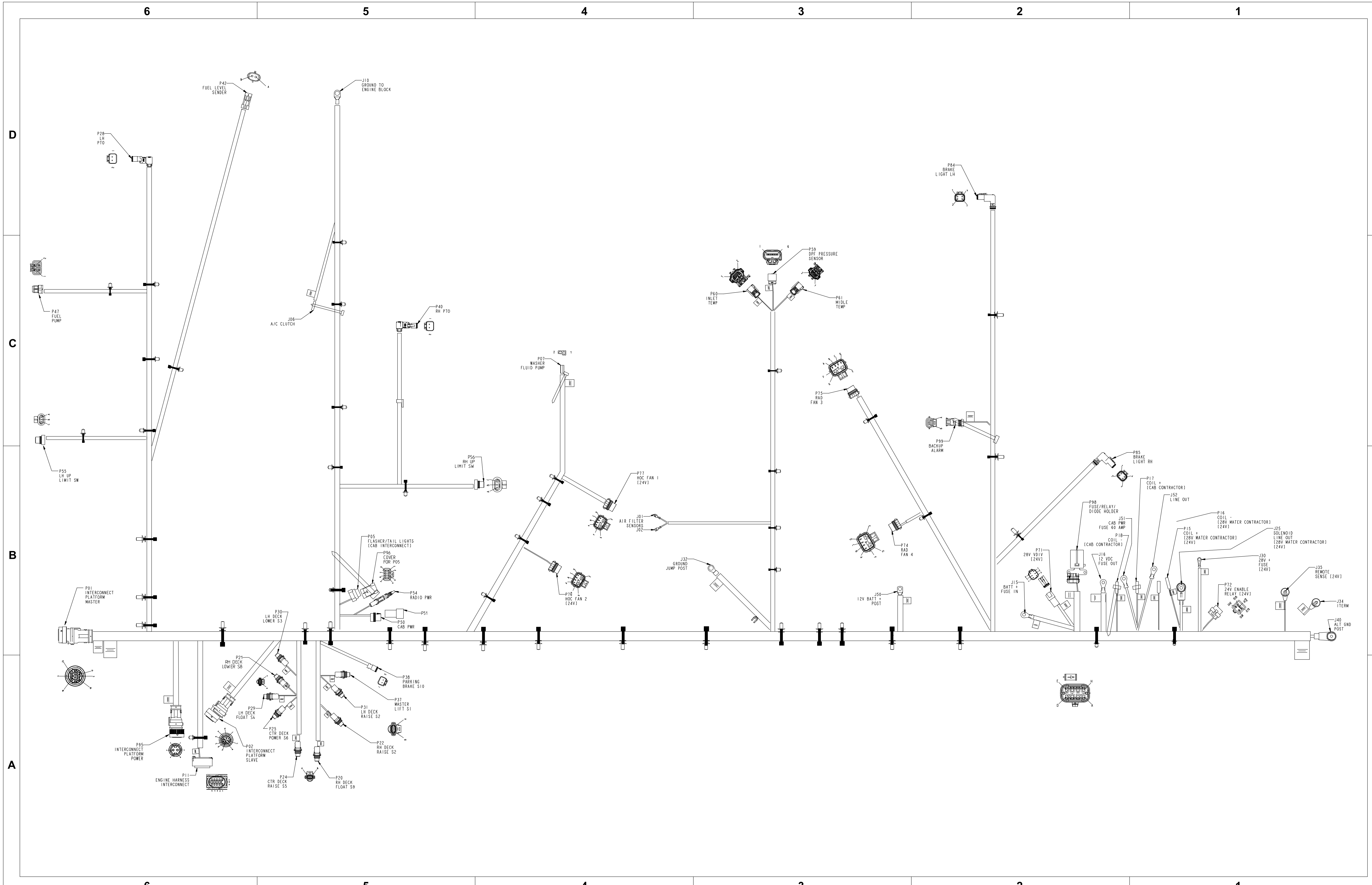
g299974

Rear Wire Harness Diagram (machine serial numbers below 316000200)



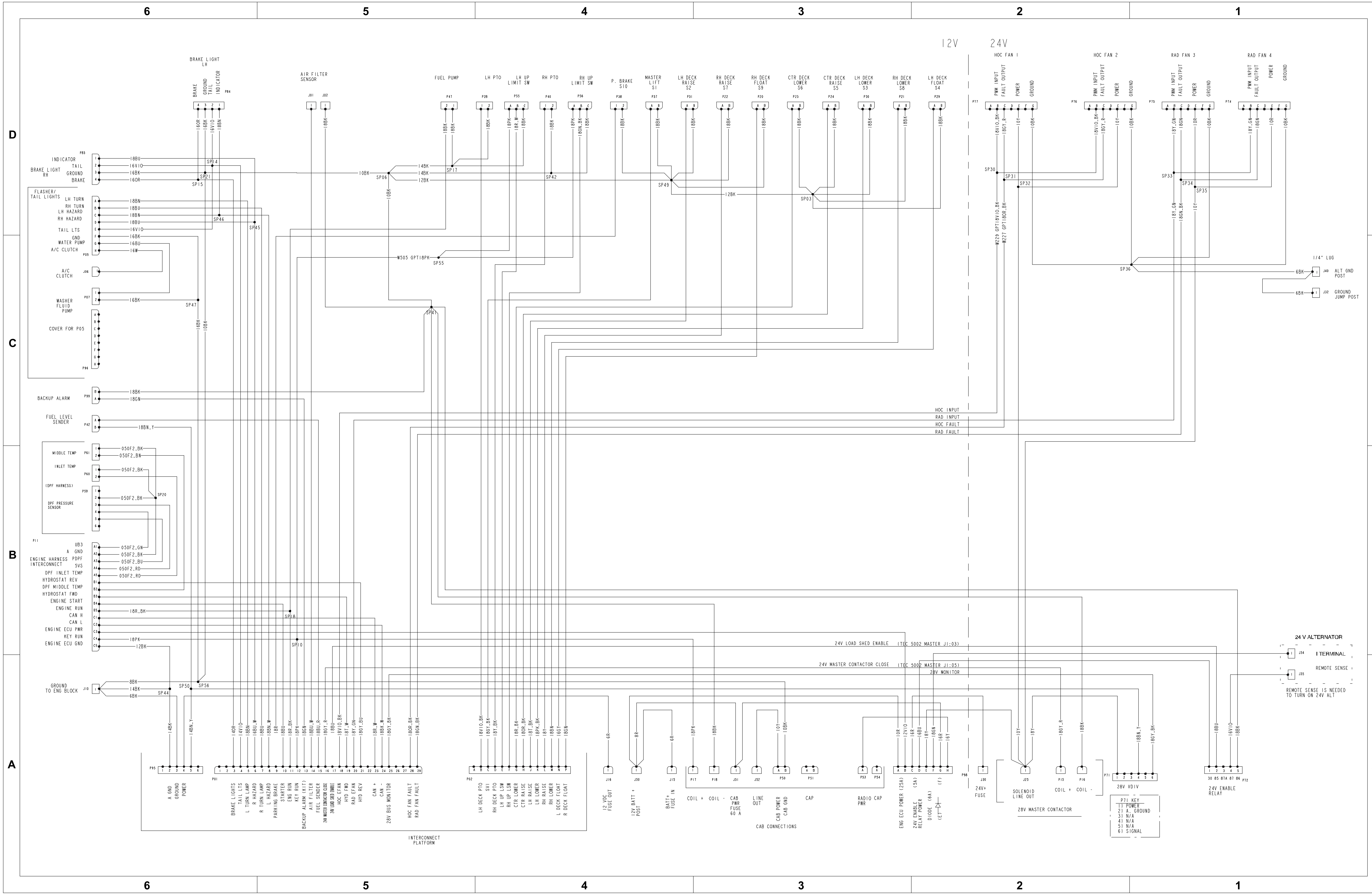
g299975

Rear Wire Harness Drawing (machine serial numbers 316000201 to 403450000)



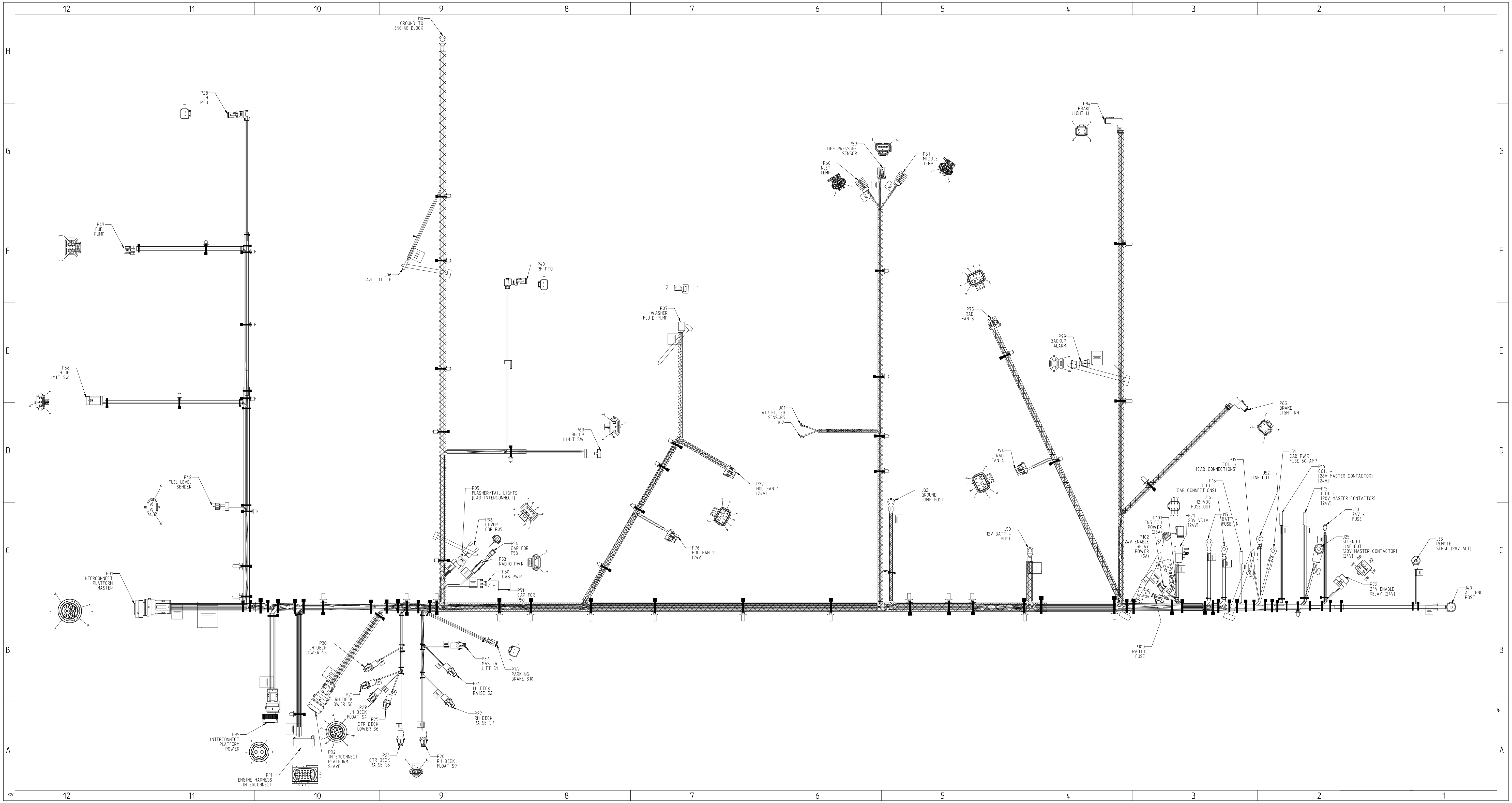
g299990

Rear Wire Harness Drawing (machine serial numbers 316000201 to 403450000)



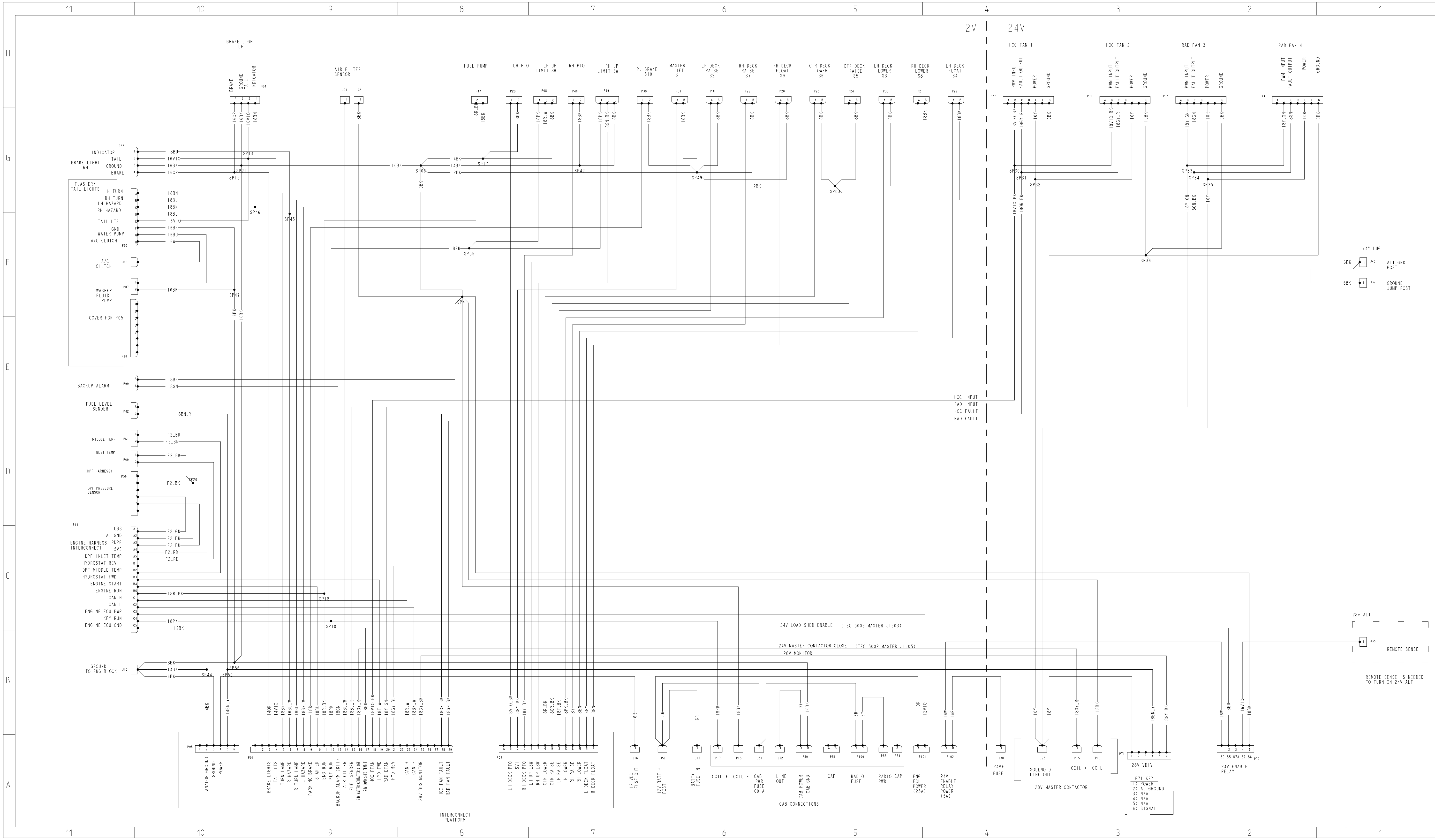
g299991

Rear Wire Harness Drawing (machine serial numbers 403450001 to 405600000)



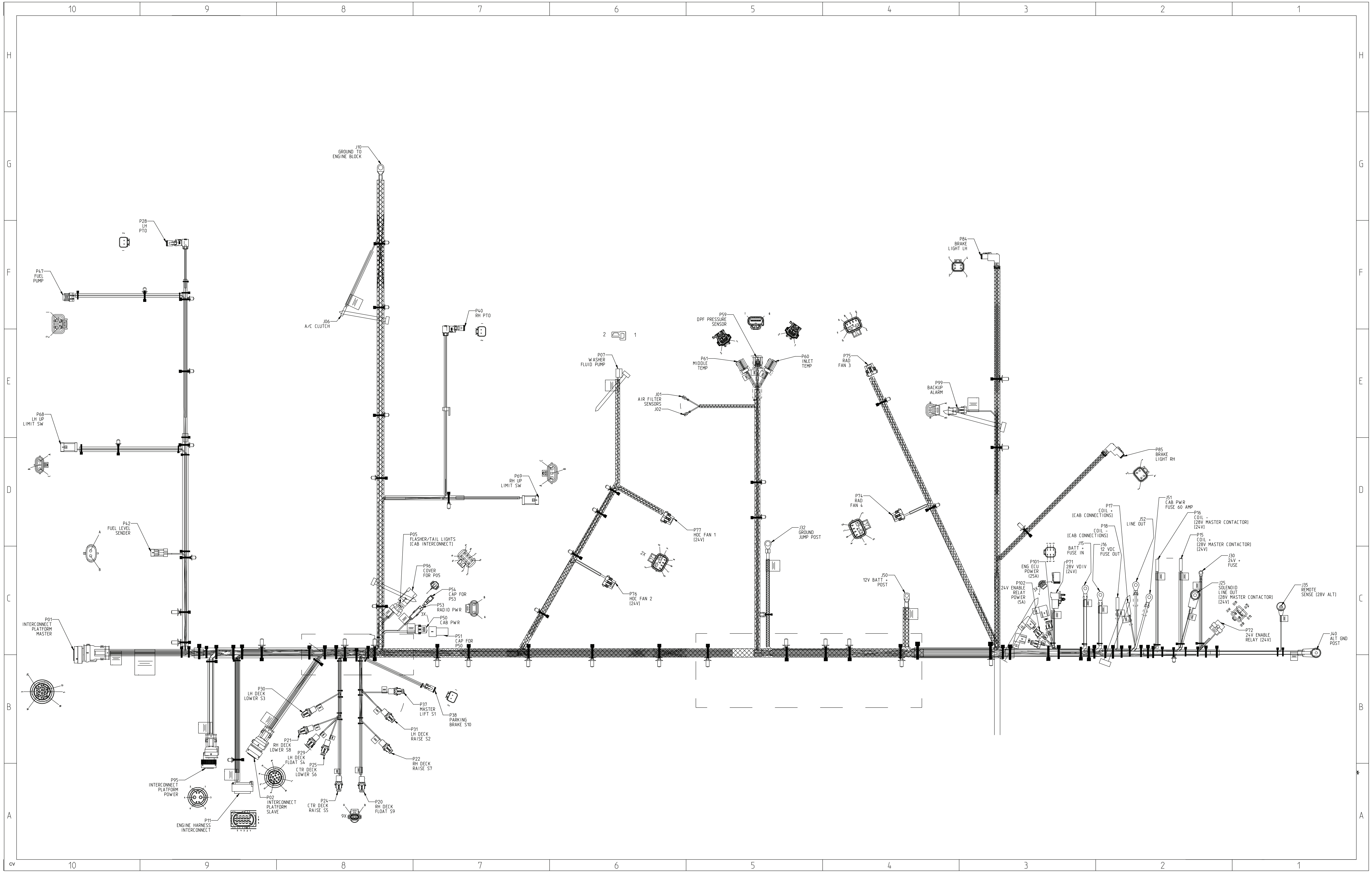
g302318

Rear Wire Harness Drawing (machine serial numbers 403450001 to 405600000)



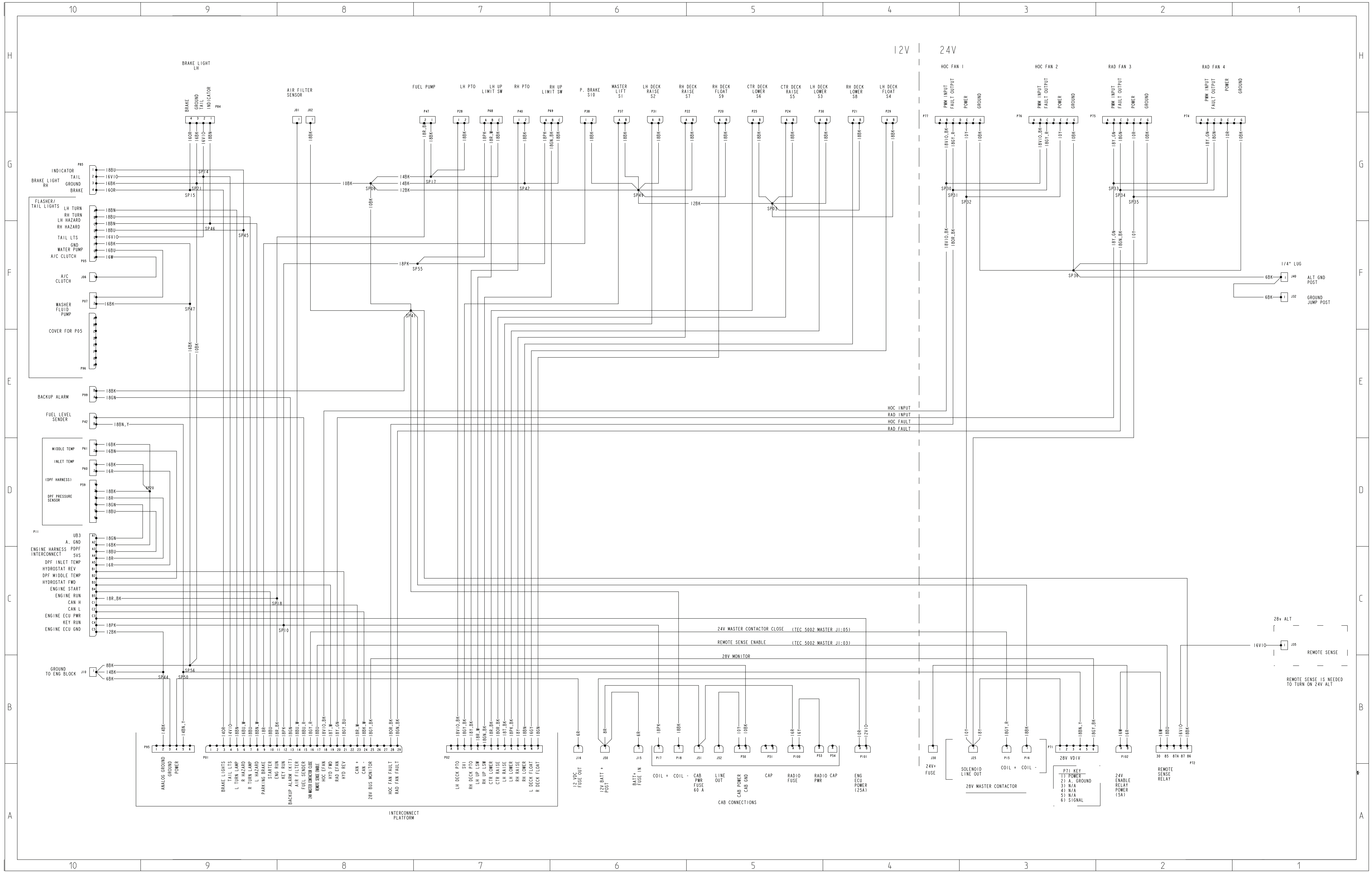
g302319

Rear Wire Harness Drawing (machine serial numbers 405600001 to 408000000)



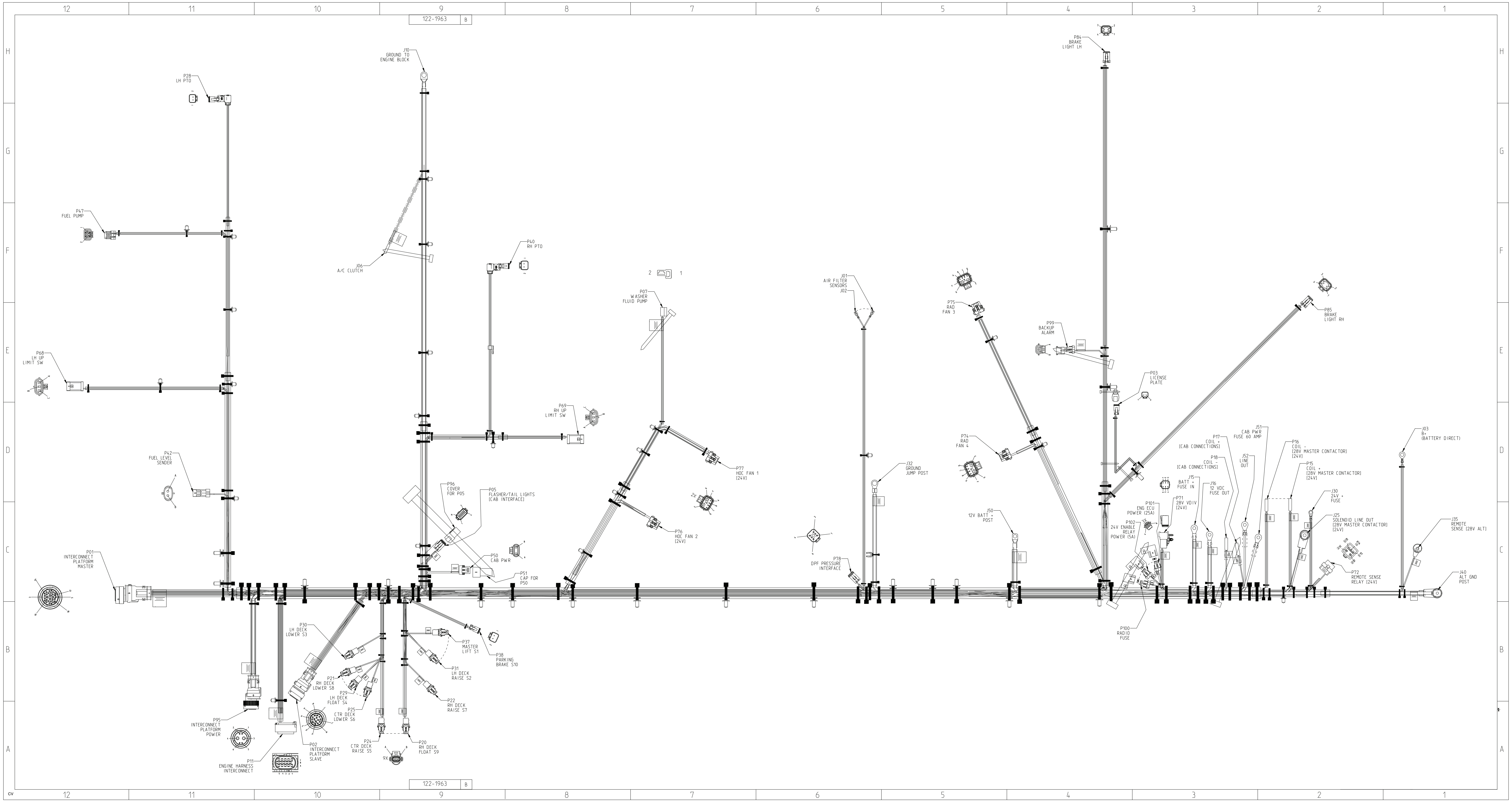
g329180

Rear Wire Harness Diagram (machine serial numbers 405600001 to 408000000)



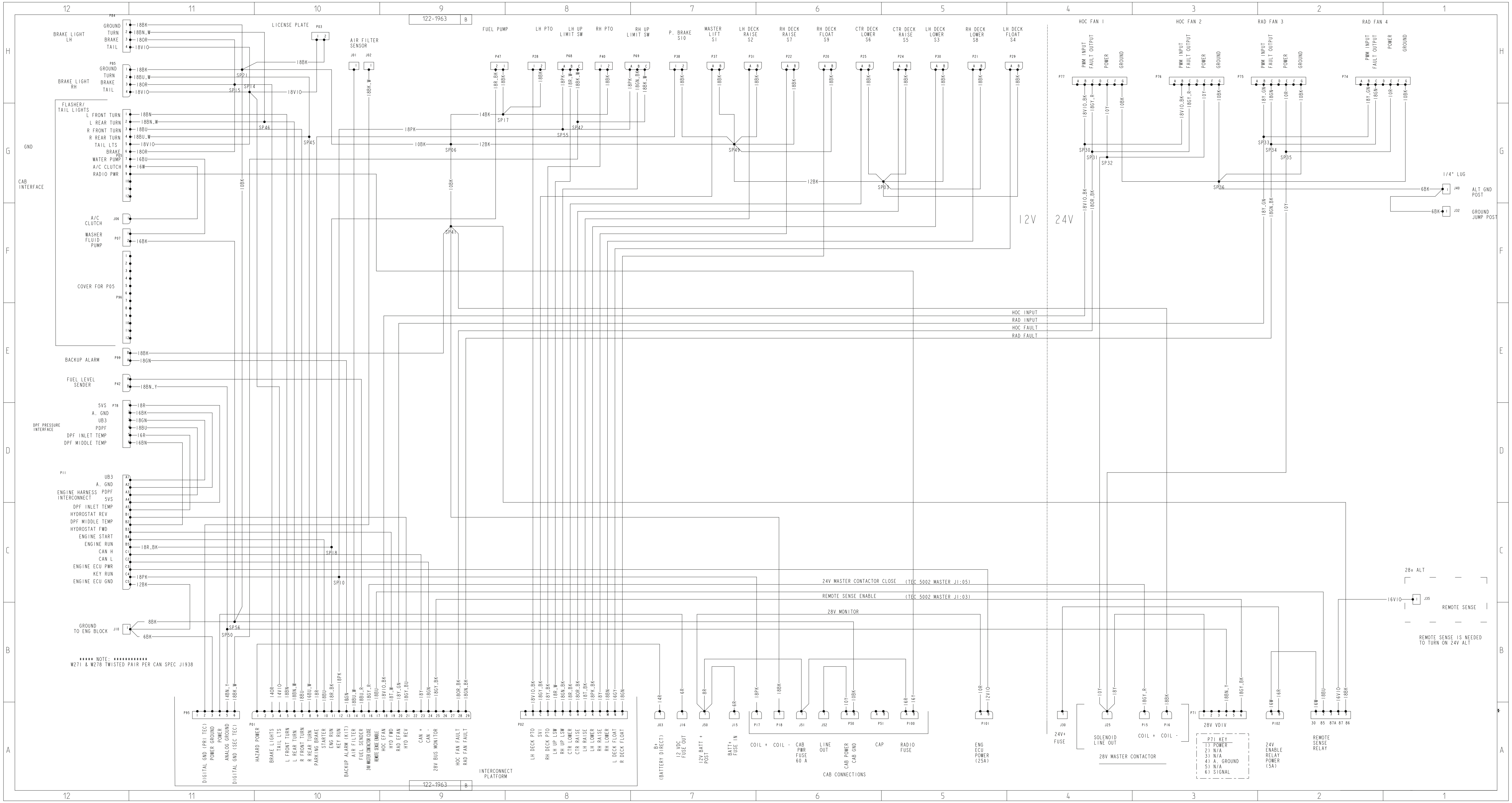
g329181

Rear Wire Harness Drawing (machine serial numbers above 408000000)

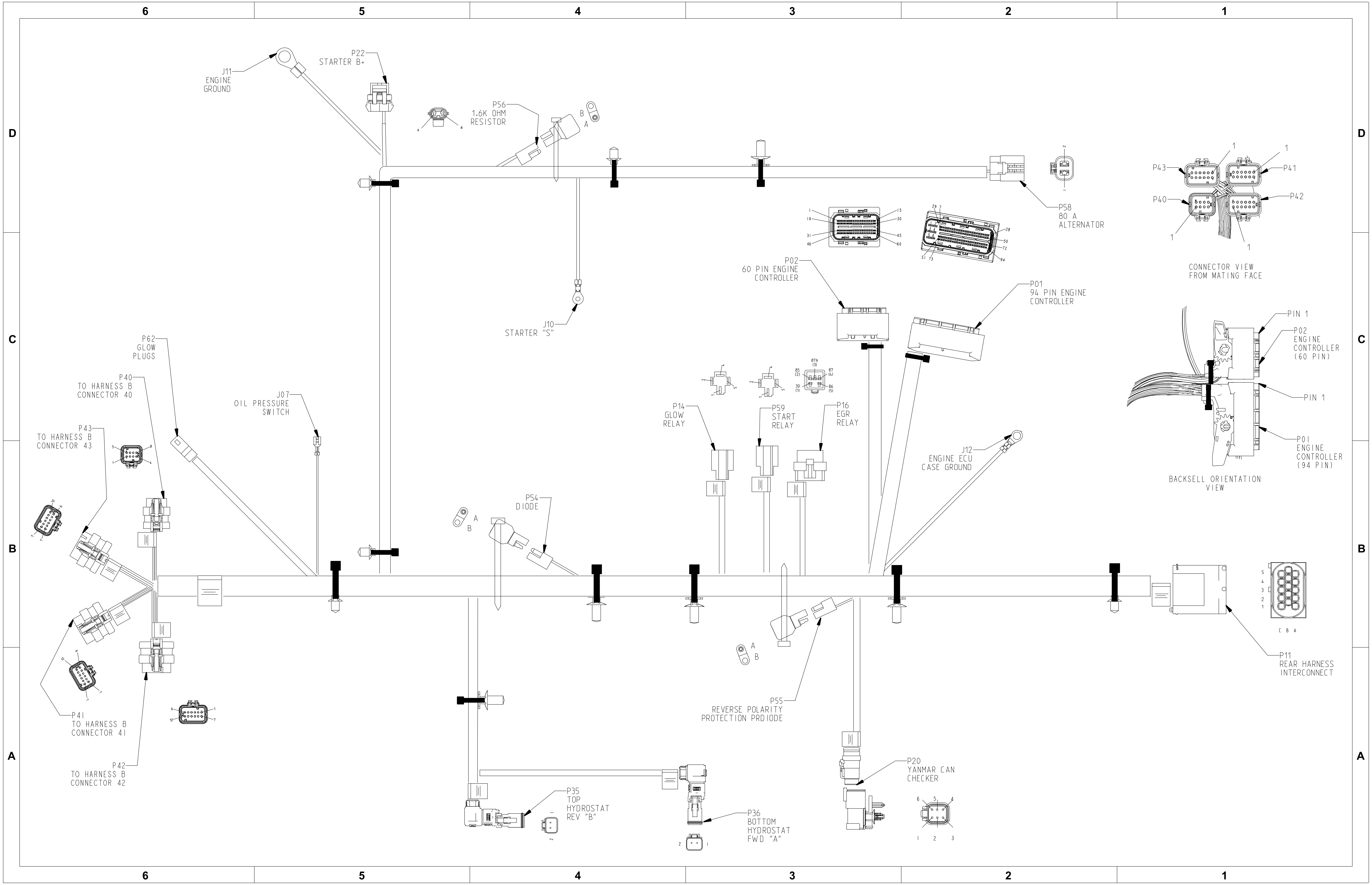


g362770

Rear Wire Harness Diagram (machine serial numbers above 408000000)

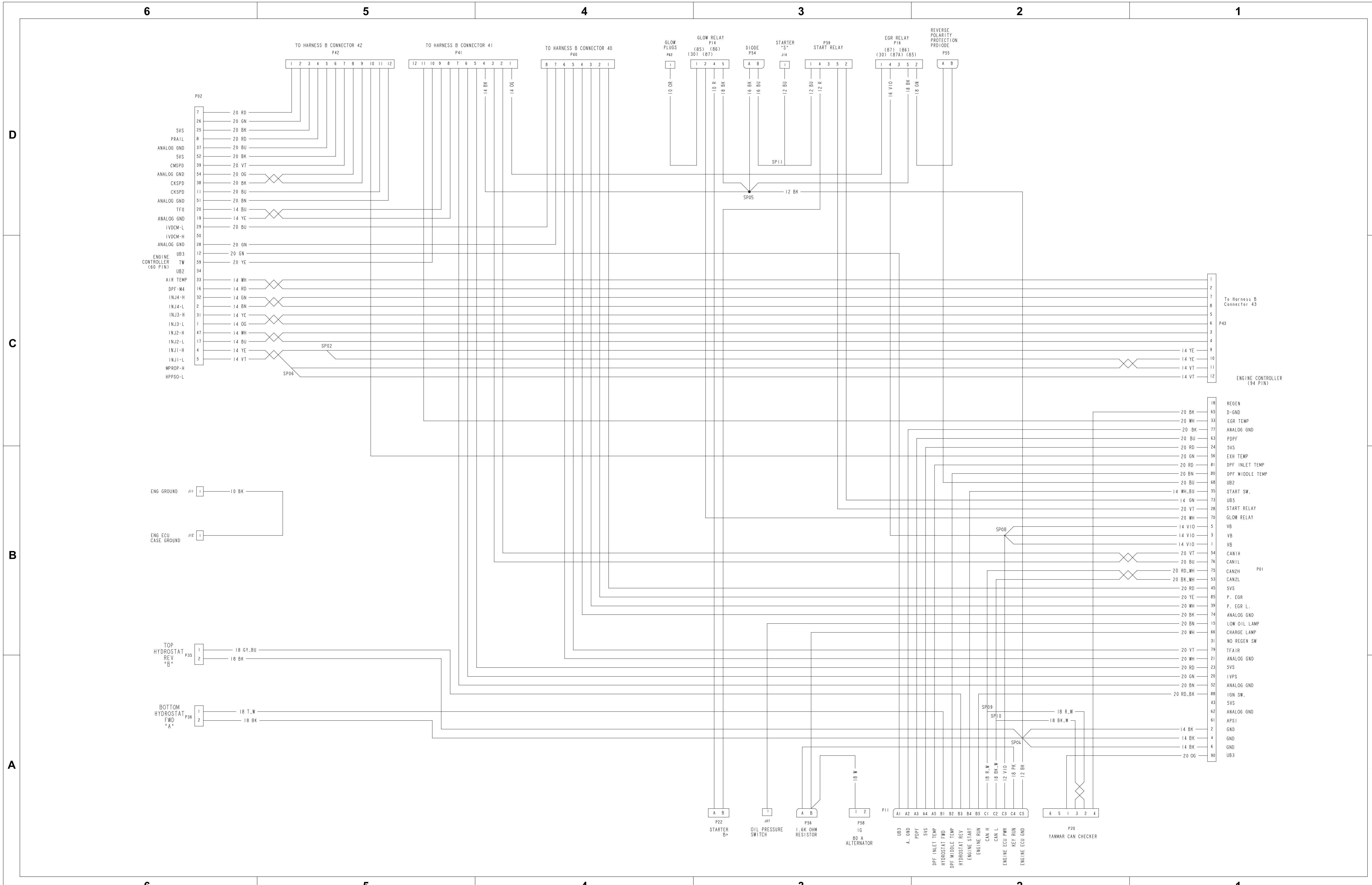


g362771

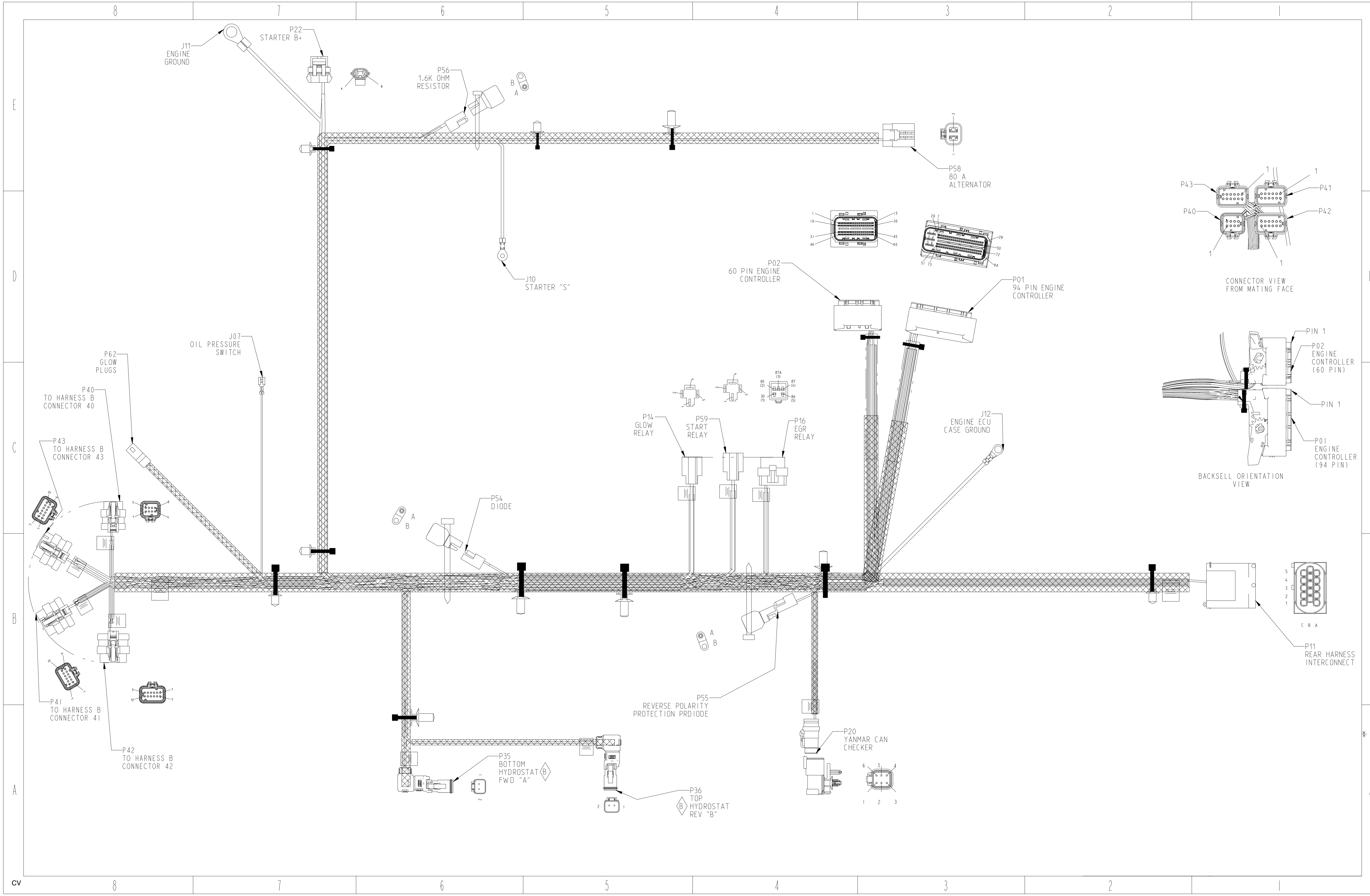

J11
ENGINE
GROUND
P22
STARTER B+
P56
1.6K OHM
RESISTOR
P58
80 A
ALTERNATOR
P02
60 PIN ENGINE
CONTROLLER
P01
94 PIN ENGINE
CONTROLLER
CONNECTOR VIEW
FROM MATING FACE
P43
P41
P40
P42
J10
STARTER "S"
P62
GLOW
PLUGS
P40
TO HARNESS B
CONNECTOR 40
J07
OIL PRESSURE
SWITCH
P43
TO HARNESS B
CONNECTOR 43
P14
GLOW
RELAY
P59
START
RELAY
P16
EGR
RELAY
J12
ENGINE ECU
CASE GROUND
PIN 1
P02
ENGINE
CONTROLLER
(60 PIN)
PIN 1
P01
ENGINE
CONTROLLER
(94 PIN)
BACKSELL ORIENTATION
VIEW
P54
DIODE
P11
REAR HARNESS
INTERCONNECT
P55
REVERSE POLARITY
PROTECTION PRIODE
P41
TO HARNESS B
CONNECTOR 41
P42
TO HARNESS B
CONNECTOR 42
P35
TOP
HYDROSTAT
REV "B"
P36
BOTTOM
HYDROSTAT
FWD "A"
P20
YANMAR CAN
CHECKER

g299992

Engine Wire Harness Drawing (machine serial numbers 316000001 to 316999999)

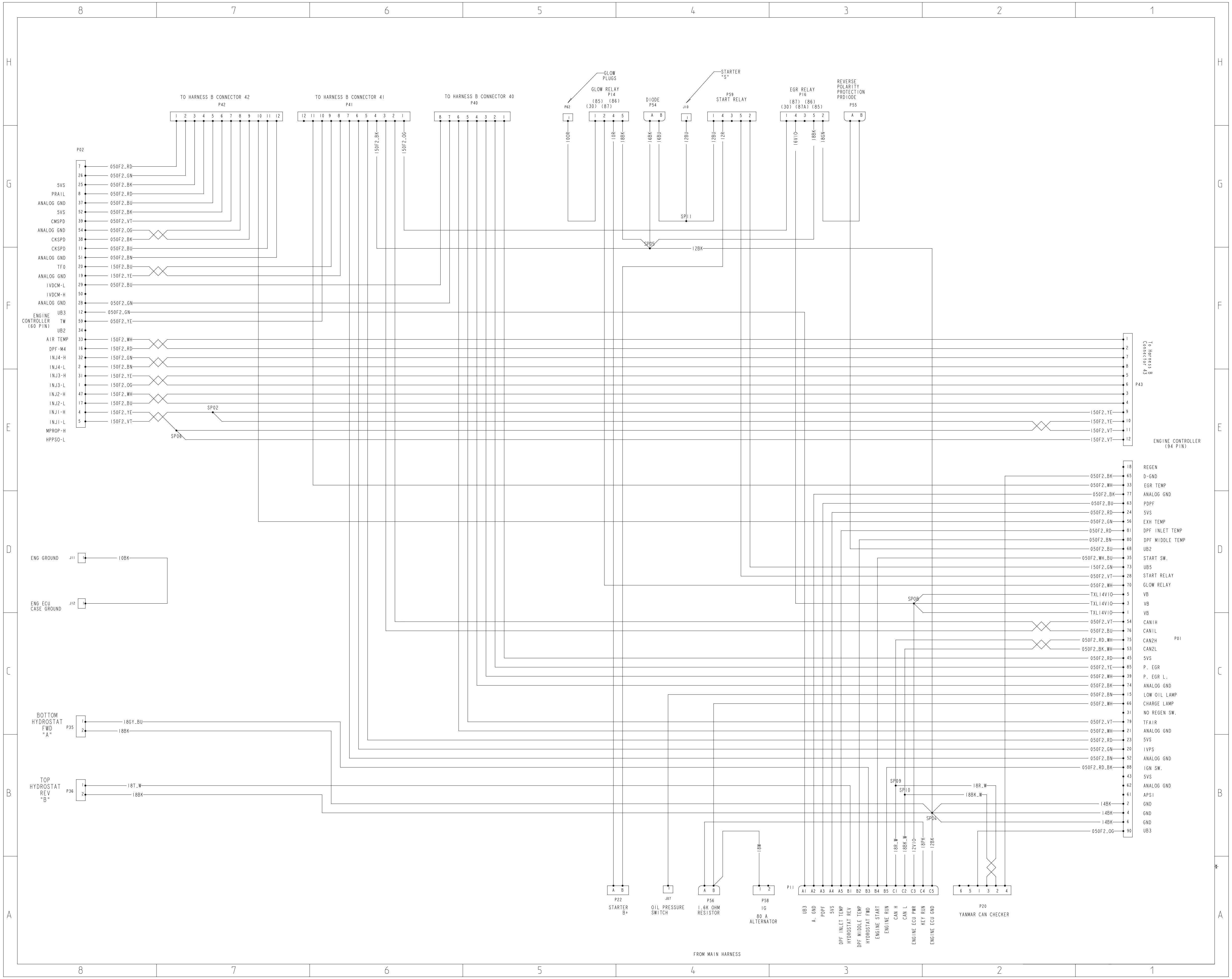


g299993

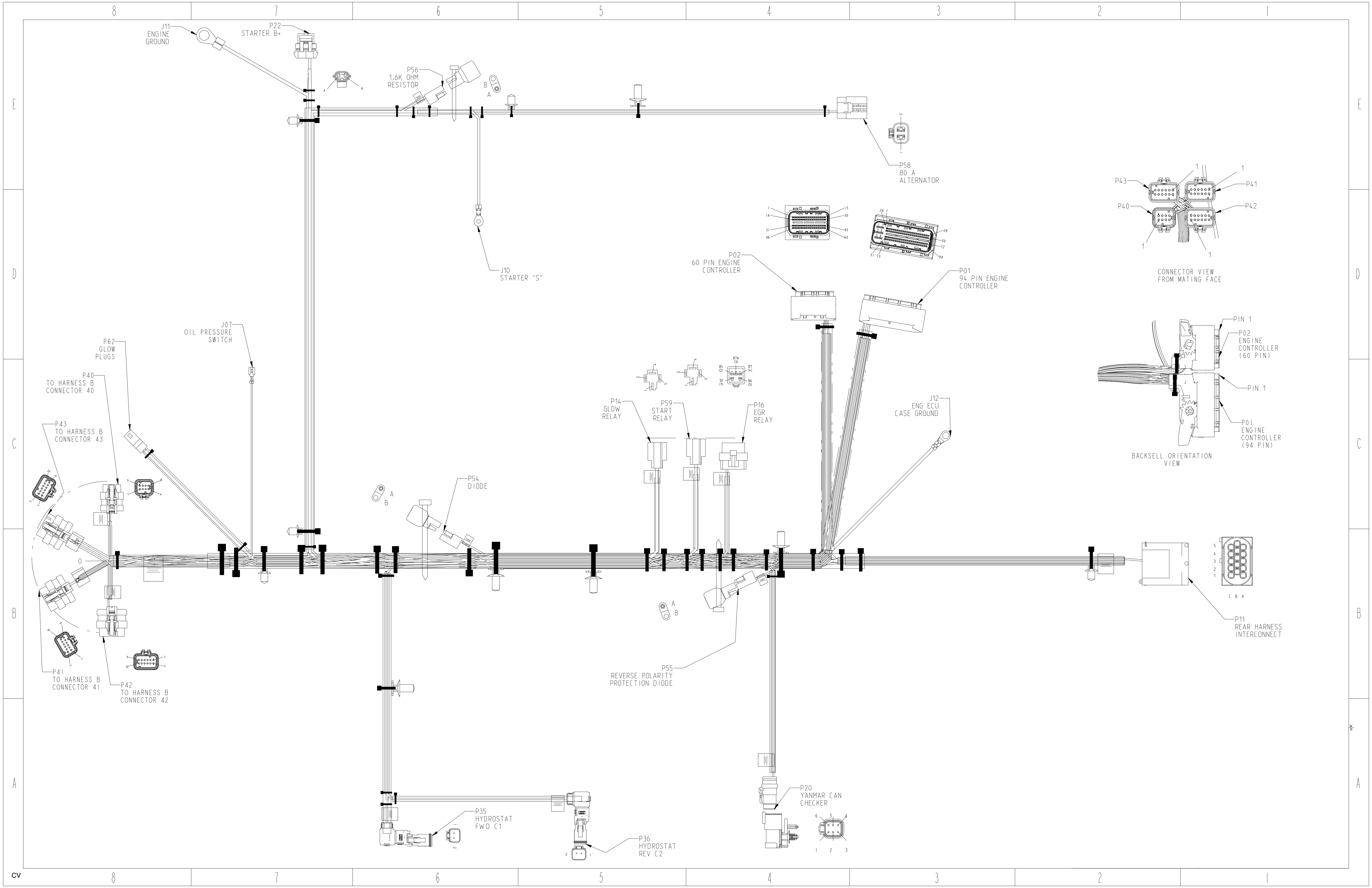

J11
ENGINE
GROUND
P22
STARTER B+
P56
1.6K OHM
RESISTOR
P58
80 A
ALTERNATOR
J10
STARTER "S"
P02
60 PIN ENGINE
CONTROLLER
P01
94 PIN ENGINE
CONTROLLER
P43
P41
P40
P42
CONNECTOR VIEW
FROM MATING FACE
PIN 1
P02
ENGINE
CONTROLLER
(60 PIN)
PIN 1
P01
ENGINE
CONTROLLER
(94 PIN)
BACKSELL ORIENTATION
VIEW
J07
OIL PRESSURE
SWITCH
P62
GLOW
PLUGS
P40
TO HARNESS B
CONNECTOR 40
P43
TO HARNESS B
CONNECTOR 43
P14
GLOW
RELAY
P59
START
RELAY
P16
EGR
RELAY
J12
ENGINE ECU
CASE GROUND
P54
DIODE
P11
REAR HARNESS
INTERCONNECT
P55
REVERSE POLARITY
PROTECTION PRDIODE
P41
TO HARNESS B
CONNECTOR 41
P42
TO HARNESS B
CONNECTOR 42
P35
BOTTOM
HYDROSTAT
FWD "A"
P36
TOP
HYDROSTAT
REV "B"
P20
YANMAR CAN
CHECKER
CV

g302386

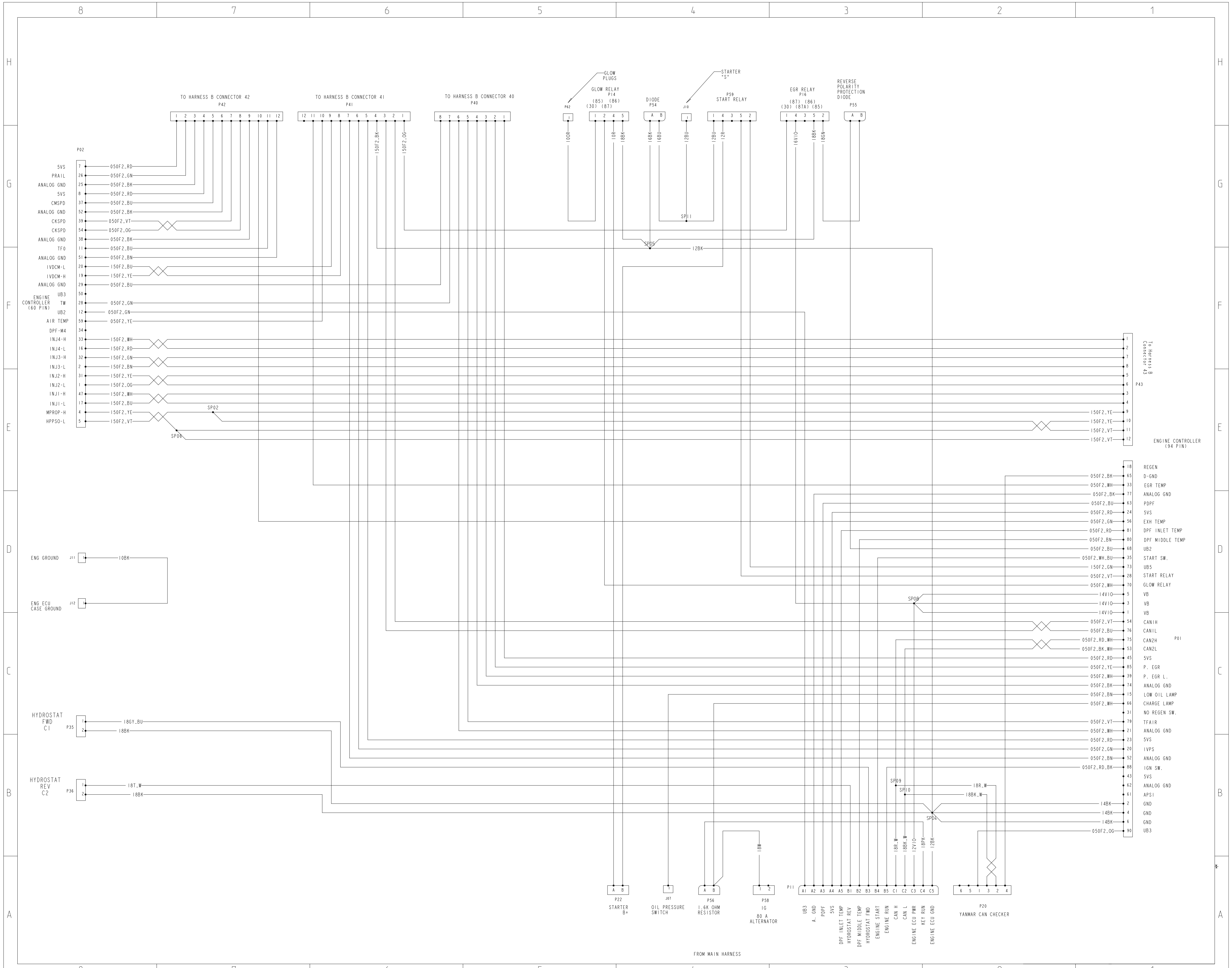
Engine Wire Harness Drawing (machine serial numbers 400000000 to 403450000)



Engine Wire Harness Drawing (machine serial numbers above 403450001)

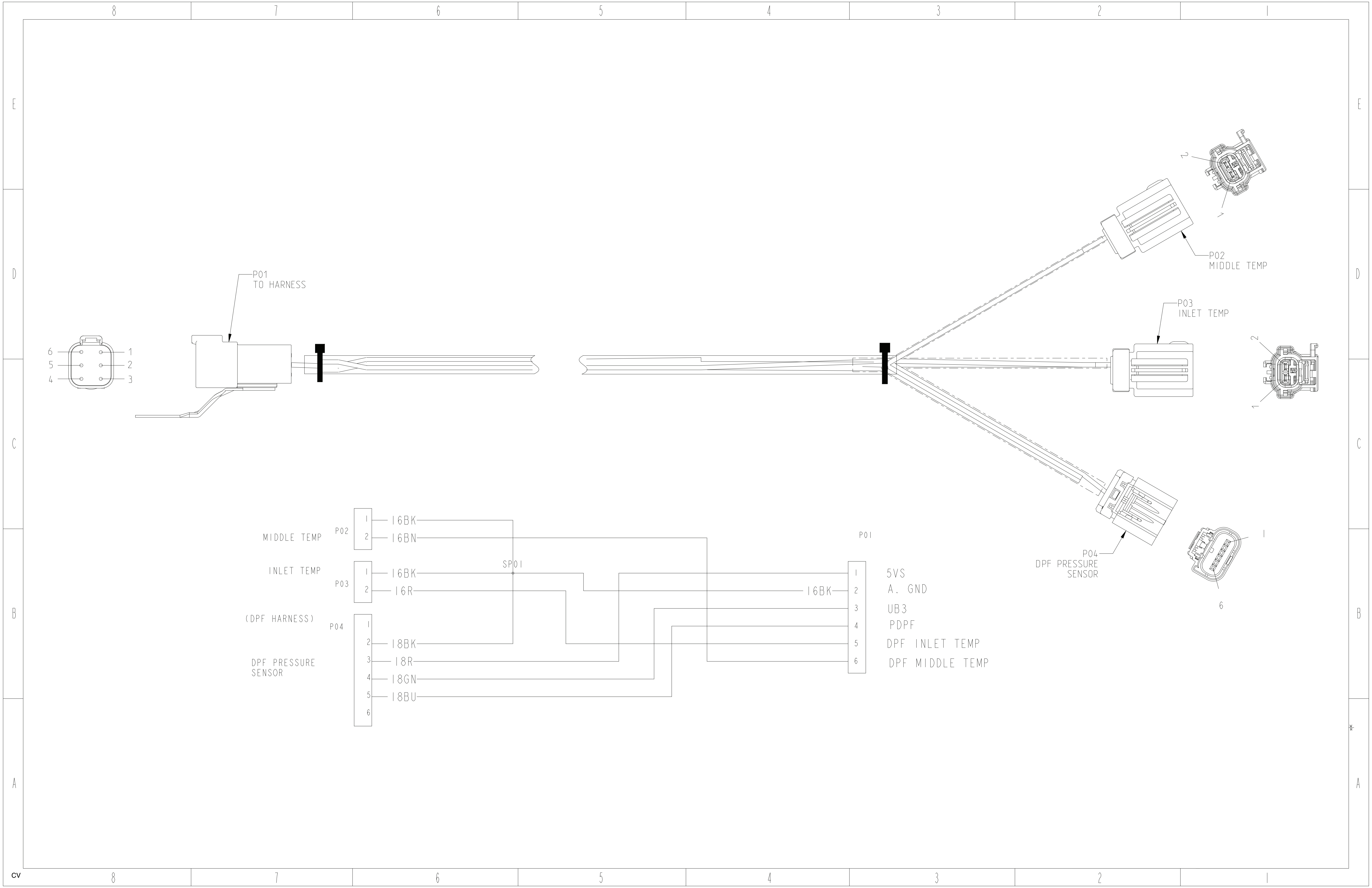


Engine Wire Harness Drawing (machine serial numbers above 403450001)



g302427

Engine DPF Wire Harness Drawing (machine serial numbers above 408000000)



CV
g362767

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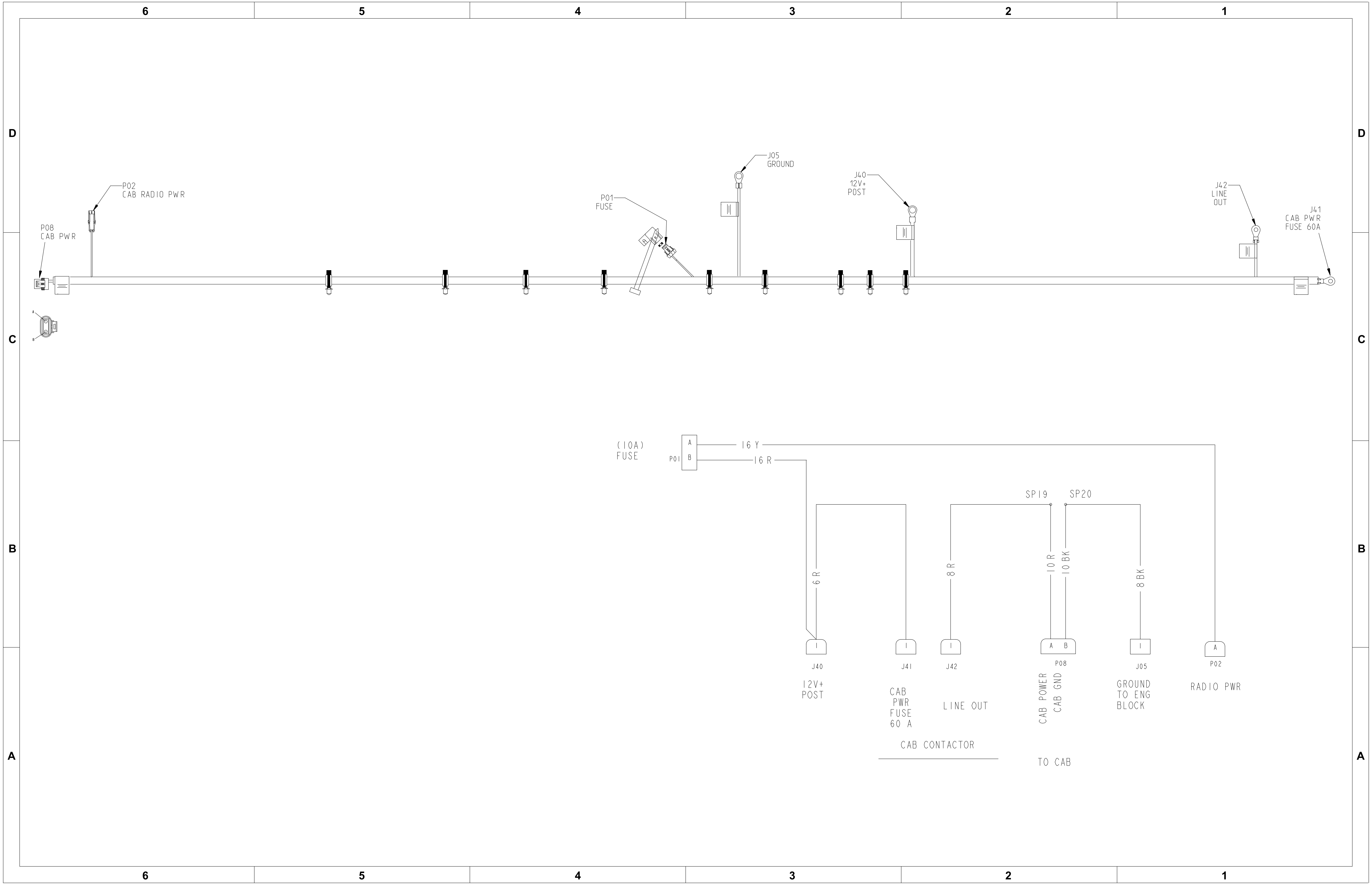
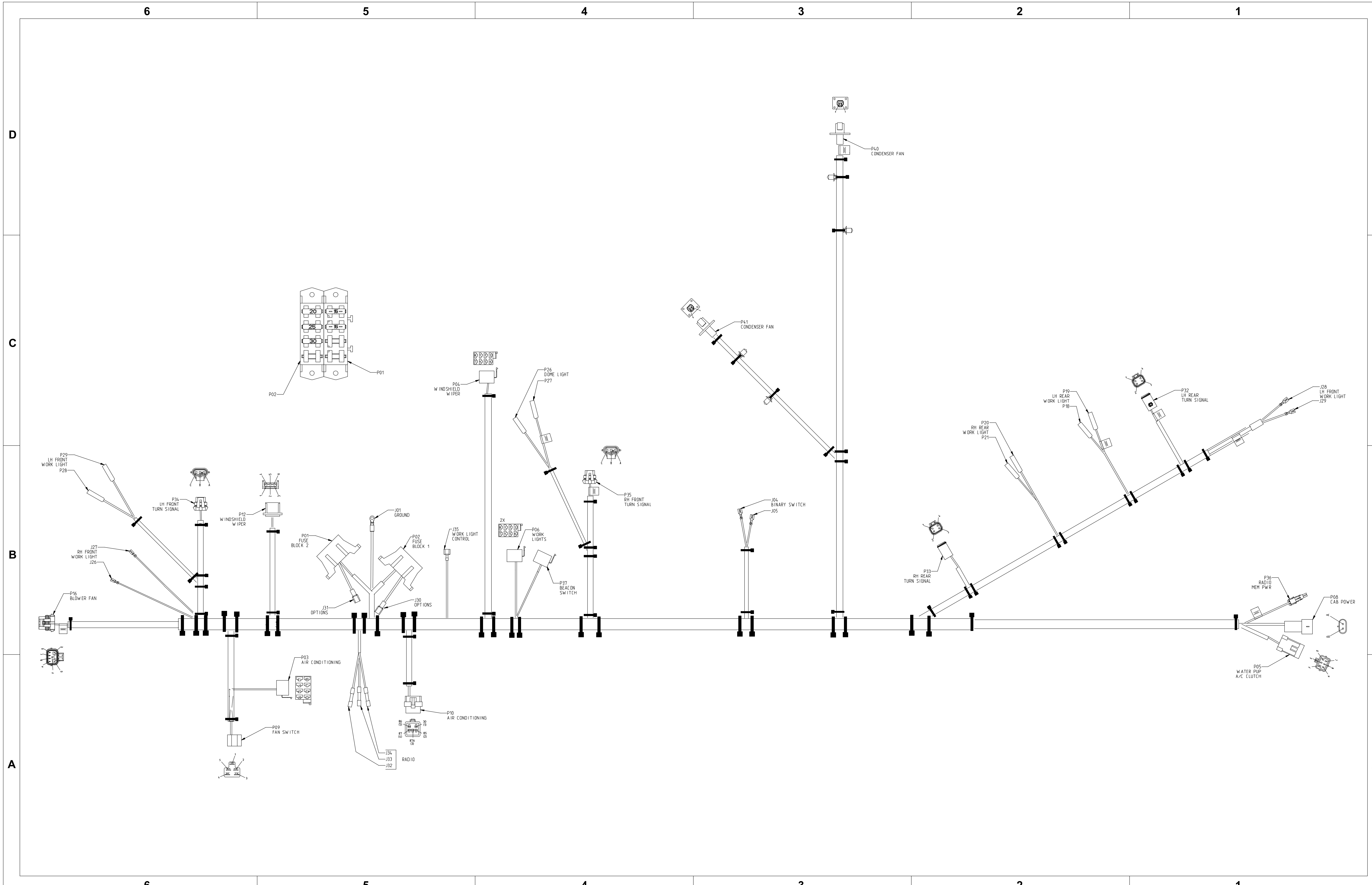
g326106

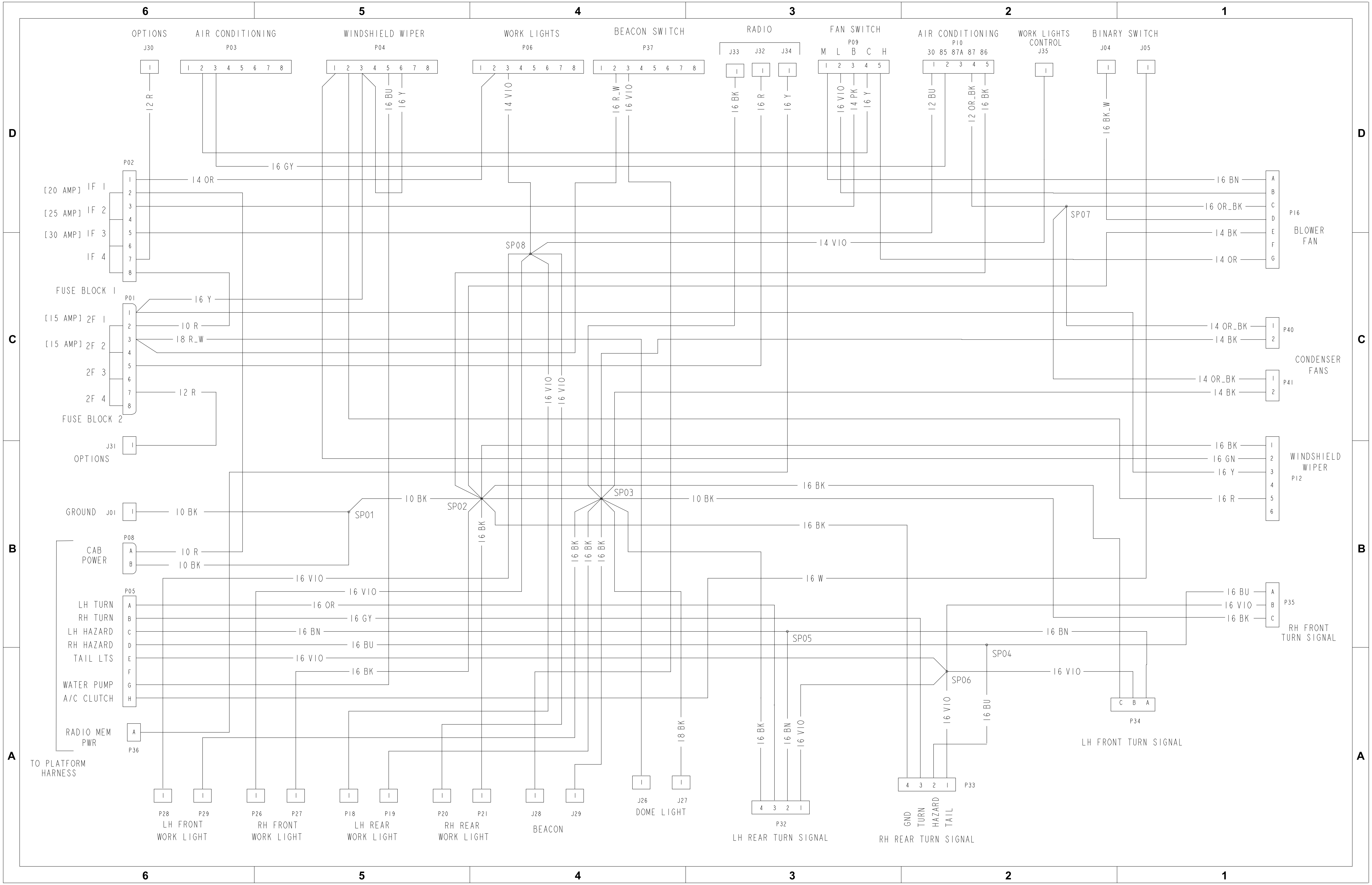
Cab Power Supply Wire Harness (Machine serial numbers below 316000200)



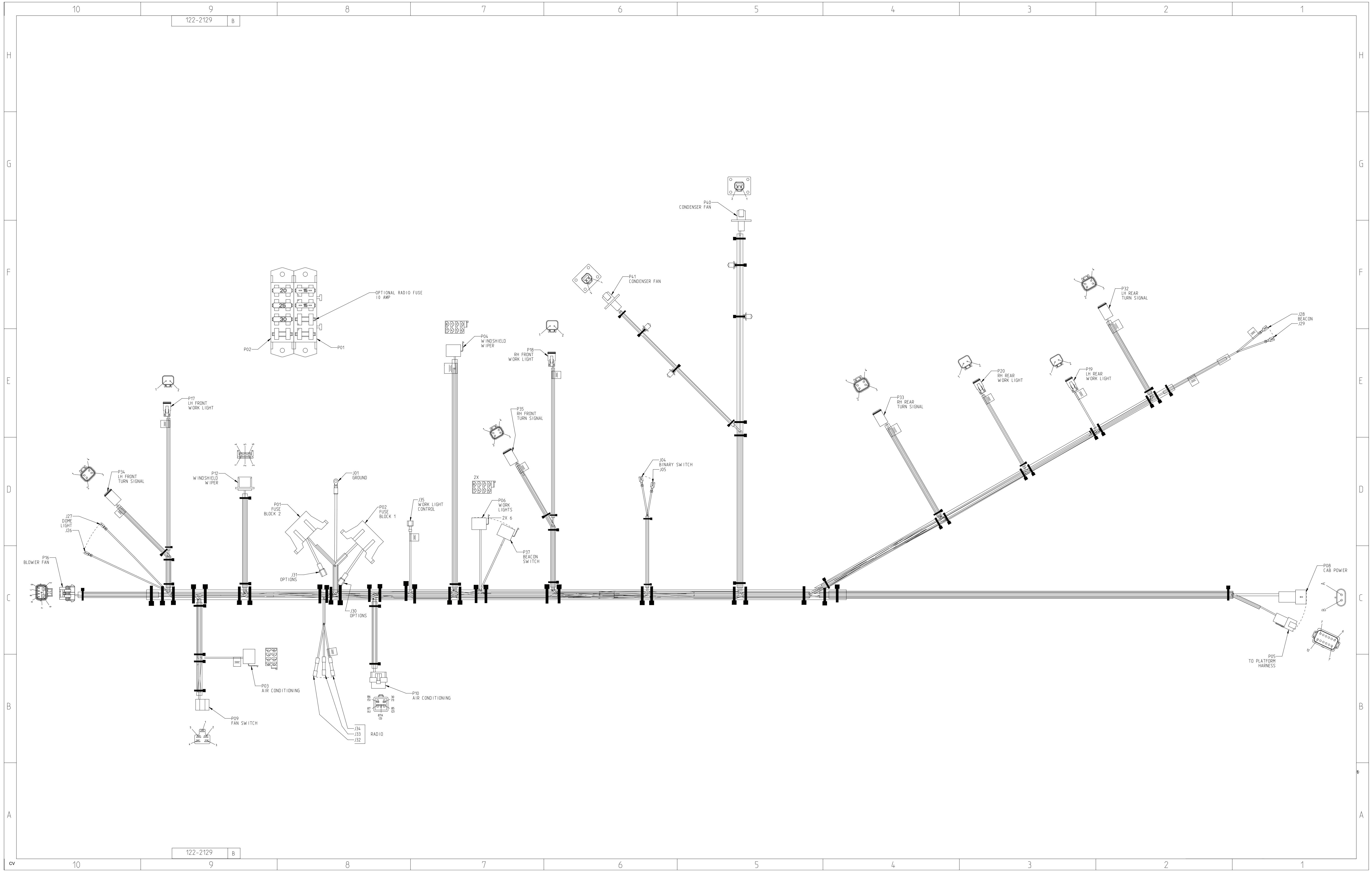
Cab Headliner Wire Harness Drawing (Machine serial numbers below 308000000)



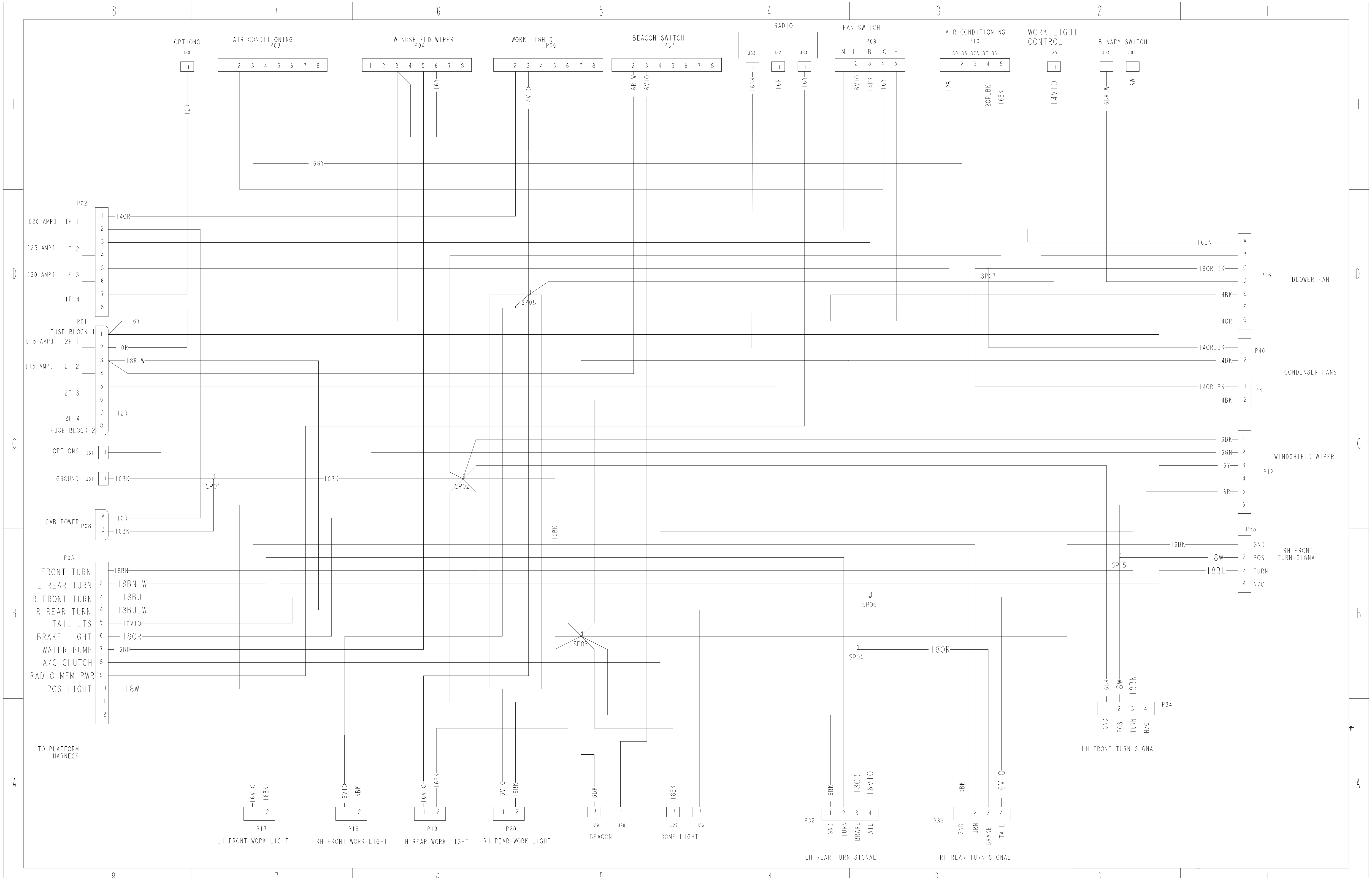
g299995


OPTIONS J30
AIR CONDITIONING P03
WINDSHIELD WIPER P04
WORK LIGHTS P06
BEACON SWITCH P37
RADIO J33 J32 J34
FAN SWITCH P09 M L B C H
AIR CONDITIONING P10 30 85 87A 87 86
WORK LIGHTS CONTROL J35
BINARY SWITCH J04 J05
FUSE BLOCK 1
[20 AMP] 1F 1
[25 AMP] 1F 2
[30 AMP] 1F 3
1F 4
FUSE BLOCK 2
[15 AMP] 2F 1
[15 AMP] 2F 2
2F 3
2F 4
OPTIONS J31
GROUND J01
CAB POWER P08
LH TURN
RH TURN
LH HAZARD
RH HAZARD
TAIL LTS
WATER PUMP
A/C CLUTCH
RADIO MEM PWR P36
TO PLATFORM HARNESS
BLOWER FAN P16
CONDENSER FANS P40 P41
WINDSHIELD WIPER P12
RH FRONT TURN SIGNAL P35
LH FRONT TURN SIGNAL P34
SP01 SP02 SP03 SP04 SP05 SP06 SP07 SP08
LH FRONT WORK LIGHT P28 P29
RH FRONT WORK LIGHT P26 P27
LH REAR WORK LIGHT P18 P19
RH REAR WORK LIGHT P20 P21
BEACON J28 J29
DOME LIGHT J26 J27
LH REAR TURN SIGNAL P32
RH REAR TURN SIGNAL P33
GND TURN HAZARD TAIL
g299996

Cab Headliner Wire Harness Drawing (Machine serial numbers above 308000000)

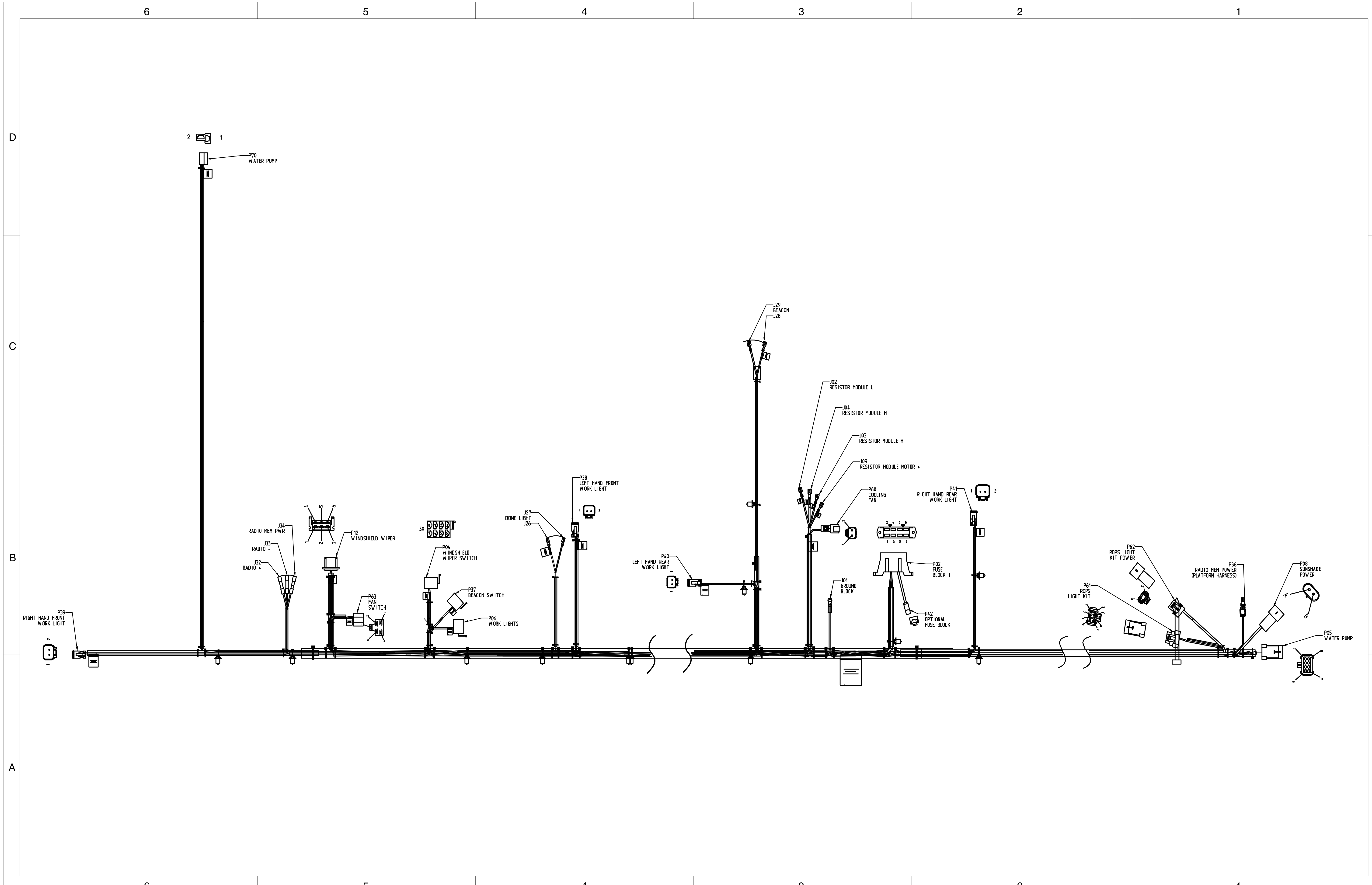


Cab Headliner Wire Harness Diagram (Machine serial numbers above 308000000)

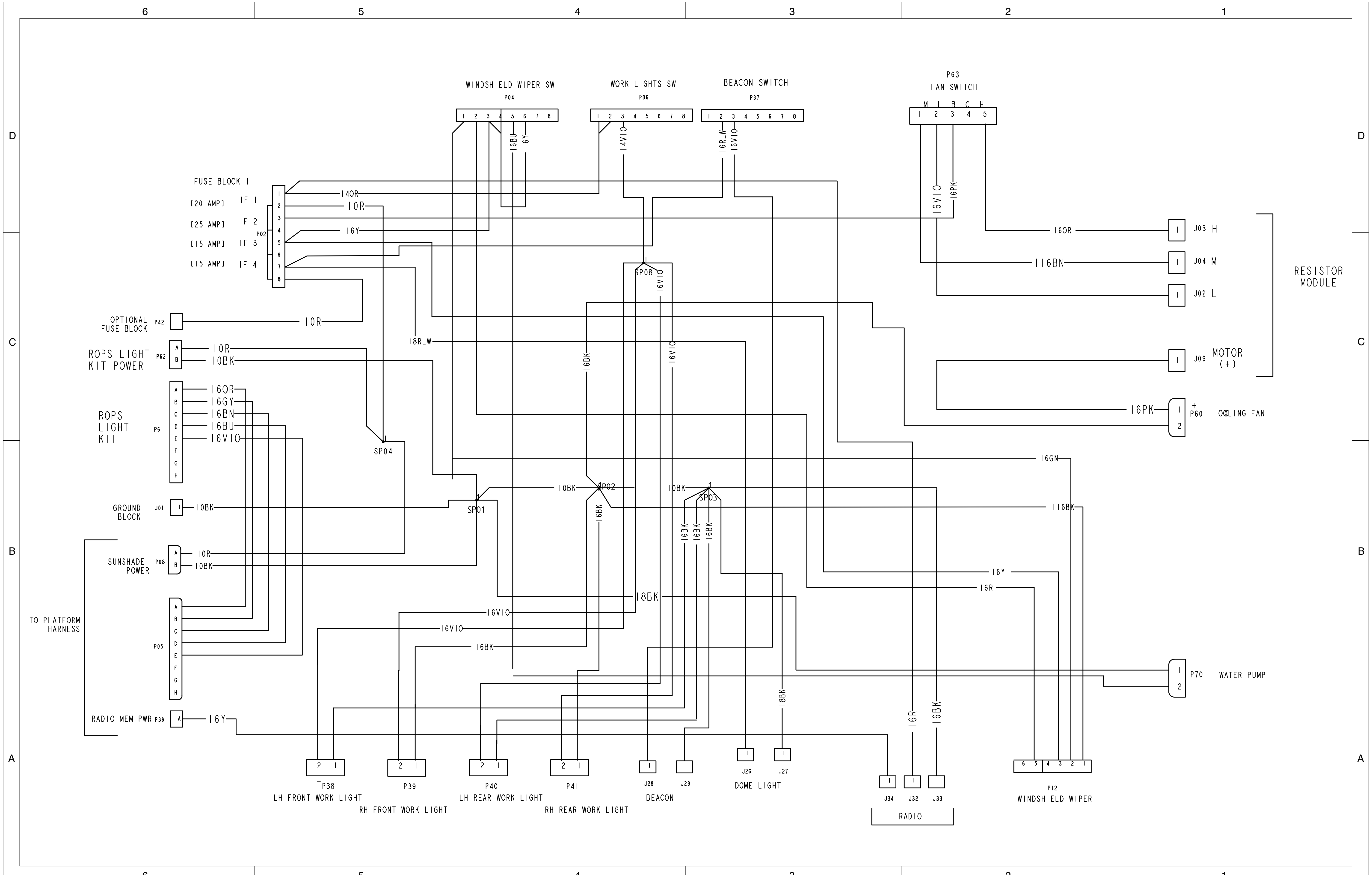


g362775

Wire Harness Diagram − Two−Post ROPS Extension



g299997


WINDSHIELD WIPER SW
P04
WORK LIGHTS SW
P06
BEACON SWITCH
P37
P63
FAN SWITCH
M L B C H
FUSE BLOCK 1
[20 AMP] 1F 1
[25 AMP] 1F 2
[15 AMP] 1F 3
[15 AMP] 1F 4
P02
OPTIONAL FUSE BLOCK
P42
ROPS LIGHT KIT POWER
P62
ROPS LIGHT KIT
P61
GROUND BLOCK
J01
SUNSHADE POWER
P08
TO PLATFORM HARNESS
P05
RADIO MEM PWR
P36
SP01
SP02
SP03
SP04
SP08
J03 H
J04 M
J02 L
J09 MOTOR (+)
RESISTOR MODULE
P60 COOLING FAN
P70 WATER PUMP
P38
LH FRONT WORK LIGHT
P39
RH FRONT WORK LIGHT
P40
LH REAR WORK LIGHT
P41
RH REAR WORK LIGHT
J28
J29
BEACON
J26
J27
DOME LIGHT
J34
J32
J33
RADIO
P12
WINDSHIELD WIPER
g299998

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