Form No. 18234SL Rev F

Count on it.

Service Manual

Outcross 9060

Models 07511AA/BA/CA/DA

Revision History

Revision	Date	Description
A	10/2018	Initial Release
B	11/2018	Parker hydraulic valve service information
C	9/2020	TEC connector torque, 3–point hitch position sensor alignment procedure
D	07/2021	Updated Hydraulic, Electrical and Traction and PTO Drive chapters.
E	08/2022	Updated the axle motor and hydraulic brake procedures, and the Traction and PTO Drive chapter for the axle-drive gearbox.
F	07/2023	Updated removing and installing the engine, PTO gearbox, and tandem piston (traction) pump; traction and hitch circuit diagrams; traction and steering/hitch testing; removing/installing the tandem piston (traction) pump; removing and installing the front steering cylinder; InfoCenter display; speed sensor figures; traction pressure sensor figures; removing the front PTO gearbox, PTO clutch service, servicing the PTO driveshaft; removing and installing the air-conditioning compressor, servicing the air conditioning system after a catastrophic compressor failure; removing the operator's platform or cab and installing the operator's platform or cab; removing the steering wheel, instrument panels and dash cover and installing the steering wheel, instrument panels and dash cover; removing the windshield and installing the windshield; disassembling the door and assembling the door; and hydraulic schematics.

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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Preface

The purpose of this publication is to provide the service technician with information for troubleshooting, testing, and repairing the major systems and components of the Outcross 9060 traction unit (Model No. 07511AA, 07511BA, 07511CA, and 07511DA).

Refer to the traction unit *Operator's Manual* and accessory *Installation Instructions* for installation, operation, maintenance, and adjustment information. Keep a copy of the *Operator's Manuals*, accessory *Installation Instructions* and *Parts Catalogs* for your machine and its accessories with this *Service Manual* for reference. Additional copies of the *Operator's Manuals*, *Installation Instructions*, *Parts Catalogs*, and this *Service Manual* 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** provides additional information about the correct operation, maintenance, service, testing, or repair of the machine.

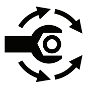
Service Procedure Icons

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

Critical Process

This icon highlights the following information:

- 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 highlights an assembly torque requirement that is different than what is recommended in the Standard Torque Tables; refer to Standard Torque for Dry, Zinc Plated, and Steel Fasteners (Inch Series) (page 2–9) or Standard Torque for Dry, Zinc Plated, and Steel Fasteners (Metric Fasteners) (page 2–10).

Fluid Specifications

This icon highlights fluid specifications and capacities that are less common, and may not appear on the machine service decal or in the machine *Operator's Manual* or accessory *Installation Instructions*.

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

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Additional Reference Materials

Yanmar TNV (Tier 4) Series Service Manual

Yanmar Tier 4 and Stage V TNV Troubleshooting Manual

Danfoss H1 Closed Circuit Axial Piston Pumps Service Manual

Danfoss H1 Closed Circuit Axial Piston Pumps Repair Instructions

Danfoss K and L Frame Variable Motors Service Manual

Danfoss Steering Unit Type OSPB, OSPC and OSPF Service Manual

Gresen/Parker Hydraulics Model V10 Sectional Body Directional Control Valve Service Manual

Carraro DriveTech Model 26.09M Axle Repair Manual

Sanden SD Compressor Service Guide

Safety

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Safety Instructions

The Outcross 9060 machine is tested and certified by Toro for compliance with existing safety standards and specifications. Although hazard control and accident prevention are partially dependent upon the design and configuration of the machine, hazard control and accident prevention are also dependent upon the awareness, concern and proper training of the personnel involved in the operation, transport, maintenance, and storage of the machine. Improper use or maintenance of the machine can result in injury or death. To reduce the potential for injury or death, comply with the following safety instructions.

WARNING

To reduce the potential of injury or death, comply with the following safety instructions as well as information found in the traction unit *Operator's Manual*, accessory *Installation Instructions*, and the *Operator and Safety Training Videos* found on www.toro.com.

Supervisor's Responsibilities

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

Before Operating the Machine

- Review and understand the contents of the traction unit *Operator's Manual*, all operating and safety decals on the machine, and any operation information found in the *Installation Instructions* for accessories that are installed on the machine. Additional copies of the traction unit *Operator's Manual* and accessory *Installation Instructions* are available at www.toro.com.
- View and understand the *Operator and Safety Training Videos* found at www.toro.com.
- Never allow children to operate the machine. Never allow adults to operate the machine without proper instructions.
- Become familiar with the controls and know how to stop the machine and engine quickly.
- Keep all the shields, safety devices, and decals in place. If a shield, safety device, or decal is illegible or damaged, repair or replace it before operating the machine.
- Always wear substantial shoes. Do not operate machine while wearing sandals, tennis shoes or sneakers. Do not wear loose fitting clothing which could get caught in moving parts and cause personal injury.
- Wearing safety glasses, safety shoes, long pants and a helmet is advisable and required by some local safety and insurance regulations.
- Make sure work area is clear of objects which might be picked up and thrown by the attachments.
- Keep everyone, especially children and pets, away from the area of operation.
- Ensure the safety interlocks are functioning properly. Adjust or replace any malfunctioning switches or interlock mechanisms before operating the machine. Refer to Checking the Operation of the Interlock Switches (page 6–13) for additional information.
- Diesel fuel is highly flammable; handle it carefully.
  - Store fuel in containers specifically designed for storing fuel.
  - Do not remove the fuel tank cap of the machine while the engine is hot or running.
  - Do not smoke while handling fuel.
  - Fill the fuel tank outdoors and only to a level within an inch of the top of the tank, not the filler neck. Do not overfill the fuel tank.
  - Replace the fuel tank and fuel container caps securely after refueling the machine.
  - If you spill fuel, do not attempt to start the engine but move the machine away from the spill. Avoid creating any source of ignition until fuel vapors have dissipated. Wipe up any spilled fuel.

Operating the Machine

⚠ DANGER ⚠

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

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

Note: Operator advisories are automatically displayed by the InfoCenter when a machine function is prevented, and additional action is required. Typically, an advisory can be eliminated with a change in machine controls by the operator. Refer to Operator Advisories (page 3–3) for additional information.

1. Sit on the operator seat when starting the machine.
2. To start the engine:
   A. Disengage the PTO (switch in down position)
   B. Move the transmission shift lever to the NEUTRAL position.
   C. Ensure that the auxiliary hydraulic lever is in the center position.
   D. Set the ignition key to the RUN position.
   E. Engage the parking brake (switch illuminated).
   F. Keep your foot off the accelerator pedal.
   G. Turn the ignition key to the START position and hold until the engine starts (no longer than 20 seconds).
3. Using the machine demands operator attention. To prevent loss of machine control:
   A. Operate machine attachments only in daylight or when there is good artificial light.
   B. Watch for holes or other hidden hazards.
   C. Do not drive close to sand traps, ditches, creeks, or other hazards.
   D. Traverse slopes carefully. Do not start or stop suddenly when traveling uphill or downhill.
   E. Reduce speed when making sharp turns. Avoid sudden stops and starts.
   F. Before backing up, look to the rear to be sure no one is behind the machine.
   G. Watch out for traffic when near or crossing roads. Always yield the right-of-way.
   H. Depress the decelerator pedal when going downhill to keep forward speed slow and to maintain control of the machine.
4. Keep hands, feet, and clothing away from moving parts and the discharge area of an attachment.
5. Raise the attachments when driving from one work area to another.
6. Do not touch the engine, muffler, or exhaust pipe while the engine is running or soon after it is stopped because these areas could be hot enough to cause burns.
7. If an attachment strikes a solid object or vibrates abnormally, stop immediately, turn the engine off, wait for all motion to stop and inspect for damage. A damaged attachment must be repaired or replaced before operation is continued.
8. **DON'T TAKE AN INJURY RISK!** When a person or pet appears unexpectedly in or near the area while operating an attachment, **STOP**.

Operating the Machine (continued)

Careless operation, combined with terrain angles, ricochets, or improperly positioned guards can lead to thrown object injuries. Do not resume operation until the area is cleared.

9. Before getting off the seat:

   A. Make sure any attachments are shut off.

IMPORTANT

When an attachment is lowered to the ground, the pressure in the hydraulic lift circuit is released and accidentally lowering the attachment is avoided.

   B. Lower any attachments to the ground.

   C. Set the parking brake if the engine will be left running or stop the engine and remove the key from key switch.

10. When using the optional InchMode feature:

   A. Keep bystanders away from the machine.

   B. Use the InchMode feature only on a level surface.

   C. While moving the machine, do not stand in front of or behind the machine.

Maintenance and Service

The maintenance procedures and recommended service intervals for your machine are covered in the traction unit *Operator's Manual* and accessory *Installation Instructions*. Refer to this publication when performing regular equipment maintenance. Several maintenance procedures have break-in intervals identified in the traction unit *Operator's Manual* and accessory *Installation Instructions*. Refer to the *Engine Operator's Manual* for additional engine specific maintenance procedures.

- Before servicing or making any adjustments to the machine, lower any attachments, shut off the engine, and remove the key from the key switch.
- Ensure that the machine is in safe operating condition by keeping all the nuts, bolts, and screws tight.
- Ensure that all hydraulic line connectors are tight and that all the hydraulic hoses and lines are in good condition before applying pressure to the hydraulic system.
- Use eye protection when working on the hydraulic system and its components.
- Keep your body and hands away from pin-hole leaks in the hydraulic lines that eject hydraulic fluid under high pressure. Use cardboard or paper to find hydraulic leaks. The hydraulic fluid escaping under pressure can penetrate the skin and cause injury. If hydraulic fluid is accidentally injected into the skin, you must have it surgically removed within a few hours by a doctor familiar with this type of injury. Otherwise, gangrene may result.
- Before disconnecting or performing any work on the hydraulic system, release all the pressure in the system by parking the machine on a level surface, lowering the cutting deck (or implement) completely, and then shutting off the engine.
- To reduce potential fire hazards, keep the engine area free of excessive grease, grass, leaves, and dirt. Clean the protective screen on the machine frequently.
- Check all fuel lines for tightness and wear on a regular basis. Tighten or repair fuel lines as needed.
- If you must run the engine to perform maintenance or to make an adjustment, keep your hands, feet, clothing, and other parts of the body away from any attachments and other moving parts. Keep bystanders away.
- Shut off the engine before checking or adding oil to the engine crankcase.
- Disconnect the battery before servicing the machine. Disconnect the negative battery cable and then the positive cable. If battery voltage is necessary for troubleshooting or test procedures, temporarily connect the battery. Connect the positive battery cable and then the negative cable.
- Battery acid is poisonous and can cause burns. Avoid acid contact with skin, eyes, and clothing. Protect your face, eyes, and clothing when working with a battery.
- Battery gases can explode. Keep cigarettes, sparks, and flames away from the battery.
- If it is necessary to lift the machine to perform a service procedure; refer to Jacking Instructions (page 1–8).
- Before performing any welding on the machine, turn the key switch to the OFF position. To prevent damage to the machine electrical system, disconnect the ground (-) cable to the frame when welding on the frame or disconnect the ground (-) cable to the operator platform when welding on the operator platform.
- If major repairs are necessary, contact your Authorized Toro Distributor.

Maintenance and Service (continued)

- Ensure to dispose of potentially harmful waste (e.g., fuel, oil, engine coolant, filters, battery) in an environmentally safe manner. Follow all local codes and regulations when recycling or disposing of waste.
- At the time of manufacture, the machine conformed to Machinery Directive 2006/42/EC, Electromagnetic Compatibility (EMC) Directive 2014/30/EU, and ISO standards for power, mass, vibration, and sound. To ensure the optimum performance and continued safety certification of the machine, use genuine Toro replacement parts and accessories. The replacement parts and accessories of other manufacturers can result in non-conformance with the safety standards and can void the warranty.

Jacking Instructions

⚠ CAUTION ⚠

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

Approximate weights:

- **Base model = 2,340 kg (5,160 lbs)**
- **Cab model = 2,640 kg (5,820 lbs)**

When changing the attachments, tires, or performing other service:

- **Before you lift the machine, remove all the attachments that may interfere with the safe and correct lift of the machine. Remove the front loader attachment and counterweight if equipped.**
- **Park the machine on a solid level surface, such as a concrete floor.**
- **Always block the wheels with chocks.**
- **Use the correct blocks, hoists, and jacks to lift the machine.**
- **Use the appropriate jack stands to support the raised machine.**
- **Do Not use an attachment as a jacking point.**

Raising the Front of the Machine

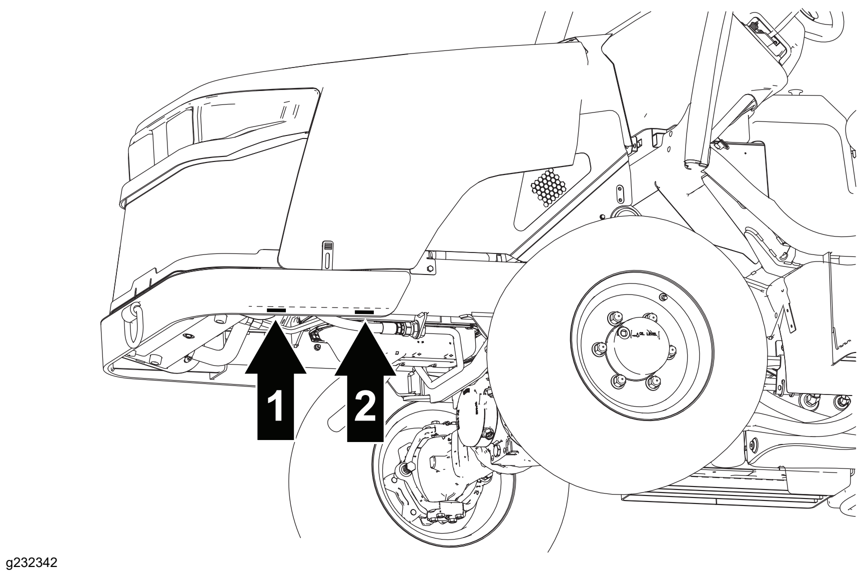

Figure 1

1. Front jack point (frame channel behind side plate)
2. Front jack-stand point (frame channel behind side plate)

1. Block the 2 rear wheels with chocks to prevent the machine from moving.
2. Position the jack securely under the desired front jacking point.
3. After raising the front of the machine, use an appropriate jack stand under the vehicle frame to support the machine.

Raising the Rear of the Machine

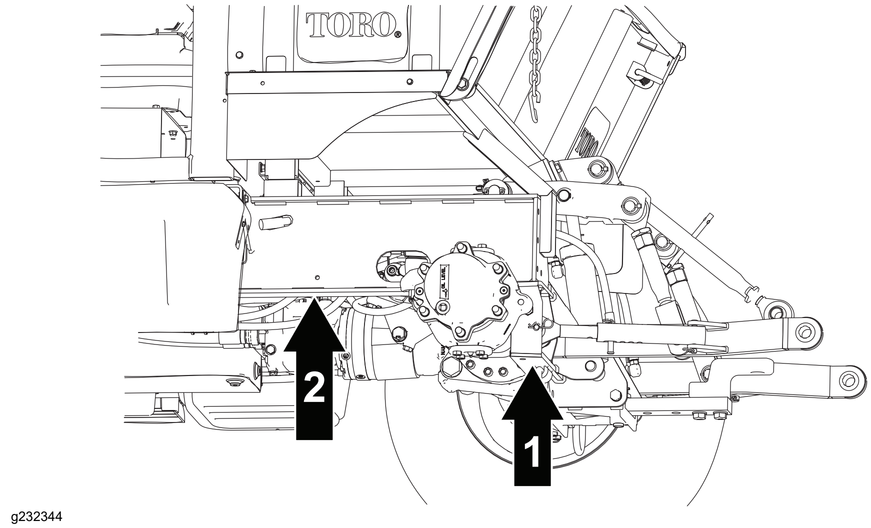

Figure 2

1. Rear jack point
2. Rear jack-stand point (frame channel)

1. Block the 2 front wheels with chocks to prevent the machine from moving.
2. Position the jack securely under the desired rear jacking point.
3. After raising the rear of the machine, use an appropriate jack stand under the vehicle frame to support the machine.

Safety and Instructional Decals

Numerous safety and instruction decals are affixed to the traction unit and attachments of your Outcross 9060 machine. If any decal becomes illegible or damaged, install a new decal. Decal part numbers are listed in the *Parts Catalog*, traction unit *Operator's Manual*, and accessory *Installation Instructions*. Order replacement decals from an Authorized Toro Distributor.

Specifications and Maintenance

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Specifications

Overall Dimensions

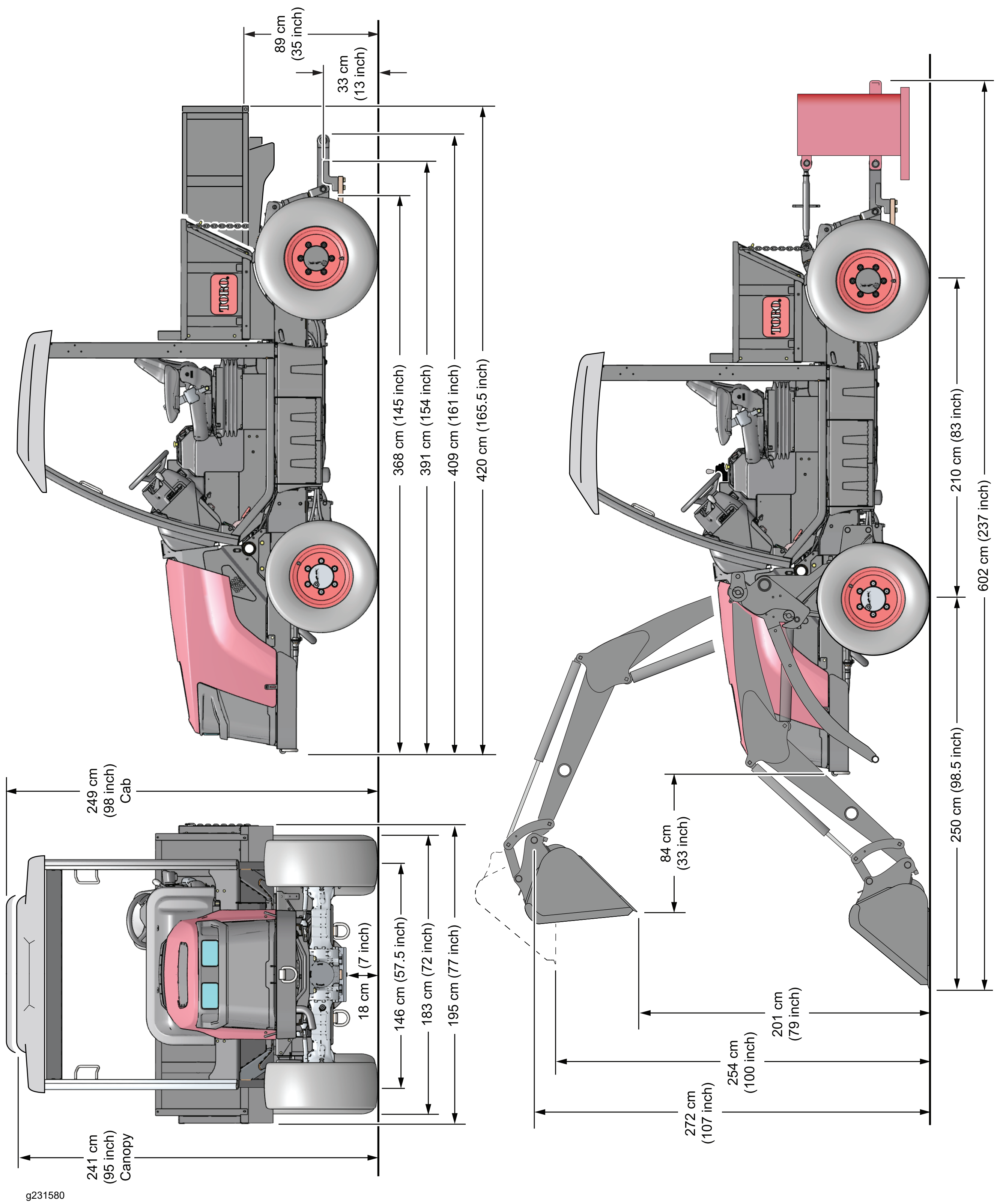


Figure 3

Outcross 9060

Traction Unit

Item	Description
Weight	
Model 07511AA (base model)	2,340 kg (5,160 lb)
Model 07511BA (base model with front loader*)	2,680 kg (5,910 lb)
Model 07511CA (cab model)	2,640 kg (5,820 lb)
Model 07511DA (cab model with front loader*)	2,980 kg (6,570 lb)

*Front loader attachment (bucket) and rear counterweight not included

Engine

Item	Description
Make/Designation	Yanmar 4TNV86CT-DTR2: 4−Cycle, 4 Cylinder, Water Cooled, Turbocharged, EPA Tier 4 compliant Diesel
Bore	86 mm (3.38 inches)
Stroke	90 mm (3.54 inches)
Total displacement	2,090 cm^3 (127.5 in^3)
Firing order	1 (closest to the flywheel end) - 3 - 4 (farthest from flywheel) - 2
Direction of rotation	Counterclockwise (viewed from the flywheel)
Fuel	Diesel or Biodiesel fuel (up to B20) with ultra-low sulfur content
Fuel tank capacity	53.4 L (14.1 US gallons)
Fuel pump	Yanmar electric supply pump
Fuel injection type	Common rail system (EPA Tier 4 certified)
Governor	Electronic All Speed
Low idle (no load)	1,200 +/- 100 rpm
ECO mode (no load)	2,300 +/- 100 rpm
High idle (no load)	3,000 +/- 100 rpm
Engine oil	API CJ-4, ACEA E-6, JASO DH-2
Engine-oil viscosity	Refer to the *Operator's Manual*
Crankcase-oil capacity	5.7 L (6 US qt)
Oil pump	Yanmar trochoid pump
Coolant capacity	without Operator cab 7.6 L (8 US qt) with Operator cab 8.5 L (9 US qt)
Alternator/Regulator	12 VDC, 55 A
Engine weight (dry)	225 kg (496 lb)

Hydraulic System

Item	Description
Piston (traction) pump (P1 and P2)	Danfoss tandem variable displacement axial piston pump
Maximum pump displacement (per pump)	37.8 cc (2.31 in³/rev) per revolution
Gear pump	Casappa 2 section, positive displacement gear type pump
Front section (P3) displacement	16.9 cc (1.03 in³) per revolution
Rear Section (P4) displacement	11 cc (0.67 in³) per revolution
Axle drive motors	Danfoss positive displacement, 2 position, axial piston motor with loop flushing valve
Displacement (per revolution)	38 cc (2.32 in³) maximum / 18.5 cc (1.13 in³) minimum
Steering valve	Danfoss Steering Unit Type OSPC load sensing distributor valve with rotary meter
Relief Pressures	
Traction circuit	Forward = 33,095 kPa (4,800 psi)
	Reverse = 33,095 kPa (4,800 psi)
Charge circuit	1,999 kPa (290 psi)
Steering (RV1)	20,684 kPa (3,000 psi)
Hitch lift (RV2)	20,684 kPa (3,000 psi)
Auxiliary load valve	20,684 kPa (3,000 psi)
Hydraulic filter	Spin-on cartridge type
Hydraulic fluid	Refer to the traction unit *Operator's Manual*
Hydraulic tank capacity	48 L (12.75 gallons)

Traction and PTO Drive

Item	Description
Tires	
Front	Turf Tread 29 x 12.5–15, 6 ply—151 to 165 kPa (22 to 24 psi)
	Turf Tread 29 x 12.5–15, 12 ply—413 to 448 kPa (60 to 65 psi)
Rear	Turf Tread 32 x 16–15, 6 ply—151 to 165 kPa (22 to 24 psi)
Wheel lug nut torque	380 to 434 N·m (280 to 320 ft-lb)
Drive axle fluid capacity	
Wheel hub	0.4 L (0.4 US qt) Mobil 424® multipurpose tractor lubricant
Axle	9 L (9.5 US qt) Mobil 424 multipurpose tractor lubricant
Axle-drive gearboxes	Approximately 252 ml (8.5 oz) Mobil 424 multipurpose tractor lubricant
Rear PTO gearbox fluid capacity	1.4 L (1.5 US qt) Mobil 424 multipurpose tractor lubricant or equivalent
Brake Assembly fluid capacity	160 ml (5.4 ounces) Mobil 424 multipurpose tractor lubricant

Chassis

Item	Capacity/volume
Standard utility box	453 kg (1,000 lb), 0.6 cubic meters (0.8 cubic yards)
Cargo bed (optional)	2,041 kg (4,500 lb), 1 cubic meter (1.3 cubic yards)

Torque Specifications

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

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

As noted in the following tables, the torque values should be **reduced by 25% for lubricated fasteners or fasteners with a wet thread locking compound applied** 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

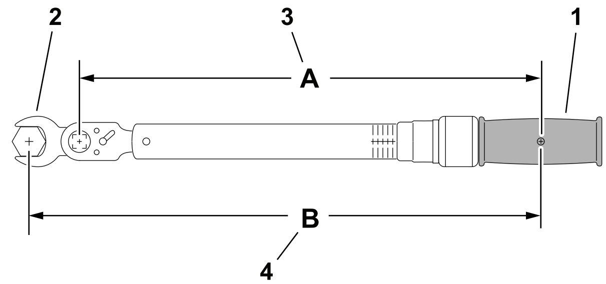


Figure 4

Torque Conversion Factor = A / B

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

Using a drive-adapter wrench (e.g., crowfoot wrench) in any position other than 90° and 270° to the frame of the torque wrench will affect the torque value measured by the torque wrench because of the effective length (lever) of the torque wrench changes. When using a torque wrench with a drive-adapter wrench, multiply the listed torque recommendation by the calculated torque conversion factor (Figure 4) to determine proper tightening torque. When using a torque wrench with a drive-adapter wrench, the calculated torque will be lower than the listed torque recommendation.

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

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

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

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

Identifying the Fastener

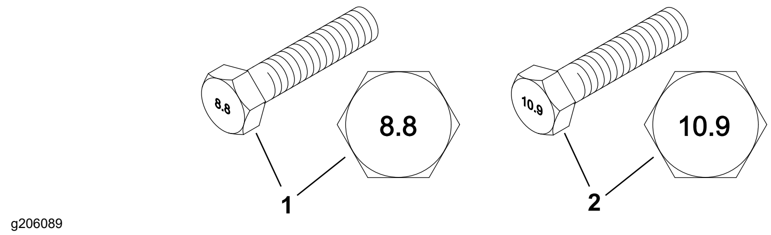


Figure 5

Metric Bolts and Screws

1. Class 8.8
2. Class 10.9

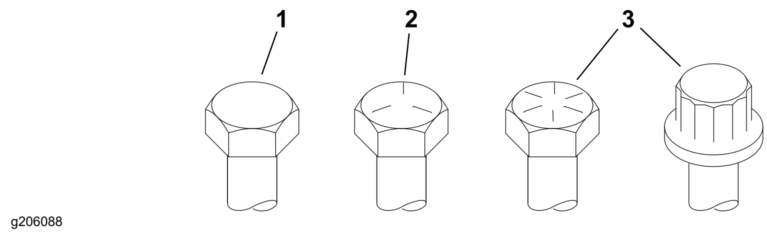


Figure 6

Inch Series Bolts and Screws

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

Fasteners with a Locking Feature

IMPORTANT

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

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

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

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

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

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

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

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

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

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

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

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

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

Other Torque Specifications

SAE Grade 8 Steel Set Screws

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

Thread Cutting Screws (Zinc Plated Steel)

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

Wheel Bolts and Lug Nuts

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

*For steel wheels and non-lubricated fasteners

Thread Cutting Screws (Zinc Plated Steel)

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

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

Conversion Factors

in-lb X 11.2985 = N·cm	N·cm X 0.08851 = in-lb
ft-lb X 1.3558 = N·m	N·m X 0.7376 = ft-lb

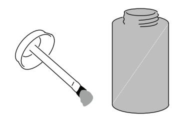
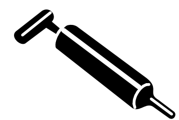
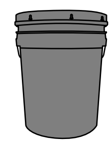
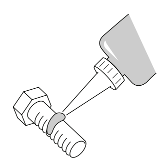
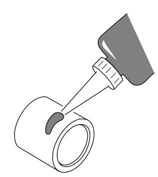
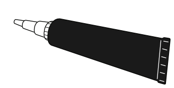
Shop Supplies

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.

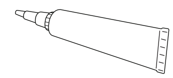
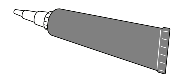
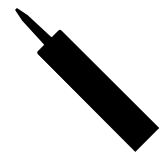
IMPORTANT

Always follow manufacturer's instructions when using or storing shop supplies.

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.	
O-ring Lubricant Use vanishing oil Toro part number 505-133 to lubricate O-rings prior to assembly.	
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 the compound can be applied after fastener installation. Most thread locking compounds allow the fastener to be removed with standard tools once cured. High strength thread locking compounds may require applying heat to the fastener and the surrounding area to allow fastener removal. **Note:** Some fasteners have a dry thread locking compound pre-applied (Patch-Loc) so no additional thread locking compound is necessary when installing a "new" fastener. These fasteners are designed to be removed and re-installed only once before applying additional thread locking compound is necessary.	
RETAINING COMPOUND (bearings and sleeves) An adhesive used to secure bearings, bushings, and cylindrical parts into housings or onto shafts. When cured, bearing and sleeve retaining compound fills the gap between mating parts with a hard resin that increases load distribution and protects against corrosion.	
ADHESIVE Used to secure a variety of components immediately prior to assembly. May be recommended for installing new components or when reusing a component that had a pre-applied adhesive such as hood seals, moldings, and weather-stripping.	

Shop Supplies (continued)

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 based or silicone based, and cure when exposed to air or designed to cure in an air-less environment (anaerobic). Most gasket compounds are designed to be applied to clean surfaces free of oil, chemical residue and previously used gaskets or gasket compounds.	
SILICONE SEALANT Designed for a broad variety of sealing and bonding requirements, silicone sealants are usually room temperature vulcanizing (RTV) which form a flexible silicone rubber that bonds to a wide variety of smooth or porous materials when cured. Standard silicone sealants are designed to perform in temperatures from -51° F to 232° C (-60° F to 400° F), while high temperature sealants can perform in temperatures up to 343° C (650° F)	

Special Tools

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

Hydraulic Pressure Testing Kit

Toro Part No. TOR47009

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

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57 LPM (15 gpm) Hydraulic Tester Kit

Toro Part No. TOR214678

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

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

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

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

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

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

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

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150 LPM (40 gpm) Hydraulic Tester

Toro Part No. AT40002

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

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

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

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

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

Hydraulic O-Ring Kit

Toro Part No. 117-2727

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

Hydraulic Hose Kit

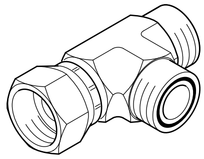
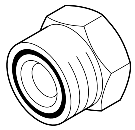
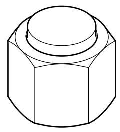
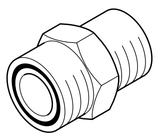
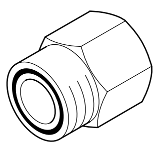
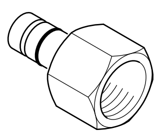
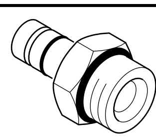
Toro Part No. TOR6007

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

Hydraulic Test Fitting Kit

Toro Part No. TOR4079

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

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

High Flow Hydraulic Filter Kit

Toro Part Number: TOR6011

The high flow hydraulic filter kit is designed with large flow (150 LPM or 40 gpm) and high pressure (34,500 kPa or 5,000 psi) capacity. This kit provides for bidirectional filtration which prevents filtered unwanted material from entering 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 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. Refer to Filtering the Closed-Loop Traction Circuit (page 5–70) for additional information.

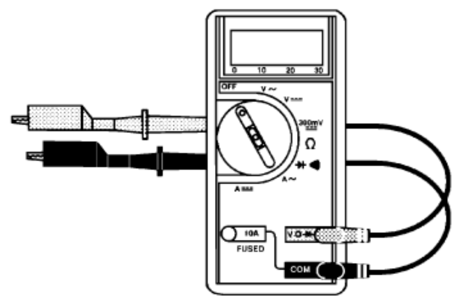
Note: This kit does not include the hydraulic hoses; refer to Hydraulic Hose Kit (page 2–15).

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

Multimeter

Obtain this tool locally

Use the multimeter to test 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.

Troubleshooting

Table of Contents

The information in this chapter is intended to help troubleshoot machine operation issues. Keep in mind there can be more than one cause for a machine malfunction.

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?

Operator Advisories

Operator advisories are automatically displayed by the InfoCenter when a machine function is prevented, and additional action is required. 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 table lists each advisory in detail.

Operator Advisories

Advisory Number	Advisory Name	Qualifiers	Instructions
B2003	START DENIED	Transmission not In Neutral	To start | Return transmission to neutral
B2004	START DENIED	PTO Switch Engaged	To start | Disengage PTO
B2005	START DENIED	Not In Seat AND Parking Brake not ON	To start | Must be seated or set parking brake
B2008	START DENIED	Traction Pedal Engaged	To start | Move traction pedal to neutral
B200A	START DENIED	Starter has been active for 30 seconds	30 second starter time out
B2013	START DENIED	Fault Active	To start | Resolve active faults
B2016	START DENIED	Auxiliary Hydraulic Switch Closed	To start | Disengage auxiliary hydraulics
B2017	START DENIED	Three Point Raise or Lower Switch Closed	To start | Disengage Three Point Raise/Lower
B2018	START DENIED	Inch Mode Switches Closed	To start | Disengage Inch Mode Switch
B2026	ENGINE ADVISORY	Speed restricted: Hydraulic oil too cold	Engine RPM Restricted | Let hydraulic oil warm
B2027	ENGINE ADVISORY	Engine shutdown due to high temperature	Engine | Let engine cool
B2028	ENGINE ADVISORY	Engine derate due to high temperature	Engine | Let engine cool
B2155	TRACTION DISABLED	Parking brake ON	For traction | Release parking brake
B2159	TRACTION DISABLED	Out of seat	For traction | Operator must be seated
B2176	GROUND SPEED LIMITED	Hydraulic oil Hot	Ground speed limited | Hydraulic oil temperature high
B2177	GROUND SPEED LIMITED	Engine Hot	Ground speed limited | Engine temperature high
B2186	DIFFERENTIAL LOCK DENIED	Traction Engaged	To engage differential lock | Bring machine to stop
B2484	MODE CHANGE DENIED	PTO Switch Engaged	For Mode change | Disengage PTO

Operator Advisories (continued)

Advisory Number	Advisory Name	Qualifiers	Instructions
B2486	MODE CHANGE DENIED	Traction Engaged	For Mode change | Bring machine to stop
B2487	MODE CHANGE DENIED	Traction Pedal Engaged	For Mode change | Return traction pedal to neutral
B248A	MODE CHANGE DENIED	Auxiliary Hydraulic Switch Closed	For Mode change | Disengage auxiliary hydraulics
B24B2	INCH MODE DENIED	Fault Active	For Inch mode | Resolve active faults
B24B3	INCH MODE DENIED	Not in Neutral	For Inch mode | Return transmission to neutral
B24B4	INCH MODE DENIED	PTO Switch Closed	For Inch mode | Disengage PTO
B24B5	INCH MODE DENIED	Parking Brake Engaged	For Inch mode | Disengage Parking Brake
B24B7	INCH MODE DENIED	Traction Pedal Engaged	For Inch mode | Return traction pedal to neutral
B24BA	INCH MODE DENIED	Auxiliary Hydraulic Switch Closed	For Inch mode | Disengage auxiliary hydraulics
B24BE	INCH MODE DENIED	Three Point Raise or Lower Switch Closed	For Inch mode | Disengage Three Point Raise/Lower
B24C4	ATTACHMENT CHANGE DENIED	PTO Switch Closed	For attachment change | Disengage PTO
B24CA	ATTACHMENT CHANGE DENIED	Auxiliary Hydraulic Switch Closed	For attachment change | Disengage auxiliary hydraulics
B24DA	ATTACHMENT ADVISORY	Increase ground speed	Attachment | Increase Ground Speed
B24EA	ATTACHMENT MODE DENIED	Controller Mismatch	Attachment Mode Denied | Attachment Mismatch between controllers
B2503	PTO DENIED	Fault Active	To engage PTO | Resolve active fault
B2505	PTO DENIED	Not In Seat OR Parking Brake not ON	To engage PTO | Must be seated or set parking brake
B2506	PTO DENIED	Traction Disengaged	To engage PTO | Return traction pedal to Neutral
B2507	PTO DENIED	Engine Hot	To engage PTO | Let engine cool
B250C	PTO DENIED	Attachment Not Present	To engage PTO | Connect attachment
B250E	PTO DENIED	Below Minimum Work Height	To engage PTO | Raise Three Point
B250F	PTO DENIED	Above Maximum Work Height	To engage PTO | Lower Three Point
B2523	AUXILIARY HYDRAULICS DENIED	Fault Active	For auxiliary hydraulics | Resolve active fault
B2525	AUXILIARY HYDRAULICS DENIED	Neither In Seat or Parking Brake Applied	For auxiliary hydraulics | Must be seated or set parking brake

Operator Advisories (continued)

Advisory Number	Advisory Name	Qualifiers	Instructions
B2526	AUXILIARY HYDRAULICS DENIED	Traction Disengaged	For auxiliary hydraulics | Engage traction
B2527	AUXILIARY HYDRAULICS DENIED	Engine Hot	For auxiliary hydraulics | Let Engine cool
B252E	AUXILIARY HYDRAULICS DENIED	Below Minimum Work Height	For auxiliary hydraulics | Raise Three Point
B252F	AUXILIARY HYDRAULICS DENIED	Above Maximum Work Height	For auxiliary hydraulics | Lower Three Point
B262A	FUEL LEVEL	Fuel Level Low	Fuel level low | Add fuel
B2703	MACHINE UNATTENDED	Not in neutral & Out of Seat	Operator must be seated OR Return transmission to Neutral
B2800	REGEN STATUS	Regeneration complete	Regeneration Complete
B2801	REGEN STATUS	Regen Inhibited	Regeneration Required | Inhibit Active
B2802	REGEN STATUS	Regeneration Required - Low EGT	Set engine to full throttle. Regeneration Required.
B2804	REGEN STATUS	Parked Regeneration Required	Parked Regeneration Required | See Service Menu
B2805	REGEN STATUS	Parked Regeneration Required - No PTO	Parked Regeneration Required | PTO disabled
B2806	REGEN STATUS	Recovery Regeneration Required	Recovery Regeneration Required | See Service Menu
B2807	REGEN STATUS	Recovery Regeneration Required - No PTO	Recovery Regeneration Required | PTO disabled
B280A	REGEN STATUS	Regeneration failed	Regeneration Failed
B2810	REGEN DENIED	<50Hrs since last Regeneration	Less than 50 hrs. since last regeneration.
B2811	REGEN DENIED	Engine Rejected Request	Request rejected by Engine
B2812	REGEN DENIED	Active Fault	Diagnostic trouble code active
B2813	REGEN DENIED	Low Engine Temperature	Engine not warm enough
B2814	REGEN DENIED	Engine Off	Start Engine
B2815	REGEN DENIED	Not at low idle	Lower engine RPM

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.

Machine and Engine Faults

The Toro Electronic Controller (TEC) generates machine faults to identify an electrical system malfunction (fault) that occurs during machine operation. 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. The fault IDs conform to SAE J2012 standards. When a fault occurs, an audible alarm will sound, a red warning light will illuminate, and a code for the active fault will appear along the bottom of the status display. If more than one fault is active, their codes will scroll across the bottom of the status display one-by-one. Depending on the severity of the fault, a STOP icon may also be displayed.

Recent faults can be viewed and cleared via the InfoCenter Service – Fault Viewer screen. A code appears after each fault indicating which controller generated the fault. For example: P0227:T1 is a traction pedal fault generated by the T1: TEC, and P1455:EN is a DPF pressure sensor fault generated by the Yanmar engine ECU. Refer to the *Yanmar Tier 4 and Stage V TNV Troubleshooting Manual* for engine fault information.

Machine Faults

Fault ID	Fault Title	Fault Description	Controller Action	Recommended Service Actions
P0225	Traction Pedal Analog Sensor APS1 - Open Circuit	Traction pedal analog sensor APS1 is reading a voltage outside the range it was designed to operate, indicating an open circuit	Traction is disabled until ignition key is cycled	1. Use the InfoCenter to verify sensor movement (TRACTION INPUTS–TR. PEDAL SIGNAL 1) 2. If no voltage reading is displayed: A. Check the traction pedal wiring and connector. B. Test the sensor wiring. 3. Test the traction pedal assembly if possible and replace if necessary.
P0227	Traction Pedal Analog Sensor APS1 - Short to Ground	Traction pedal analog sensor APS1 is reading a voltage outside the range it was designed to operate, indicating a short to ground.	Traction is disabled until ignition key is cycled	1. Use the InfoCenter to verify sensor movement (TRACTION INPUTS–TR. PEDAL SIGNAL 1). 2. If no voltage reading is displayed: A. Check the traction pedal wiring and connector. B. Test the sensor wiring. 3. Test the traction pedal assembly if possible and replace if necessary.
P0460	Fuel level Sender - Open Circuit	Open circuit detected on fuel level sender		1. Check sender wiring and connector. 2. Test fuel sender and replace if necessary.
P0461	Fuel level Sender - Short to Ground	Short to ground detected on fuel level sender		1. Check sender wiring and connector. 2. Test fuel sender and replace if necessary.
P0575	Cruise Control Switch Correlation Fault	Cruise engage (SET) input is active, but the cruise enable (ON) input is off.	Cruise is not enabled	1. Check switch wiring and connector. 2. Test the cruise control OFF/ON/SET switch and replace if necessary.

Machine Faults (continued)

Fault ID	Fault Title	Fault Description	Controller Action	Recommended Service Actions
P057C	Decelerator Pedal Position Sensor - Analog Short to Ground	Short to ground detected on decelerator pedal position sensor – analog	Traction is disabled until ignition key is cycled	1. Use the InfoCenter to verify sensor operation (TRACTION INPUTS–BRAKE PEDAL SIGNAL). 2. If no voltage reading is displayed: A. Check the decelerator pedal position sensor wiring and connector. B. Test the sensor wiring. 3. Test the decelerator pedal position sensor and replace if necessary.
P057D	Decelerator Pedal Position Sensor - Analog Open Circuit	Open circuit detected on decelerator pedal position sensor – analog	Traction is disabled until ignition key is cycled	1. Use the InfoCenter to verify sensor operation (TRACTION INPUTS–BRAKE PEDAL SIGNAL). 2. If no voltage reading is displayed: A. Check the decelerator pedal position sensor wiring and connector. B. Test the sensor wiring. 3. Test the decelerator pedal position sensor and replace if necessary.
P05E0	Decelerator Pedal Position Sensor - Analog to Decelerator Pedal Neutral Switch – Digital Correlation Fault	The analog and digital inputs for the decelerator pedal do not match	Traction is disabled until ignition key is cycled	1. Make sure the decelerator pedal moves freely to its full rest (up) position. 2. Use the InfoCenter to verify neutral switch operation (TRACTION INPUTS–BRAKE NEUTRAL ON). 3. Use the InfoCenter to verify position sensor operation (TRACTION INPUTS–BRAKE PEDAL SIGNAL). 4. If no voltage reading is displayed: A. Check the decelerator pedal position sensor wiring and connector. B. Test the position sensor wiring. 5. Check the decelerator pedal neutral switch wiring and connector. 6. Test the neutral switch wiring. 7. Test the decelerator pedal neutral switch and replace if necessary. 8. Test the decelerator pedal position sensor and replace if necessary.
P0615	Start Output - Open Circuit	Open circuit detected on engine start output		1. Check the engine start output circuit wiring and all output circuit connectors. 2. Test the engine start output circuit wiring between T1: TEC and Engine ECU. 3. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).
P0616	Start Output – Overcurrent	Overcurrent detected on engine start output. Indicates a short to ground		1. Check the engine start output circuit wiring and all output circuit connectors. 2. Test the engine start output circuit wiring between T1: TEC and Engine ECU. 3. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).

Machine Faults (continued)

Fault ID	Fault Title	Fault Description	Controller Action	Recommended Service Actions
P0617	Engine Start Output - Short to Battery	Low current detected on engine start output . Indicates a short to battery		1. Check the engine start output circuit wiring and all output circuit connectors. 2. Test the engine start output circuit wiring between T1: TEC and Engine ECU. 3. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).
P06E9	Starter Time-out	Starter has been engaged continuously for more than 30 seconds	Starter output is disabled	1. Check key switch is not stuck in start position. 2. Test key switch and replace if necessary. 3. Test start relay and replace if necessary.
P0939	Hydraulic Fluid Temperature Sender - Short to Ground	Short to ground detected on hydraulic temperature sender		1. Check temperature sender wiring and connector. 2. Test temperature sender and replace if necessary.
P0940	Hydraulic Fluid Temperature Sender - Open Circuit	Open circuit detected on hydraulic temperature sender		1. Check temperature sender wiring and connector. 2. Test temperature sender and replace if necessary.
P100C	Engine Coolant Temperature Above Threshold - PTO Disabled	Engine coolant temperature has exceeded 105° C (221° F)	PTO is disabled	1. Allow engine to cool. 2. Check fan condition and operation. 3. Clear air flow passages. 4. Check coolant level and condition, adjust and replace as necessary. 5. Check temperature sender wiring and connector. 6. Test temperature sender and replace if necessary.
P100D	Engine Coolant Temperature Above Threshold - Engine Shut Down	Engine coolant temperature has exceeded 115° C (239° F)	Engine is shut down	1. Allow engine to cool. 2. Check fan condition and operation. 3. Clear air flow passages. 4. Check coolant level and condition, adjust and replace as necessary. 5. Check temperature sender wiring and connector. 6. Test temperature sender and replace if necessary.
P1104	Traction Coil (front pump forward valve - C1) Overcurrent	Overcurrent detected. Indicates a short to ground.		1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–FRONT FWD HYDRO). 2. If no amperage reading is displayed: A. Check the traction coil wiring and connector. B. Test the traction coil wiring. 3. Test the traction coil and replace if necessary. 4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance).

Machine Faults (continued)

Fault ID	Fault Title	Fault Description	Controller Action	Recommended Service Actions
P110C	Traction Coil (front pump forward valve - C1) Validation Failure - Current Converge	A current monitor which validates the intended traction coil current is indicating an unexpected variance between the desired level of current to the traction coil and the actual level of current to the traction coil.	Traction is disabled until ignition key is cycled.	1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–FRONT FWD HYDRO). 2. If no amperage reading is displayed: A. Check the traction coil wiring and connector. B. Test the traction coil wiring. 3. Test the traction coil and replace if necessary. 4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance).
P110D	Traction Coil (front pump forward valve - C1) Validation Failure - PWM Converge	PWM convergence is checking 2 fault conditions. The first check is to confirm that the PWM duty cycle across the coil is decreasing when the desired current to the coil is 0. The second check is to verify that the PWM duty cycle across the coil is not greater than the max allowed limit.	Traction is disabled until ignition key is cycled	1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–FRONT FWD HYDRO). 2. If no amperage reading is displayed: A. Check the traction coil wiring and connector. B. Test the traction coil wiring. 3. Test the traction coil and replace if necessary. 4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance).
P1114	Traction Coil (front pump reverse valve - C2) Overcurrent	Overcurrent detected. Indicates a short to ground.		1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–FRONT REV HYDRO). 2. If no amperage reading is displayed: A. Check the traction coil wiring and connector. B. Test the traction coil wiring. 3. Test the traction coil and replace if necessary. 4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance).
P111C	Traction Coil (front pump reverse valve - C2) Validation Failure - Current Converge	A current monitor which validates the intended traction coil current is indicating an unexpected variance between the desired level of current to the traction coil and the actual level of current to the traction coil.	Traction is disabled until ignition key is cycled.	1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–FRONT REV HYDRO). 2. If no amperage reading is displayed: A. Check the traction coil wiring and connector. B. Test the traction coil wiring. 3. Test the traction coil and replace if necessary. 4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance).

Machine Faults (continued)

Fault ID	Fault Title	Fault Description	Controller Action	Recommended Service Actions
P111D	Traction Coil (front pump reverse valve - C2) Validation Failure - PWM Converge	PWM convergence is checking 2 fault conditions. The first check is to confirm that the PWM duty cycle across the coil is decreasing when the desired current to the coil is 0. The second check is to verify that the PWM duty cycle across the coil is not greater than the max allowed limit.	Traction is disabled until ignition key is cycled	1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–FRONT REV HYDRO). 2. If no amperage reading is displayed: A. Check the traction coil wiring and connector. B. Test the traction coil wiring. 3. Test the traction coil and replace if necessary. 4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance).
P1124	Traction Coil (rear pump forward valve -C1) Overcurrent	Overcurrent detected. Indicates a short to ground.		1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–REAR FWD HYDRO). 2. If no amperage reading is displayed: A. Check the traction coil wiring and connector. B. Test the traction coil wiring. 3. Test the traction coil and replace if necessary. 4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance).
P112C	Traction Coil (rear pump forward valve -C1) Validation Failure - Current Converge	A current monitor which validates the intended traction coil current is indicating an unexpected variance between the desired level of current to the traction coil and the actual level of current to the traction coil.	Traction is disabled until ignition key is cycled.	1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–REAR FWD HYDRO). 2. If no amperage reading is displayed: A. Check the traction coil wiring and connector. B. Test the traction coil wiring. 3. Test the traction coil and replace if necessary. 4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance).
P112D	Traction Coil (rear pump forward valve -C1) Validation Failure - PWM Converge	PWM convergence is checking 2 fault conditions. The first check is to confirm that the PWM duty cycle across the coil is decreasing when the desired current to the coil is 0. The second check is to verify that the PWM duty cycle across the coil is not greater than the max allowed limit.	Traction is disabled until ignition key is cycled	1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–REAR FWD HYDRO). 2. If no amperage reading is displayed: A. Check the traction coil wiring and connector. B. Test the traction coil wiring. 3. Test the traction coil and replace if necessary. 4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance).

Machine Faults (continued)

Fault ID	Fault Title	Fault Description	Controller Action	Recommended Service Actions
P1134	Traction Coil (rear pump reverse valve - C2) Overcurrent	Overcurrent detected. Indicates a short to ground.		1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–REAR REV HYDRO). 2. If no amperage reading is displayed: A. Check the traction coil wiring and connector. B. Test the traction coil wiring. 3. Test the traction coil and replace if necessary. 4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance).
P113C	Traction Coil (rear pump reverse valve - C2) Validation Failure - Current Converge	A current monitor which validates the intended traction coil current is indicating an unexpected variance between the desired level of current to the traction coil and the actual level of current to the traction coil.	Traction is disabled until ignition key is cycled.	1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–REAR REV HYDRO). 2. If no amperage reading is displayed: A. Check the traction coil wiring and connector. B. Test the traction coil wiring. 3. Test the traction coil and replace if necessary. 4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance).
P113D	Traction Coil (rear pump reverse valve - C2) Validation Failure - PWM Converge	PWM convergence is checking 2 fault conditions. The first check is to confirm that the PWM duty cycle across the coil is decreasing when the desired current to the coil is 0. The second check is to verify that the PWM duty cycle across the coil is not greater than the max allowed limit.	Traction is disabled until ignition key is cycled	1. Use the InfoCenter to verify the traction coil operation (TRACTION OUTPUTS–REAR REV HYDRO). 2. If no amperage reading is displayed: A. Check the traction coil wiring and connector. B. Test the traction coil wiring. 3. Test the traction coil and replace if necessary. 4. Replace T1: TEC (contact your Authorized Toro Distributor for assistance).

Machine Faults (continued)

Fault ID	Fault Title	Fault Description	Controller Action	Recommended Service Actions
P114C	Front Traction Hydraulic Circuit - Charge Pressure Low **Note:** If fault P115C is also present, a charge circuit issue exists outside of the traction pump (steering and/or lift operation will also be affected). Confirm charge pressure at the test port provided and perform gear pump (P4) flow test.	Charge pressure in front traction circuit is less than 1103 kPa (160 psi)		1. Use the InfoCenter to verify pressure sensor reading (TRACTION INPUTS–FRONT TRACTION). 2. If no pressure reading is displayed: A. Check front pressure sensor (left side of traction pump) wiring and connector. B. Test the pressure sensor wiring. C. Test the pressure sensor if possible and replace if necessary. 3. Perform front traction pump (P1) flow and relief valve test.
P114D	Hydraulic Fluid Temperature – Over Temperature	Hydraulic fluid temperature has exceeded 95° C (203° F)	Maximum traction speed is reduced	1. Make sure the auxiliary load valve joystick is not stuck in an enable position. 2. Reduce traction speed. 3. Allow hydraulic fluid to cool below 90° C (194° F).
P115C	Rear Traction Hydraulic Circuit - Charge Pressure Low **Note:** If fault P114C is also present, a charge circuit issue exists outside of the traction pump (steering and/or lift operation will also be affected). Confirm charge pressure at the test port provided and perform gear pump (P4) flow test.	Charge pressure in rear traction circuit is less than 1103 kPa (160 psi)		1. Use the InfoCenter to verify pressure sensor reading (TRACTION INPUTS–REAR TRACTION). 2. If no pressure reading is displayed: A. Check rear pressure sensor (right side of traction pump) wiring and connector. B. Test the pressure sensor wiring. C. Test the pressure sensor if possible and replace if necessary. 3. Perform rear traction pump (P4) flow and relief valve test.

Machine Faults (continued)

Fault ID	Fault Title	Fault Description	Controller Action	Recommended Service Actions
P210E	Traction Pedal Sensor/Switch Analog vs Analog conflict	The traction pedal has 2 position sensors (APS1 and APS2), each producing its own analog signal. The analog signals independently indicate a pedal position relative to neutral (rest). The two signals are reporting differing positions outside of an expected variance.	Traction is disabled until pedal position is returned to neutral (rest)	1. Use the InfoCenter to verify sensor movement (TRACTION INPUTS–TR. PEDAL SIGNAL 1 and TRACTION INPUTS–TR. PEDAL SIGNAL 2). 2. If one or both voltage readings are not displayed: A. Check the traction pedal wiring and connector. B. Test the sensor wiring. 3. Test the traction pedal assembly if possible and replace if necessary.
P2130	Traction Pedal Analog Sensor APS2 - Short to Ground	Traction pedal analog sensor APS2 is reading a voltage outside the range it was designed to operate, indicating a short to ground.	Traction is disabled until ignition key is cycled	1. Use the InfoCenter to verify sensor movement (TRACTION INPUTS–TR. PEDAL SIGNAL 2). 2. If no voltage reading is displayed: A. Check the traction pedal wiring and connector. B. Test the sensor wiring. 3. Test the traction pedal assembly if possible and replace if necessary.
P2132	Traction Pedal Analog Sensor APS2 - Open Circuit	Traction pedal analog sensor APS2 is reading a voltage outside the range it was designed to operate, indicating an open circuit	Traction is disabled until ignition key is cycled	1. Use the InfoCenter to verify sensor movement (TRACTION INPUTS–TR. PEDAL SIGNAL 2). 2. If no voltage reading is displayed: A. Check the traction pedal wiring and connector. B. Test the sensor wiring. 3. Test the traction pedal assembly if possible and replace if necessary.
P2152	Wheel Speed Sensor Failure	One of the speed sensors has failed to report to the T1: TEC	PTO is disabled and machine enters limp mode after the machine comes to a stop	1. Use the InfoCenter to verify sensor readings (TRACTION INPUTS–FRONT GROUND and TRACTION INPUTS–REAR GROUND while the machine is in motion). 2. If no speed reading is displayed: A. Check the speed sensor wiring and connector. B. Test the sensor wiring. 3. Replace the speed sensor if necessary.
P2503	System Voltage - Too Low	The system voltage is less than 8.8 VDC.		1. Use the Status Display to verify system voltage. 2. Check and clean battery connections. 3. Test and charge battery. 4. Check alternator belt condition and adjust if necessary. 5. Check alternator wiring and connectors. 6. Test the alternator wiring. 7. Test the alternator; refer to the *Yanmar TNV (Tier 4) Series Service Manual*.

Machine Faults (continued)

Fault ID	Fault Title	Fault Description	Controller Action	Recommended Service Actions
P2504	System Voltage - Too High	The system voltage is more than 16.3 VDC.		1. Use the Status Display to verify system voltage with engine operating at 2300 RPM min. 2. Test the alternator; refer to the *Yanmar TNV (Tier 4) Series Service Manual*.
P2530	Key Start/Run Correlation Fault	Key start input is active, but the key run input is inactive	Machine will shut down since key run input is inactive	1. Use the InfoCenter to verify the run and start circuit inputs (ENGINE RUN INPUTS–KEY RUN OFF and ENGINE RUN INPUTS–KEY START ON). 2. Check the key switch circuit wiring and connectors at the key switch and the T1: TEC. 3. Test the key switch circuit wiring between the key switch and the T1: TEC. 4. Test the key switch and replace if necessary.
C1013	Engine Run/Fuel Pump Output - Short to Battery	Low current detected on engine run/fuel pump output. Indicates a short to battery		1. Check the engine run/fuel pump output circuit wiring and all output circuit connectors. 2. Test the engine run/fuel pump output circuit wiring. 3. Test the electric fuel pump. 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).
C1014	Engine Run/Fuel Pump Output – Overcurrent	Overcurrent detected in engine run/fuel pump output. Indicates a short to ground		1. Check the engine run/fuel pump output circuit wiring and all output circuit connectors. 2. Test the engine run/fuel pump output circuit wiring. 3. Test the electric fuel pump. 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).
C1015	Engine Run/Fuel Pump Output - Open Circuit	Open circuit detected on engine run/fuel pump output		1. Check the engine run/fuel pump output circuit wiring and all output circuit connectors. 2. Test the engine run/fuel pump output circuit wiring. 3. Test the electric fuel pump. 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).
C1020	Parking Brake Disengage Output - Fault Undetermined	The fault type is undetermined due to hardware restrictions. Cycling the output will allow the software to determine whether the fault is because of a short to battery, short to ground/overcurrent, or an open circuit.		Cycle the parking brake switch ON and OFF (key switch in RUN position) to allow the software to determine the fault type.

Machine Faults (continued)

Fault ID	Fault Title	Fault Description	Controller Action	Recommended Service Actions
C1023	Parking Brake Disengage Output - Short to Battery	Low current detected on parking brake disengage output. Indicates a short to battery.		1. Check the parking brake disengage output circuit wiring and all output circuit connectors. 2. Test the parking brake disengage output circuit wiring. 3. Test the hydraulic solenoid valve SV2 coil. 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).
C1024	Parking Brake Disengage Output - Overcurrent	Overcurrent detected on parking brake disengage output. Indicates short to ground.		1. Check the parking brake disengage output circuit wiring and all output circuit connectors. 2. Test the parking brake disengage output circuit wiring. 3. Test the hydraulic solenoid valve SV2 coil. 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).
C1025	Parking Brake Disengage Output - Open Circuit	Open circuit detected on parking brake disengage output		1. Check the parking brake disengage output circuit wiring and all output circuit connectors. 2. Test the parking brake disengage output circuit wiring. 3. Test the hydraulic solenoid valve SV2 coil. 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).
C1093	Warning Buzzer Output - Short to Battery	Low current detected on warning buzzer output. Indicates a short to battery		1. Check the warning buzzer output circuit wiring and all output circuit connectors. 2. Test the warning buzzer output circuit wiring. 3. Test the warning buzzer. 4. Replace the T2: TDM (contact your Authorized Toro Distributor for assistance).
C1094	Warning Buzzer Output - Overcurrent	Overcurrent detected on warning buzzer output. Indicates short to ground.		1. Check the warning buzzer output circuit wiring and all output circuit connectors. 2. Test the warning buzzer output circuit wiring. 3. Test the warning buzzer. 4. Replace the T2: TDM (contact your Authorized Toro Distributor for assistance).
C1095	Warning Buzzer Output - Open Circuit	Open circuit detected on warning buzzer output.		1. Check the warning buzzer output circuit wiring and all output circuit connectors. 2. Test the warning buzzer output circuit wiring. 3. Test the warning buzzer. 4. Replace the T2: TDM (contact your Authorized Toro Distributor for assistance).
C10A3	Parking Brake Light Output - Short to Battery	Low current detected on parking brake light output. Indicates a short to battery		1. Check the parking brake light output circuit wiring and all output circuit connectors. 2. Test the parking brake light output circuit wiring. 3. Test the parking brake light. 4. Replace the T2: TDM (contact your Authorized Toro Distributor for assistance).

Machine Faults (continued)

Fault ID	Fault Title	Fault Description	Controller Action	Recommended Service Actions
C10A4	Parking Brake Light Output - Overcurrent	Overcurrent detected on parking brake light output. Indicates short to ground.		1. Check the parking brake light output circuit wiring and all output circuit connectors. 2. Test the parking brake light output circuit wiring. 3. Test the parking brake light. 4. Replace the T2: TDM (contact your Authorized Toro Distributor for assistance).
C10A5	Parking Brake Light Output - Open Circuit	Open circuit detected on parking indicator brake light output.		1. Check the parking brake indicator light output circuit wiring and all output circuit connectors. 2. Test the parking brake indicator light. 3. Test the parking brake indicator light output circuit wiring. 4. Replace the T2: TDM (contact your Authorized Toro Distributor for assistance).
C10B3	Optional Brake Controller Output - Short to Battery	Low current detected on optional brake controller output. Indicates a short to battery		1. Check the optional brake controller output circuit wiring and all output circuit connectors. 2. Test the optional brake controller output circuit wiring. 3. Test the optional brake controller if possible; refer to manufacturer documentation supplier with brake controller. 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).
C10B4	Optional Brake Controller Output - Overcurrent	Overcurrent detected on optional brake controller output. Indicates short to ground.		1. Check the optional brake controller output circuit wiring and all output circuit connectors. 2. Test the optional brake controller output circuit wiring. 3. Test the optional brake controller if possible; refer to manufacturer documentation supplier with brake controller. 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).
C1314	3-Point Hitch Raise Output - Overcurrent	Overcurrent detected on 3-point hitch raise output. Indicates short to ground.		1. Check the 3-point hitch raise output circuit wiring and all output circuit connectors. 2. Test the 3-point hitch raise output circuit wiring. 3. Test the hydraulic solenoid valve SP1 coil. 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).
C1315	3-Point Hitch Raise Output - Open Circuit	Open Circuit detected on 3-point hitch raise output.		1. Check the 3-point hitch raise output circuit wiring and all output circuit connectors. 2. Test the 3-point hitch raise output circuit wiring. 3. Test the hydraulic solenoid valve SP1 coil. 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).

Fault ID	Fault Title	Fault Description	Controller Action	Recommended Service Actions
C1324	3-Point Hitch Lower Output - Overcurrent	Overcurrent detected on 3-point hitch lower output. Indicates short to ground.		1. Check the 3-point hitch lower output circuit wiring and all output circuit connectors. 2. Test the 3-point hitch lower output circuit wiring. 3. Test the hydraulic solenoid valve SP2 coil. 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).
C1325	3-Point Hitch Lower Output - Open Circuit	Open Circuit detected on 3-point hitch lower output.		1. Check the 3-point hitch lower output circuit wiring and all output circuit connectors. 2. Test the 3-point hitch lower output circuit wiring. 3. Test the hydraulic solenoid valve SP2 coil. 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).
C1450	Differential Lock Output - Fault Undetermined	The fault type is undetermined due to hardware restrictions. Cycling the output will allow the software to determine whether the fault is because of a short to battery, short to ground/overcurrent, or an open circuit.		Cycle the parking brake switch ON and OFF (key switch in RUN position) to allow the software to determine the fault type.
C1453	Differential Lock Output - Short to Battery	Low current detected on differential lock output. Indicates a short to battery		1. Check the differential lock output circuit wiring and all output circuit connectors. 2. Test the differential lock output circuit wiring. 3. Test the hydraulic solenoid valve SV3 coil. 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).
C1454	Differential Lock Output - Overcurrent	Overcurrent detected on differential lock output. Indicates short to ground.		1. Check the differential lock output circuit wiring and all output circuit connectors. 2. Test the differential lock output circuit wiring. 3. Test the hydraulic solenoid valve SV3 coil. 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).
C1455	Differential Lock Output - Open Circuit	Open Circuit detected on differential lock output.		1. Check the differential lock output circuit wiring and all output circuit connectors. 2. Test the differential lock output circuit wiring. 3. Test the hydraulic solenoid valve SV3 coil. 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).
C14A3	Optional Solenoid Control Valve (SCV) Output - Short to Battery	Low current detected on optional SCV output. Indicates a short to battery		1. Check the optional SCV output circuit wiring and all output circuit connectors. 2. Test the optional SCV output circuit wiring. 3. Test the SCV relay. 4. Test all 4 of the hydraulic solenoid valve SCV coils. 5. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).

Machine Faults (continued)

Fault ID	Fault Title	Fault Description	Controller Action	Recommended Service Actions
C14A4	Optional Solenoid Control Valve (SCV) Output - Overcurrent	Overcurrent detected on optional SCV output. Indicates short to ground.		1. Check the optional SCV output circuit wiring and all output circuit connectors. 2. Test the optional SCV output circuit wiring. 3. Test the SCV relay. 4. Test all 4 of the hydraulic solenoid valve SCV coils. 5. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).
C14A5	Optional Solenoid Control Valve (SCV) Output - Open Circuit	Open Circuit detected on optional SCV output.		1. Check the optional SCV output circuit wiring and all output circuit connectors. 2. Test the optional SCV output circuit wiring. 3. Test the SCV relay. 4. Test all 4 of the hydraulic solenoid valve SCV coils. 5. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).
C14B0	Range Hi Output - Fault Undetermined	The fault type is undetermined due to hardware restrictions. Cycling the output will allow the software to determine whether the fault is because of a short to battery, short to ground, or an open circuit.		Cycle the mode selector to LOW and back to HIGH (key switch in RUN position) to allow the software to determine the fault type.
C14B3	Range Hi Output - Short to Battery	Low current detected on range Hi output. Indicates a short to battery		1. Check the range Hi output circuit wiring and all output circuit connectors. 2. Test the range Hi output circuit wiring. 3. Test the hydraulic solenoid valve SV1 coil. 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).
C14B4	Range Hi Output - Overcurrent	Overcurrent detected on range Hi output. Indicates short to ground.		1. Check the range Hi output circuit wiring and all output circuit connectors. 2. Test the range Hi output circuit wiring. 3. Test the hydraulic solenoid valve SV1 coil. 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).
C14B5	Range Hi Output - Open Circuit	Open circuit detected on range Hi output.		1. Check the range Hi output circuit wiring and all output circuit connectors. 2. Test the range Hi output circuit wiring. 3. Test the hydraulic solenoid valve SV1 coil. 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).

Machine Faults (continued)

Fault ID	Fault Title	Fault Description	Controller Action	Recommended Service Actions
C14C4	PTO Output -Overcurrent	Overcurrent detected on PTO output. Indicates short to ground.		1. Check the PTO output circuit wiring and all output circuit connectors. 2. Test the PTO output circuit wiring. 3. Test the hydraulic solenoid valve EH coil. 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).
C14C5	PTO Output - Open Circuit	Open Circuit detected on PTO output.		1. Check the PTO output circuit wiring and all output circuit connectors. 2. Test the PTO output circuit wiring. 3. Test the hydraulic solenoid valve EH coil. 4. Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).
C1514	Front Hydraulic Pressure Sensor - Short to Ground	Front hydraulic pressure sensor is shorted to ground (out of range low)	PTO is disabled and machine enters limp mode after the machine comes to a stop	1. Check front pressure sensor (left side of traction pump) wiring and connector. 2. Test the pressure sensor wiring. 3. Test the pressure sensor if possible and replace if necessary.
C1515	Front Hydraulic Pressure Sensor - Open Circuit	Front hydraulic pressure sensor is open (out of range high)	PTO is disabled and machine enters limp mode after the machine comes to a stop	1. Check front pressure sensor (left side of traction pump) wiring and connector. 2. Test the pressure sensor wiring. 3. Test the pressure sensor if possible and replace if necessary.
C1524	Rear Hydraulic Pressure Sensor - Short to Ground	Rear hydraulic pressure sensor is shorted to ground (out of range low)	PTO is disabled and machine enters limp mode after the machine comes to a stop	1. Check rear pressure sensor (right side of traction pump) wiring and connector. 2. Test the pressure sensor wiring. 3. Test the pressure sensor if possible and replace if necessary.
C1525	Rear Hydraulic Pressure Sensor - Open Circuit	Rear hydraulic pressure sensor is open (out of range high)	PTO is disabled and machine enters limp mode after the machine comes to a stop	1. Check rear pressure sensor (right side of traction pump) wiring and connector. 2. Test the pressure sensor wiring. 3. Test the pressure sensor if possible and replace if necessary.
C153C	3-Point Hitch Raise Stall	3-point hitch raise output is enabled, but 3-point hitch position sensor does not report movement	Raise is disabled for paddle-controlled attachments	1. If 3-point hitch is moving: A. Make sure 3-point hitch position sensor is properly installed (mounting bracket is stationary, and sensor shaft moves with lift arm pivot shaft). B. Test the 3-point hitch position sensor. 2. If 3-point hitch is not moving: A. Make sure the hitch assembly is not obstructed or overloaded. B. Service hydraulic cartridge valve SP1 and replace if necessary. C. Test hydraulic relief valve RV2 and adjust, service, or replace if necessary.

Machine Faults (continued)

Fault ID	Fault Title	Fault Description	Controller Action	Recommended Service Actions
B1027	Cruise Control Speed Increase/ Decrease Switch is Broken	Both CRUISE CONTROL INPUTS–SPEED INCREASE and CRUISE CONTROL INPUTS–SPEED DECREASE are active at the same time	Cruise speed increase/ decrease is disabled	1. Check the cruise control speed increase/decrease switch circuit wiring and all the circuit connectors. 2. Test the cruise control speed increase/decrease switch. 3. Test the cruise control speed increase/decrease switch circuit wiring.
B1107	Transmission Lever Switch Broken	Both TRACTION INPUTS–TRANMISSION FWD and TRACTION INPUTS–TRANMISSION REV are active at the same time	Traction is disabled	1. Use the transmission lever and the InfoCenter to determine which transmission lever switch does not match transmission lever movement (TRACTION INPUTS–TRANMISSION FWD and TRACTION INPUTS–TRANMISSION REV). 2. Check the circuit wiring and all the circuit connectors for the unresponsive switch. 3. Test the unresponsive switch. 4. Test the unresponsive switch circuit wiring.
B1117	Optional InchMode Raise/Lower Switch Broken	Both INCH MODE INPUTS–INCH MODE LOWER and INCH MODE INPUTS–INCH MODE RAISE are active at the same time	InchMode 3-point hitch control is disabled	1. Check the optional InchMode raise/lower switch circuit wiring and all the circuit connectors. 2. Test the optional InchMode raise/lower switch. 3. Test the optional InchMode raise/lower switch circuit wiring.
B1127	Optional InchMode Forward/ Reverse Switch Broken	Both INCH MODE INPUTS–INCH MODE FWD and INCH MODE INPUTS–INCH MODE REV are active at the same time	InchMode traction control is disabled	1. Check the optional InchMode forward/reverse switch circuit wiring and all the circuit connectors. 2. Test the optional InchMode forward/reverse switch. 3. Test the optional InchMode forward/reverse switch circuit wiring.
B1137	Paddle Switch Broken	Both 3-POINT INPUTS–3-POINT LOWER and 3-POINT INPUTS–3-POINT RAISE are active at the same time	3-point hitch control is disabled	1. Use the paddle and the InfoCenter to determine which paddle switch does not match paddle movement (3-POINT INPUTS–3-POINT LOWER and 3-POINT INPUTS–3-POINT RAISE). 2. Check the circuit wiring and all the circuit connectors for the unresponsive switch. 3. Test the unresponsive switch. 4. Test the unresponsive switch circuit wiring.
B1154	Mode Selector - Short to Ground	Short to ground detected on mode selector	Default to low mode operation and disable PTO	1. Check the mode selector circuit wiring and all circuit connectors. 2. Test the mode selector circuit wiring. 3. Test the mode selector if possible and replace if necessary.
B1155	Mode Selector - Open Circuit	Open circuit detected on mode selector	Default to low mode operation and disable PTO	1. Check the mode selector circuit wiring and all circuit connectors. 2. Test the mode selector circuit wiring. 3. Test the mode selector if possible and replace if necessary.

Machine Faults (continued)

Fault ID	Fault Title	Fault Description	Controller Action	Recommended Service Actions
B1164	3-Point Hitch Position Sensor - Short to Ground	Short to ground detected on 3-point hitch position sensor	Disable autonomous 3-point hitch control	1. Check the 3-point hitch position sensor circuit wiring and all circuit connectors. 2. Test the 3-point hitch position sensor circuit wiring. 3. Test the 3-point hitch position sensor if possible and replace if necessary.
B1165	3-Point Hitch Position Sensor - Open Circuit	Open circuit detected on 3-point hitch position sensor	Disable autonomous 3-point hitch control	1. Check the 3-point hitch position sensor circuit wiring and all circuit connectors. 2. Test the 3-point hitch position sensor circuit wiring. 3. Test the 3-point hitch position sensor if possible and replace if necessary.
U0100	CAN Bus Communication Fault - Engine ECU		All machine functions disabled	1. Check power supply to engine ECU. A. Test fuse F-A2 10A. B. Test engine ECU supply and ground circuit wiring. 2. Test CAN bus resistance.
U012A	CAN Bus Communication Fault - T2: TDM		T2: TDM display blank, but machine functions may continue	1. Check power supply to T2: TDM. A. Test fuse F-A4 2A. B. Test T2: TDM supply and ground circuit wiring. 2. Test external CAN bus termination resistor. 3. Test CAN bus resistance.
U012B	CAN Bus Communication Fault - Expansion Port (example: T3: InchMode option)		Optional InchMode feature shifts from an ACTIVE state to a PENDING state and InchMode control box switches are disabled	1. Check power supply to expansion port. A. Test fuse F-C2 10A. B. Test expansion port supply and ground circuit wiring. 2. Test external CAN bus termination resistor. 3. Test CAN bus resistance.
U0156	CAN Bus Communication Fault - InfoCenter		InfoCenter display blank but machine functions may continue	1. Check power supply to InfoCenter. A. Test fuse F-B3 2A. B. Test InfoCenter supply and ground circuit wiring. 2. Test external CAN bus termination resistor. 3. Test CAN bus resistance.
U1007	Main Power Relay **Note:** CAN bus communication faults will also appear	The main power relay has failed		1. Test fuse F-B2 2A. 2. Test relay and replace if necessary. 3. Test main power relay circuit wiring and connector. 4. Test T1: TEC output fuses F-A1, F-B1, F-C1, and F-D1 7.5A.
U1022	T1: TEC Fuse Output PWR 2 Failure	Power supply for outputs 1-4 of T1: TEC has failed.		Check power supply to T1: TEC outputs: 1. Test fuse F-A1 7.5A. 2. Test PWR 2 supply circuit wiring.

Machine Faults (continued)

Fault ID	Fault Title	Fault Description	Controller Action	Recommended Service Actions
U1023	T1: TEC Fuse Output PWR 3 Failure	Power supply for outputs 9–12 of T1: TEC has failed.		Check power supply to T1: TEC outputs: 1. Test fuse F-B1 7.5A. 2. Test PWR 3 supply circuit wiring.
U1024	T1: TEC Fuse Output PWR 4 Failure	Power supply for outputs 5–8 of T1: TEC has failed.		Check power supply to T1: TEC outputs: 1. Test fuse F-C1 7.5A. 2. Test PWR 4 supply circuit wiring.
U1025	T1: TEC Fuse Output PWR 5 Failure	Power supply for outputs 13-16 of T1: TEC. has failed.		Check power supply to T1: TEC outputs: 1. Test fuse F-D1 7.5A. 2. Test PWR 5 supply circuit wiring.
U1117	Source Address Contention Fault	T1: TEC received a message from another controller on the CAN bus using the same source address	Machine is disabled	Update machine software (contact your Authorized Toro Distributor for assistance).
U1308	Software Version Incompatibility - T2: TDM	T2: TDM software is incompatible	Machine is disabled	Update machine software (contact your Authorized Toro Distributor for assistance).
U1309	Software Version Incompatibility - Expansion Port (example: T3: InchMode option)	Expansion Port (example: T3: InchMode option) software is incompatible	Machine is disabled	Update machine software (contact your Authorized Toro Distributor for assistance).
U130A	Software Version Incompatibility - InfoCenter	InfoCenter software is incompatible	Machine is disabled	Update machine software (contact your Authorized Toro Distributor for assistance).
U130F	Software Version Incompatibility - Unknown	Unknown Software Version – Incompatible	Machine is disabled	Update machine software (contact your Authorized Toro Distributor for assistance).
U1701	Board Internal Error - IPE	Inputs or outputs on T1: TEC are not working correctly. Inputs cannot be trusted	Machine is disabled	Replace the T1: TEC (contact your Authorized Toro Distributor for assistance).

Using the InfoCenter display for Troubleshooting

The Service − Input/Output screens of the InfoCenter display can be very helpful when troubleshooting machine operation issues. Electrical components and their circuit wiring can be evaluated quickly using the Input/Output screens prior to testing the component individually. The Input/Output screens show the current state of the inputs and the outputs required to allow a machine operation to proceed.

CAUTION

It may be necessary to start and run the engine, raise and lower the attachments, or otherwise operate the machine during the troubleshooting process. Make sure the machine is in a well-ventilated area and keep away from attachments 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 attachments if possible and stop engine.
2. Set the key switch to the RUN position and navigate to the InfoCenter Service − Input/Output Screen for the desired machine function. Traction has been selected for the following example.
3. Manually operate the input component. The component state on the InfoCenter display should alternate ON and OFF or the signal voltage from the component should change as the component is cycled. If ON and OFF do not alternate or signal voltage does not change during component operation, the component or its circuit wiring is faulty and should be tested; refer to Electrical Component Testing (page 6–14) and Appendix A (page A–1).

   Note: – – – means no signal from the input is available and the input or its circuit wiring should be tested.

   When the correct inputs are received by the controllers, the outputs identified on the Output screen should show as ON (or a control amperage in the case of the traction pump control solenoids). If the inputs are properly positioned and the output remains OFF, a problem with controller power (circuit wiring or fuse) may exist, or the controller software may require reloading or replacement. Contact your Authorized Toro Distributor for assistance.

   A faulty output component will not be identified by the Output screen. The Output screen reflects the actions of the controller, not the component(s) involved in the operation. If all inputs and outputs are correct for the machine operation selected, yet the operation does not function as it should, the output component may be faulty. Test the specific output component and the wiring from the controller to the component; refer to Electrical Component Testing (page 6–14) and Appendix A (page A–1).

TRACTION (example):

Using the Inputs Screen

- Move the transmission lever to the FORWARD, NEUTRAL and REVERSE positions. The TRANSMISSION FWD and REV inputs should alternate ON and OFF based on the lever position. If not, the transmission lever switches or their circuit wiring are faulty and should be tested.

- Depress the traction pedal slowly. The TR. PEDAL SIGNAL 1 and 2 voltages should increase as the pedal is depressed. Signal 1 should be approximately twice as high as signal 2. If not, the traction pedal or its circuit wiring is faulty and should be tested.
- Depress the decelerator pedal slowly. The BRAKE NEUTRAL input should be OFF when the pedal is depressed and ON when the pedal is fully at rest. If not, the decelerator pedal neutral switch or its circuit wiring is faulty and should be tested.
- Depress the decelerator pedal slowly. The BRAKE PEDAL SIGNAL voltage should increase as the pedal is depressed. If not, the decelerator pedal or its circuit wiring is faulty and should be tested.
- Toggle the parking brake switch ON and OFF. The PBRAKE OFF input should alternate ON and OFF. If not, the parking brake switch or its circuit wiring is faulty and should be tested.
- Press and release the differential lock button. The DIFF. LOCK input should alternate OFF and ON. If not, the differential lock button or its circuit wiring is faulty and should be tested.
- When the vehicle is stationary, both FRONT and REAR GROUND (speed sensors) should display 0.0MPH/KPH. When the vehicle is in motion, both speed sensors should display approximately the same speed. If not, one of the speed sensors or its circuit wiring is faulty and should be tested.
- When the engine is running and the vehicle is stationary, both FRONT and REAR TRACTION (pressure sensors) should display the system charge pressure of approximately 1860 kPa (270 psi). A charge pressure reading of less than 1103 kPa (160 psi) indicates a pressure sensor or a hydraulic charge circuit issue.
- When the engine is running and the vehicle is in motion, both FRONT and REAR TRACTION should display approximately the same pressure due to the traction pressure compensation feature. If not, one of the pressure sensors or its circuit wiring may be faulty and should be tested, or the traction pressure compensation software may require reloading or replacement. Contact your Authorized Toro Distributor for assistance in reloading the machine software.

Using the Outputs Screen

Note: An inappropriate output reading may indicate an issue with the controller. Contact your Authorized Toro Distributor for assistance with controller reprogramming or replacement.

- When the vehicle is stationary, FRONT/REAR FWD/REV HYDRO will display a minimum amount of amperage being sent to the various traction pump control valve solenoids. All four displays should be approximately the same. When the vehicle is in motion, the amount of amperage being sent to the various traction pump control valve solenoids should increase. If the output reading is appropriate and the vehicle does not perform correctly, the traction pump control valve solenoid or its circuit wiring may be faulty and should be tested.
- When the decelerator pedal is pressed, the BRAKE OUTPUT (optional electric trailer brake controller) toggles form OFF to ON. If the output reading is appropriate and the vehicle does not perform correctly, the optional electric trailer brake controller, the electric trailer brakes, or their circuit wiring may be faulty and should be tested.
- Once all the required conditions are satisfied (engine running, vehicle stationary, parking brake disengaged), pressing and releasing the differential lock button should toggle DIFF. LOCK OUTPUT ON and OFF. Also, the DIFF. LOCK OUTPUT is ON when the parking brake switch is ON and OFF when

TRACTION (example): (continued)

the parking brake switch is OFF. If the output reading is appropriate and the vehicle does not perform correctly, the solenoid valve SV3 or its circuit wiring may be faulty and should be tested.

- Setting the mode selector to H then L or A should toggle RANGE HI ON and OFF. If the output reading is appropriate and the vehicle does not perform correctly, the solenoid valve SV1 or its circuit wiring may be faulty and should be tested.
- When the engine is running and the vehicle is stationary, switching the parking brake switch ON and OFF toggles the PBRAKE DISENGAGE ON and OFF. If the output reading is appropriate and the vehicle does not perform correctly, the solenoid valve SV2 or its circuit wiring may be faulty and should be tested.
- Switching the parking brake switch ON and OFF toggles the PBRAKE LIGHT ON and OFF. If the output reading is appropriate and the vehicle does not perform correctly, the parking brake switch light or its circuit wiring may be faulty and should be tested.

General Hydraulic System Problems

Problem	Possible Cause	Corrective Action
Hydraulic fluid is leaking from the system.	The fitting(s), hose(s), or tube(s) are loose or damaged.	Secure or replace loose or damaged hydraulic connections.
	The O-ring(s) or seal(s) are missing or damaged.	Install a new O-ring(s) or seal(s).
The hydraulic fluid foams excessively causing fluid leakage from the hydraulic tank breather.	The hydraulic fluid level in the hydraulic tank is low.	Adjust the hydraulic fluid level.
	The hydraulic system has a wrong type of fluid.	Replace the hydraulic fluid.
	Note: Refer to the traction unit *Operator's Manual* for hydraulic fluid specifications.	
	The incompatible hydraulic fluids are mixed in the system.	Replace the hydraulic fluid.
	There is water in the hydraulic system.	Replace the hydraulic fluid.
	The pump suction line has an air leak.	Replace the pump suction line.
The hydraulic system operates hot (exceeds 95° C (203° F).	The hydraulic fluid level in the hydraulic tank is low.	Adjust the hydraulic fluid level.
	The suction filter or suction line is damaged, loose, or clogged.	Secure, clean or replace the suction filter or suction line.
	The hydraulic fluid is contaminated or the fluid viscosity is too light.	Replace the hydraulic fluid.
	Note: Refer to the traction unit *Operator's Manual* for hydraulic fluid specifications.	
	The hydraulic fluid cooler is damaged or plugged.	Repair or replace the hydraulic fluid cooler.
	The fluid cooler air flow is obstructed.	Verify cooling fan operation and remove debris from in and around the fluid cooler.
	The traction pump bypass valve(s) is open or damaged.	Close or replace the traction pump bypass valve(s).
	The charge pressure is low (steering and lift circuit performance is also affected).	Verify charge pressure; refer to the InfoCenter SERVICE–INPUT/OUTPUT –TRACTION–TRACTION INPUTS FRONT TRACTION and REAR TRACTION readings while the machine is stationary.
	The traction pump is worn or damaged.	Verify traction pump operation; refer to Traction Pump (P1 and P2) Tests in the Hydraulic System chapter of this manual.
	The axle drive motor is worn or damaged.	Repair or replace the axle drive motor.
	Note: If a traction circuit component has internal wear or damage, it is possible that the other traction components are also damaged.	

Traction System Problems

Problem	Possible Cause	Corrective Action
The traction response is sluggish.	The hydraulic fluid is very cold.	Allow the hydraulic fluid to warm by safely operating the machine at rest.
	The hydraulic fluid level in the hydraulic tank is low.	Adjust the hydraulic fluid level.
	The traction pump bypass valve(s) is open or damaged.	Close or replace the traction pump bypass valve(s).
	Engine speed is low.	Increase the engine speed.
	A piston pump control solenoid is damaged.	Replace the appropriate piston pump control solenoid valve. 2 solenoid valves are used to control reverse operation (one for each pump/axle drive motor), and 2 solenoid valves are used to control forward operation (one for each pump/axle drive motor).
	One or more orifice or screen in the piston (traction) pump control assembly is partially obstructed or damaged.	Clean or repair piston (traction) pump passages.
	The traction pump relief valves are leaking or damaged.	Clean or repair the piston (traction) pump relief valves.
	The charge pressure is low (steering and lift circuit performance is also affected).	Verify charge pressure; refer to the InfoCenter SERVICE–INPUT/OUTPUT –TRACTION–TRACTION INPUTS FRONT TRACTION and REAR TRACTION readings while the machine is stationary.
	Note: If a traction circuit component has internal wear or damage, it is possible that the other traction components are also damaged.	
	The traction pump is worn or damaged.	Verify traction pump operation; refer to Traction Pump (P1 and P2) Tests in the Hydraulic System chapter of this manual.
	The axle drive motor is worn or damaged.	Repair or replace the axle drive motor.
The machine travels too far before stopping when the traction pedal is released.	Traction pedal assembly movement is restricted or traction pedal assembly is damaged.	Test and replace traction pedal assembly if necessary.
	A piston pump control solenoid is damaged.	Test and replace the control solenoid if necessary
The Front or rear axle operates in one direction only (forward or reverse).	The traction pump bypass valve(s) is open or damaged.	Close or replace the traction pump bypass valve(s).
	An electrical problem exists with the control solenoid(s).	Test and replace the control solenoid if necessary.
		Test the machine wire harness pump control solenoid circuit(s).
	One or more orifice or screen in piston (traction) pump control assembly is partially obstructed or damaged.	Clean or repair piston (traction) pump passages.
	The traction pump relief valves are leaking or damaged.	Clean or repair the piston (traction) pump relief valves.

Traction System Problems (continued)

Problem	Possible Cause	Corrective Action
No traction exists in either direction.	The hydraulic fluid level in the hydraulic tank is low (other hydraulic circuit performance is affected as well).	Adjust the hydraulic fluid level.
	The traction pump bypass valve(s) is open or damaged.	Close or replace the traction pump bypass valve(s).
	One or more orifice or screen in piston (traction) pump control assembly is partially obstructed or damaged.	Clean or repair piston (traction) pump passages.
	The charge pressure is low (steering and lift circuit performance is also affected).	Verify charge pressure; refer to the InfoCenter SERVICE–INPUT/OUTPUT –TRACTION–TRACTION INPUTS FRONT TRACTION and REAR TRACTION readings while the machine is stationary.
	The traction pump charge relief valve is leaking or damaged.	Clean or repair the charge relief valve.
	Problem with the piston (traction) pump control solenoid circuit exists.	
		Verify traction pedal sensor operation and the machine wire harness traction pedal circuit.
		Verify the TEC output to the pump control solenoids is occurring.
		Test the machine wire harness pump control solenoid circuits.
	The traction pump relief valves are leaking or damaged.	Clean or repair the piston (traction) pump relief valves.
	The traction pump is worn or damaged.	Verify traction pump operation; refer to Traction Pump (P1 and P2) Tests in the Hydraulic System chapter of this manual.
	The axle drive motor is worn or damaged.	Repair or replace the axle drive motor.
	Note: If a traction circuit component has internal wear or damage, it is possible that the other traction components are also damaged.	
High range traction speed will not engage.	An electrical problem exists in the solenoid valve (SV1) circuit.	Test and replace the valve solenoid if necessary.
		Test the machine wire harness solenoid valve (SV1) circuit.
	Solenoid valve (SV1) in the main manifold is leaking or faulty.	Clean the solenoid valve and replace the seals
		Replace solenoid valve if necessary.

Traction System Problems (continued)

Problem	Possible Cause	Corrective Action
The parking brake cannot be disengaged with engine running.	An electrical problem exists in the solenoid valve (SV2) circuit.	Test and replace the valve solenoid if necessary.
		Test the machine wire harness solenoid valve (SV2) circuit.
	Solenoid valve (SV2) in the main manifold is leaking or faulty.	Clean the solenoid valve and replace the seals
		Replace solenoid valve if necessary.
The differential lock will not engage.	An electrical problem exists in the solenoid valve (SV3) circuit.	Test and replace the valve solenoid if necessary.
		Test the machine wire harness solenoid valve (SV3) circuit.
	Solenoid valve (SV3) in the main manifold is leaking or faulty.	Clean the solenoid valve and replace the seals.
		Replace solenoid valve if necessary.

Steering System Problems

Problem	Possible Cause	Corrective Action
Steering is sluggish, operates poorly or is inoperative.	Steering components (e.g., rod ends, steering cylinders, steering stops) are worn or binding.	Inspect steering components and repair or replace if necessary.
		Verify and adjust rod end and steering stop lengths and adjust if necessary.
	Oil supply to the steering control valve is insufficient (traction charge and lift circuits affected as well).	Verify charge pressure; refer to the InfoCenter SERVICE–INPUT/OUTPUT –TRACTION–TRACTION INPUTS FRONT TRACTION and REAR TRACTION readings while the machine is stationary.
		Verify gear pump (P4) performance; refer to Gear Pump (P4) Flow Text in the Hydraulic System chapter of this manual
	Relief valve (RV1) in the main manifold is stuck, leaking or damaged.	Clean the relief valve and replace the seals.
		Replace relief valve if necessary.
	Steering priority valve (EC1) in the main manifold is faulty.	Clean the relief valve and replace the seals.
		Replace the priority valve if necessary.
	Steering control valve is worn or damaged.	Rebuild or replace the steering control valve.
Turning steering wheel turns wheels in the wrong direction.	Hydraulic hoses to the steering cylinders are connected incorrectly.	Correct hydraulic hose connections.
Gear pumps (P3 and P4) are noisy from cavitation (steering, traction charge, lift circuit and attachment circuit performance are affected).	The hydraulic fluid level in the hydraulic tank is low (other hydraulic circuit performance is affected as well).	Adjust the hydraulic fluid level.
	The suction filter or suction line is damaged, loose, or clogged.	Secure, clean or replace the suction filter or suction line.

PTO System Problems

Problem	Possible Cause	Corrective Action
The PTO shaft will not engage.	An electrical problem exists in the proportional solenoid valve (EH) circuit.	Test and replace the valve solenoid if necessary.
		Test the machine wire harness proportional solenoid valve (EH) circuit.
	Proportional solenoid valve (EH) in the main manifold is stuck, leaking or faulty.	Clean the solenoid valve and replace the seals.
		Replace the solenoid valve if necessary.

3-Point Hitch System Problems

Problem	Possible Cause	Corrective Action
Hitch cylinders will not raise or raise slowly.	Engine speed is too low.	Increase engine speed.
	Hitch components are binding, worn or damaged.	Inspect hitch components and repair or replace if necessary.
	The hydraulic fluid level in the hydraulic tank is low (other hydraulic circuit performance is affected as well).	Adjust the hydraulic fluid level.
	Relief valve (RV2) in the main manifold is stuck, leaking or damaged.	Clean the relief valve and replace the seals.
	An electrical problem exists in the proportional solenoid valve (SP1) circuit.	Test and replace the valve solenoid if necessary.
		Test the machine wire harness proportional solenoid valve (SP1) circuit.
	Proportional solenoid valve (SP1) in the main manifold is stuck, leaking or faulty.	Clean the solenoid valve and replace the seals.
		Replace the solenoid valve if necessary.
	Hitch cylinder circuit pressure is low (traction charge and steering circuits affected as well).	Verify charge pressure; refer to the InfoCenter SERVICE–INPUT/OUTPUT –TRACTION–TRACTION INPUTS FRONT TRACTION and REAR TRACTION readings while the machine is stationary.
		Verify gear pump (P4) performance; refer to Gear Pump (P4) Flow Text in the Hydraulic System chapter of this manual
Hitch cylinders raise but will not stay up. **NOTE:** Hitch cylinders cannot provide a perfect seal. The lift arms will eventually lower if left supporting an attachment in the raised position during storage.	Proportional solenoid valve (SP1), (SP2), or check valve (CV2) in the main manifold is stuck, leaking or faulty.	Clean the valve(s) and replace the seals.
		Replace the valve(s) if necessary.
	A hitch cylinder is leaking internally.	Test and repair or replace the hitch cylinder if necessary.
Hitch cylinders will not lower.	An electrical problem exists in the proportional solenoid valve (SP2) circuit.	Test and replace the valve solenoid if necessary.
		Test the machine wire harness proportional solenoid valve (SP2) circuit.
	Proportional solenoid valve (SP2) in the main manifold is stuck, leaking or faulty.	Clean the solenoid valve and replace the seals.
		Replace the solenoid valve if necessary.
Gear pumps (P3 and P4) are noisy from cavitation (steering, traction charge, lift circuit and attachment circuit performance are affected).	The hydraulic fluid level in the hydraulic tank is low (other hydraulic circuit performance is affected as well).	Adjust the hydraulic fluid level.
	The suction filter or suction line is damaged, loose, or clogged.	Secure, clean or replace the suction filter or suction line.

Attachment/Loader Problems

Problem	Possible Cause	Corrective Action
Attachment cylinder or motor operates poorly or is inoperative.	A mechanical problem exists with the attachment cylinder or motor application that affects operation (for example: binding or worn pivots, arms, linkage, or couplings).	Inspect attachment components and repair or replace if necessary.
	Relief valve in auxiliary load valve is stuck, leaking or damaged.	Clean the relief valve and replace the seals.
	If a selector control valve kit (optional) is installed:	
	– An electrical problem exists in the selector control solenoid valve circuit.	Test and replace the valve solenoids if necessary.
		Test the machine wire harness selector control solenoid valve circuit.
	– Selector control solenoid valve(s) are stuck, leaking or faulty.	Clean the solenoid valve(s) and replace the seals.
		Replace the solenoid valve if necessary.
	Attachment cylinder or motor is worn or damaged.	Test and repair or replace the attachment cylinder or motor if necessary.
	Auxiliary load valve is worn or damaged.	Repair or replace the auxiliary load valve.
	Gear pump (P3) is worn or damaged.	Verify gear pump (P3) performance; refer to Gear Pump (P3) Flow Test in the Hydraulic System chapter of this manual.
Attachment cylinder or motor operates in reverse.	Hydraulic hoses to the steering cylinders are connected incorrectly.	Correct hydraulic hose connections.

Attachment/Loader Problems (continued)

Problem	Possible Cause	Corrective Action
Loader cylinder operates poorly or is inoperative.	A mechanical problem exists with the loader cylinder that affects operation (example: binding or worn pivots, arms, linkage, or couplings).	Inspect loader components and repair or replace if necessary.
	Relief valve in auxiliary load valve is stuck, leaking or damaged.	Clean the relief valve and replace the seals.
	If a selector control valve kit (optional) is installed:	
	– An electrical problem exists in the selector control solenoid valve circuit.	Test and replace the valve solenoids if necessary.
		Test the machine wire harness selector control solenoid valve circuit.
	– Selector control solenoid valve(s) are stuck, leaking or faulty.	Clean the solenoid valve(s) and replace the seals.
		Replace the solenoid valve if necessary.
	Loader cylinder is worn or damaged.	Test and repair or replace the loader cylinder if necessary.
	Auxiliary load valve is worn or damaged.	Repair or replace the auxiliary load valve.
	Loader valve is worn or damaged.	Repair or replace the loader valve.
	Gear pump (P3) is worn or damaged.	Verify gear pump (P3) performance; refer to Gear Pump (P3) Flow Test in the Hydraulic System chapter of this manual.
Loader cylinder operates in reverse.	Hydraulic hoses to the steering cylinders are connected incorrectly.	Correct hydraulic hose connections.
Gear pumps (P3 and P4) are noisy from cavitation (steering, traction charge, lift circuit and attachment circuit performance are affected).	The hydraulic fluid level in the hydraulic tank is low (other hydraulic circuit performance is affected as well).	Adjust the hydraulic fluid level.
	The suction filter or suction line is damaged, loose, or clogged.	Secure, clean or replace the suction filter or suction line.

Chapter 4

Engine

Table of Contents

Additional Reference Materials

Yanmar TNV (Tier 4) Series Service Manual

Yanmar Tier 4 and Stage V TNV Troubleshooting Manual

General Information

This chapter provides information for repairing the various systems that support the Yanmar diesel engine used in the Outcross 9060. The general maintenance procedures are described in the *Operator's Manual* and the *Yanmar TNV Series Operation Manual* supplied with the machine. Detailed information on engine troubleshooting, testing, disassembly, and assembly is identified in the *Yanmar TNV (Tier 4) Series Service Manual* and the *Yanmar TNV (Tier 4) Series Troubleshooting Manual*.

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

Service and repair parts for the Yanmar engines are supplied through your Authorized Toro Distributor. Copies of the traction unit *Parts Catalog* for this machine are available at www.toro.com.

Traction Unit Operator's Manual

The traction unit *Operator's Manual* provides information regarding basic engine operation, general engine maintenance, and engine maintenance intervals for your machine. Refer to the traction unit *Operator's Manual* for additional information.

Yanmar Service and Troubleshooting Manuals

The engine that powers your Outcross 9060 machine is a Yanmar Model 4TNV86CT, a Tier 4 compliant engine. The *Yanmar TNV (Tier 4) Series Service Manual* and the *Yanmar TNV (Tier 4) Series Troubleshooting Manual* are available for this engine. Ensure that the correct engine manuals are used when servicing the engine on your machine.

Shutting Off the Engine

IMPORTANT

The engine used on the Outcross 9060 machine is a turbo-charged diesel engine. Before shutting off the engine after full-load operation, allow the engine to run at low-idle speed for 2 minutes. This allows the turbocharger and internal engine components to adequately cool-down. Failure to allow this cool-down period may lead to premature turbocharger and engine failure.

Engine Electronic Control Unit (ECU)

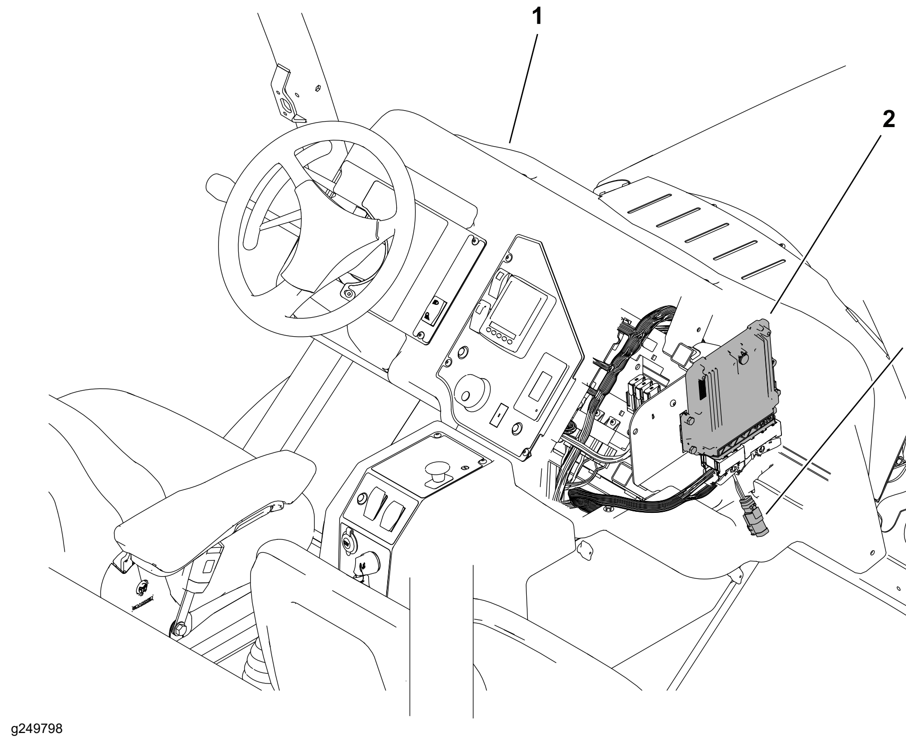


Figure 7

1. Dash cover
2. Engine ECU
3. Yanmar SA-D connector

The Yanmar engine that powers your Outcross 9060 machine uses an Electronic Control Unit (ECU) for engine management. The primary controller (T1: TEC), the status display controller (T2: TDM), the Yanmar Engine Control Unit (ECU), the InfoCenter display, and the optional InchMode controller (T3: TEC) used on the Outcross 9060 machine communicate with each other on a Controller Area Network (CAN) bus system. 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.

A variety of engine electrical components (e.g., ECU, fuel injectors, EGR sensor, exhaust DPF sensor, etc.) are identified and matched in the engine ECU program. If engine electrical components are replaced on the engine, the Yanmar SmartAssist–Direct tool (SA-D) must be used to update the ECU program to ensure correct engine operation. The Yanmar SA-D connector is located near the engine ECU, under the dash cover in the passenger foot well.

If the engine ECU identifies that an engine problem exists, an engine fault will be displayed on the T2: TDM screen and the engine speed may be reduced, or the engine might stop. The *Yanmar TNV (Tier 4) Series Troubleshooting Manual* and the Yanmar SmartAssist–Direct tool (SA-D) should be used to help identify the cause of the problem, and the repairs that may be necessary. Contact your Toro distributor for assistance in Yanmar engine troubleshooting.

IMPORTANT

Do not disconnect the engine ECU for 60 seconds after the machine key switch is turned off. The engine ECU may remain energized even though the key switch is in the OFF position.

Yanmar Engine

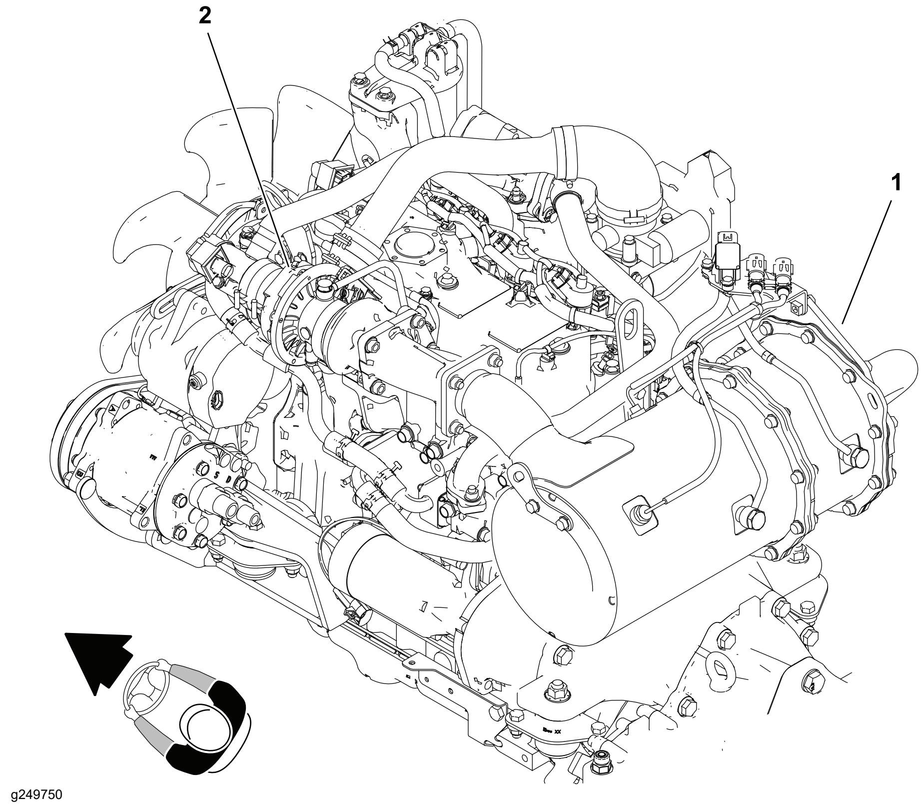


Figure 8

1. Diesel particulate filter (DPF)
2. Turbocharger

The engine used on Outcross 9060 machine is a Yanmar TNV Series, turbocharged, diesel engine that complies with EPA Tier 4F emission regulations. The engine features include an electronic control unit (ECU) that controls a common rail fuel injection system, an exhaust gas recirculation (EGR) system, an electronic governor, a diesel exhaust particulate filter (DPF), and a turbocharger. Glow plugs are used to assist starting the engine. Numerous engine sensors are used to allow the ECU to monitor and control the engine operation for optimum engine performance.

During the operation of the engine, if conditions warrant, the ECU may generate an engine fault; refer to Machine and Engine Faults (page 3–6). Use the *Yanmar Tier 4 and Stage V TNV Troubleshooting Manual* and the Yanmar SmartAssist–Direct tool (SA-D) to help identify the cause of the problem and the repairs that may be necessary. Contact your authorized Toro Distributor for assistance.

Diesel Particulate Filter

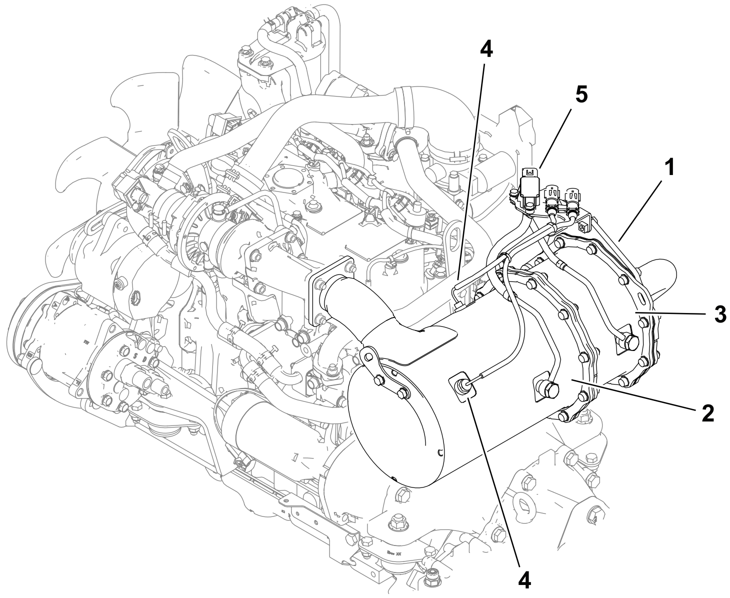


Figure 9

1. Diesel Particulate Filter assembly (DPF)
2. Diesel Oxidation Catalyst (DOC)
3. Soot filter
4. Temperature sensor (2 each)
5. Pressure differential sensor

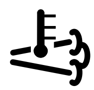
The diesel particulate filter (DPF) used on Yanmar Tier 4F compliant engines is designed to break down the hazardous elements in the exhaust and prevent the discharge of unburned fuel or oil known as particulate matter or soot. The DPF includes a Diesel Oxidation Catalyst (DOC), a Soot Filter (SF), 2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

Regeneration

The engine ECU monitors the exhaust pressure before and after the soot filter in the DPF to determine if soot is accumulating. If soot is accumulating during normal engine operation, the pressure differential will increase. The increase in pressure will signal the engine to begin a process called regeneration. Regeneration increases the exhaust temperature and the length of time the engine operates at a higher-than-normal exhaust temperature, incinerating the accumulated 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). The length of time the engine will operate at a higher-than-normal exhaust temperature to burn out the soot is also related to the amount of particulate matter in the soot filter.

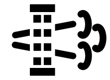
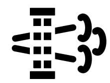
Regeneration (continued)

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. Passive regeneration occurs as part of normal engine operation. The InfoCenter does not display an icon during passive regeneration. While operating the machine, run the engine at full-engine speed and high load, when possible, to promote DPF regeneration.
Assist	Occurs because of prolonged operation at low engine speed, low engine load, or when the engine ECU detects the soot filter is becoming obstructed.	The engine ECU adjusts the exhaust intake throttle to raise the exhaust temperature. The InfoCenter does not display an icon during assist regeneration.
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.	 The InfoCenter displays the high exhaust temperature icon. The engine ECU adjusts the exhaust intake throttle and the injector timing to raise the exhaust temperature. Do not shut off the engine or reduce the engine speed while the reset regeneration is processing.

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 occur because the InfoCenter was set to inhibit reset regeneration and machine operation continued, adding more soot to the DPF after a reset regeneration was requested. May be caused by prolonged operation at low engine speed, low engine load, or the use of incorrect fuel or engine oil. Can be initiated when prompted by the engine ECU or manually after a minimum of 50 hours of engine operation.	 The InfoCenter displays the stationary regeneration icon. Manually initiate a parked regeneration as soon as possible. A parked regeneration will take approximately 30 to 60 minutes and should not be started with less than 1/4 tank of fuel. The machine must remain stationary (cannot be operated) during the entire parked regeneration process.
Recovery	Occurs when exhaust back pressure in the DPF increases due to soot buildup reaching a critical level. May occur because parked regeneration requests were ignored and machine operation continued, adding more soot to the DPF after a parked regeneration was requested. Can only be initiated when prompted by the engine ECU.	 The InfoCenter displays the stationary regeneration icon. 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.

Refer to the traction unit *Operator's Manual* for additional DPF regeneration information, and instructions for using the InfoCenter DPF Regeneration Menus.

Soot Accumulation

If the types of regeneration that are performed automatically (while the machine is operating) are not allowed to complete, 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 T2: TDM display, the engine output power will be reduced.

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 T2: TDM display, the engine output power will be reduced.

Service and Repairs

Air Cleaner System

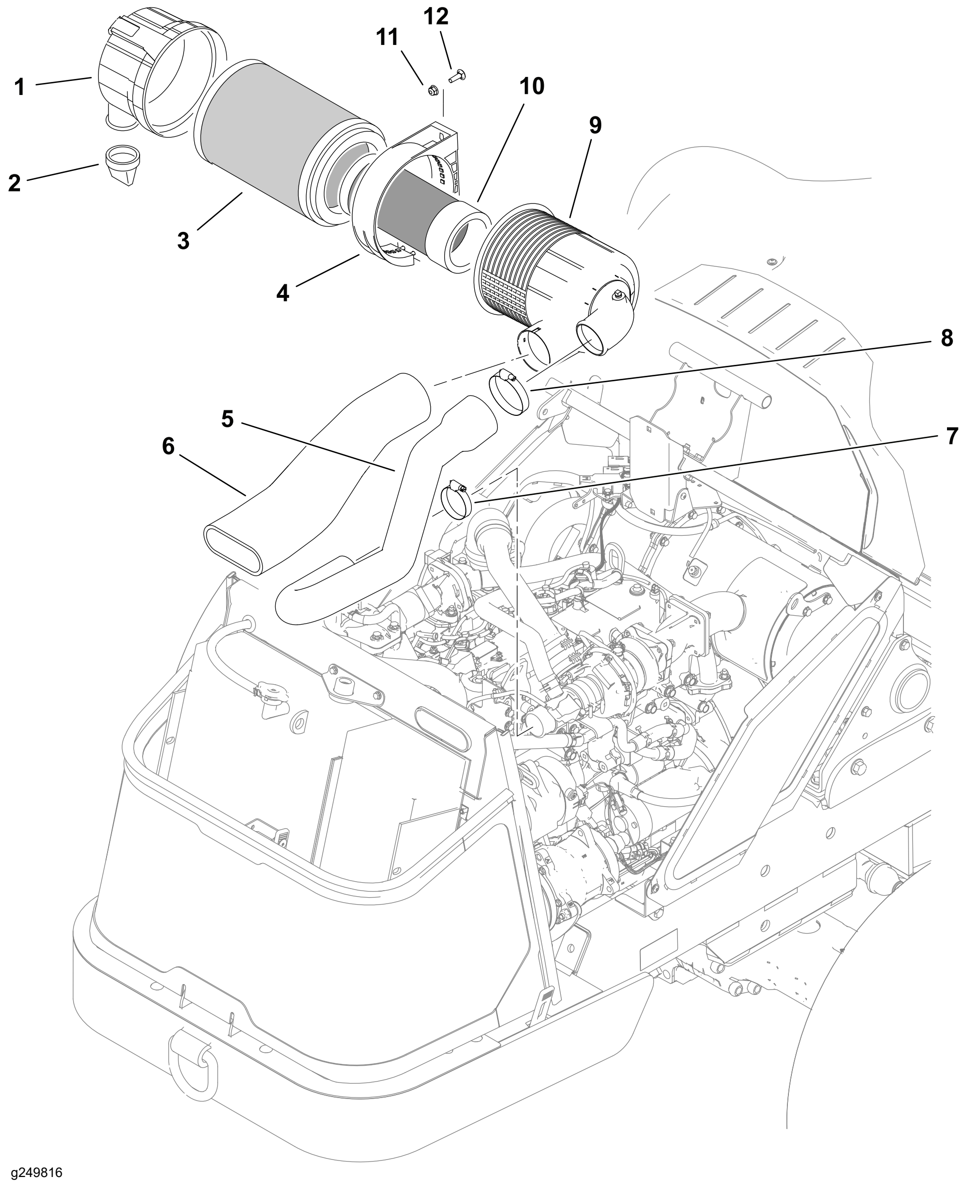


Figure 10

1.	Cover	7.	Hose clamp
2.	Vacuator valve	8.	Hose clamp
3.	Element	9.	Body
4.	Air cleaner mounting band	10.	Pre-cleaner
5.	Engine Intake hose	11.	Flange nut (2 each)
6.	Air cleaner inlet hose	12.	Carriage screw (2 each)

Removing and Installing the Air Cleaner System

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

1. Remove the air cleaner components as necessary.
2. Examine the air cleaner assembly for wear or damage that could possibly cause air leaks.

Removing and Installing the Air Cleaner System (continued)

3. Examine the hoses for wear or damage and replace them if necessary.
4. Examine the hood and radiator/oil cooler seals for wear or damage and replace the seals if necessary.

IMPORTANT

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

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5. Assemble the air cleaner components as shown in Figure 10.

Exhaust System

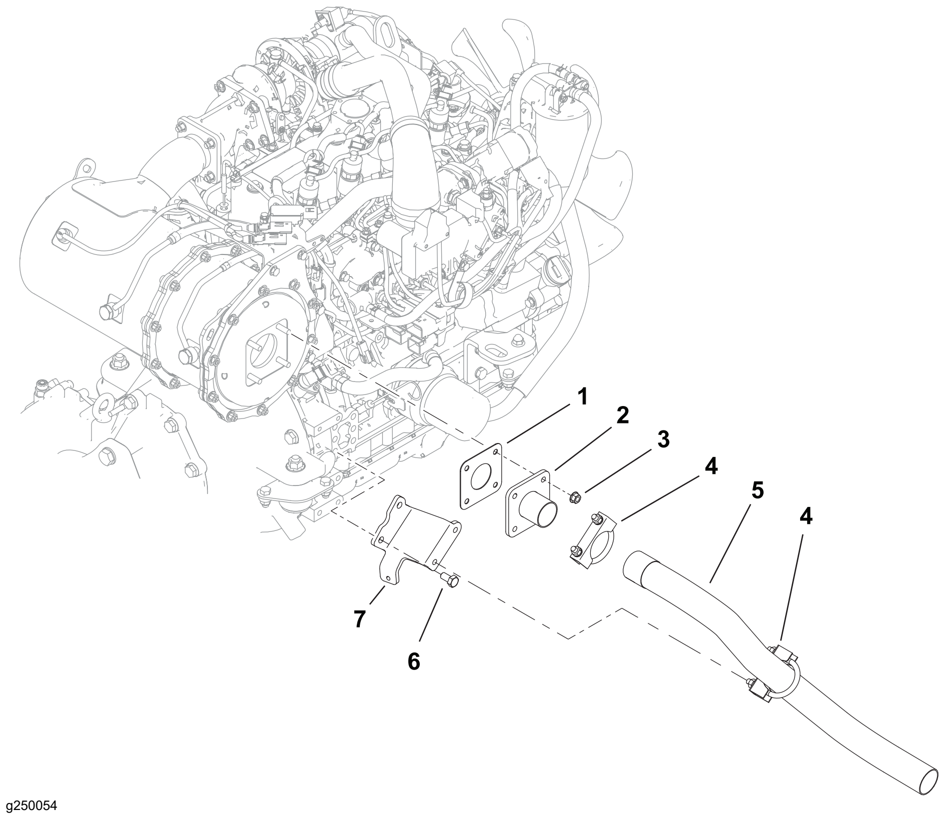

Figure 11

1. Gasket
2. Flange
3. Flange nut (4 each)
4. Muffler clamp (2 each)
5. Exhaust pipe
6. Capscrew (2 each)
7. Exhaust bracket

The engine that powers your Outcross 9060 machine is equipped with an exhaust system that includes a Diesel-Particulate Filter (DPF). The DPF includes a Diesel Oxidation Catalyst (DOC), a Soot Filter (SF), 2 temperature sensors, and a pressure differential sensor. The diesel-particulate filter (DPF) is kept clean through a series of regeneration processes that are controlled by the engine ECU; refer to Diesel Particulate Filter (page 4–5).

Reconditioning the soot filter (SF) may be necessary over the life of the machine which will require exhaust system disassembly. Soot filter reconditioning should be done by a company that has the necessary equipment. Contact your Toro Distributor for information on reconditioning the soot filter.

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.

Information about the diesel-particulate filter (DPF) operation and maintenance can be found in the *Yanmar TNV (Tier 4) Series Service Manual* and the *Yanmar Tier 4 and Stage V TNV Troubleshooting Manual*.

Radiator

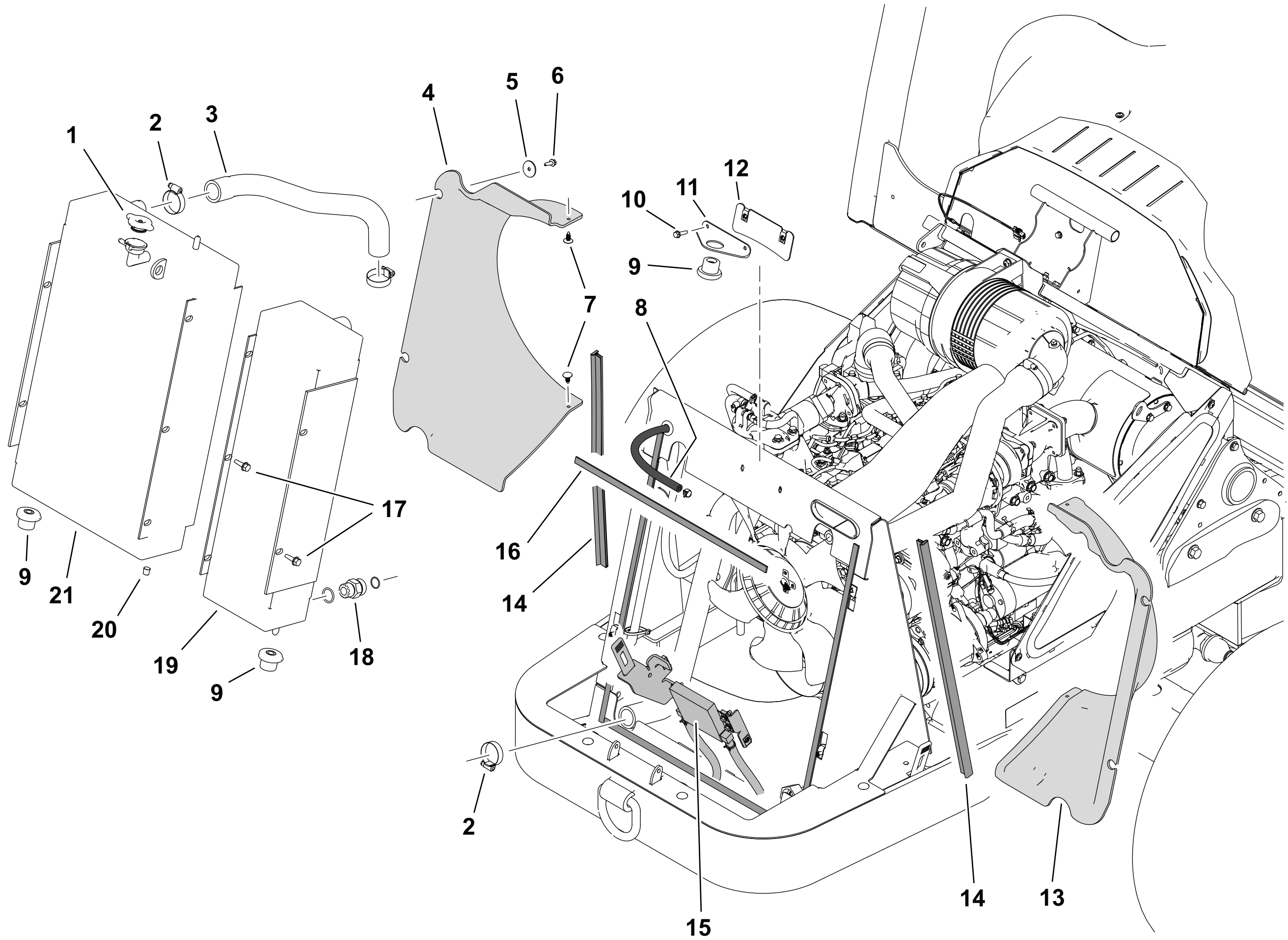

Figure 12

1.	Radiator cap	8.	Hose – coolant reservoir	15.	Fuel cooler assembly
2.	Hose clamp (2 each)	9.	Isolator mount (3 each)	16.	Foam seal (4 each)
3.	Upper radiator hose	10.	Flange-head screw(2 each)	17.	Flange-head screw (4 each)
4.	Fan shroud – right	11.	Bracket – top	18.	Straight hydraulic fitting (2 each)
5.	Flat washer (4 each)	12.	Nut plate – top	19.	Hydraulic fluid cooler
6.	Flange-head screw (4 each)	13.	Fan shroud – left	20.	Pipe plug
7.	Panel fastener (2 each)	14.	Bulb seal (2 each)	21.	Radiator

The radiator on your Outcross 9060 is combined with the hydraulic fluid cooler. The procedure for removing and installing the radiator and hydraulic fluid cooler as an assembly is provided.

Note: If desired, the radiator and hydraulic fluid cooler may be separated from each other in the machine and removed individually.

Removing the Radiator and Hydraulic Fluid Cooler

1. Park the machine on a level surface, lower any attachments, shut off the engine, and remove the key from the key switch.
2. Raise and latch the hood, then remove the front screen; refer to Removing and Installing the Front Screen (page 8–3).

DANGER

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

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

WARNING

Ethylene-glycol antifreeze is poisonous.

Keep the coolant away from children and pets.

Keep the coolant in a labelled container.

Discard the coolant in accordance with local hazardous waste ordinances.

3. Drain the coolant from the radiator.
4. Disconnect the upper and lower radiator hoses from the radiator. Disconnect the reservoir hose at the radiator. Cover or plug the disconnected coolant hoses to prevent contamination.

   Note: The lower hydraulic hose can be easily disconnected at the bulkhead below the vehicle frame.
5. Refer to General Precautions for Removing and Installing the Hydraulic System Components (page 5–65) and disconnect the hydraulic lines from the cooler.
6. Remove the fasteners securing the fuel cooler assembly to the hydraulic fluid cooler and move the fuel cooler out of the way.
7. Remove the top nut plate, top bracket, isolator mount and the fan shrouds.
8. Carefully remove the radiator and hydraulic fluid cooler assembly from the machine.
9. If necessary, remove the hydraulic fittings from the hydraulic fluid cooler and discard the O-rings.
10. Cover or plug the openings in the hydraulic fluid cooler and radiator to prevent contamination from entering the system.
11. Inspect the isolator mounts and all seals on the radiator frame and replace as necessary.

Installing the Radiator and Hydraulic Fluid Cooler

1. Lubricate new O-rings and place them onto the hydraulic fittings. If previously removed, install the fittings into the cooler ports using alignment marks made during removal; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–11).
2. Position the radiator and hydraulic fluid cooler assembly over the lower isolator mounts.
3. Install the isolator mount, top bracket, and top nut plate.
4. Install the fan shrouds. Center the fan shroud around the fan blades before tightening the shroud fasteners.

Installing the Radiator and Hydraulic Fluid Cooler (continued)

5. Secure the fuel cooler assembly to the hydraulic fluid cooler.
6. Remove the covers and plugs from the openings in the radiator and the hydraulic fluid cooler and the disconnected coolant and hydraulic lines that were installed during removal.
7. Connect the hydraulic lines to the hydraulic fluid cooler.
8. Connect the upper and lower radiator hoses and the reservoir hose to the radiator and secure the hoses with the hose clamps.
9. Fill the reservoir with coolant; refer to the traction unit *Operator's Manual*.
10. Add hydraulic fluid to the hydraulic reservoir as necessary; refer to the traction unit *Operator's Manual*.
11. Start the engine and check for coolant and hydraulic fluid leaks. Repair any leaks as required.
12. Continue to run the engine to obtain the operating temperature. Check the coolant and hydraulic fluid levels and adjust as necessary before returning the machine to service.
13. Install the front screen.

Fuel System

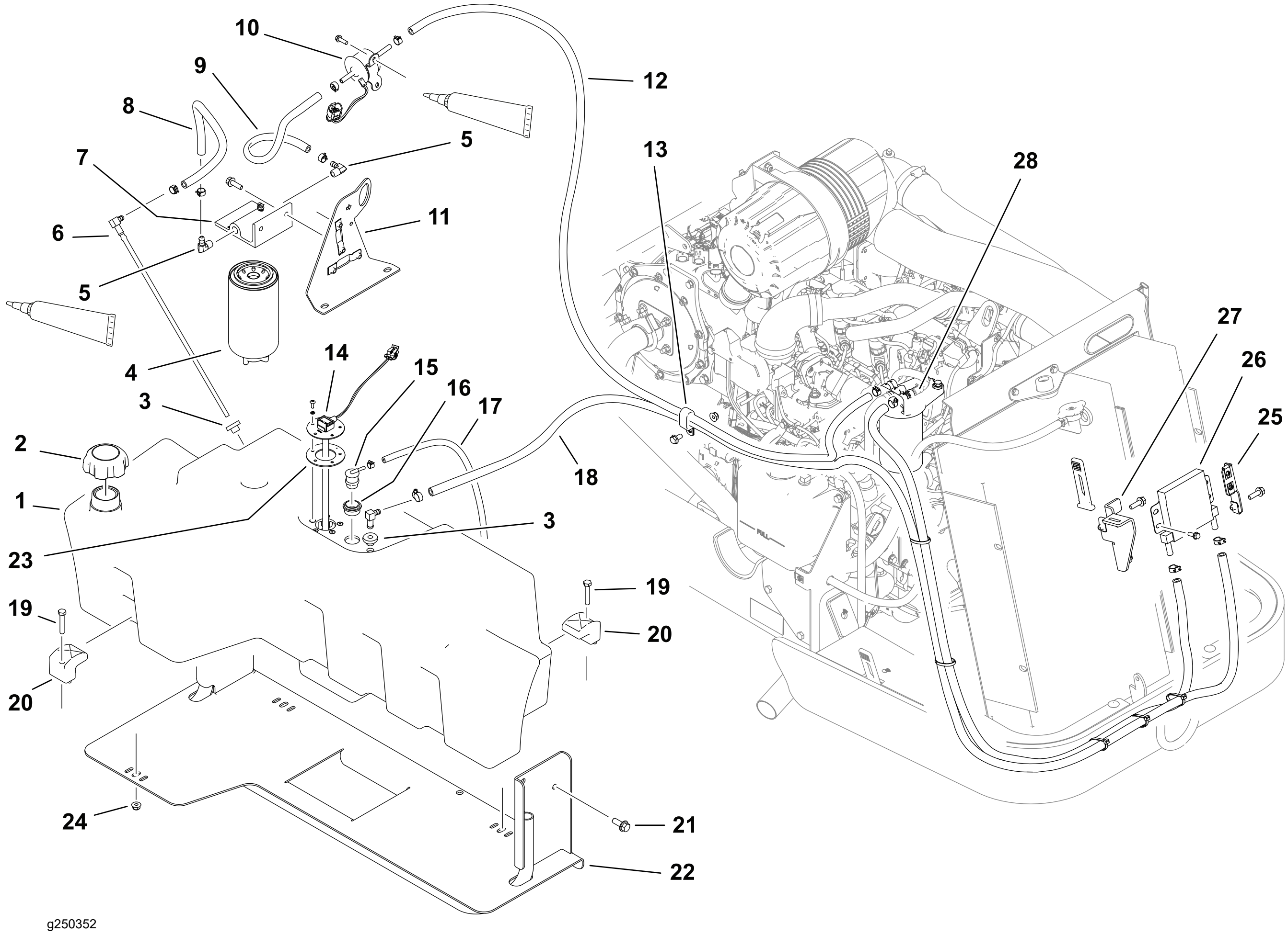

Figure 13

1.	Fuel tank	11.	Separator and pump bracket	21.	Flange-head screw (4 each)
2.	Fuel tank cap	12.	Fuel hose – fuel pump to fuel filter	22.	Tank support bracket
3.	Rubber bushing (2 each)	13.	Clamp	23.	Fuel sender gasket
4.	Fuel/water separator	14.	Fuel level sender	24.	Flange nut (3 each)
5.	90° elbow fitting (2 each)	15.	Rollover valve	25.	Fuel cooler bracket – LH
6.	Standpipe	16.	Grommet	26.	Fuel cooler
7.	Fuel/water separator head	17.	Vent hose	27.	Fuel cooler bracket – RH
8.	Fuel hose – standpipe to separator head	18.	Fuel hose – fuel cooler to tank	28.	Fuel filter
9.	Fuel hose – separator head to fuel pump	19.	Capscrew (3 each)		
10.	Electric fuel pump	20.	Clamp (3 each)		

The fuel system includes a fuel tank with an electric fuel level sender on the right side of the machine, a fuel/water separator and a low pressure electric fuel pump located behind the fuel tank, a fuel filter, a mechanical high pressure fuel pump at the front right side of the engine, and a fuel cooler located in front of the hydraulic fluid cooler assembly. For testing procedures for the low pressure electric fuel pump and the electric fuel level sender; refer to Electrical Component Testing (page 6–14).

⚠ DANGER ⚠

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

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

Checking the Fuel Lines and Connections

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

Priming the Fuel System

The fuel system needs to be primed before starting the engine for the first time, after running out of fuel, or after fuel system maintenance (e.g., draining the fuel/water separator, replacing the fuel filter, or disconnecting a fuel hose).

IMPORTANT

Do not turn the key switch to the START position to prime the fuel system.

To prime the fuel system:

1. Ensure that the fuel tank has fuel in it.
2. Rotate the key switch to the RUN position for 10 to 15 seconds.

IMPORTANT

Do not start the engine.

Note: The electric fuel pump to primes the fuel system.

Removing and Installing the Fuel Tank

1. Park the machine on a level surface, lower any attachments, shut off the engine, and remove the key from the key switch.
2. Unlatch and raise the hood.
3. Remove the front right fender.
4. Remove the right step.
5. Empty the fuel tank through the filler neck.
6. Support the fuel tank, then remove the 4 support bracket screws. Lower the fuel tank and bracket a few inches.

Removing and Installing the Fuel Tank (continued)

7. Disconnect the wire harness connection from the fuel sender.

IMPORTANT

To prevent damage to the fuel hoses, numerous cable ties and clamps are used to secure the hoses to the machine components. Record the location of all cable ties and clamps that are removed from the machine so they can be properly replaced.

8. Label the fuel hoses for assembly purposes. Loosen the hose clamps and disconnect the hoses from the fuel tank.
9. Cover or plug the fuel hoses or fitting openings to prevent contamination from entering the fuel system.
10. Lower the tank and support bracket to the ground. Separate the tank and bracket by removing the 3 clamps if necessary.
11. If the fuel level sender is removed, use a new gasket when installing the fuel sender.
12. If the elbow fittings are removed from the fuel/water separator head, apply thread sealant to the fittings when installing.
13. To install the fuel tank, follow this procedure in reverse order.

Engine

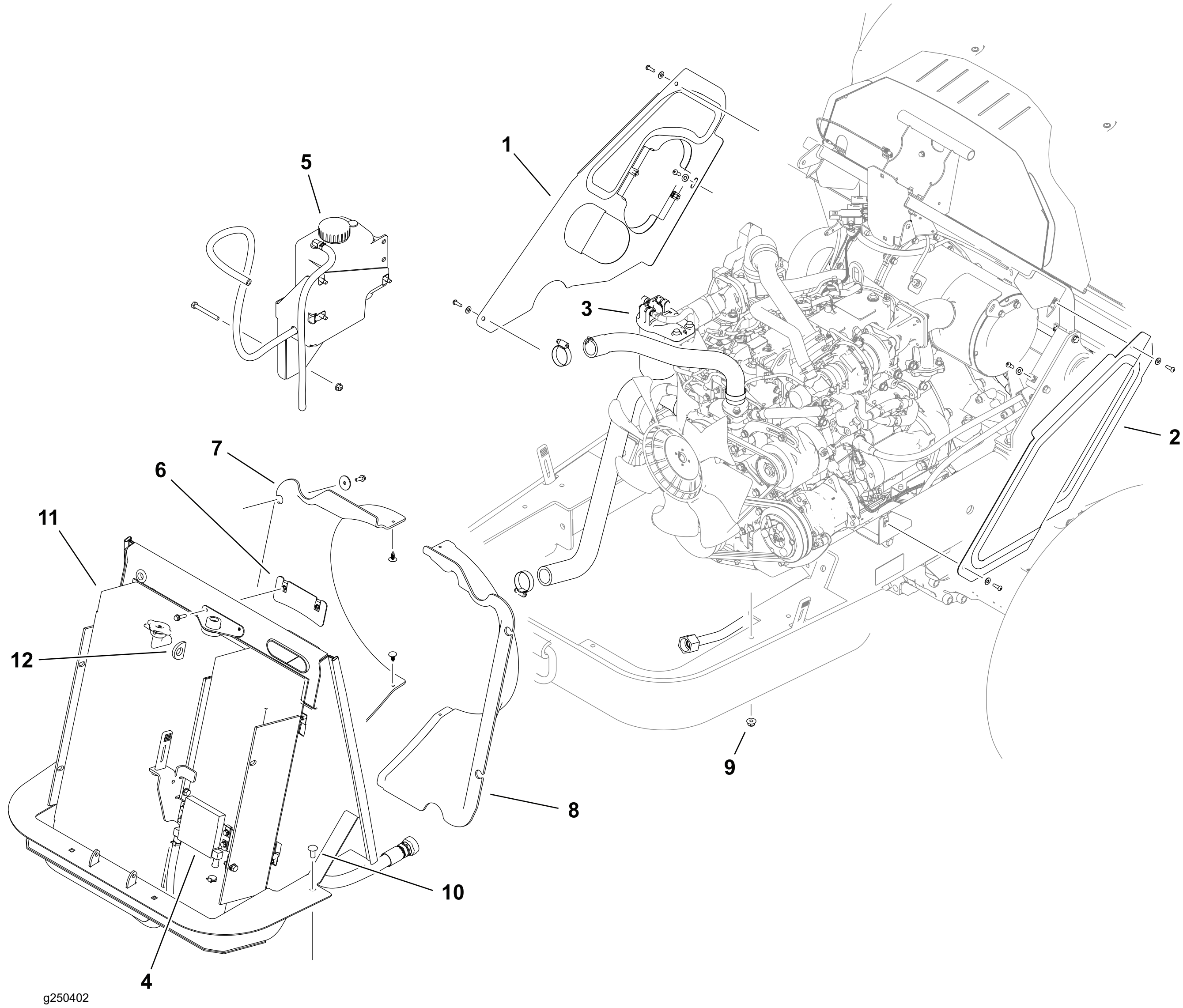

Figure 14

1. Side shield – RH	5. Coolant reservoir assembly	9. Flange nut (4 each)
2. Side shield – LH	6. Top nut plate	10. Carriage screw (4 each)
3. Fuel filter	7. Fan shroud – RH	11. Radiator and mount assembly
4. Fuel cooler	8. Fan shroud – LH	12. Lifting lug

Removing the Engine, PTO Gearbox, and Tandem Piston (Traction) Pump.

Preparing the Air Conditioning System—Machines with a Cab

Recover the refrigerant in accordance with local regulations.

IMPORTANT

Do not allow refrigerant to discharge into the atmosphere. Before opening or disconnecting parts from the refrigerant circuit, reclaim the refrigerant into a specified recovery cylinder, and dispose of it correctly.

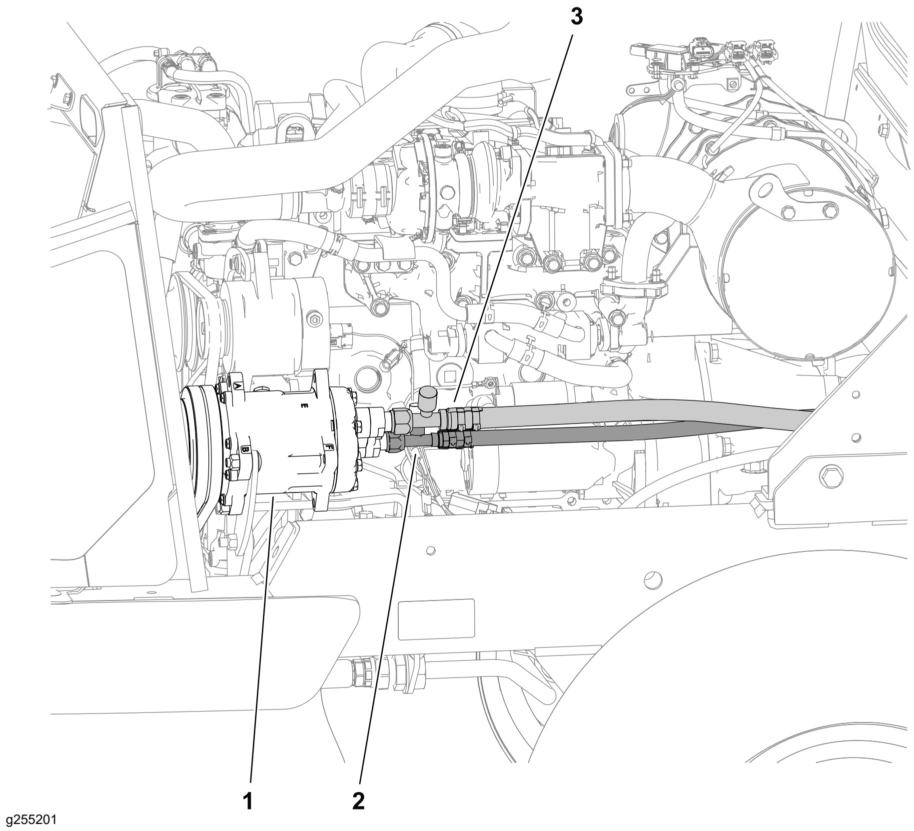

Figure 15

1. Compressor
2. Refrigerant hose (high side)
3. Refrigerant hose (low side)

Preparing the Machine.

1. Park the machine on a level surface.
2. If installed, remove the front loader, and lower rear counterweight to the ground.
3. If installed, remove the rear attachment from the 3-point hitch or the draw bar.
4. Remove the standard utility box; refer to Standard Utility Box (page 8–35), or the optional cargo bed; refer to the *Installation Instructions*.
5. Disconnect the battery; refer to Removing the Battery (page 6–83).
6. Remove the hood; refer to Removing and Installing the Hood (page 8–5).
7. Remove the front screen; refer to Removing and Installing the Front Screen (page 8–3).
8. Remove the left side shield and right side shield; refer to Figure 14.
9. Remove the air cleaner assembly and 2 air hoses; refer to Removing and Installing the Air Cleaner System (page 4–8).
10. Remove the flange and exhaust tube from the diesel-particulate filter of the engine, loosen the muffler clamp at the exhaust bracket, and remove the exhaust tube from the machine; refer to Exhaust System (page 4–10).

Disconnecting the Fuel Hoses.

IMPORTANT

To prevent damage to the fuel hoses, numerous cable ties and clamps are used to secure the hoses to the machine components. Record the location of all cable ties and clamps that are removed from the machine so they can be properly replaced.

Disconnect the fuel hoses; refer to Fuel System (page 4–14):

1. Disconnect the hose between the engine fuel filter and the fuel cooler at the engine fuel filter.
2. Disconnect the hose between the electric fuel pump and the engine fuel filter at the engine fuel filter.
3. Disconnect the hose between the fuel cooler and the fuel tank at the fuel cooler.
4. Cover or plug the fuel hoses or fitting openings to prevent contamination from entering the fuel system.

Removing the Cooling System.

DANGER

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

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

WARNING

Ethylene-glycol antifreeze is poisonous.

Keep the coolant away from children and pets.

Keep the coolant in a labelled container.

Discard the coolant in accordance with local hazardous waste ordinances.

1. Disconnect the reservoir hose at the radiator and remove the coolant reservoir assembly (Figure 14).
2. Drain the coolant from the radiator.
3. Disconnect the upper and lower radiator hoses from the radiator. Cover or plug the disconnected coolant hoses to prevent contamination.
4. Refer to General Precautions for Removing and Installing the Hydraulic System Components (page 5–65) and disconnect the hydraulic lines from the cooler.

   Note: The lower hydraulic hose can be easily disconnected at the bulkhead below the vehicle frame.

Removing the Engine, PTO Gearbox, and Tandem Piston (Traction) Pump. (continued)

5. Remove the bolts securing the rear clamp bracket to the radiator mount. Remove the 4 bolts and washers that secure the fan shrouds to the radiator mount, and remove the fan shroud. Loosely assemble the rear clamp bracket to the radiator mount (Figure 14).
6. Remove the 4 flange nuts and carriage screws securing the radiator mount assembly to the frame, and remove the radiator mount and radiator from the machine.

Disconnecting the Cables and Engine Harness.

1. Remove the flange nut that secures the positive battery cable to the starter solenoid, and separate the cable from the solenoid.

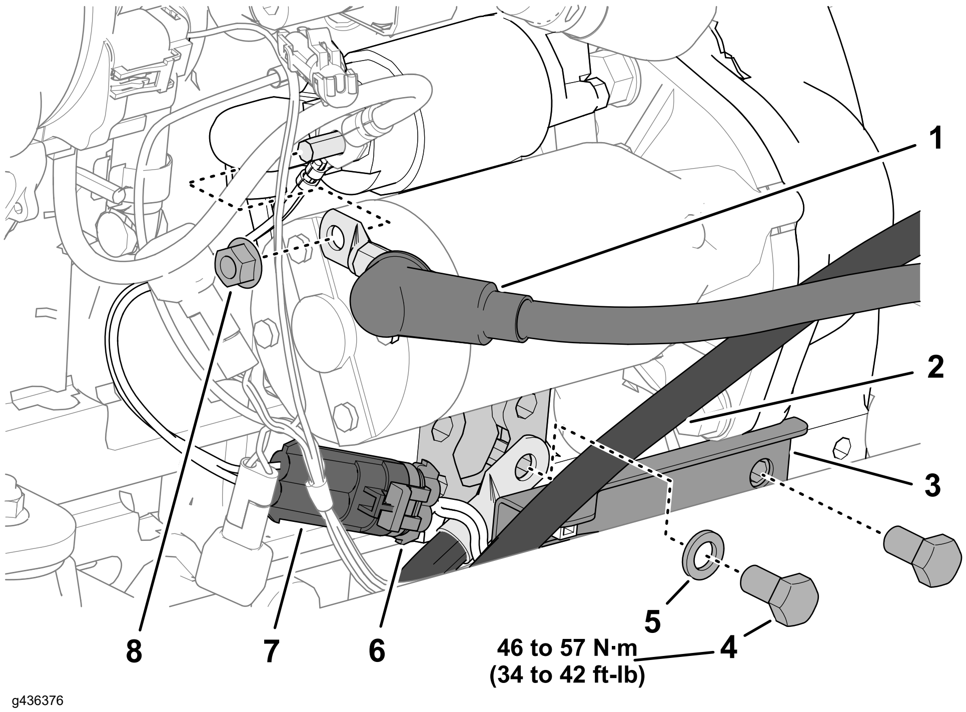

Figure 16

1. Positive battery cable
2. Ground cable
3. Harness bracket
4. Capscrew
5. Washer
6. Main harness connector P22
7. Fusible link harness connector
8. Flange nut

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2. Thread the flange nut onto the stud of the starter solenoid to retain the engine harness terminal and alternator cable.
3. Remove the harness bracket from engine block.
4. Below the starter, unplug the main harness connector P22 from the starter (B+) connector.
5. Remove the ground cable assembly from engine block.
6. Remove the screw that secures the DPF connector bracket to the cowl mount.

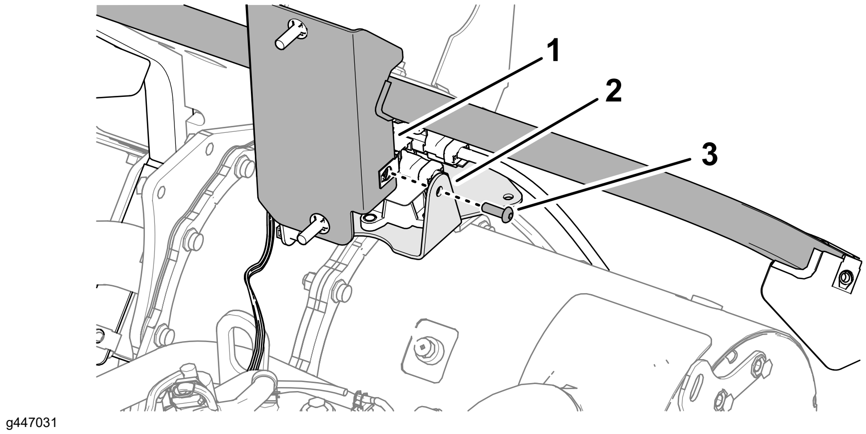

Figure 17

1. Cowl mount
2. Screw
3. DPF connector bracket

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7. If installed, unplug the main harness from the optional horn.

Removing the Operator’s Platform or Cab.

Perform the following procedures found in Removing the Operator’s Platform or Cab:

1. Disconnecting the Hydraulic Manifold Hoses (page 8–8)
2. Disconnecting the Electrical Harnesses (page 8–8)
3. Preparing the Console Controls (page 8–11)
4. Disconnecting the Steering Hoses (page 8–12)
5. Disconnecting the Heating and Air Conditioning Hoses—Machines with a Cab (page 8–12)
6. Separating the Operator’s Platform or Cab from the Frame of the Machine (page 8–14)

Disconnecting the Driveshaft.

Disconnect the driveshaft from the PTO gearbox hub, and slide the driveshaft rearward.

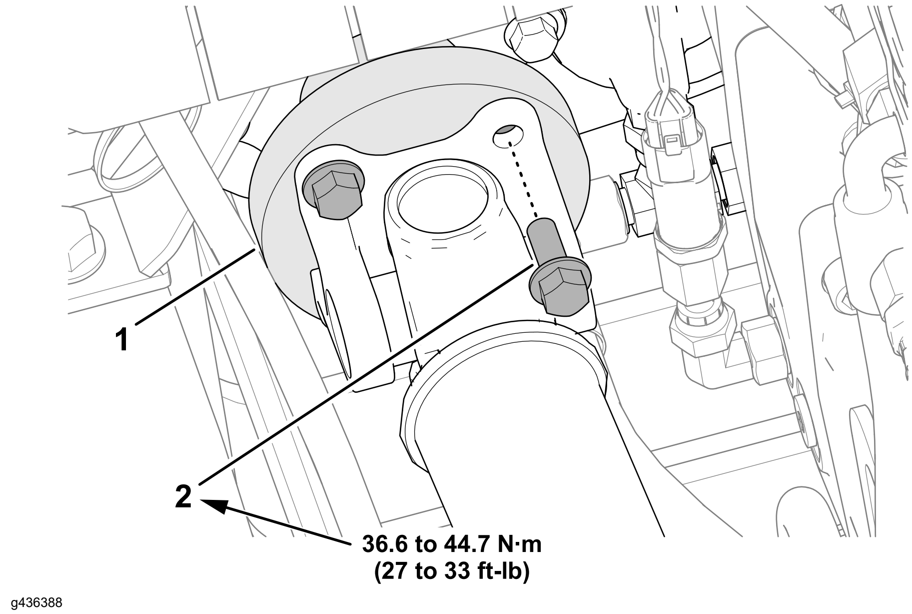


Figure 18

1. PTO gearbox hub
2. Capscrew

Disconnecting the Dual Gear Pump.

Note: If you need to remove the dual gear pump from the machine, refer to Removing the Dual Gear Pump (P3) and (P4) (page 5–86).

1. Disconnect the hose from the fitting at the top, rear port of the dual gear pump. Cap the fitting and plug the hose, and label it.

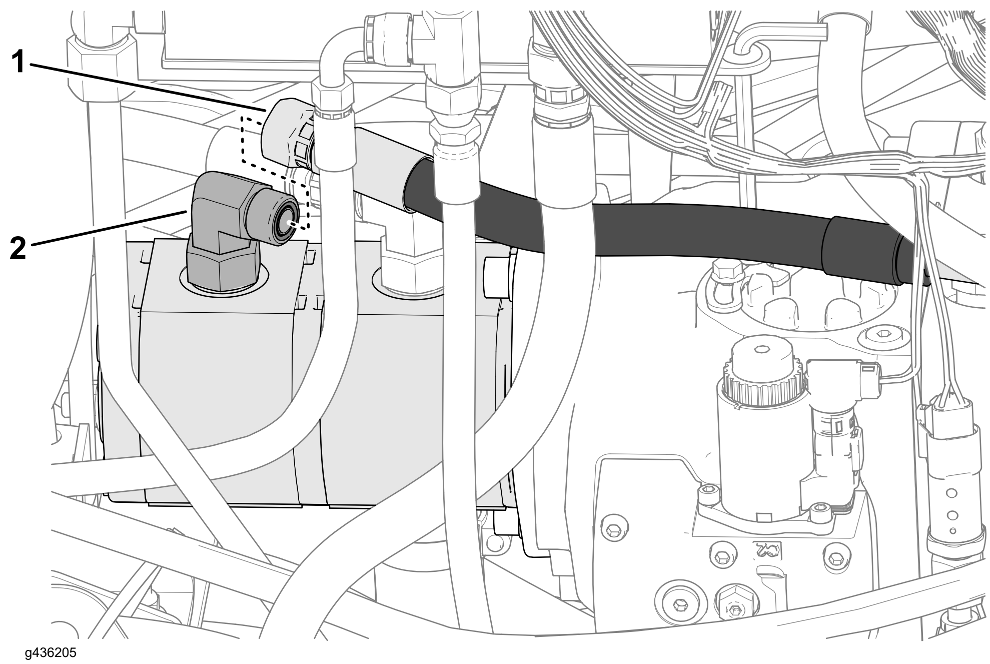


Figure 19

1. Hose
2. Fitting (rear gear pump port)

---

2. Remove 2 socket-head screws and washers that secure the dual gear pump to the traction pump, and separate the pumps.

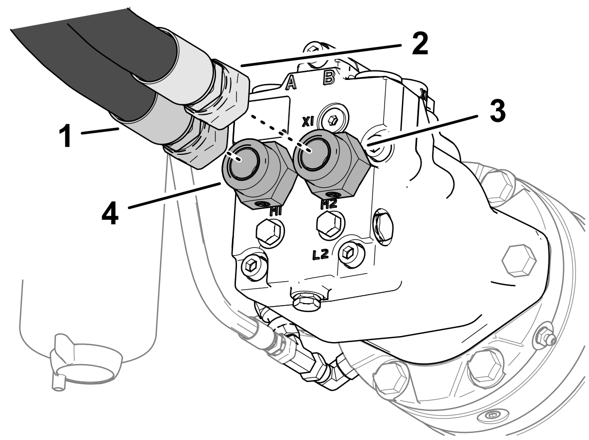
3. Support the dual gear pump.
4. Locate and retrieve the pump drive coupler and O-ring from the traction pump. Discard the O-ring.

Draining the Rear Axle Drive Motor Hoses

1. Disconnect the hydraulic hose from the fitting in port A of the rear axle drive motor.

Model/Serial Table (Figure 20)

Model	Serial Range	Rear Axle Drive Motor Port	Pressure Circuit	Tandem Piston (Traction) Pump Port
07511AA, 07511BA, 07511CA, and 07511DA	400000000 through 409999999	A	Forward	C
		B	Reverse	D



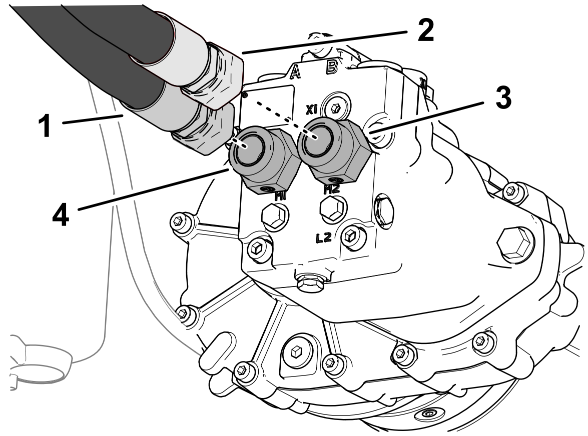
g438178

Figure 20

1. Hydraulic hose (forward)
2. Hydraulic hose (reverse)
3. Port B fitting
4. Port A fitting

Model/Serial Table (Figure 21)

Model	Serial Range	Rear Axle Drive Motor Port	Pressure Circuit	Tandem Piston (Traction) Pump Port
07511AA, 07511BA, 07511CA, and 07511DA with Gearbox Reduction Kit 144-9700	400000000 through 409999999	A	Reverse	D
		B	Forward	C
07511AA, 07511BA, 07511CA, and 07511DA	410000000 and higher	A	Reverse	D
		B	Forward	C



g438177

Figure 21

1. Hydraulic hose (reverse)
2. Hydraulic hose (forward)
3. Port B fitting
4. Port A fitting

---

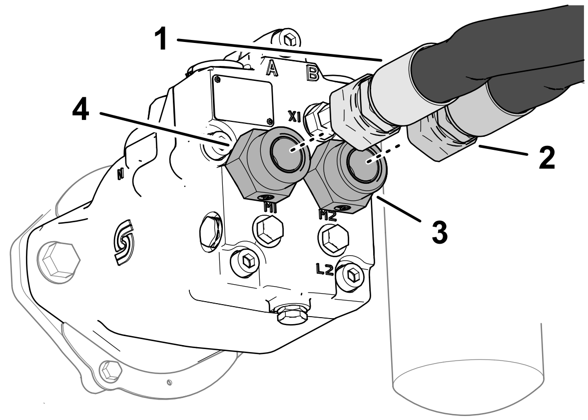
2. Allow the hydraulic fluid to drain from the hose.
3. Install the hydraulic hose to the fitting in port A of the rear axle drive motor.
4. Disconnect the hydraulic hose from the fitting in port B of the rear axle drive motor.
5. Allow the hydraulic fluid to drain from the hose.
6. Install the hydraulic hose to the fitting in port B of the rear axle drive motor.

Removing the Front Axle Drive Motor

1. Disconnect the hydraulic hose from the fitting in port A of the front axle drive motor.

Model/Serial Table (Figure 22)

Model	Serial Range	Rear Axle Drive Motor Port	Pressure Circuit	Tandem Piston (Traction) Pump Port
07511AA, 07511BA, 07511CA, and 07511DA	400000000 through 409999999	A	Forward	A
		B	Reverse	B



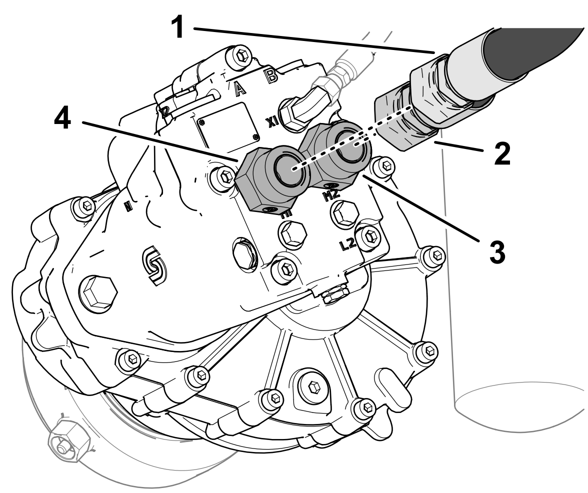
g438176

Figure 22

1. Hydraulic hose (forward)
2. Hydraulic hose (reverse)
3. Port B fitting
4. Port A fitting

Model/Serial Table (Figure 23)

Model	Serial Range	Rear Axle Drive Motor Port	Pressure Circuit	Tandem Piston (Traction) Pump Port
07511AA, 07511BA, 07511CA, and 07511DA with Gearbox Reduction Kit 144-9700	400000000 through 409999999	A	Forward	C
		B	Reverse	D
07511AA, 07511BA, 07511CA, and 07511DA	410000000 and higher	A	Forward	C
		B	Reverse	D



g438175

Figure 23

1. Hydraulic hose (forward)
2. Hydraulic hose (reverse)
3. Port B fitting
4. Port A fitting

2. Allow the hydraulic fluid to drain from the hose. Plug the hose, cap the axle motor fitting, and label hose for reassembly.
3. Disconnect the hydraulic hose from the fitting in port B of the rear axle drive motor.
4. Allow the hydraulic fluid to drain from the hose. Plug the hose, cap the axle motor fitting, and label hose for reassembly.
5. Remove the axle drive motor; refer to the following:
   - Removing the Axle Drive Motor (Machines with an Axle-Drive Gearbox) (page 5–92)
   - Removing the Axle Drive Motor (Machines without an Axle-Drive Gearbox) (page 5–94)

Disconnecting the Hydraulic Hoses

Note: Refer to General Precautions for Removing and Installing the Hydraulic System Components (page 5–65).

1. Thoroughly clean the exterior of the piston (traction) pump, gear pump, and all fittings and hose/tube connections.
2. At the left side of the tandem piston (traction) pump, unplug main harness connector P18 labeled FRONT TRACTION PRESSURE from the pressure transducer.

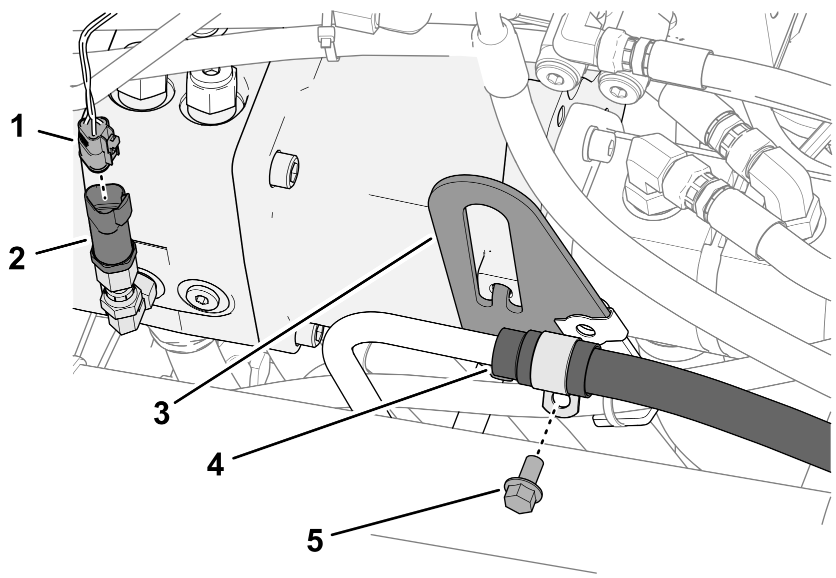


Figure 24

1. Main harness connector P18 (FRONT TRACTION PRESSURE)
2. Pressure transducer
3. Pump hanger plate
4. PTO gearbox case drain tube
5. Flange head capscrew

---

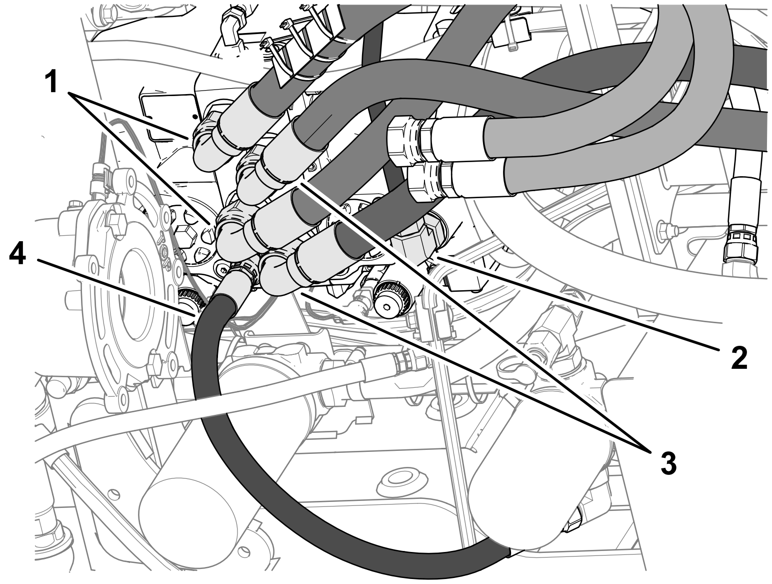
3. Remove the flange head capscrew that secures the support clamp for the hydraulic hose/tube assemble to the pump hanger plate.
4. Remove the front axle-drive gearbox, refer to Removing the Axle-Drive Gearbox (page 7–22).

Axle-Drive Gearbox Table

Axle-Drive Gearbox Table (continued)

Model	Serial Range
07511AA, 07511BA, 07511CA, and 07511DA with Gearbox Reduction Kit 144-9700	400000000 through 409999999
07511AA, 07511BA, 07511CA, and 07511DA	410000000 and higher

5. Disconnect the charge circuit hose from the fitting in port E of the tandem piston (traction) pump. Plug the hose, cap the pump fitting, and label hose for reassembly.



g437789

Figure 25

1. Front axle motor hoses
2. Case drain tube
3. Rear axle motor hoses
4. Charge filter hose

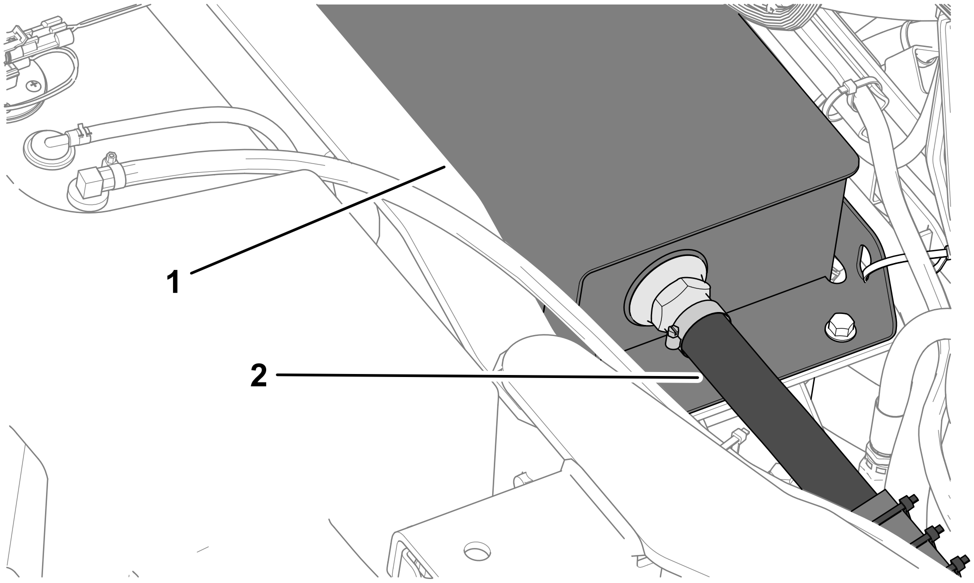
6. Disconnect the 2 rear axle motor hoses from the tandem piston (traction) pump fittings, then the 2 front axle motor hoses. Plug the hoses, cap the pump fittings, and label hoses with the port letters for reassembly.

Traction Pump Port Table

Traction Pump P1 (front axle motor ports)	Traction Pump P2 (rear axle motor ports)
Port A (forward) and Port B (reverse)	Port C (forward) and Port D (reverse)

7. Disconnect the case drain tube from the fitting in port L3 of the tandem piston (traction) pump. Cap and plug the traction pump fitting and hose (Figure 25).

8. Disconnect the PTO gearbox return hose from the fitting at the front of the hydraulic tank. Cap and plug the hydraulic tank fitting and hose.



g437836

Figure 26

1. Hydraulic tank
2. PTO gearbox return hose

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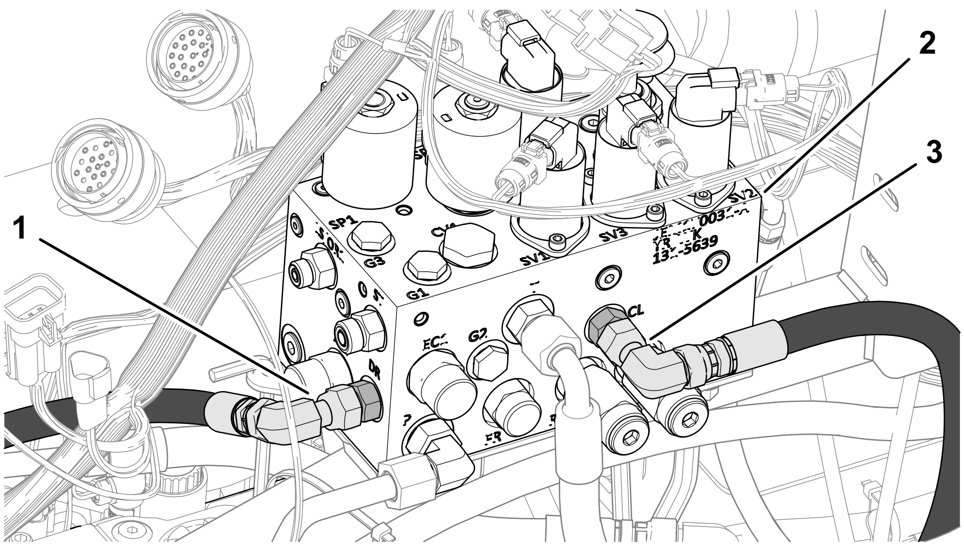
9. Disconnect the PTO gearbox drain hose from the fitting at main hydraulic manifold port DR. Cap and plug the manifold fitting and hose, and label the hose.



g437835

Figure 27

1. PTO gearbox drain hose
2. Main hydraulic manifold
3. PTO clutch pressure hose

---

10. Disconnect the PTO clutch pressure hose from the fitting at main hydraulic manifold port CL. Cap and plug the manifold fitting and hose.

Disconnecting the Main Harness Electrical Connectors

1. At the bottom of the machine, unplug main harness connector P25 labeled FRONT SPEED from the gear-tooth (speed) sensor in the hydraulic-motor mount. If needed, label wire harness connector.

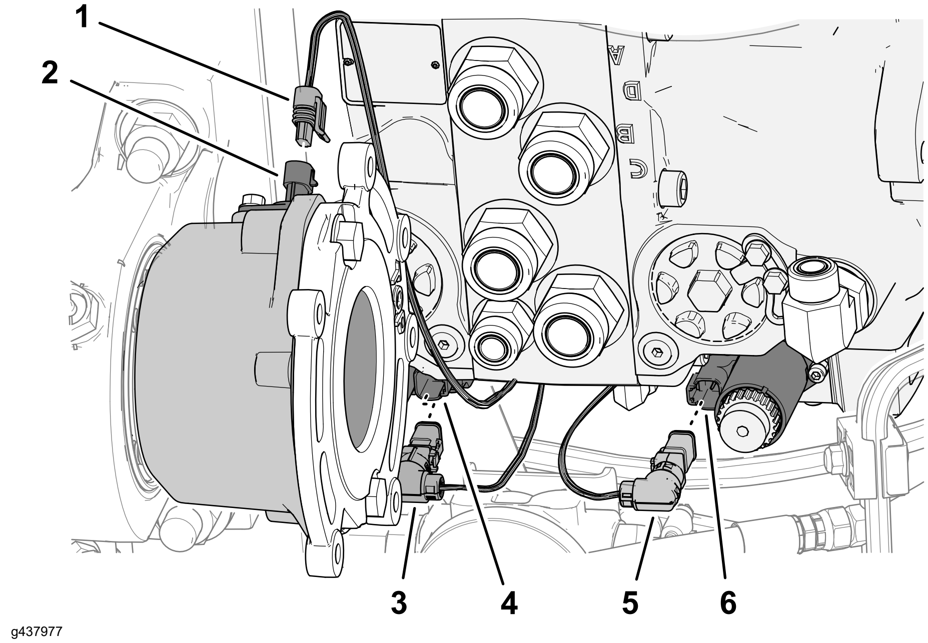


Figure 28

1. Main harness connector P25 (FRONT SPEED)
2. Gear-tooth (speed) sensor
3. Main harness connector P13 (FRONT REV HYDRO)
4. Solenoid (port AB-C2)
5. Main harness connector P14 (REAR FWD HYDRO)
6. Solenoid (port CD-C1)

2. Unplug main harness connector P13 labeled FRONT REVERSE SOLENOID from the solenoid at port AB-C2 of the tandem piston (traction) pump. If needed, label wire harness connector.
3. Unplug main harness connector P14 labeled REART FORWARD SOLENOID from the solenoid at port CD-C1 of the tandem piston (traction) pump. If needed, label wire harness connector.
4. At the top, right side of the tandem piston (traction) pump, unplug main harness connector P54 labeled REAR REV HYDRO from the solenoid at port AB-C1 of the traction pump. If needed, label wire harness connector.

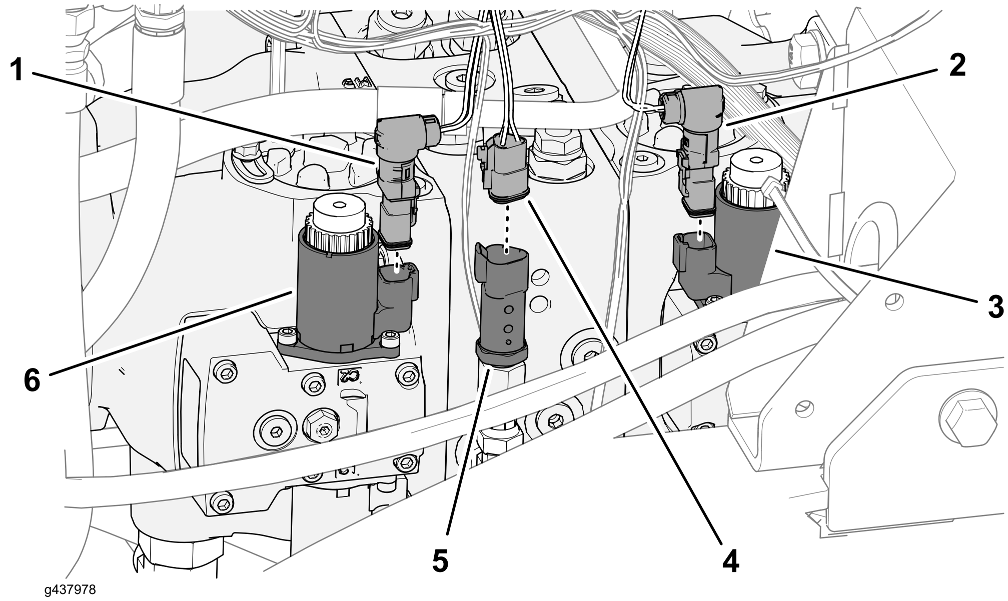


Figure 29

1. Main harness connector P54 (REAR REV HYDRO)
2. Main harness connector P10 (FRONT FWD HYDRO)
3. Solenoid (port CD-C2)
4. Main harness connector P17 (REAR TRACTION PRESSURE)
5. Pressure transducer
6. Solenoid (port AB-C1)

5. Unplug main harness connector P17 labeled REAR TRACTION PRESSURE from the pressure transducer. If needed, label wire harness connector.
6. Unplug main harness connector P10 labeled FRONT FWD HYDRO from the solenoid at port CD-C2 of the traction pump. If needed, label wire harness connector.

Removing the Engine, PTO Gearbox, and Tandem Piston Pump from the Machine.

CAUTION

The engine, PTO gearbox, and traction pump weigh approximately 280 kg (617 lbs).

Ensure that the load capacity of the hoist or lift, and load leveling bar used to remove the engine assembly can lift and support the specified weight.

1. Connect a suitable hoist or lift and load leveling bar to the front and rear lift brackets on engine. Do not allow the lift chains or straps to contact the diesel particulate filter.

Removing the Engine, PTO Gearbox, and Tandem Piston (Traction) Pump. (continued)

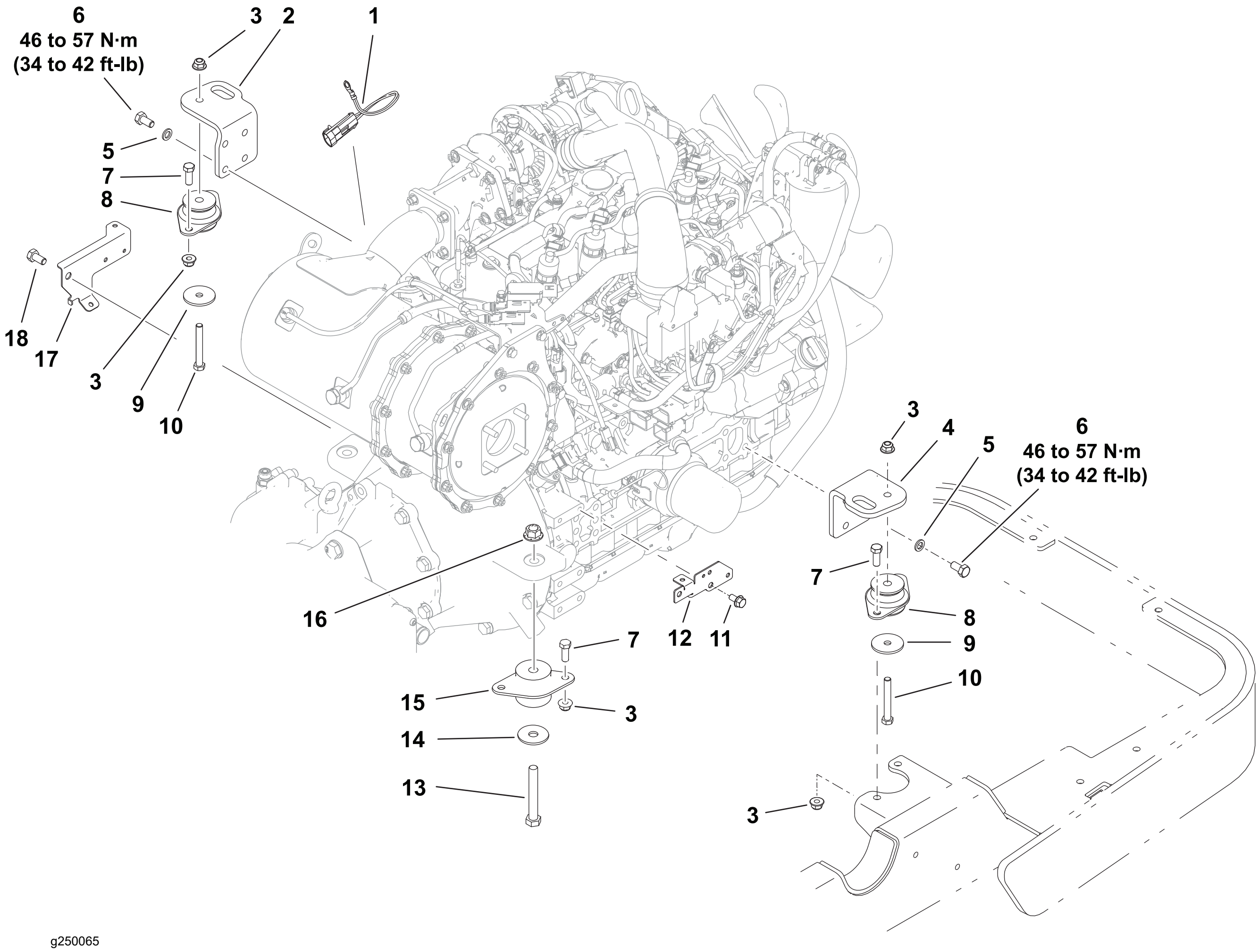


Figure 30

1.	Fusible link	7.	Capscrew (8 each)	13.	Bolt – rear (2 each)
2.	Bracket – front left (for machines without air conditioning shown)	8.	Engine mount – front (2 each)	14.	Snubbing washer – rear (2 each)
3.	Flange nut (10 each)	9.	Snubbing washer – front (2 each)	15.	Engine mount – rear (2 each)
4.	Bracket – front right	10.	Bolt – front (2 each)	16.	Flange nut (2 each)
5.	Lock washer (8 each)	11.	Flange-head screw	17.	Wire harness bracket
6.	Capscrew (8 each)	12.	Wire harness bracket	18.	Capscrew

2. Remove lock nuts, snubbing washers, and capscrews securing the engine brackets to the front engine mounts of the frame.
3. Remove lock nuts, snubbing washers, and capscrews securing the flywheel housing to the rear engine mounts of the frame.

CAUTION

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

Removing the Engine, PTO Gearbox, and Tandem Piston (Traction) Pump. (continued)

IMPORTANT

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

4. Carefully raise the engine, PTO gearbox, and tandem piston (traction) pump from the machine, moving it toward the front of the machine.
5. Cover or plug all engine openings to prevent contaminants from entering the engine.
6. Inspect the condition of the dampeners of the engine mounts.

   Note: Replace worn or damaged engine mounts.
7. Remove the additional wire harness and engine mount brackets from the engine as needed.

Removing Engine Installed Components.

Remove the following components as needed:

Removing the Tandem Piston (Traction) Pump.

Refer to Removing the Tandem Piston (Traction) Pump (P1) and (P2) (page 5–81).

Removing the PTO Gearbox.

Refer to Removing the Front PTO Gearbox (page 7–24).

Removing the Flywheel Housing.

Refer to Removing and Installing the Flywheel Housing and Drive Coupler (page 4–45).

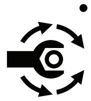
Installing the Engine, PTO Gearbox, and Traction Pump

Preparing the Engine.

IMPORTANT

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

Ensure that the following components are installed to the engine before installing it into the machine:

- 

  If front engine mount brackets were removed from the engine, install the brackets to engine, and tighten the fasteners from **46 to 57 N·m (34 to 42 ft-lb)**.
- Wire harness brackets: refer to Removing the Engine, PTO Gearbox, and Tandem Piston (Traction) Pump. (page 4–17).
- Flywheel housing: refer to Removing and Installing the Flywheel Housing and Drive Coupler (page 4–45)

- PTO gearbox: refer to Installing the Front PTO Gearbox (page 7–27).
- Tandem Piston (Traction) Pump; refer to Installing the Tandem Piston (Traction) Pump (P1) and (P2) (page 5–83).

Assembling the Engine, PTO Gearbox, and Traction Pump to the Machine.

CAUTION

The engine, PTO gearbox, and traction pump weigh approximately 280 kg (617 lbs).

Ensure that the load capacity of the hoist or lift, and load leveling bar used to remove the engine assembly can lift and support the specified weight.

CAUTION

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

1. Apply anti-seize lubricant to the dual gear pump drive coupler and the new O-ring, and install the O-ring onto the case of the pump.

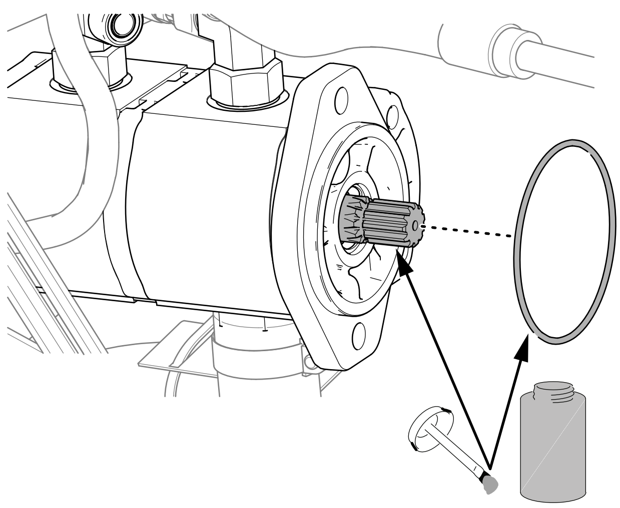


Figure 31

2. Connect a suitable hoist or lift and load leveling bar to the front and rear lift brackets on engine. Do not allow the lift chains or straps to contact the diesel particulate filter.
3. Carefully lower the engine into the machine, aligning the engine brackets to the front engine mounts of the frame, and the flywheel housing mount to the rear engine mount.

IMPORTANT

Carefully guide the hoses connected to the PTO gearbox rearward as you align the engine, PTO gearbox, and traction pump to the machine.

IMPORTANT

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

4. Install the capscrews, snubbing washers, and lock nuts securing the engine mounts to the engine brackets.

Connecting the Main Harness Electrical Connectors

1. At the top, right side of the tandem piston (traction) pump, plug main harness connector P54 labeled REAR REV HYDRO into the solenoid at port AB-C1 of the traction pump.

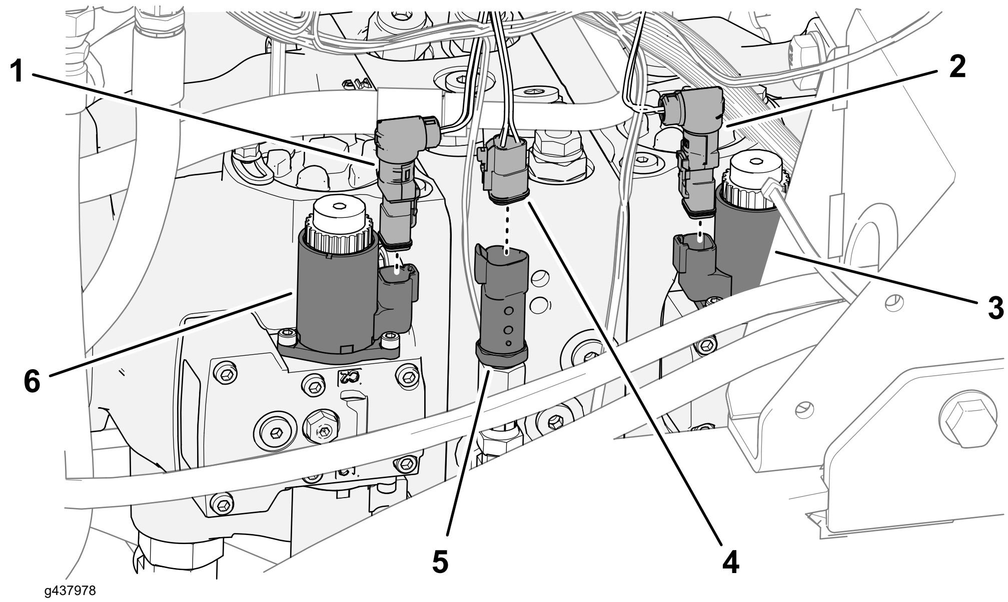


Figure 32

1.	Main harness connector P54 (REAR REV HYDRO)	4.	Main harness connector P17 (REAR TRACTION PRESSURE)
2.	Main harness connector P10 (FRONT FWD HYDRO)	5.	Pressure transducer
3.	Solenoid (port CD-C2)	6.	Solenoid (port AB-C1)

2. Plug main harness connector P17 labeled REAR TRACTION PRESSURE into the pressure transducer.
3. Plug main harness connector P10 labeled FRONT FWD HYDRO into the solenoid at port CD-C2 of the traction pump.
4. At the bottom of the machine, plug main harness connector P25 labeled FRONT SPEED into the gear-tooth (speed) sensor in the hydraulic-motor mount.

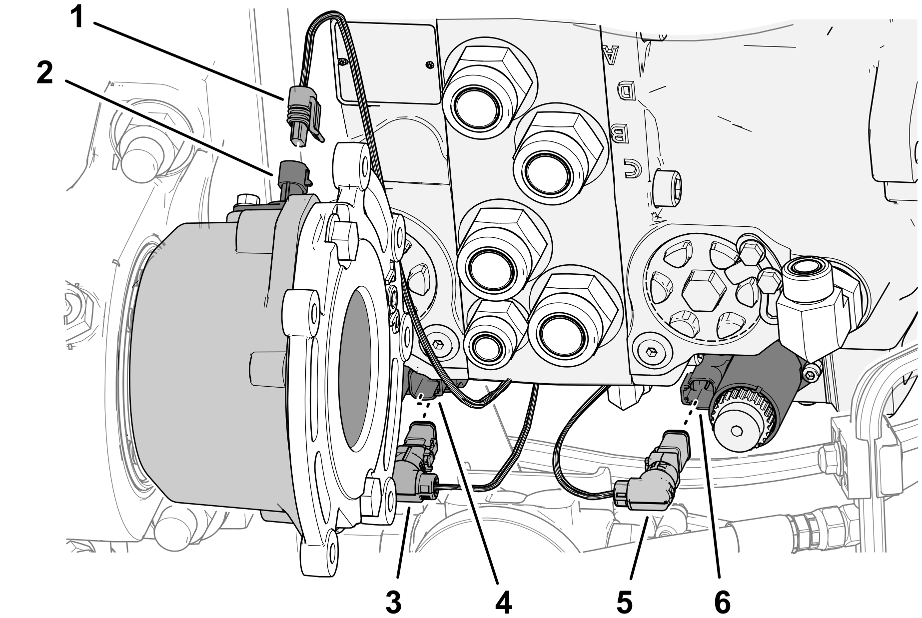


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Figure 33

1. Main harness connector P25 (FRONT SPEED)
2. Gear-tooth (speed) sensor
3. Main harness connector P13 (FRONT REV HYDRO)
4. Solenoid (port AB-C2)
5. Main harness connector P14 (REAR FWD HYDRO)
6. Solenoid (port CD-C1)

Connecting the Hydraulic Hoses.

1. At the top of the machine, install the PTO gearbox drain hose to the fitting at main hydraulic manifold port DR.

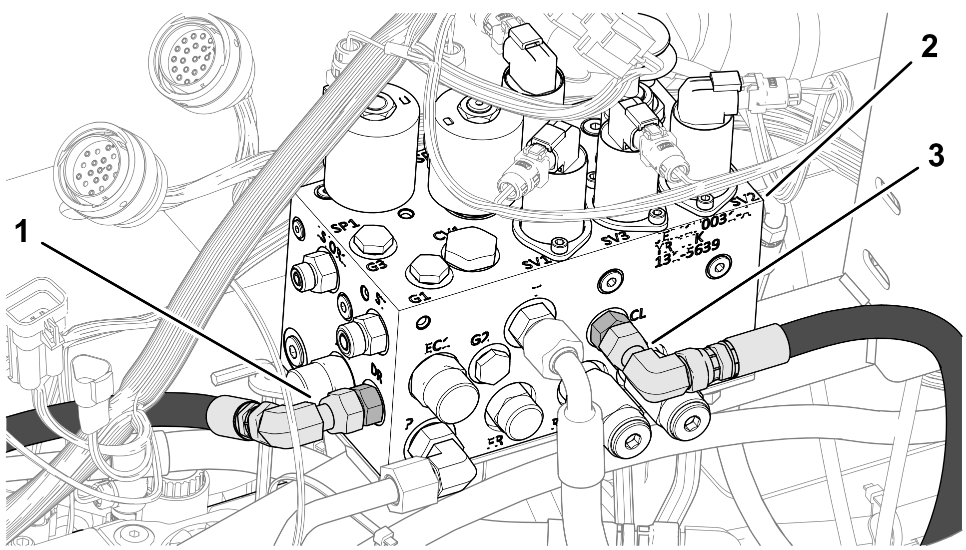

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Figure 34

1. PTO gearbox drain hose
2. Main hydraulic manifold
3. PTO clutch pressure hose

Installing the Engine, PTO Gearbox, and Traction Pump (continued)

2. Install the PTO clutch pressure hose to the fitting at main hydraulic manifold port CL.
3. At the right side of the machine, install the PTO gearbox return hose to the fitting at the front of the hydraulic tank.

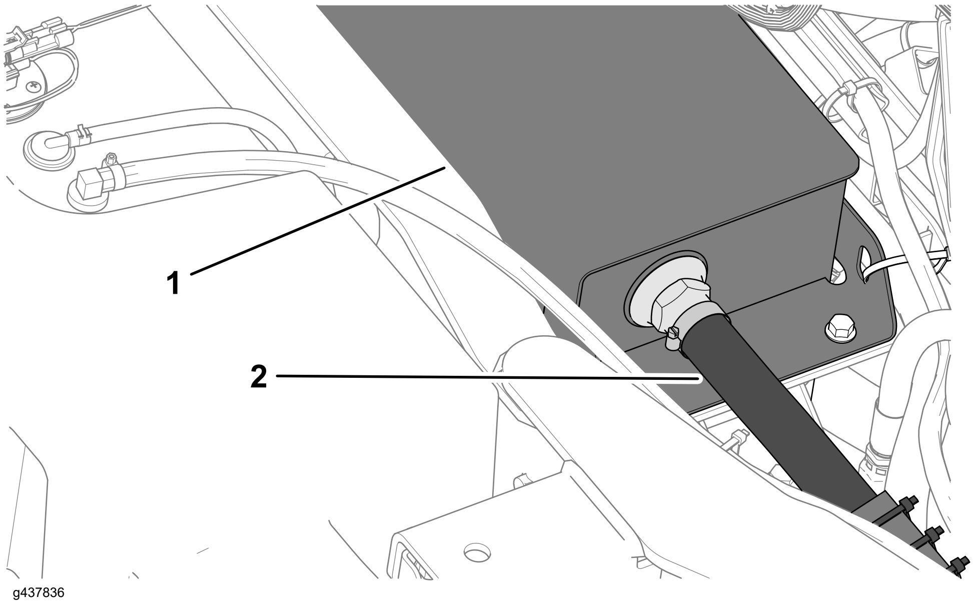

Figure 35

1. Hydraulic tank
2. PTO gearbox return hose

4. At the bottom of the machine, install the case drain tube to the fitting in port L3 of the tandem piston (traction) pump.

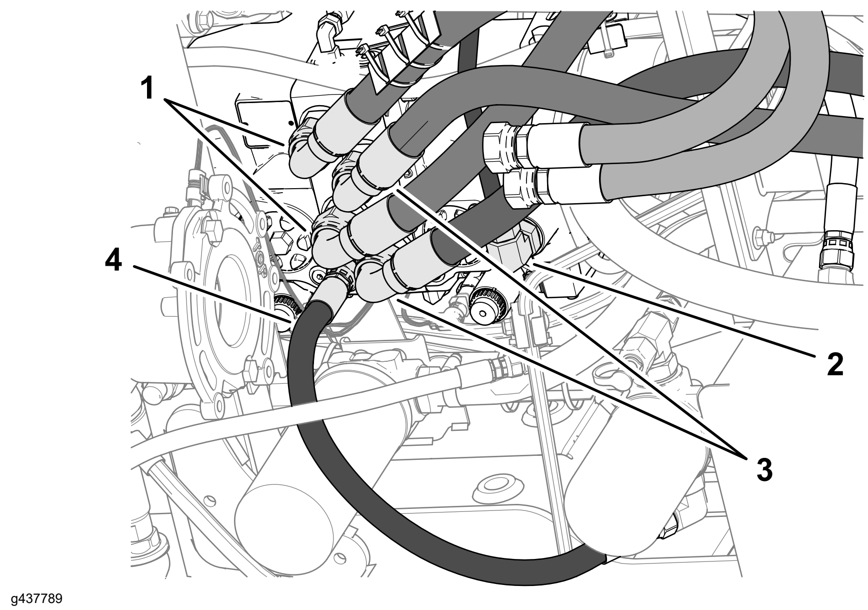

Figure 36

1. Front axle motor hoses
2. Case drain tube
3. Rear axle motor hoses
4. Charge filter hose

5. Install the hydraulic motor hoses to the fittings of the tandem piston (traction) pump fittings.

Traction Pump Port Table

Traction Pump P1 (front axle motor ports)	Traction Pump P2 (rear axle motor ports)
Port A (forward) and Port B (reverse)	Port C (forward) and Port D (reverse)

6. Install the charge circuit hose (from the hydraulic filter) to the fitting in port E of the tandem piston (traction) pump.
7. Install the front axle-drive gearbox, refer to Installing the Axle-Drive Gearbox (page 7–22).

Axle-Drive Gearbox Table

Model	Serial Range
07511AA, 07511BA, and 07511DA with Gearbox Reduction Kit 144-9700	400000000 through 409999999
07511CA with Gearbox Reduction Kit 144-9700	400000000 through 409999999
07511AA, 07511BA, 07511CA, and 07511DA	410000000 and higher

8. At the left side of the tandem piston (traction) pump, plug main harness connector P18 labeled FRONT TRACTION PRESSURE into the pressure transducer.

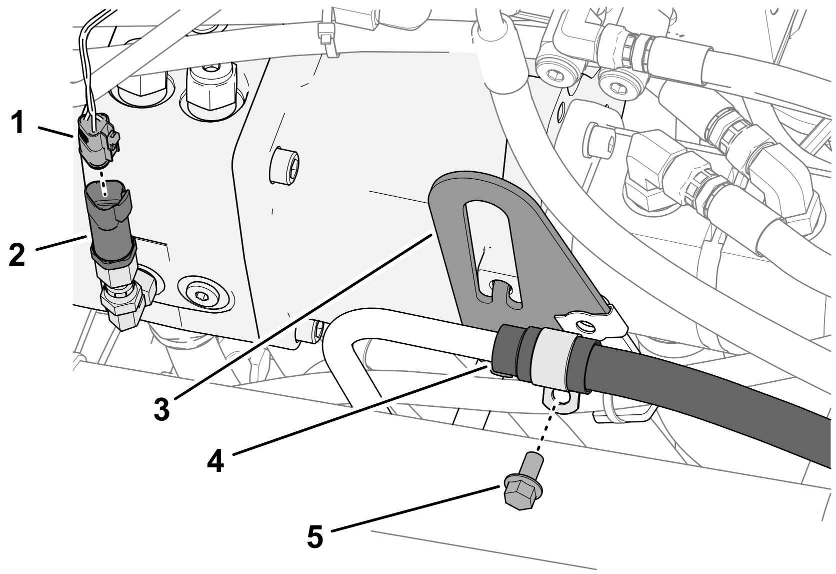

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Figure 37

1. Main harness connector P18 (FRONT TRACTION PRESSURE)
2. Pressure transducer
3. Pump hanger plate
4. PTO gearbox case drain tube
5. Flange head capscrew

9. Secure the support clamp for the hydraulic hose/tube assemble to the pump hanger plate with the flange head capscrew.

Installing the Front Axle Drive Motor

1. Install the front axle drive motor; refer to the following:
   - Installing the Axle Drive Motor (Machines with an Axle-Drive Gearbox) (page 5–93)

- Installing the Axle Drive Motor (Machines without an Axle-Drive Gearbox) (page 5–95)

2. Connect the hydraulic hose to the fitting in port B of the rear axle drive motor, and tighten the hose fitting.

Model/Serial Table (Figure 38)

Model	Serial Range	Rear Axle Drive Motor Port	Pressure Circuit	Tandem Piston (Traction) Pump Port
07511AA, 07511BA, 07511CA, and 07511DA	400000000 through 409999999	A	Forward	A
		B	Reverse	B

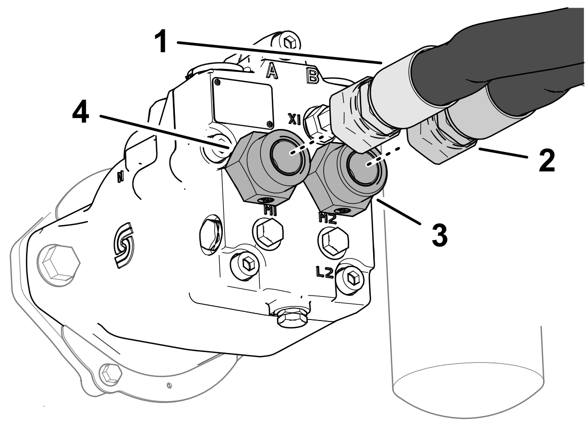

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Figure 38

1. Hydraulic hose (forward)
2. Hydraulic hose (reverse)
3. Port B fitting
4. Port A fitting

Model/Serial Table (Figure 39)

Model	Serial Range	Rear Axle Drive Motor Port	Pressure Circuit	Tandem Piston (Traction) Pump Port
07511AA, 07511BA, 07511CA, and 07511DA with Gearbox Reduction Kit 144-9700	400000000 through 409999999	A	Forward	C
		B	Reverse	D
07511AA, 07511BA, 07511CA, and 07511DA	410000000 and higher	A	Forward	C
		B	Reverse	D

Installing the Engine, PTO Gearbox, and Traction Pump (continued)

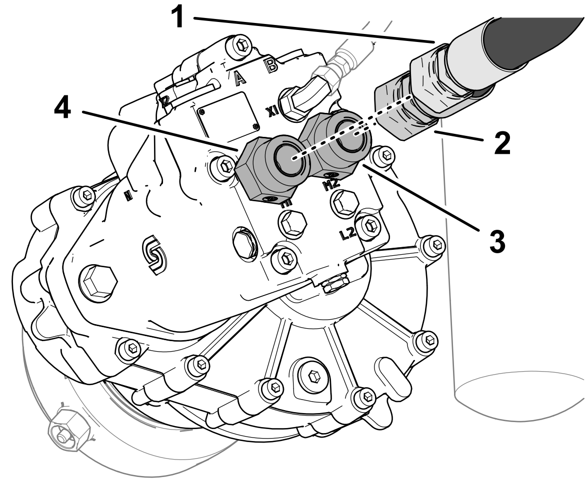

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Figure 39

1. Hydraulic hose (forward)
2. Hydraulic hose (reverse)
3. Port B fitting
4. Port A fitting

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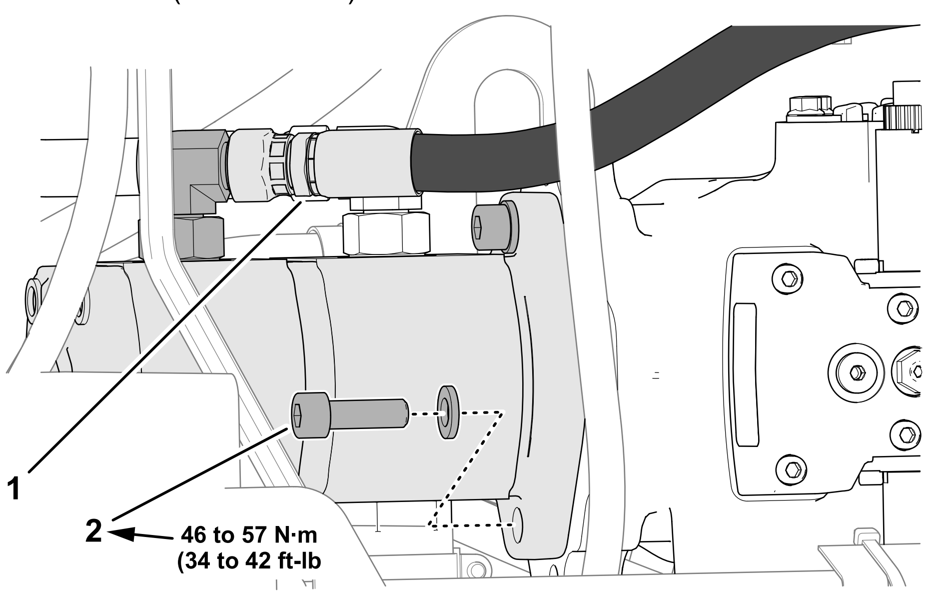
3. Connect the hydraulic hose to the fitting in port A of the rear axle drive motor, and tighten the hose fitting.

Installing the Dual Gear Pump

1. Ensure that the pump drive coupler and O-ring are assembled to the gear pump.

2. Engage the splines of the gear pump drive coupling with the splines of the tandem piston (traction) pump.

   Assemble the gear pump to the tandem piston (traction) pump with the 2 socket-head screws and washers, and torque the socket-head screws to 46 to 57 N·m (34 to 42 ft-lb).



g436400

Figure 40

1. Hose
2. Socket-head screw

Installing the Engine, PTO Gearbox, and Traction Pump (continued)

3. Install the hose to the fitting at the top, rear port of the dual gear pump.

Connecting the PTO Driveshaft

1. Grease the PTO driveshaft, refer to the *Operator's Manual* for the machine.
2. Assemble the driveshaft to the PTO gearbox hub, and torque the capscrews to 36.6 to 44.7 N·m (27 to 33 ft-lb).

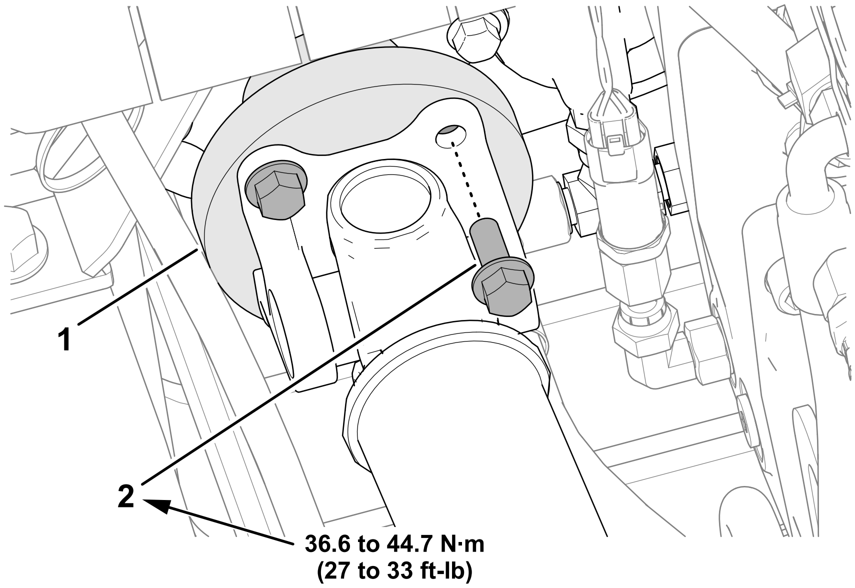


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Figure 41

1. PTO gearbox hub
2. Capscrew

Installing the Operator's Platform or Cab

IMPORTANT

Ensure that the wire harness is not pinched between the operator's platform or cab, and the machine.

Perform the following procedures found in Installing the Operator's Platform or Cab:

1. Assembling the Operator's Platform or Cab to the Frame of the Machine (page 8–17)
2. Connecting the Heating and Air Conditioning Hoses—Machines with a Cab (page 8–17)
3. Connecting the Hydraulic Manifold Hoses (page 8–18)
4. Assembling the Console Controls (page 8–19)
5. Connecting the Electrical Harnesses (page 8–20)
6. Connecting the Steering Hoses (page 8–23)

Note: You will complete the steps for Finishing the Operator's Platform or Cab Installation at the end of the Installing the Engine, PTO Gearbox, and Traction Pump section.

Connecting the Cables and Engine Harness

Connect the positive battery cable at starter solenoid and the engine ground cable near the left rear engine mount.

1. Remove the flange nut, assemble the positive battery cable onto the stud of the starter solenoid, install and tighten the flange nut, and position the insulating boot over the solenoid terminal.

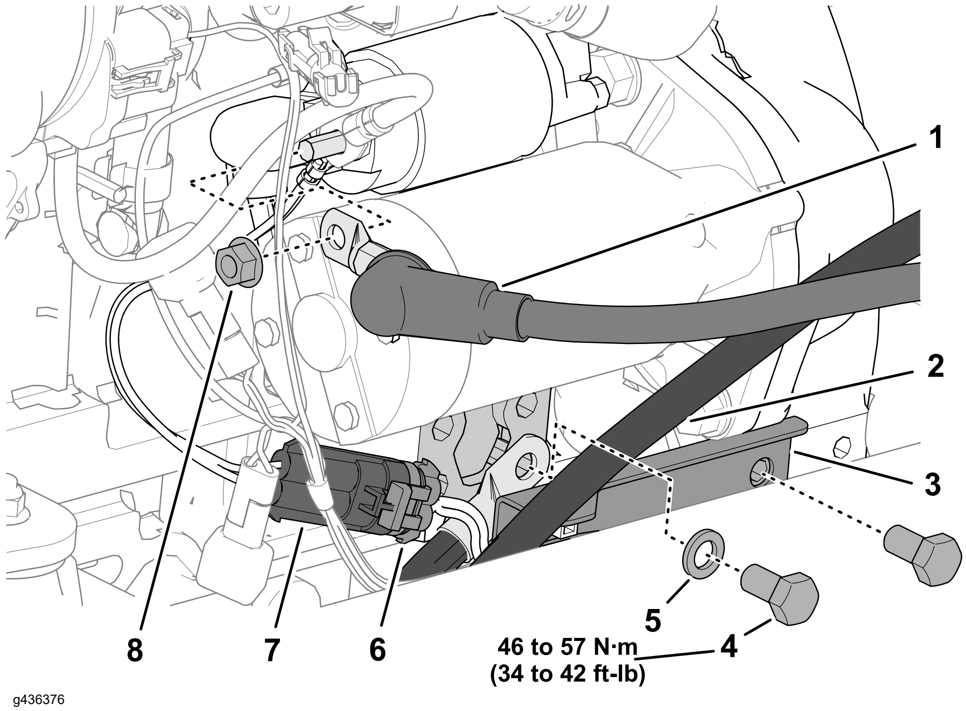

Figure 42

1. Positive battery cable	5. Washer
2. Ground cable	6. Main harness connector P22
3. Harness bracket	7. Fusible link harness connector
4. Capscrew	8. Flange nut

2. Clean the terminal of the ground cable and the ground point on the engine block of corrosion and dirt.
3. Install the ground cable assembly from engine block with the capscrew and washer, and torque the capscrew to 46 to 57 N·m (34 to 42 ft-lb).
4. Apply a coat of terminal protector (Toro P/N 505-177) to the terminal of the ground cable and the frame.
5. Install the harness bracket to engine block with the capscrew.
6. Plug the main harness connector P22 into the starter (B+) connector.
7. If installed, plug the main harness terminals onto the optional horn.
8. Secure the DPF connector bracket to the cowl mount with the screw.

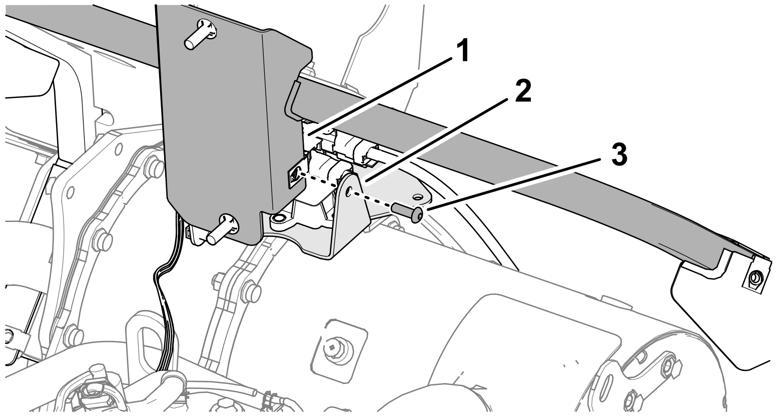

Figure 43

1. Cowl mount
2. Screw
3. DPF connector bracket

Installing the Cooling System

WARNING

Ethylene-glycol antifreeze is poisonous.

Keep the coolant away from children and pets.

Keep the coolant in a labelled container.

Discard the coolant in accordance with local hazardous waste ordinances.

1. Align the radiator assembly to the machine, and secure the radiator mount assembly to the frame with the 4 flange nuts and carriage screws.
2. Install the fan shrouds and the top nut plate.
3. Connect the hydraulic lines to the cooler; refer to General Precautions for Removing and Installing the Hydraulic System Components (page 5–65).

   Note: The lower hydraulic hose connects at the bulkhead below the vehicle frame.
4. Install the radiator drain plug.

   Note: New radiator drain plugs are pre-coated with thread sealant. Clean the threads and apply thread sealant if you are installing a used drain plug.
5. Install the lower radiator hose between the engine and radiator.
6. Install the upper radiator hose between the engine and radiator.
7. Install the coolant reservoir assembly, and connect the reservoir hose to the radiator .
8. Fill the radiator with the specified coolant; refer to the *Operator's Manual* for the machine.

Connecting the Fuel Hoses

1. At the fuel cooler, install the hose between the fuel cooler and the fuel tank.
2. At the engine fuel filter, install the hose between the electric fuel pump and the engine fuel filter.

Installing the Engine, PTO Gearbox, and Traction Pump (continued)

3. At the engine fuel filter, install the hose between the engine fuel filter and the fuel cooler.
4. Connect the fuel supply and return hoses to the engine, and secure the fuel hoses with hose clamps; refer to Fuel System (page 4–14).

Install or Connect Components

1. Install the flange and exhaust tube; refer to Exhaust System (page 4–10).
   A. Remove the old gasket from the flange on the exhaust tube and the mounting surface of the diesel-particulate filter of the engine.
   B. Insert the exhaust tube through the muffler clamp at the exhaust bracket.
   C. Assemble the flange and exhaust tube from the DPF with a new gasket and the 4 nuts, and torque the nuts to 39 to 44 N·m(29 to 33 ft-lb).
   D. Torque the muffler clamp nuts at the exhaust bracket to 39 to 44 N·m(29 to 33 ft-lb)
2. Install the air cleaner assembly; refer to Removing and Installing the Air Cleaner System (page 4–8).
3. Install the left side shield and right side shield; refer to Figure 14.
4. Install the front screen; refer to Removing and Installing the Front Screen (page 8–3).
5. Removing and Installing the Front Screen (page 8–3).
6. Install the hood; refer to Removing and Installing the Hood (page 8–5).

Finishing the Engine Installation

1. Ensure that all the wires, fuel lines, hydraulic hoses, and cables are clear of moving parts and secured to their original locations.
2. Check the engine-oil level and adjust it as necessary.
3. Replace the hydraulic filters.
4. Check the hydraulic-fluid level in the hydraulic reservoir and add correct if necessary; refer to the traction unit *Operator's Manual*.
5. Prime the fuel system; refer to Priming the Fuel System (page 4–15).
6. Start the engine and operate the hydraulic controls to properly fill the hydraulic system; refer to Charging the Hydraulic System (page 5–76).
7. Check and adjust the engine coolant level; refer to the traction unit *Operator's Manual*.
8. Stop engine then check for and correct any hydraulic oil leaks. Check hydraulic fluid level and adjust it if necessary.

Finishing the Operator's Platform or Cab Installation

1. Install the standard utility box; refer to Standard Utility Box (page 8–35), or the optional cargo bed; refer to the *Installation Instructions*.
2. If removed, raise rear counterweight from the ground and installed the front loader.
3. If removed, installed the rear attachment to the 3-point hitch or the draw bar.
4. Operate the machine carefully at first to allow the hydraulic system to refill with fluid. Check for and correct any hydraulic leaks. Check and adjust the hydraulic fluid level as required; refer to the traction unit *Operator's Manual*.
5. Machines equipped with air conditioning—have a certified refrigeration technician fill/recharge and test the air conditioning system.

6. Machines equipped with a cab heater—operate the heater and adjust the coolant level as required; refer to the traction unit *Operator's Manual*.

Flywheel Housing and Drive Coupler

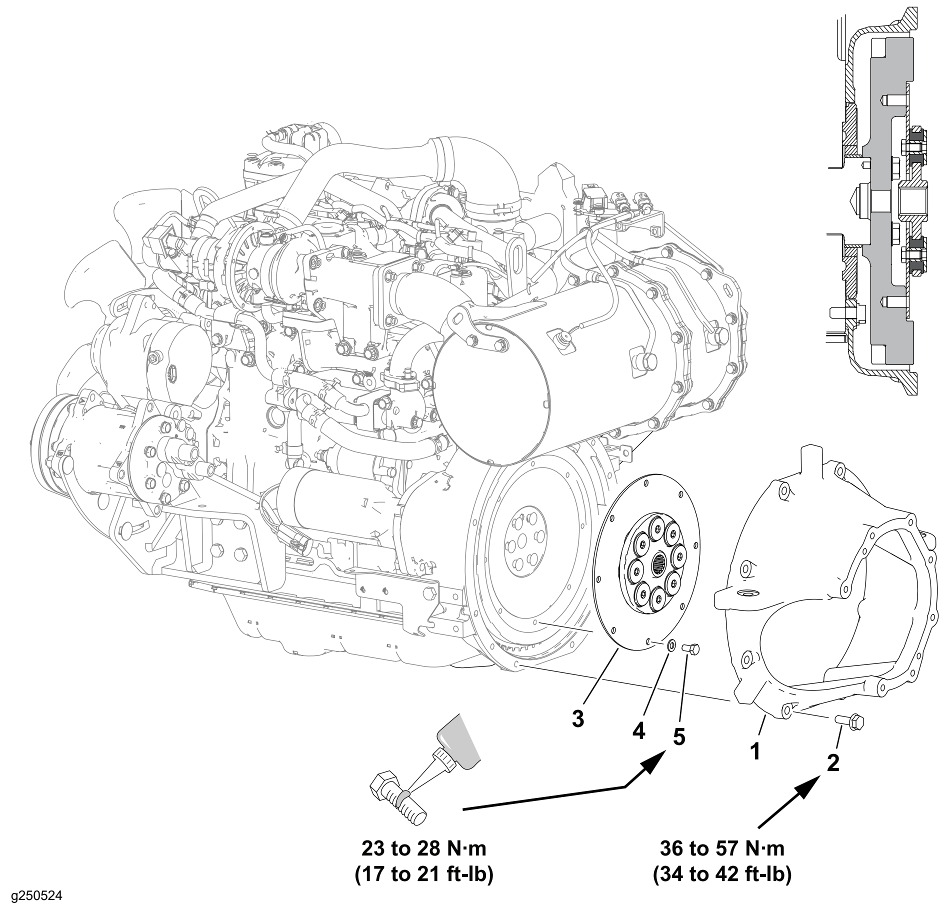

Figure 44

1. Flywheel housing
2. Flange-head screw (8 each)
3. Flywheel coupler
4. Hardened washer (8 each)
5. Capscrew (8 each)

Removing and Installing the Flywheel Housing and Drive Coupler

Note: Removing the engine from the machine before removing the flywheel housing and drive coupler is required.

1. Remove the flywheel housing and drive coupler components as necessary.
2. Position the drive coupler to the engine flywheel and align mounting holes. Ensure that the coupler hub is away from the engine flywheel as shown.
3. Use medium strength thread locking compound and secure the coupler to the engine flywheel with eight 8 capscrews and hardened washers. Tighten capscrews in a crossing pattern from **23 to 28 N·m (17 to 21 ft−lb)**.
4. Position flywheel housing to engine and secure with 8 flange-head screws. Tighten screws in a crossing pattern from **36 to 57 N·m (34 to 42 ft−lb)**.

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 K and L Frame Variable Motors Service Manual

Danfoss Steering Unit Type OSPB, OSPC and OSPF Service Manual

Gresen/Parker Hydraulics Model V10 Sectional Body Directional Control Valve Service Manual

General Information

Traction Unit Operator's Manual and Accessory Installation Instructions

The traction unit *Operator's Manual* and accessory *Installation Instructions* provide information regarding the operation, general maintenance and maintenance intervals for the machine and its accessories. Refer to the traction unit *Operator's Manual* and accessory *Installation Instructions* for additional information.

Relieving Pressure from the Hydraulic System

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

Note: If you park the machine on an incline or slope, the pressure in the traction circuit does not release.

1. Move the machine to a level surface.
2. Lower any attachments fully.
3. Turn the key switch to the OFF position and allow the engine to stop.
4. Make sure all electrically operated control valves are actuated by setting the key switch to the RUN position but Do Not start the engine.
5. Slowly move the auxiliary load valve to the fully FORWARD and fully REARWARD positions.
6. If the machine is equipped with a front loader, move the loader control valve to the FORWARD, REARWARD, fully LEFT, and fully RIGHT positions.
7. Turn the steering wheel in both the LEFT and the RIGHT directions.
8. Turn the key switch to the OFF position.

Towing the Traction Unit

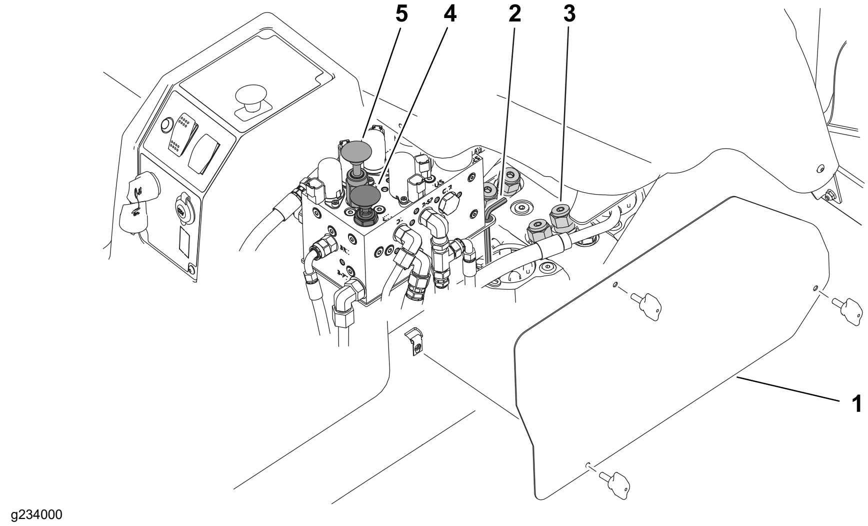

Figure 45

1. Access panel
2. 6 mm hex wrench
3. Bypass valves (4 each)
4. Manual valve
5. Hand pump

IMPORTANT

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

If it becomes necessary to tow or push the machine, the tandem piston (traction) pump must be set to bypass hydraulic fluid and the hydraulic brake circuit must be manually pressurized to release the brake. Move the machine at a speed **below 3.2 kph (2 mph)**, and for a short distance. If the machine needs to be moved more than a short distance, the machine should be transported on a trailer.

IMPORTANT

Do not start or run the engine when the valves are set to the bypass position.

1. Remove the access panel from the right side of the control console and retrieve the 6 mm hex wrench provided.

Towing the Traction Unit (continued)

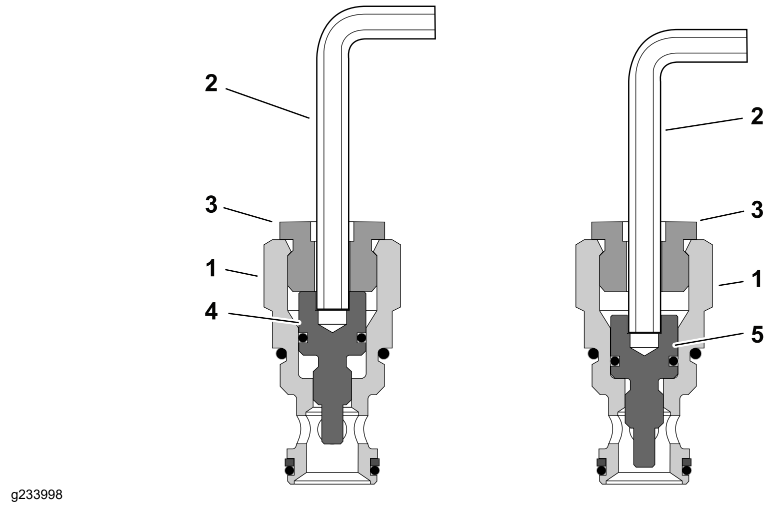

Figure 46

1. Bypass valve assembly
2. 6 mm hex wrench
3. Plug
4. Plunger (normal operating position)
5. Plunger (bypass position for towing)

Note: To prevent hydraulic fluid leakage, do not loosen the bypass valve assemblies.

2. Set the valves to the bypass position by inserting a 6 mm hex wrench through the valve plug and turning the plunger all the way in clockwise. Repeat this step for each bypass valve assembly (4 total).
3. To release the brake, lift and hold the manual valve while pumping the hand pump.
4. Pump the hand pump until resistance is felt. When enough pressure has been created, the manual valve will remain in the raised position and the brake will be released.
5. After towing and before starting the engine, insert a 6 mm hex wrench through the valve plug and turn the plunger all the way out counterclockwise. Repeat this step for each bypass valve assembly (4 total).
6. Push the manual valve down to engage the parking brake.
7. Secure the 6 mm hex wrench provided and install the access panel.

Traction Circuit (Closed-Loop) Component Failure

The traction system of the Outcross 9060 machine consists of two closed-loop circuits, each with its own piston (traction) pump, axle drive motor, and control valves. The two traction pumps (P1 and P2) are part of the tandem piston (traction) pump. Pump (P1) supplies the front traction circuit, and pump (P2) supplies the rear traction circuit. If a component in one of the traction circuits should fail, unwanted material and contamination from the damaged component will circulate throughout that traction circuit. This contamination can damage other components in that circuit. The contamination must be removed as soon as possible to prevent additional component failure.

The recommended method of removing contamination from a traction circuit is to temporarily install a Toro high flow hydraulic filter into the traction circuit; refer to High Flow Hydraulic Filter Kit (page 2–17). If a traction circuit failure is suspect, the filter should be installed before connecting hydraulic test gauges to test traction circuit components or after replacing a failed traction circuit component. The filter will ensure that contaminates are removed from the closed-loop traction circuit and thus, prevent additional component damage. Refer to Filtering the Closed-Loop Traction Circuit (page 5–70) for additional information on using the Toro high flow hydraulic filter.

Note: If traction circuit contamination exists, the traction pump and axle drive motor drains could allow contaminates to enter the hydraulic tank.

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 the components, the hydraulic tank, and the hydraulic tubes and 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 failures.

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 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; refer to Relieving Pressure from the Hydraulic System (page 5–3).

- **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 5–9).

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 O-rings

1. Inspect to ensure both parts are clean and free of nicks, scratches, etc.
2. Ensure O-ring is fitted correctly in the groove.
3. Lubricate the O-ring with Toro part number 505-133 vanishing oil.

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

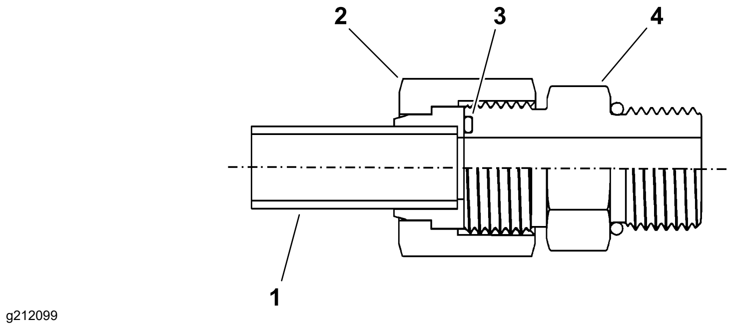

Figure 47

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

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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 47).
4. Use your hand to thread the swivel nut onto the fitting. While you hold the hose/tube in alignment with a wrench, use a torque wrench to tighten the swivel nut to the recommended torque value within the specified range of torque values; refer to the Hose/Tube Installation Torque Table (page 5–10). This procedure to tighten the swivel nut requires a drive-adapter wrench (e.g., crowfoot wrench).

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

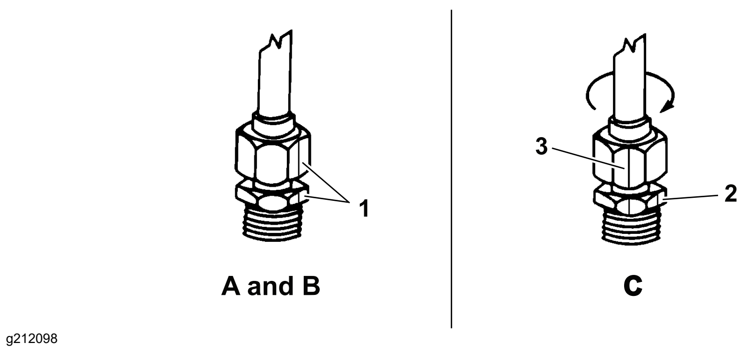

Figure 48

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 Figure 48). 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 48).

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

Installing a Non-Adjustable Fitting

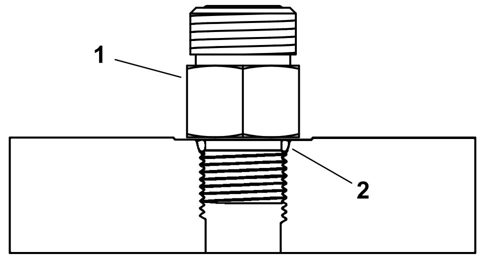

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Figure 49

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 5–13).

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

5. If a torque wrench is not available or if space at the port prevents the use of a torque wrench, use the 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 5–13).

   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 5–13).

Installing an Adjustable Fitting

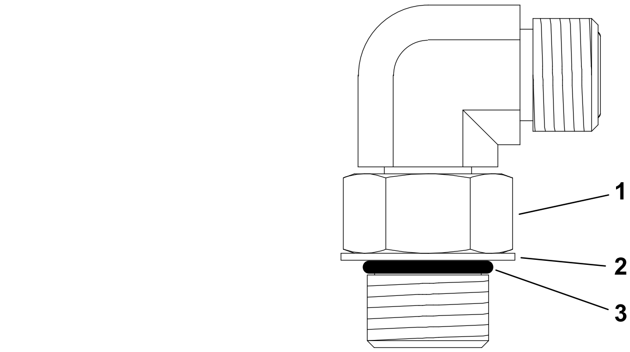


Figure 50

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

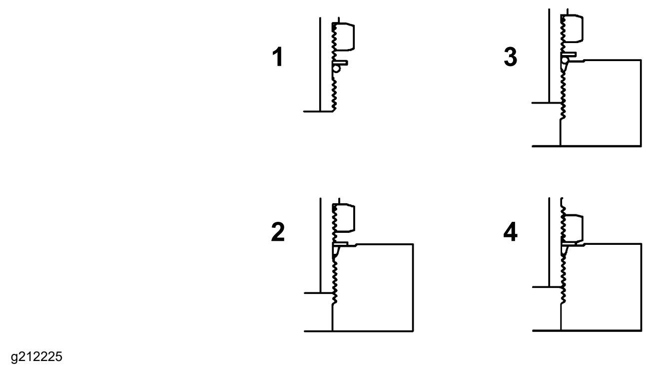


Figure 51

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 51).
5. Install the adjustable fitting into the port by hand until the washer contacts the face of the port (Step 2 in Figure 51).
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 51). 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.

7. Tighten the fitting lock nut (Step 4 in Figure 51):

Installing an Adjustable Fitting (continued)

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 5–13). 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 2–7)

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 5–13).

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 5–13).

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 the Outcross 9060 machine is in Appendix A (page A–1).

Hydraulic Flow Diagrams

Traction Circuit

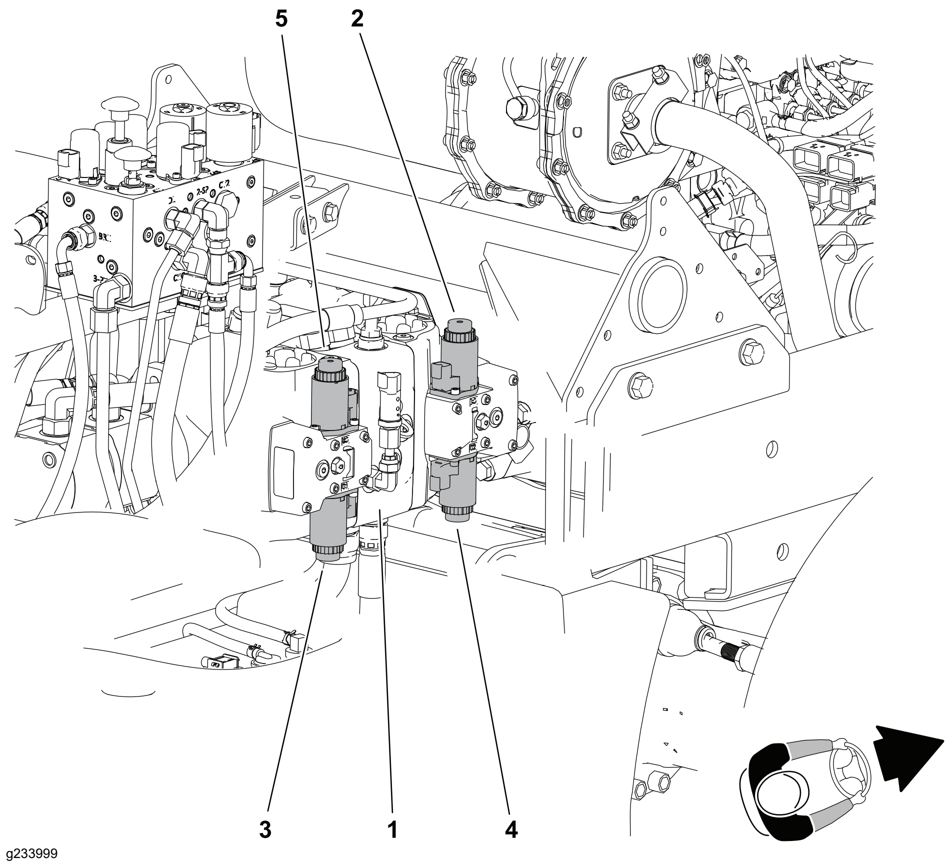


Figure 52

1. Tandem piston (traction) pump (P1 and P2)
2. Solenoid AB-C1 (front pump valve C1 – forward)
3. Solenoid CD-C1 (rear pump valve C1 – forward)
4. Solenoid AB-C2 (front pump valve C2 – reverse)
5. Solenoid CD-C2 (rear pump valve C2 – reverse)

The traction circuit of the Outcross 9060 machine consists of two closed-loop circuits, each with its own piston (traction) pump, axle drive motor, and control valves. The two traction pumps (P1) and (P2) are part of the tandem piston (traction) pump. Pump (P1) supplies the front traction circuit, and pump (P2) supplies the rear traction circuit. The tandem, variable displacement, bidirectional piston (traction) pump is directly coupled to the engine to provide hydraulic flow for the traction circuits. The swash plate movement for each pump is controlled separately by a pair of solenoid-operated displacement-control valves mounted to the pump (electro-hydraulic servo piston assembly). Pushing the traction pedal rotates a hall effect sensor that provides an input to the T1: TEC. The T1: TEC sends a corresponding PWM (Pulse Width Modulation) output signal to the displacement control valve solenoids to move the pump swash plate accordingly and control the pump's output volume (vehicle speed and traction control). Traction circuit pressure is constantly being monitored at both pumps when operating in the forward direction. A pair of pressure sensors provide information to the T1: TEC that is used for traction control.

The vehicle's direction of travel is controlled by the T1: TEC based on input from the transmission lever located to the left of the steering wheel. When the direction lever is in the F (forward) position and the traction pedal is pushed, solenoid AB-C1 on the front pump and solenoid CD-C1 on the rear pump are energized. When the transmission lever is in the R (reverse) position and the traction pedal is pushed, solenoid AB-C2 on the front pump and solenoid CD-C2 on the rear pump are energized.

Front and rear axle drive motors are positive displacement, 2 position axial piston motors. The 2 position drive motors can operate in either a low-speed range or high-speed range. The motors are spring biased to maximum displacement for low speed and are hydraulically shifted to minimum displacement for high speed. Solenoid valve (SV1) in the main manifold is energized by the TEC when the mode selector is set to the HIGH SPEED AUTO position. In high speed auto, hydraulic flow from solenoid valve (SV1) moves the swash plate in the drive motor to reduce the motor displacement and increase its potential rpm. The axle drive motors include a flushing valve that bleeds off a small amount of hydraulic fluid for cooling the closed-loop traction circuit. The charge circuit replenishes fluid that is bled from the traction circuit by the flushing valve, and the fluid that moves through the traction pump case to the tank during normal operation.

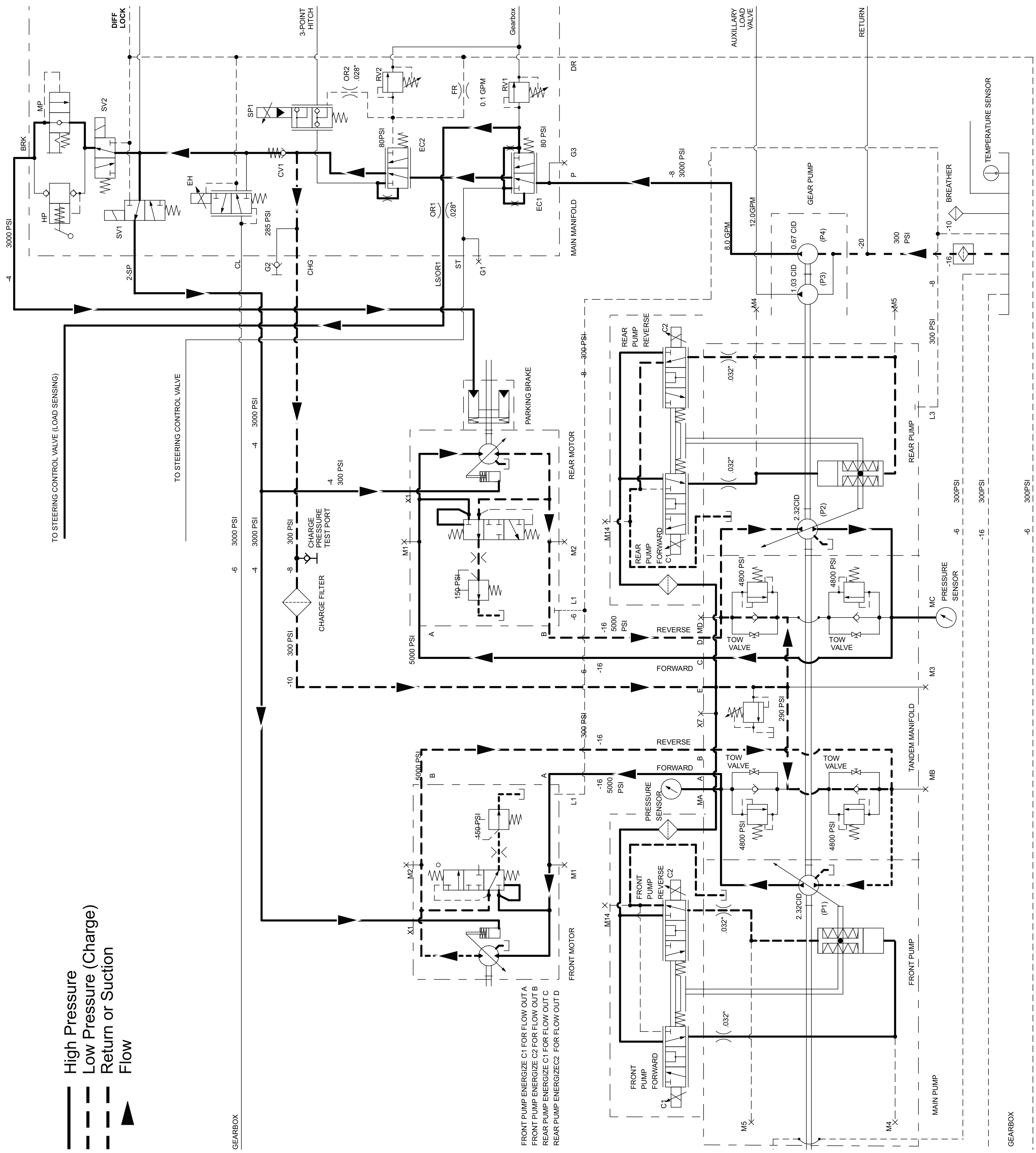
Operating pressure on the high-pressure side of the closed-loop traction circuit is determined by the amount of load developed at the axle drive motors. As the load increases, circuit pressure can increase to the relief valve setting of 33,100 kPa (4800 psi) in either forward or reverse. Traction pressure to each axle can be viewed while the machine is moving in the forward direction by using the InfoCenter SERVICE–TRACTION–TRACTION INPUTS FRONT TRACTION and REAR TRACTION readings. If pressure exceeds the relief setting, fluid flows through the unseated relief valve to the low-pressure side of the closed-loop traction circuit.

Note: The tandem piston (traction) pump includes a set of 4 bypass valves. The bypass valves are necessary to allow the machine to be towed a limited distance if necessary; Towing the Traction Unit (page 5–4).

Traction Circuit Diagram

Model/Serial Table (Figure 53)

Model	Serial Range
07511AA, 07511BA, and 07511DA	400000000 through 409999999
07511CA	400000000 through 404700000



g235767

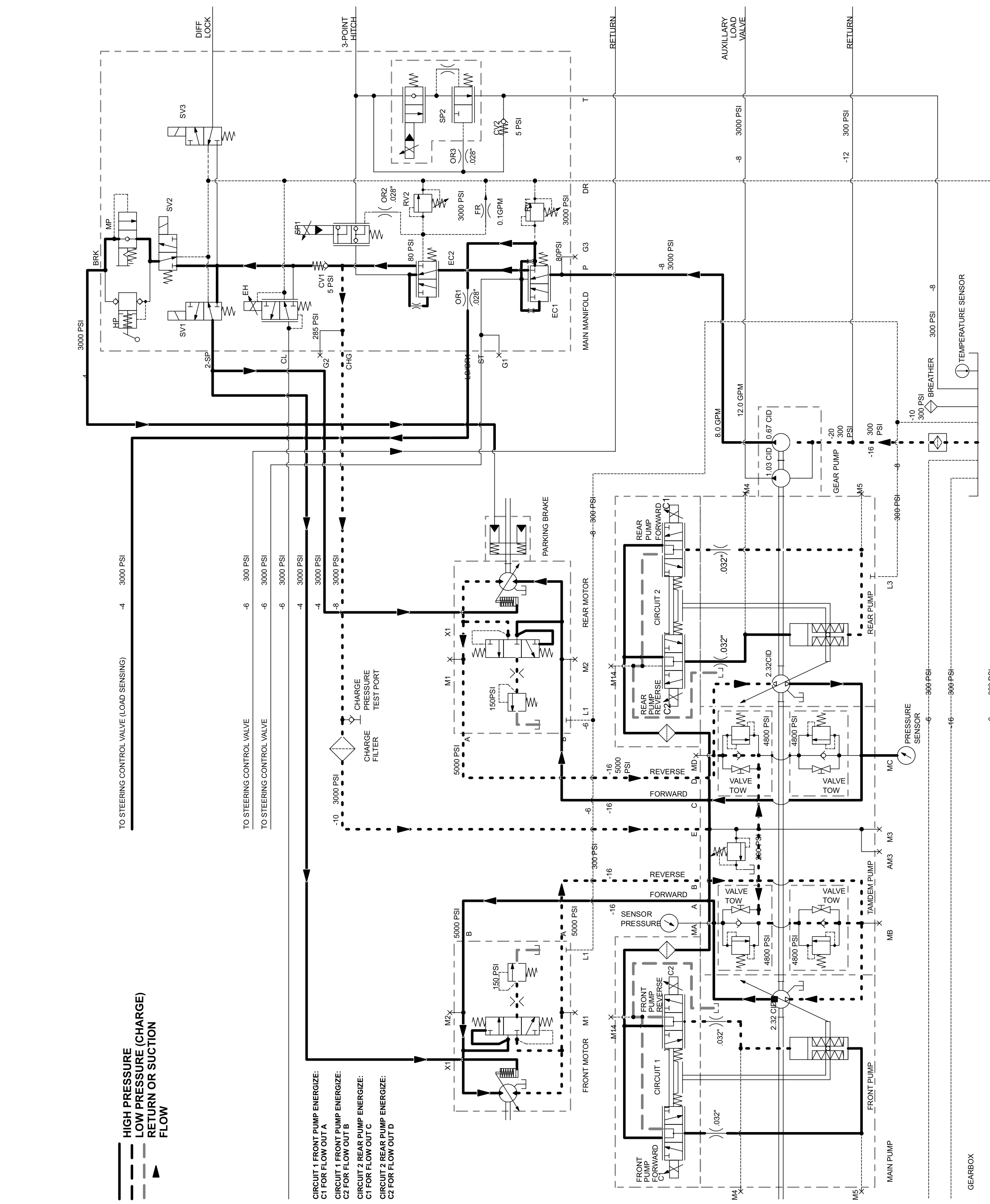
Figure 53

AUTO HIGH—Forward

Traction Circuit Diagram

Model/Serial Table (Figure 54)

Model	Serial Range
07511AA, 07511BA, and 07511DA with Gearbox Reduction Kit 144-9700	400000000 through 405799999
07511CA with Gearbox Reduction Kit 144-9700	400000000 through 404700000



g437693

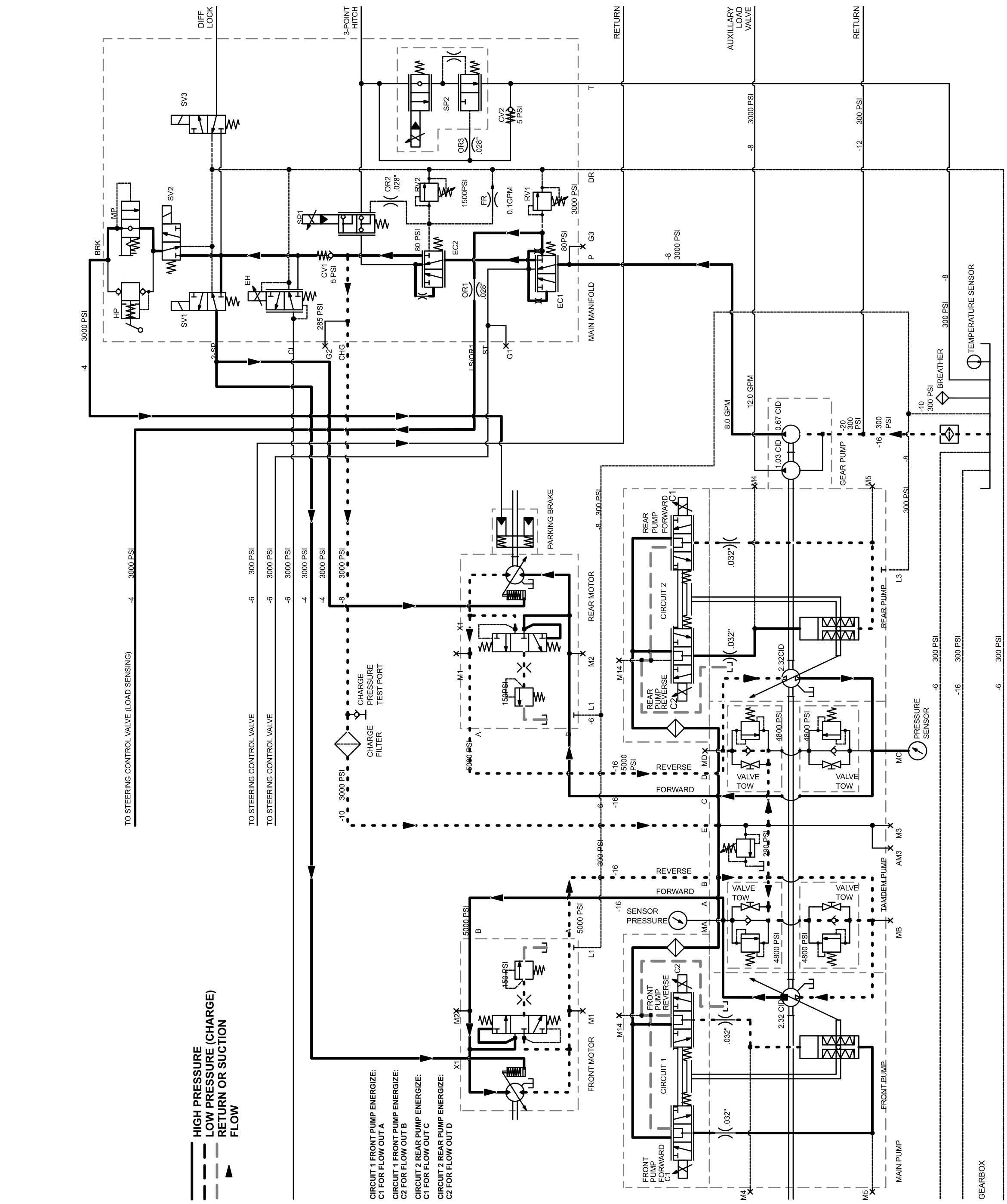
Figure 54

AUTO HIGH—Forward

Traction Circuit Diagram

Model/Serial Table (Figure 55)

Model	Serial Range
07511AA, 07511BA, and 07511DA with Gearbox Reduction Kit 144-9700	405800000 through 409999999
07511CA with Gearbox Reduction Kit 144-9700	404700001 through 409999999
07511AA, 07511BA, 07511CA, and 07511DA	410000000 and higher



g436629

Figure 55

AUTO HIGH—Forward

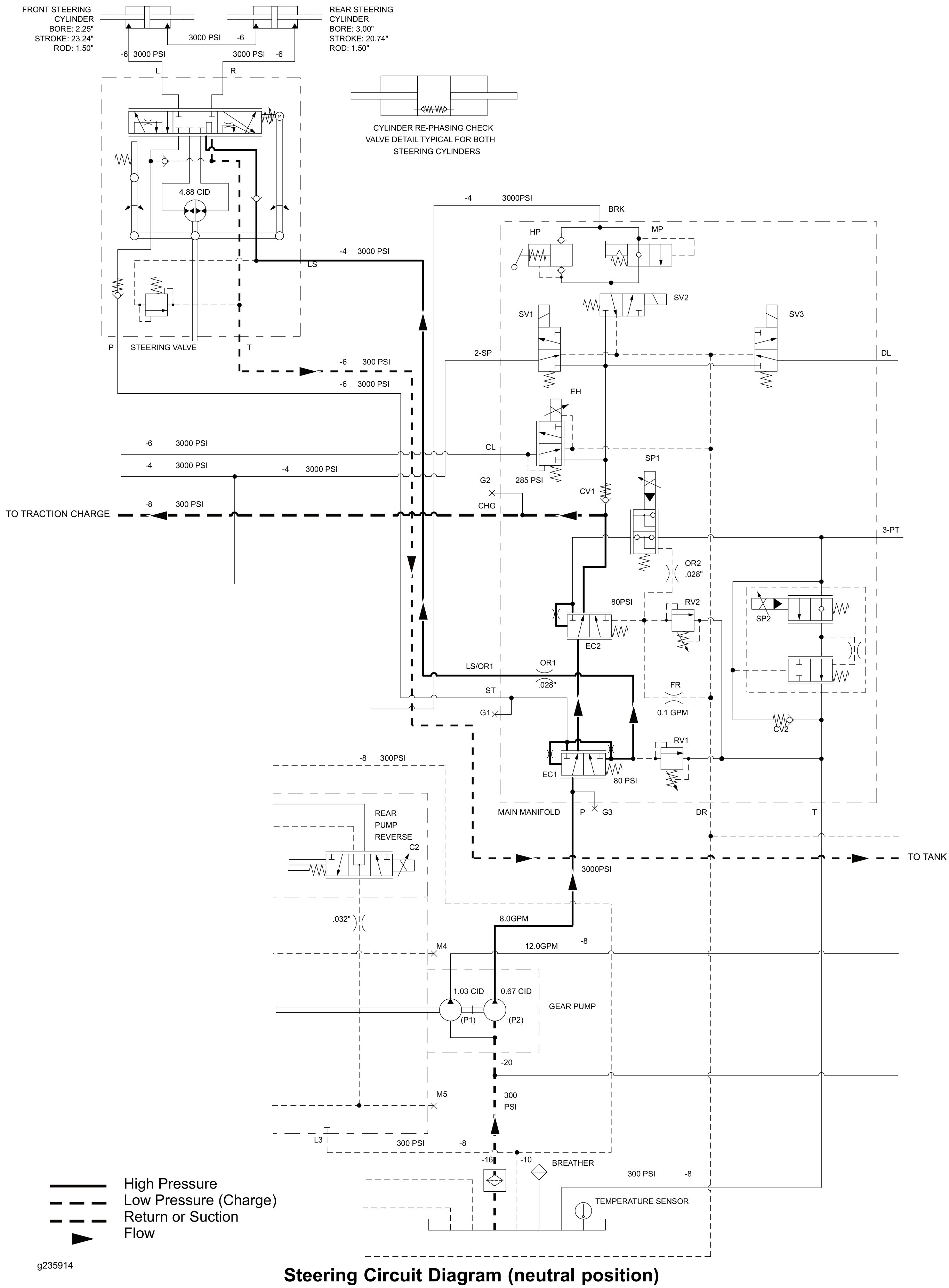
Traction Charge Circuit

The traction pumps and axle drive 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. The tandem piston (traction) pump drains from its L3 port back to the hydraulic tank. The drive motors drain from their L1 ports back to the hydraulic tank. Each drive motor also includes a shuttle valve to increase the amount for fluid change-out in the closed-loop traction circuit for cooling purposes. The traction charge circuit is designed to replace the hydraulic fluid that leaves the closed-loop traction circuit.

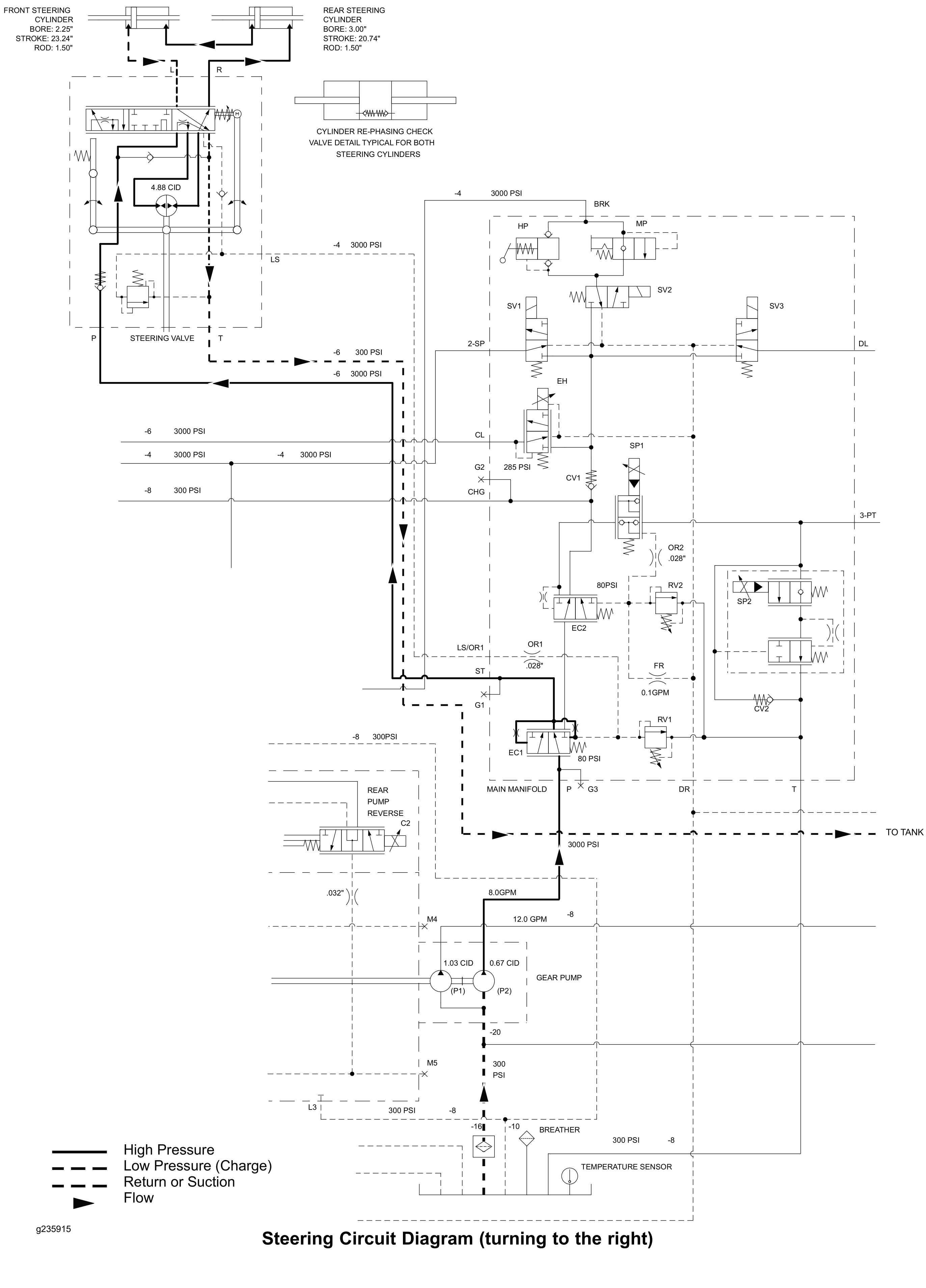
The gear pump section furthest from the piston pump, gear pump section (P4), supplies fluid to a variety of circuits including the traction charge circuit. Hydraulic fluid from gear pump (P4) enters the main manifold port P and flows through the steering priority valve (EC1); refer to Steering Circuit (page 5–21) for a full explanation of the steering priority valve (EC1) operation. Fluid flow continues through the flow regulator valve (EC2) until it reaches solenoid valve (SP1). Solenoid valve (SP1) is responsible for raising the 3-point hitch cylinders and is closed if the cylinders are not raising. Fluid is also sent to one end of the flow regulator valve (EC2) spool. If circuit flow is blocked at solenoid valve (SP1), the flow regulator valve (EC2) spool is shifted to direct flow to the traction charge, 2-speed drive motor control, brake release, differential lock, and PTO clutch circuits.

Once the steering circuit needs have been satisfied, and since the 2-speed drive motor control, brake release, differential lock, and PTO clutch circuits place very small demands on the fluid flow delivered by gear pump (P4), the remainder of the flow is directed to the traction charge circuit. Charge circuit flow passes through the charge filter before entering the tandem piston (traction) pump to prevent contaminants from entering the closed-loop traction circuit. The charge filter is located at the right side of the machine behind the front axle. Traction charge pressure is limited to 2,000 kPa (290 psi) by a relief valve located in the tandem piston (traction) pump. Charge pressure at each traction (piston) pump can be viewed while the vehicle is stationary using the InfoCenter SERVICE–TRACTION–TRACTION INPUTS–FRONT TRACTION and REAR TRACTION readings. Charge pressure can also be measured at the charge pressure test port located near the charge filter assembly. Measured pressure should be approximately 2,068 kPa (300 psi).

Steering Circuit



Steering Circuit Diagram (neutral position)



Steering Circuit Diagram (turning to the right)

A two (2) section gear pump is coupled directly to the tandem piston (traction) pump. The gear pump section furthest from the piston pump, gear pump section (P4), supplies fluid to the steering, hitch lift and traction charge circuits. Gear pump section (P4) also supplies flow to the 2-speed drive motor control, brake release, differential lock, and PTO clutch circuits.

Hydraulic flow from gear pump section (P4) is directed to the appropriate circuits by a steering priority valve (EC1) located in the main manifold. The steering priority valve ensures the steering circuit always has enough hydraulic flow to steer the machine, no matter what the hydraulic needs of the other circuits are at the time.

The steering wheel is directly attached to the steering valve. The steering valve is a closed center, load sensing rotary valve. The steering valve senses when fluid flow is needed for steering and the steering priority valve (EC1) shifts to supply hydraulic flow. Gear pump (P4) fluid flow that is not needed for the steering circuit is available for the remaining circuits.

Two (2) steering cylinders are used on the machine, one for steering the front wheels and one for steering the rear wheels. The cylinders are connected to the steering valve in series. To allow for synchronization of the front and rear steering cylinders, both the steering cylinders include an internal re-phasing check valve assembly in the cylinder piston. While rotating the steering wheel for a turn (either right or left), the cylinder check valve will open when the cylinder is fully extended or retracted. After both cylinders have moved fully, the 4-wheel steering system has been synchronized. If the steering wheel continues to be turned, the check valves will stay open and will allow flow through the circuit.

Neutral Position

When the steering wheel is in the neutral position (at rest) and the engine is running, hydraulic fluid from gear pump (P4) enters the main manifold port P, flows through the steering priority valve (EC1), and is routed to the steering valve where it dead heads at the control valve spool. Fluid is also sent to both ends of the steering priority valve (EC1) spool. On one end of the spool, fluid is directed to both the steering relief valve (RV1), and to orifice OR1 then out the manifold LS/OR1 port to the steering valve. This flow provides steering load sensing that is directed through a small passage in the steering valve spool and sleeve before returning to the hydraulic tank. If this load sense flow is returning to the tank due to no steering input, the steering priority valve (EC1) spool is shifted to direct fluid to the flow regulator valve (EC2) for other uses.

Left Turn

When a left turn is made with the engine running, the turning of the steering wheel positions the steering valve spool so that the load sense flow is blocked. Without load sense flow, pressures on the ends of the steering priority valve (EC1) start to equalize causing (EC1) to move toward its un-shifted “neutral” position which directs the fluid needed to turn the machine to the steering valve. Fluid is routed out manifold port ST, into steering valve port P, through the steering valve spool, passes through the rotary meter and out the L port to the steering cylinders. The rotary meter ensures that the fluid flow to the cylinders is proportional to the amount that the steering wheel is turned. Fluid leaving the cylinders flows back through steering valve R port, the valve spool, out the T port and is then returned to the hydraulic reservoir. The steering valve returns to the neutral position when the steering wheel is released or turning is completed.

Right Turn

When a right turn is made with the engine running, the turning of the steering wheel positions the steering valve spool so that the load sense flow is blocked.

Right Turn (continued)

Without load sense flow, pressures on the ends of the steering priority valve (EC1) start to equalize causing (EC1) to move toward its un-shifted “neutral” position which directs the fluid needed to turn the machine to the steering valve. Fluid is routed out manifold port ST, into steering valve port P, through the steering valve spool, passes through the rotary meter and out the R port to the steering cylinders. The rotary meter ensures that the fluid flow to the cylinders is proportional to the amount that the steering wheel is turned. Fluid leaving the cylinders flows back through steering valve L port, the valve spool, out the T port and is then returned to the hydraulic reservoir. The steering valve returns to the neutral position when the steering wheel is released or turning is completed.

Steering Relief Operation

When the steering cylinders reach the end of their stroke or if a wheel should encounter an obstruction (e.g., a curb) while steering, the pressure in the steering circuit will rise. When steering circuit pressure rises to approximately 20,684 kPa (3000 psi), relief valve (RV1) in the main manifold opens and allows hydraulic flow to return to the hydraulic reservoir. This action causes the spool of the steering priority valve (EC1) to shift and send fluid away from the steering circuit and to the traction charge and hitch lift circuits. Relief valve (RV1) controls the action of the steering priority valve (EC1) and allows the valve to divert only enough fluid flow to the steering circuit to maintain relief pressure.

Hitch Cylinder Circuit

The 3-point hitch on the machine uses two (2) hydraulic cylinders to raise and lower the hitch arms. The cylinders are controlled by the paddle located below the left side of the steering wheel. A position sensor is connected to the hitch arm pivot shaft, allowing the T1: TEC to monitor the position of the 3-point hitch. Some attachments may be configured to control the 3-point hitch automatically.

The gear pump section furthest from the piston pump, gear pump section (P4), supplies fluid to a variety of circuits including the hitch lift circuit. Hydraulic fluid from gear pump (P4) enters the main manifold port P and flows through the steering priority valve (EC1); refer to Steering Circuit (page 5–21) for a full explanation of the steering priority valve (EC1) operation. Fluid flow continues through the flow regulator valve (EC2) where fluid flow dead heads at solenoid valve (SP1). Fluid is also sent to one end of the flow regulator valve (EC2) spool. If circuit flow is blocked at solenoid valve (SP1), the flow regulator valve (EC2) spool is shifted to direct flow to the traction charge, 2-speed drive motor control, brake release, differential lock, and PTO clutch circuits.

Note: Depending on the programmable attachment settings, raising and lowering the hitch may also disengage or engage the PTO.

Hitch Cylinder Circuit Diagrams

Model/Serial Table (Figure 56 and Figure 57)

Model	Serial Range
07511AA, BA, DA	400000000 through 405799999
07511CA	400000000 through 404700000

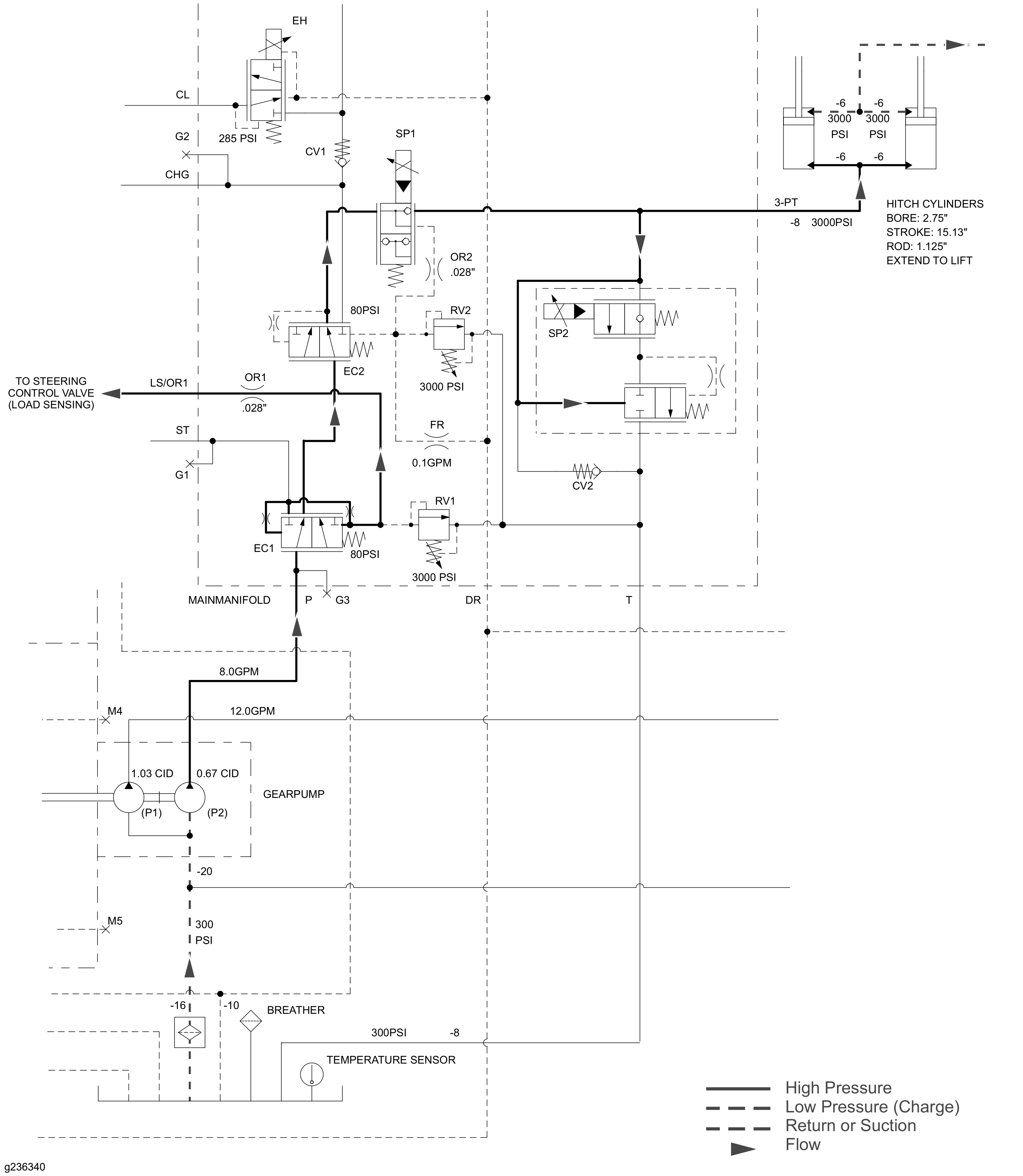


Figure 56

3-point hitch raising

Hitch Cylinder Circuit Diagrams (continued)

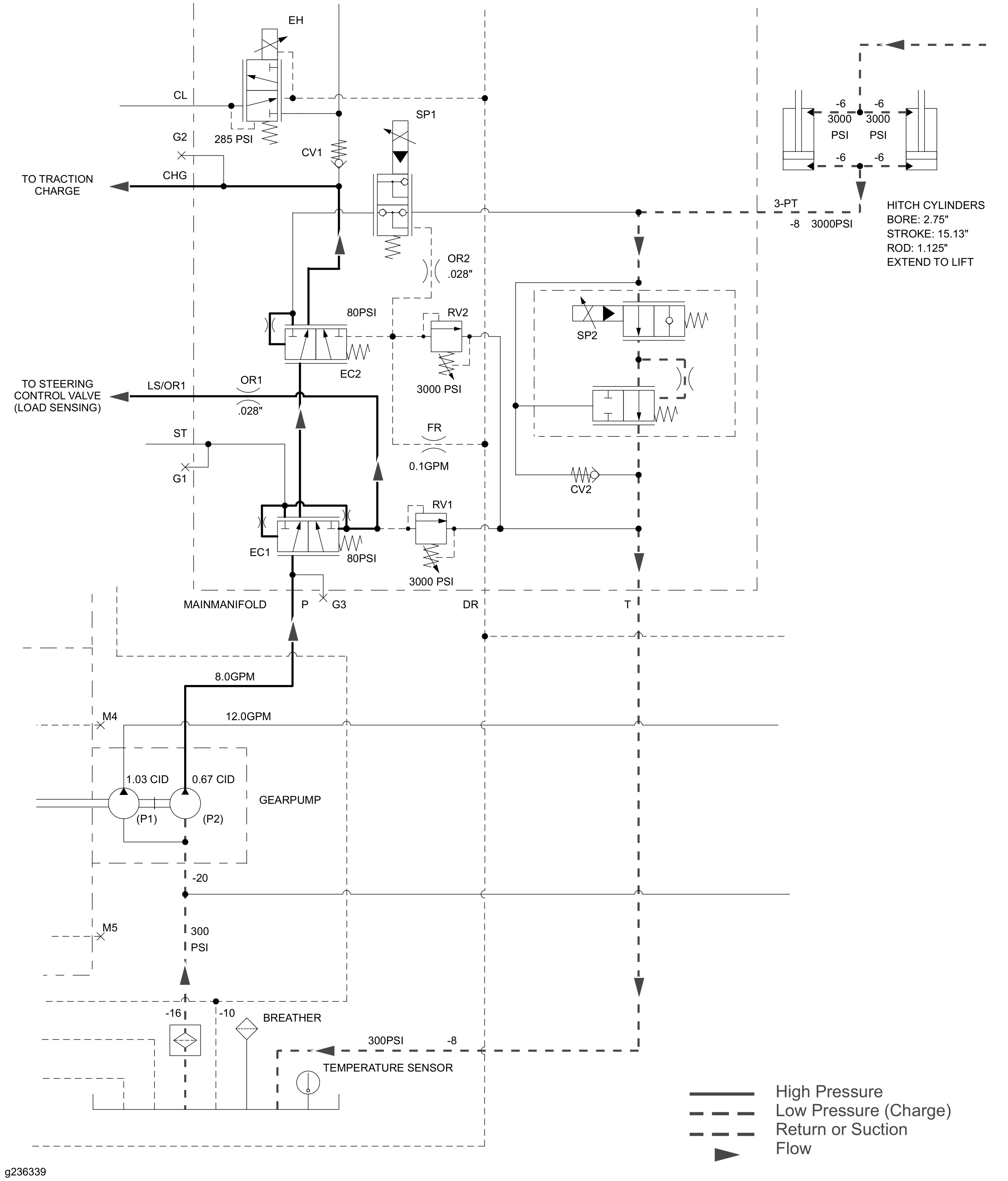


Figure 57

3-point hitch lowering

Hitch Cylinder Circuit Diagrams

Model/Serial Table (Figure 58 and Figure 59)

Model	Serial Range
07511AA, BA, DA	405800000 and later
07511CA	404700001 and later

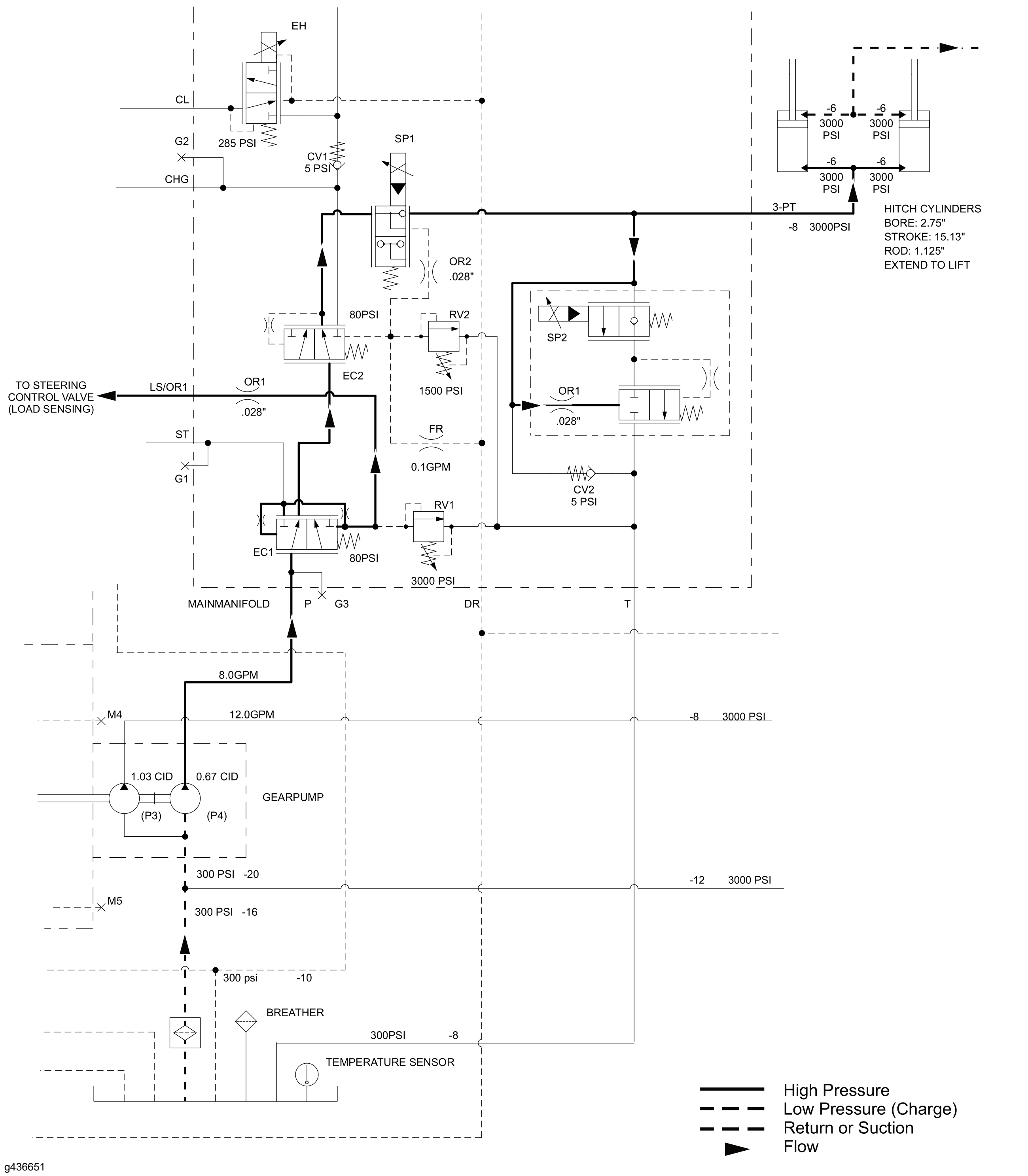


Figure 58

3-point hitch raising

Hitch Cylinder Circuit Diagrams (continued)

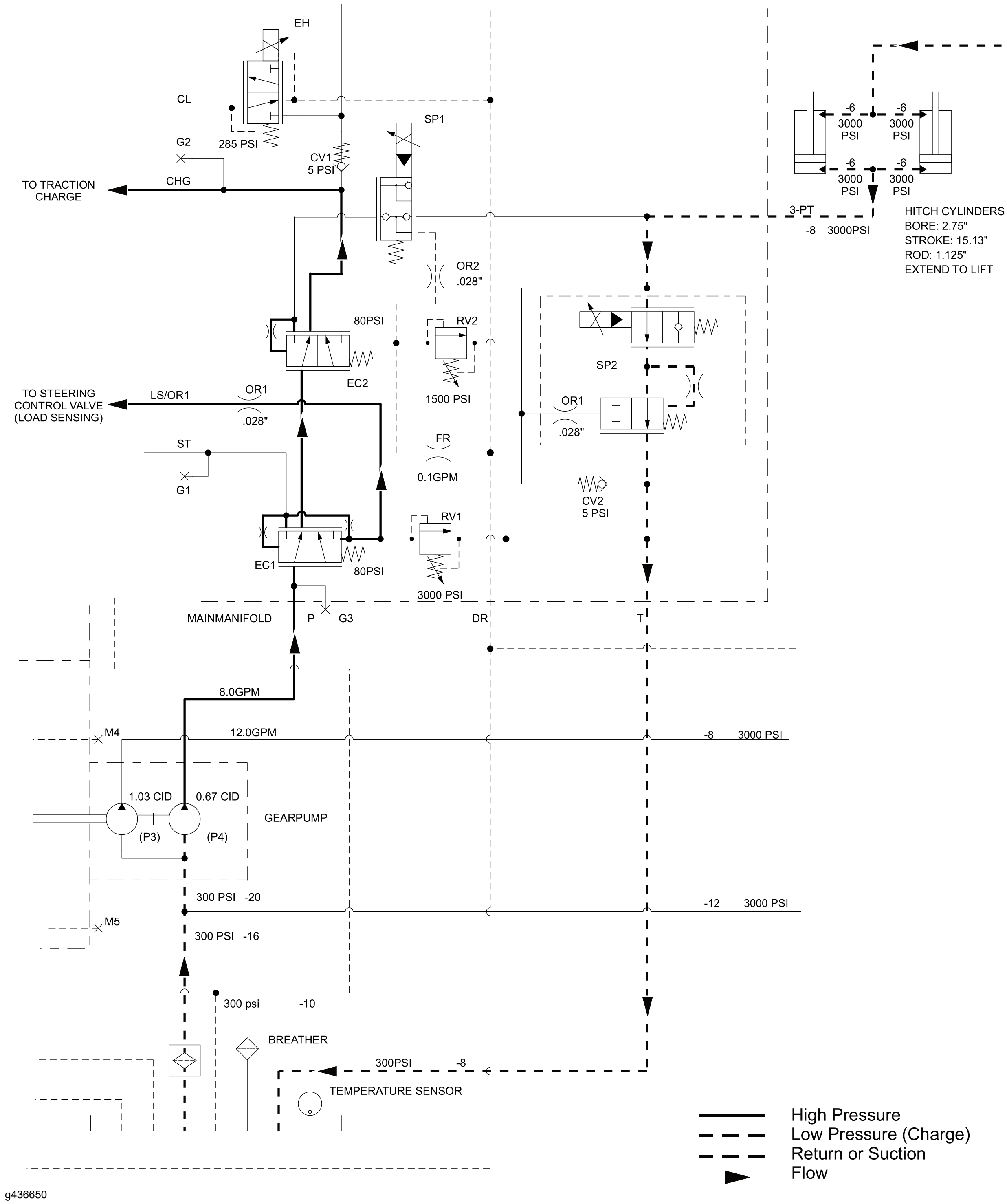


Figure 59

3-point hitch lowering

Raise

When the hitch paddle is pulled upward, solenoid valve (SP1) is energized, and fluid flow is directed to the cap end of the hitch cylinders to raise the hitch arms. As the cylinders extend, fluid from the rod end of the cylinders is allowed to return to the hydraulic tank.

If the hitch arms or the attachment being connected are restricted, or the attachment being connected is above the 3-point hitch lift capacity, relief valve (RV2) opens to prevent circuit pressure, refer to the RV2 Relief Pressure Table.

RV2 Relief Pressure Table

Model	Serial Range	Opening Pressure
07511AA, BA, DA	400000000 through 405799999	20,684 kPa (3000 psi)
07511CA	400000000 through 404700000	20,684 kPa (3000 psi)
07511AA, BA, DA	405800000 and later	10,342 kPa (1500 psi)
07511CA	404700001 and later	10,342 kPa (1500 psi)

Note: The maximum height the hitch arms can raise may be limited by the programmable attachment settings, or by the bed active switch when an optional cargo box is installed.

Hold

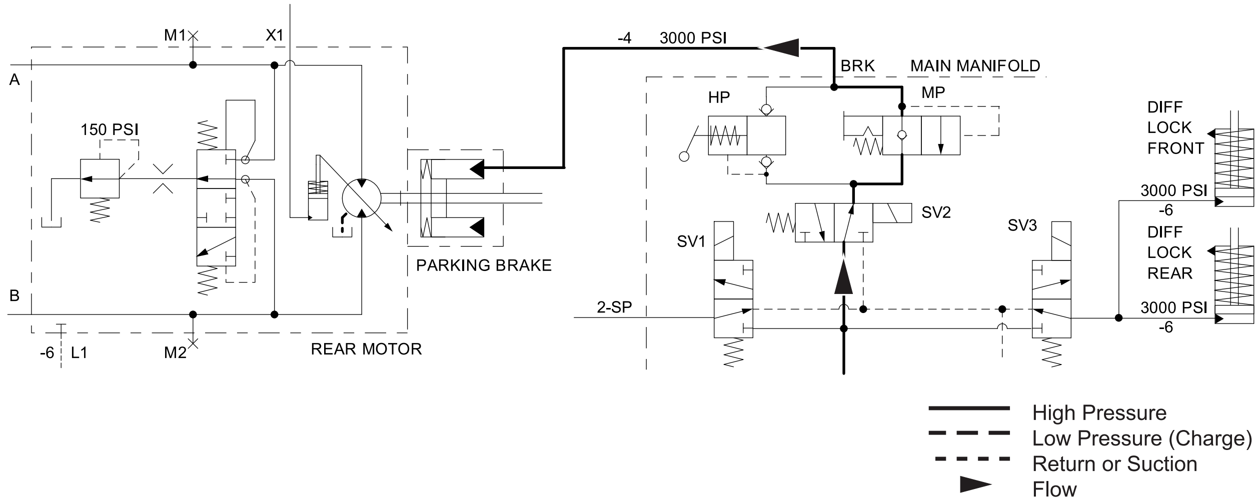
When the hitch paddle is released, solenoid valve (SP1) is de-energized and the hydraulic fluid behind the cylinder piston is trapped to hold the cylinders in position. The fluid is trapped by a check valve inside solenoid valve (SP1), a check valve inside solenoid valve (SP2) and by check valve (CV2).

Lower

When the hitch paddle is pushed downward, solenoid valve (SP2) is energized, and the hydraulic fluid trapped behind the cylinder piston is allowed to return to the hydraulic tank. The weight of the hitch arms and/or the attachment lowers the hitch arms when the hydraulic fluid behind the cylinder piston is released.

Note: The minimum height the hitch arms can lower may be limited by the programmable attachment settings.

Brake Circuit



Brake Circuit Diagram (disengaged)

A hydraulically actuated wet multi-disc brake is installed between the rear axle drive motor and the rear axle assembly. When engaged, the brake prevents the rear axle input shaft from rotating.

The gear pump section furthest from the piston pump, gear pump section (P4), supplies fluid to a variety of circuits including the brake release. Hydraulic fluid from gear pump (P4) enters the main manifold port P and flows through the steering priority valve (EC1); refer to Steering Circuit (page 5–21) for a full explanation of the steering priority valve (EC1) operation. Fluid flow continues through the flow regulator valve (EC2) where fluid flow dead heads at solenoid valve (SP1). Fluid is also sent to one end of the flow regulator valve (EC2) spool. If circuit flow is blocked at solenoid valve (SP1), the flow regulator valve (EC2) spool is shifted to direct flow to the traction charge, 2-speed drive motor control, brake release, differential lock, and PTO clutch circuits.

Parking Brake

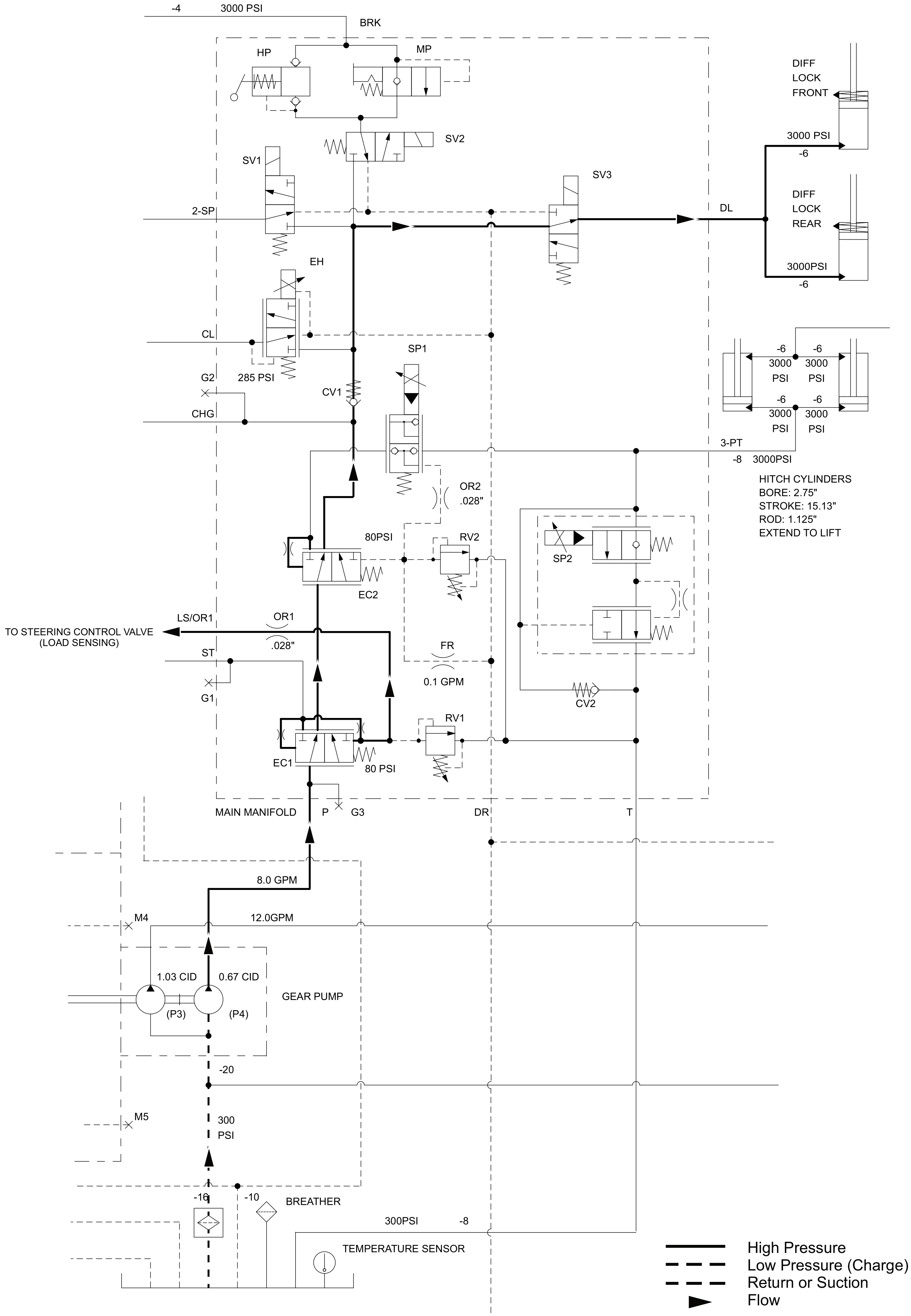
The brake is automatically engaged by springs inside the brake assembly when the engine is not running (no hydraulic pressure available). When the engine is running and the parking brake switch is set to ENGAGE position, solenoid valve (SV2) in the main manifold is de-energized and hydraulic flow bypasses the brake circuit. The brake remains engaged by the springs inside the brake assembly. When the engine is running and the parking brake switch is set to the DISENGAGE position, solenoid valve (SV2) is energized, and hydraulic flow passes through manual valve (MP) to push against the springs in the brake assembly and disengage the brake.

The parking brake may be disengaged when the engine is not running (no hydraulic pressure available) if necessary. Refer to Towing the Traction Unit (page 5–4) for additional information.

Service Brake

The brake will also engage when the decelerator pedal is fully depressed during vehicle operation. When the vehicle is in operation, the engine is running and the parking brake switch is in the DISENGAGE position. Solenoid valve (SV2) is energized, and hydraulic flow keeps the brake disengaged. When the decelerator pedal is fully depressed, solenoid valve (SV2) de-energizes. The hydraulic pressure trapped in the circuit combined with the springs inside the brake assembly, shift manual valve (MP) and the allow the brake to engage.

Differential Lock Circuit



Differential Lock Circuit Diagram (engaged)

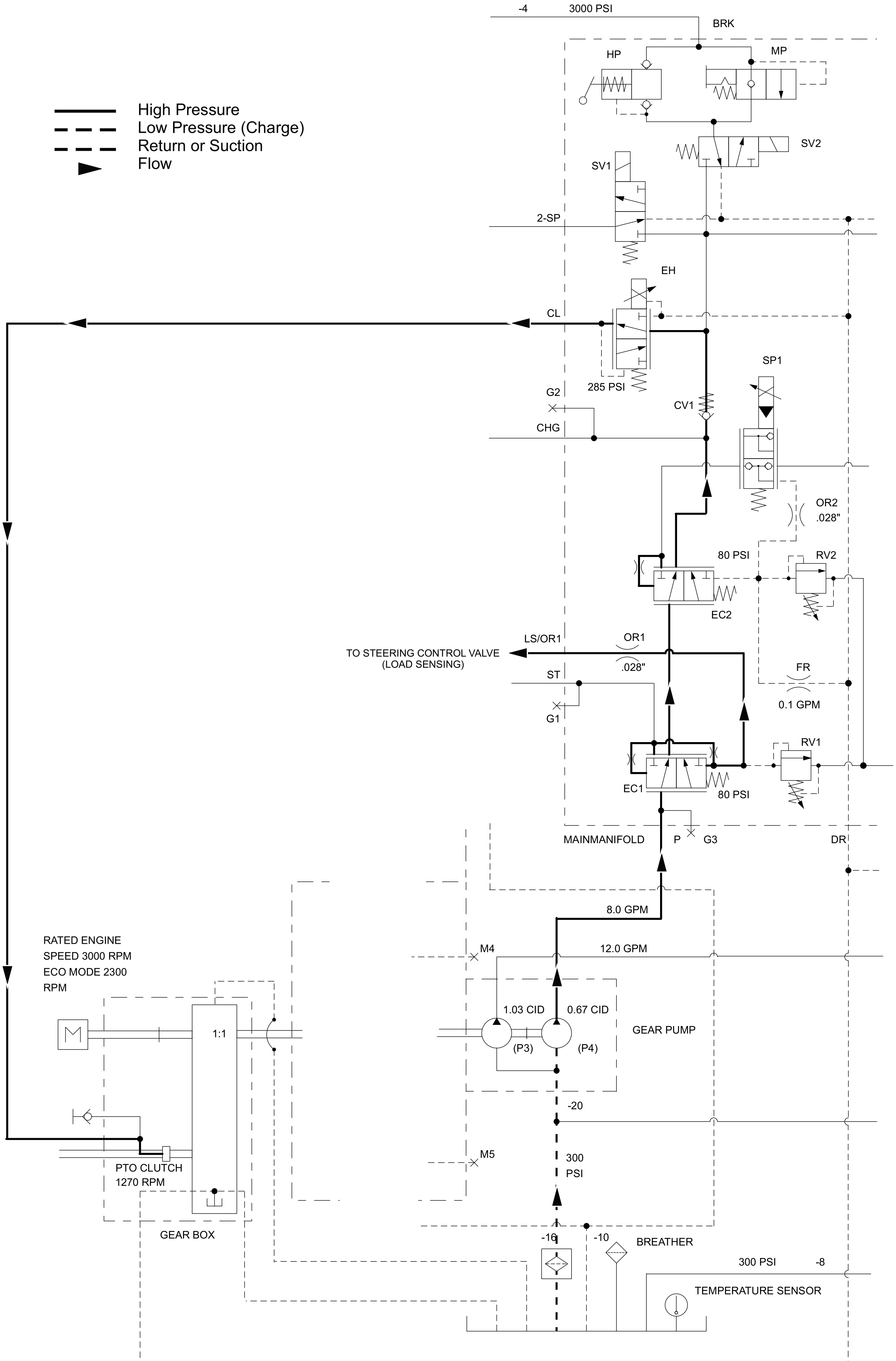
Differential Lock Circuit (continued)

The drive axles include hydraulically actuated differential locks. The differential locks are engaged when the engine is running and the differential lock button is pressed, or while the engine is running and the parking brake is engaged.

The gear pump section furthest from the piston pump, gear pump section (P4), supplies fluid to a variety of circuits including the differential lock. Hydraulic fluid from gear pump (P4) enters the main manifold port P and flows through the steering priority valve (EC1); refer to Steering Circuit (page 5–21) for a full explanation of the steering priority valve (EC1) operation. Fluid flow continues through the flow regulator valve (EC2) where fluid flow dead heads at solenoid valve (SP1). Fluid is also sent to one end of the flow regulator valve (EC2) spool. If circuit flow is blocked at solenoid valve (SP1), the flow regulator valve (EC2) spool is shifted to direct flow to the traction charge, 2-speed drive motor control, brake release, differential lock, and PTO clutch circuits.

When the differential lock switch is set to the DISENGAGE position, solenoid valve (SV3) in the main manifold is de-energized and hydraulic flow bypasses the differential lock circuit. Return springs in the differential lock assemblies keep the differential locks disengaged. When the differential lock switch is held in the ENGAGE position, solenoid valve (SV3) energizes, and hydraulic flow is directed to the pistons of the differential lock assemblies. Each piston moves a fork and collar over a series of pins on the differential assembly to lock the axles together.

PTO Clutch Circuit



PTO Circuit Diagram (engaged)

PTO Clutch Circuit (continued)

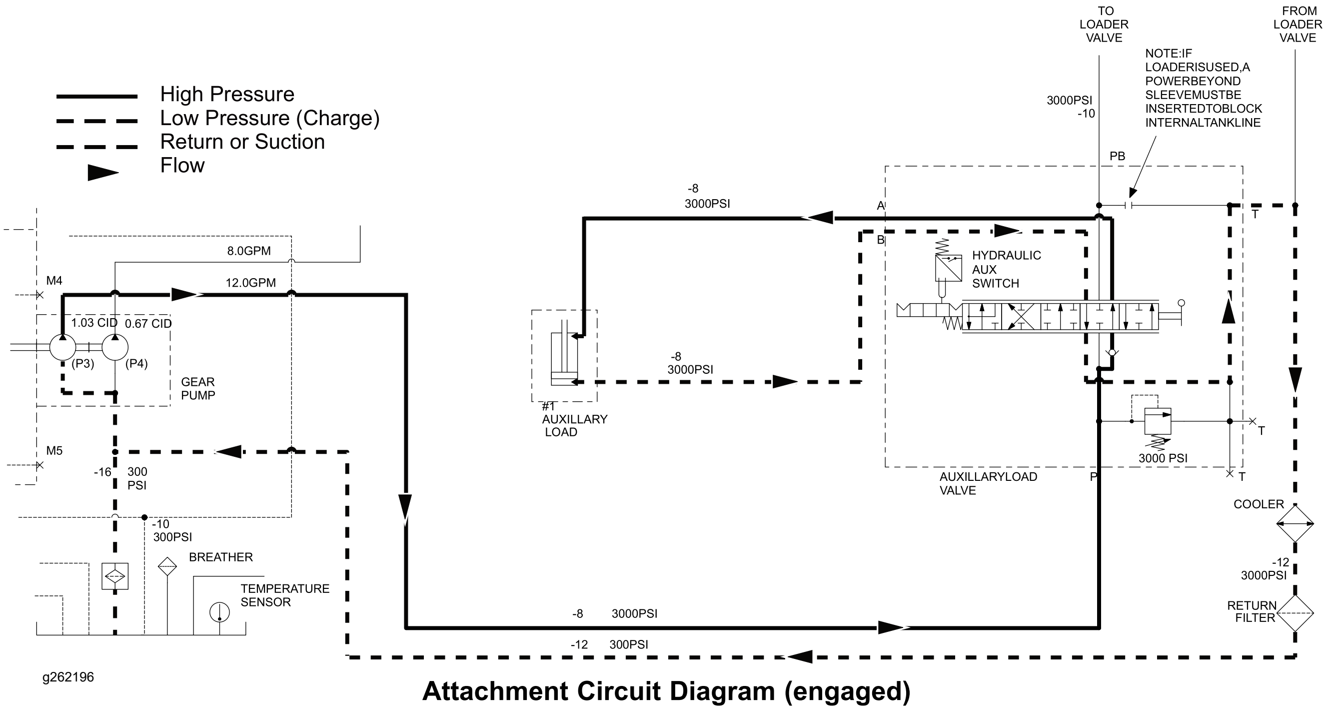
The PTO RPM is directly related to engine speed. A gearbox located between the engine and the tandem piston (traction) pump (P1 and P2) includes a 1:0.42 gear reduction and a hydraulically actuated clutch for the PTO.

The gear pump section furthest from the piston pump, gear pump section (P4), supplies fluid to a variety of circuits including the PTO clutch. Hydraulic fluid from gear pump (P4) enters the main manifold port P and flows through the steering priority valve (EC1); refer to Steering Circuit (page 5–21) for a full explanation of the steering priority valve (EC1) operation. Fluid flow continues through the flow regulator valve (EC2) where fluid flow dead heads at solenoid valve (SP1). Fluid is also sent to one end of the flow regulator valve (EC2) spool. If circuit flow is blocked at solenoid valve (SP1), the flow regulator valve (EC2) spool is shifted to direct flow to the traction charge, 2-speed drive motor control, brake release, differential lock, and PTO clutch circuits.

When the PTO switch is set to the DISENGAGE position, proportional solenoid valve (EH) in the main manifold is de-energized and hydraulic flow bypasses the PTO clutch circuit. Return springs on both sides of the PTO clutch assembly keep the clutch disengaged and the PTO brake engaged. When the machine is in Attachment Mode and the PTO switch is set to the ENGAGE position, proportional solenoid valve (EH) energizes, and hydraulic flow is directed to a piston in the PTO clutch assembly. Hydraulic flow pushes the piston away from the PTO brake to release the brake and toward the PTO clutch to engage the clutch.

Note: Depending on the programmable attachment settings, raising and lowering the hitch may also disengage or engage the PTO.

Attachment Circuit



Attachment Circuit Diagram (engaged)

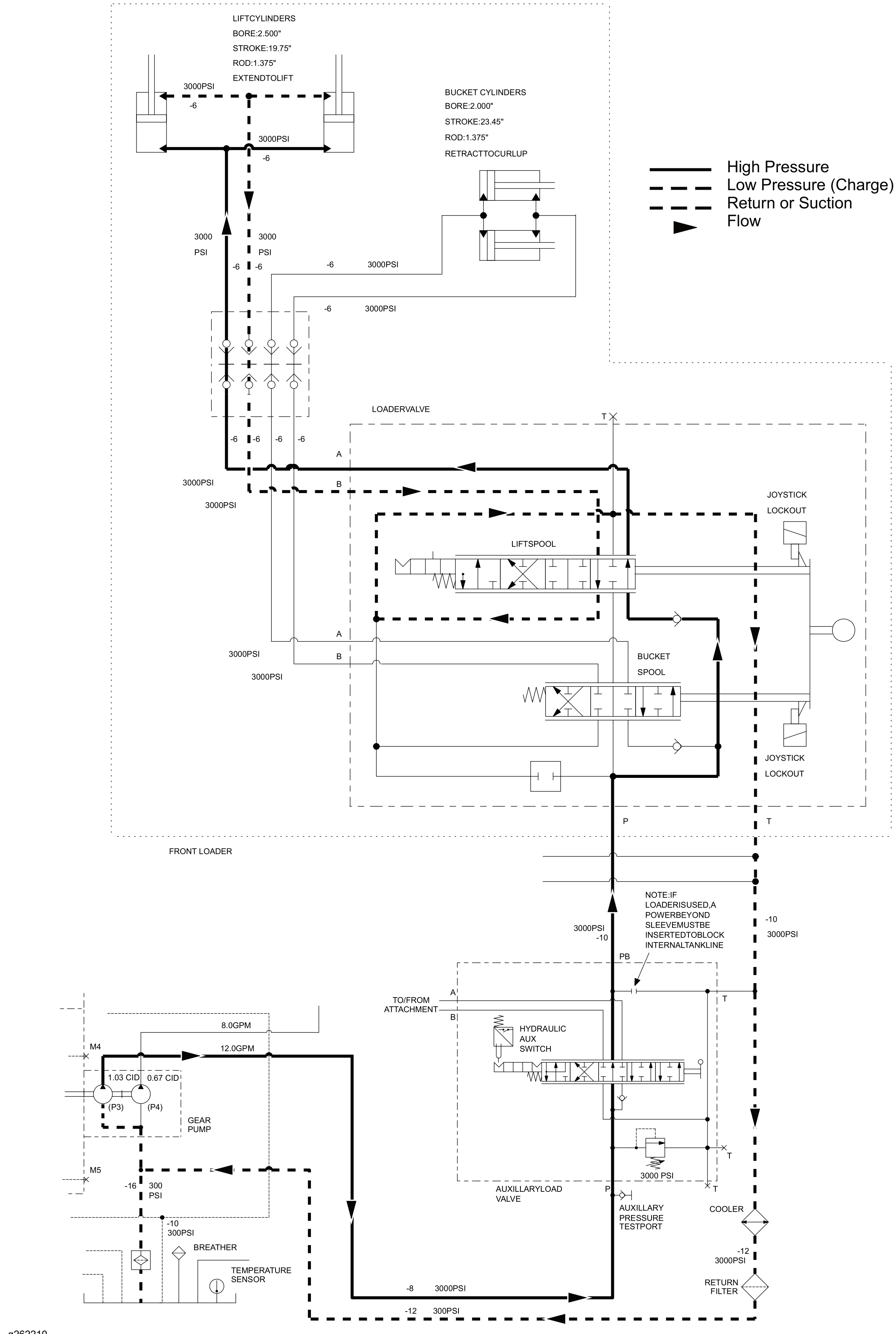
The machine includes a single function hydraulic circuit to support the hydraulic demands of a rear mount attachment. Gear pump (P3), a 5-position auxiliary load valve located between the operator and passenger seats, and a pair of hydraulic lines with quick disconnect fittings are part of the standard attachment circuit. The attachment circuit can be expanded to include an additional hydraulic function by installing a selector control valve kit (optional); refer to Selector Control Valve (SCV) Circuit (optional) (page 5–39) for additional information.

The gear pump section closest to the piston pump, gear pump section (P3), supplies fluid to the attachment circuit. Hydraulic fluid from gear pump (P3) enters the auxiliary load valve and is directed as follows based on the auxiliary load valve position:

- When the auxiliary load valve is in the A (DETENT) or the A (MANUAL) positions, flow is directed to supply line A. Return flow from supply line B is allowed to return to the hydraulic tank.
- When the auxiliary load valve is in the NEUTRAL/HOLD position, flow bypasses the attachment supply lines A and B. The flow either returns to the hydraulic tank or is made available to supply the hydraulic demands of the optional loader. Return flow from both attachment supply lines A and B is blocked.
- When the auxiliary load valve is in the B position, flow is directed to attachment supply line B. Return flow from supply line A is allowed to return to the hydraulic tank.
- When the auxiliary load valve is in the FLOAT position, flow bypasses the attachment supply lines A and B. The flow either returns to the hydraulic tank or is made available to supply the hydraulic demands of the optional loader. Attachment supply line flow is allowed to move in either direction with little to no pressure.

The hydraulic load for the attachment circuit is limited to 20,684 kPa (3000 psi) by a relief valve in the auxiliary load valve.

Front Loader Circuit



Front Loader Circuit Diagram (arms raising)

Front Loader Circuit (continued)

The machine includes a hydraulic circuit to support the hydraulic demands of an optional front mounted loader. Gear pump (P3), a 5-position auxiliary load valve located between the operator and passenger seats, a multi-position loader control valve located on the operator console, and a series of hydraulic supply lines with quick disconnect fittings are part of the loader circuit. The multi-position loader control valve can be moved to the left or right to operate the loader lift cylinders, and moved forward or rearward to operate the loader bucket curl cylinders.

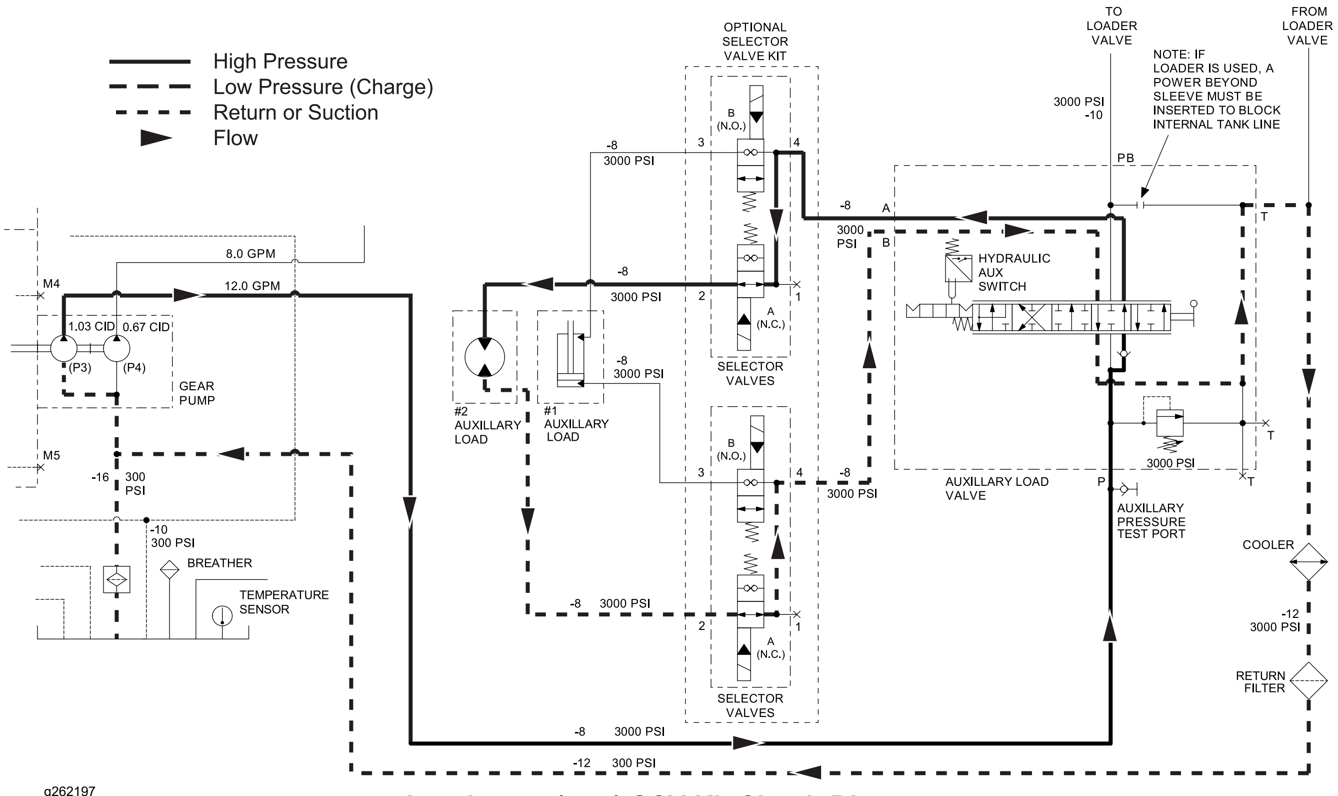
Note: The front loader circuit can be expanded to include an additional hydraulic function by installing an optional selector control valve kit; refer to Selector Control Valve (SCV) Circuit (optional) (page 5–39) for additional information.

The gear pump section closest to the piston pump, gear pump section (P3), supplies fluid to the optional loader circuit. Hydraulic fluid from gear pump (P31) supplies the loader circuit when there is no hydraulic demand for a rear mount attachment (the auxiliary load valve is in the NEUTRAL/HOLD or FLOAT position). Flow passing through the auxiliary load valve enters the loader valve and is directed as follows based on the loader valve position:

- When the loader control valve is in the NEUTRAL/HOLD position, flow bypasses the 2 loader lift supply lines and the 2 loader bucket supply lines. In this position the hydraulic flow passes through the valve and returns to the hydraulic tank. Return flow from the loader lift and bucket supply lines is blocked.
- When the loader control valve is moved to the rear RAISE position, flow is directed to lift supply line A. Return flow from lift supply line B is allowed to return to the hydraulic tank.
- When the loader control valve is moved to the forward LOWER position, flow is directed to lift supply line B. Return flow from lift supply line A is allowed to return to the hydraulic tank.
- When the loader control valve is moved to the fully forward FLOAT position, flow bypasses the lift supply lines A and B. Lift supply line flow is allowed to move in either direction with little to no pressure.
- When the loader control valve is in the right CURL DOWN position, flow is directed to bucket supply line A.
- When the loader control valve is moved to the left CURL UP position, flow is directed to bucket supply line B.

The hydraulic load for the optional loader circuit is limited to 20,684 kPa (3000 psi) by a relief valve in the auxiliary load valve.

Selector Control Valve (SCV) Circuit (optional)

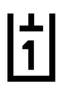


Attachment (rear) SCV Kit Circuit Diagram

The hydraulic circuit for the attachment (rear) or loader (front) can be expanded to provide flow to an additional hydraulic load by installing a selector control valve kit. The kit is installed between the auxiliary load valve and the attachment, or between the loader valve and the loader. Once installed, the 4 solenoid valves included in the kit allow the operator to select between two different hydraulic operations via 2 sets of hydraulic supply lines.

The kit solenoid valves are controlled by a switch supplied with the kit.

- **Attachment (rear) SCV Kit** – A momentary button switch located on the operator control console near the PTO switch is an input to the T1: TEC. The T1: TEC uses signals from the switch to control the kit solenoid valves.

  When the SCV kit solenoid valves are de-energized, the right side set of hydraulic quick-disconnect couplers (standard) are active and the No. 1 Hydraulic Circuit icon appears on the InfoCenter display.

  When the SCV kit solenoid valves are energized, the left side set of hydraulic quick-disconnect couplers (supplied with kit) are active and the No. 2 Hydraulic Circuit icon appears on the InfoCenter display.

- **Loader (front) SCV Kit** – A 3-position rocker switch located on the loader control valve joystick is used to control the loader SCV valves. When the switch is in the OFF (center) position, all kit solenoid valves are de-energized and hydraulic flow is directed to the manifold ports marked 3. When the switch is in the ON (forward) position or MOMENTARY (rearward) position, all kit solenoid valves are energized, and hydraulic flow is directed to the manifold ports marked 2.

Refer to the selector control valve kit *Installation Instructions* for additional information.

Testing the Hydraulic System

The most effective way to isolate hydraulic system problems is to use hydraulic test equipment, such as pressure gauges and flow meters, in the hydraulic circuit during circuit operation; refer to Special Tools (page 2–14).

WARNING

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

Before you disconnect the hydraulic components or work on the hydraulic system, release the pressure in the system; refer to Relieving Pressure from the Hydraulic System in this chapter.

WARNING

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

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

CAUTION

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

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

IMPORTANT

Before performing a hydraulic test, check the fluid supply, the filter condition, control linkage operation and adjustment, loose fasteners, or mechanical and electrical issues before you assume that a hydraulic component is the source of the problem.

IMPORTANT

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

1. Use the following resources to assist with hydraulic system troubleshooting.
   - The Hydraulic Schematic in Appendix A (page A–1)
   - Hydraulic Flow Diagrams (page 5–15)
   - General and system specific troubleshooting tables in Chapter 3 – Troubleshooting
2. Always wear the eye protection when you perform hydraulic system tests.
3. Clean the machine fully before you disconnect or disassemble the hydraulic components.

   Note: Cleanliness is required whenever you work on the hydraulic equipment. Contamination causes wear on hydraulic components.
4. To prevent hydraulic system contamination, put metal caps or plugs on any hydraulic lines left open or exposed during testing or removal of components.
5. The engine must be in good operating condition. Use the tachometer on the T2: TDM display to verify and monitor engine RPM when performing a hydraulic test. Engine speed can affect the accuracy of the test readings. Use the information below when performing hydraulic system tests. If engine RPM is above or below the specified speed during a test, you will need to adjust the expected hydraulic performance parameters (approximately 3% per 100 engine rpm at full throttle)

IMPORTANT

Hydraulic component output volume relates directly to engine RPM. For every 100 engine rpm the following component output volumes will change by the volume listed.

   - Traction Pump: 100 engine RPM = 3.8 liters (1 gallon or 129 ounces) of hydraulic fluid displaced per minute
   - Gear Pump (P3): 100 engine RPM = 1.7 liters (0.45 gallon or 57 ounces) of hydraulic fluid displaced per minute.
   - Gear Pump (P4): 100 engine RPM = 1.1 liters (0.29 gallon or 37 ounces) of hydraulic fluid displaced per minute
6. When you use a hydraulic tester (pressure and flow), ensure that the inlet and outlet hoses are properly connected and not reversed to prevent damaging the hydraulic tester or components.
7. When you use a hydraulic tester (pressure and flow), open the tester load valve fully before you start the engine to reduce the possibility of damaging the components.
8. Install the hydraulic fittings by hand and ensure that they are not cross-threaded before you tighten them with a wrench.
9. Position any test hoses away from parts that may move during the test procedure.
10. After you connect the test equipment, check the hydraulic-fluid level in the hydraulic tank and ensure that the fluid level is correct.
11. Perform all the hydraulic tests with the hydraulic fluid at normal operating temperature.

12. Record the results of all hydraulic tests performed.

Hydraulic Test Selection

Before beginning any hydraulic test, identify if the problem is related to the traction circuit, steering circuit, hitch cylinder circuit, or the attachment circuit. Once the faulty system has been identified, perform tests that relate to that circuit.

If a traction circuit problem exists, consider performing one or more of the following tests: Charge Pressure Test, and/or Traction Pump (P1) and (P2) Flow and Relief Valve Test.

If a steering or hitch cylinder circuit problem exists, consider performing one or more of the following tests: Steering Relief Valve (RV1) Pressure Test, Hitch Cylinder Test, Hitch Cylinder Relief Valve (RV2) Pressure Test, and/or Gear Pump (P4) Flow Test.

If an attachment/loader/dump circuit problem exists, consider performing one or more of the following tests: Circuit Relief Valve Pressure Test, and/or Gear Pump (P3) Flow Test.

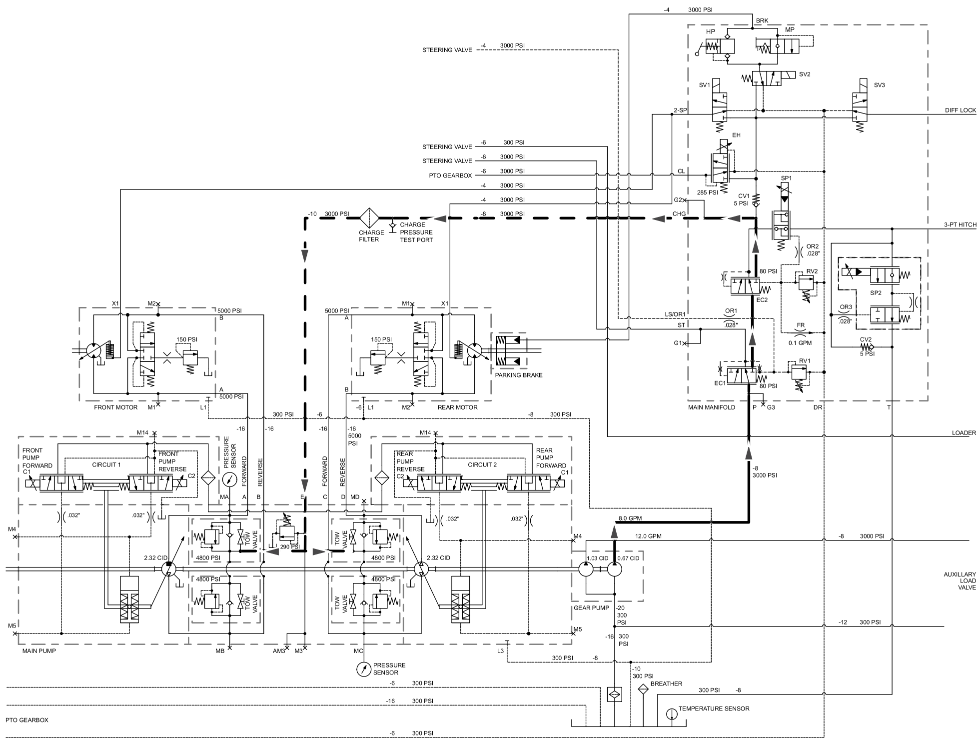
Note: If an attachment motor performance is suspect, perform an Attachment Motor Efficiency Test; refer to the attachment *Installation Instructions* or *Service Manual*.

Traction Circuit Testing

Charge Pressure Test

Model/Serial Table (Figure 60)

Model	Serial Range
07511AA, 07511BA, and 07511DA	400000000 through 409999999
07511CA	400000000 through 409999999



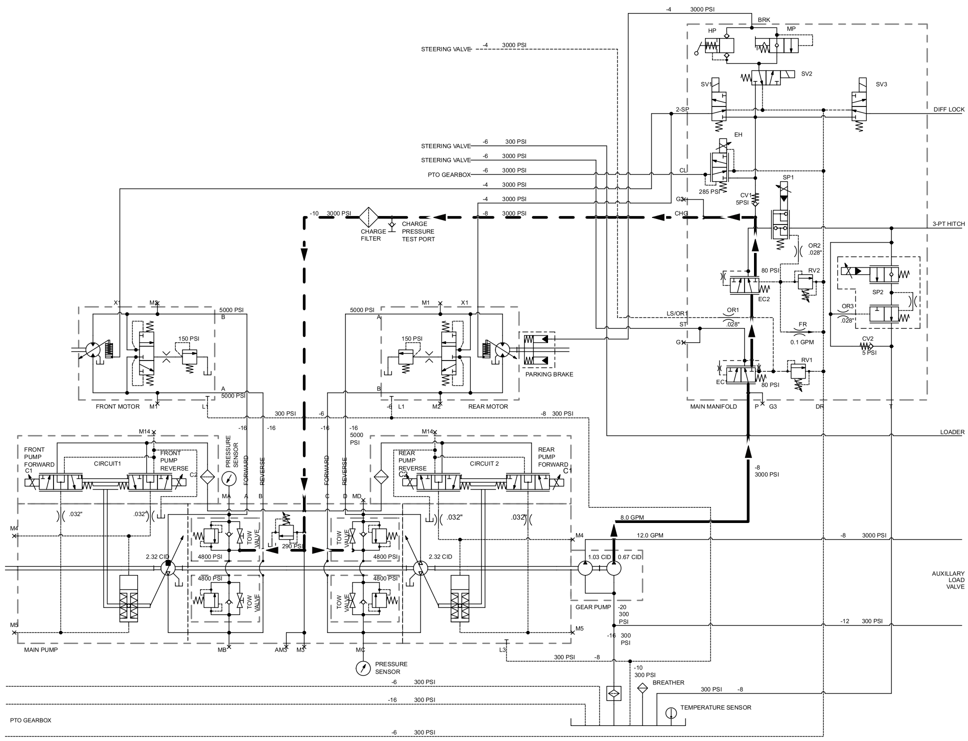
g437453

Figure 60

Charge Pressure Test (continued)

Model/Serial Table (Figure 61)

Model	Serial Range
07511AA, 07511BA, 07511CA, and 07511DA with Gearbox Reduction Kit 144-9700	400000000 through 409999999
07511AA, 07511BA, 07511CA, and 07511DA	410000000 and Higher

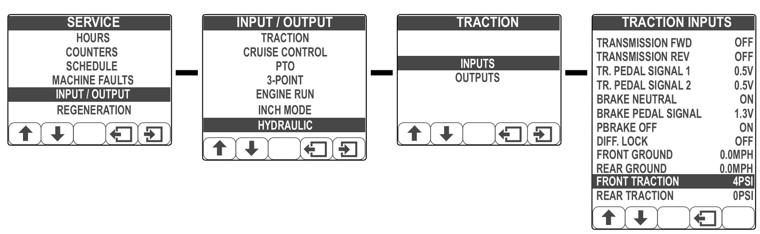


g437454

Figure 61

Charge pressure testing involves reading the charge pressure with the traction pump under no load (swash plates closed) and reading to the charge pressure while the traction pump is under a moderate load (swash plates open).

1. Ensure that the hydraulic tank is full.
2. Start the engine.
3. In The InfoCenter, navigate to the TRACTION INPUTS screen.



g438778

Figure 62

4. Move the selection bar so that both FRONT TRACTION and REAR TRACTION pressure measurement display.
5. Rotate the operation-mode selector to the Auto H position.
6. With the machine in Park, look at the traction press values.

Charge Pressure Test (continued)

Note: Normal charge pressure when the machine is parked is approximately 1,930 to 2,413 kPa (280 to 350 psi)

7. Drive the machine and watch at the traction press values.

Note: Normal charge pressure when the machine is driven is less than 1,379 kPa (200 psi)

8. Park the machine, engage that parking brake, and shut off the engine.

Troubleshoot the following components if you measure a difference in the FRONT TRACTION and REAR TRACTION pressures or a reading that is out of range:

- The charge circuit filter is plugged.
- The tandem piston (Traction) pump (P1—front axle-motor circuit) or (P2—rear axle-motor circuit) is worn or damaged.
- A main manifold component is worn or damaged.
- A dual gear pump (P4) is worn or damaged.

Testing Traction Pump (P1) and (P2) High Pressure Circuit Flow

The Outcross 9060 incorporates a tandem piston (traction) pump; one pump to drive the front axle and the other to drive the rear axle. Traction pump flow testing involves measuring the pump output flow in high range under load. A procedure for testing the traction pump(s) flow and the relief valves operation for this machine is being developed. Contact your local Toro Distributor for assistance.

Each pump includes two pressure relief valves (forward and reverse flow) set to open at 33,095 kPa (4800 psi). Relief valve testing involves increasing the traction circuit load, verifying the relief valve opens at or near the specified pressure. A procedure for testing the relief valve(s) operation for this machine is being developed. Contact your local Toro Distributor for assistance.

This test measures tandem piston (traction) pump output (flow). During this test, pump load is created at the flow meter using the adjustable load valve on the tester. If the tandem piston (traction) pump is within specification, the axle-drive motor is worn or damaged and should be replaced.

IMPORTANT

Traction circuit flow for the Outcross is approximately 102.3 LPM (27 GPM) . Use 40 GPM Hydraulic Tester #AT40002 (pressure and flow) for this test (see Special Tools (page 2–14)).

7

CAUTION

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

Preparing the Machine

1. Remove all attachments.
2. Park machine on a level surface. Make sure that hydraulic oil is at normal operating temperature, engine is shut off and the parking brake is applied.

CAUTION

All wheels will be off the ground and rotating during this test. Make sure that the machine is supported so it will not move.

3. Raise and support machine so all wheels are off the ground, refer to Jacking Instructions (page 1–8).
4. At the bottom of the machine, thoroughly clean junction of hydraulic hose at the end of axle-drive motors. Disconnect hose from right side pump fitting.
5. Disconnect the large hose of the from port A and port B of the axle-drive motor.

Model/Serial Table (Figure 63)

Model	Serial Range
07511AA, 07511BA, and 07511DA	400000000 through 409999999
07511CA	400000000 through 404700000

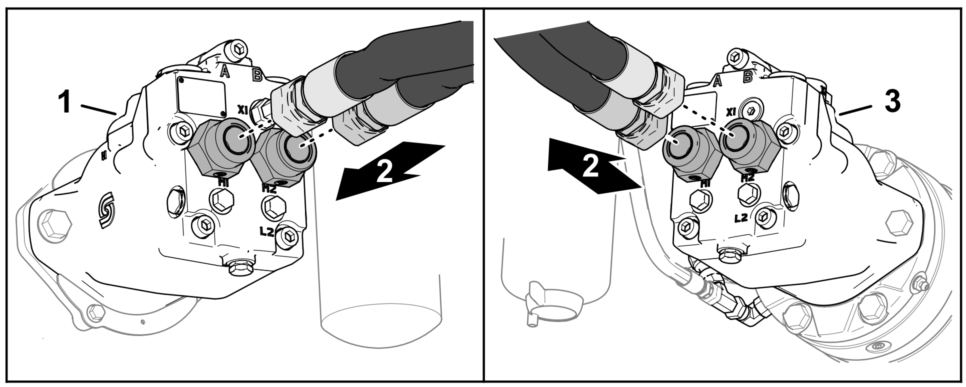


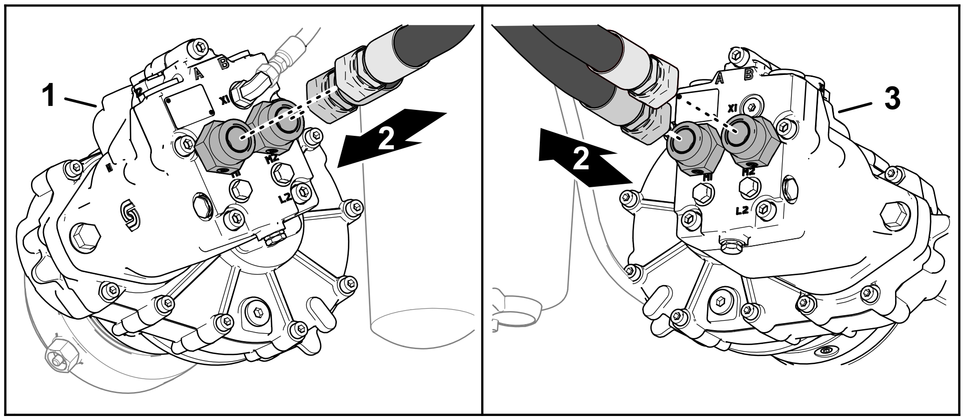
Figure 63

1. Front axle-drive motor
2. Front of the machine
3. Rear axle-drive motor

Testing Traction Pump (P1) and (P2) High Pressure Circuit Flow (continued)

Model/Serial Table (Figure 64)

Model	Serial Range
07511AA, 07511BA, 07511CA, and 07511DA with Gearbox Reduction Kit 144-9700	400000000 through 409999999
07511AA, 07511BA, 07511CA, and 07511DA	410000000 and higher



g438985

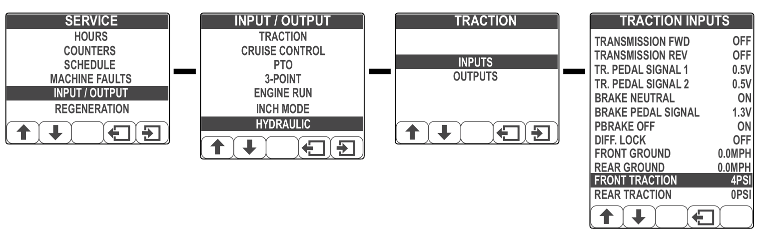
Figure 64

1. Front axle-drive motor
2. Front of the machine
3. Rear axle-drive motor

6. Use hydraulic hose kit, see Special Tools (page 2–14), to connect flow meter to axle-drive motor hoses so that the flow meter is accessible from the side of the machine.
7. Make sure that fitting and hose connections are properly tightened.
8. Make sure that the flow control valve on tester is fully open.

Testing Tandem Piston (Traction) Pump Flow

1. Start the engine.
2. In The InfoCenter, navigate to the TRACTION INPUTS screen.



g438778

Figure 65

3. Move the selection bar so that both FRONT TRACTION and REAR TRACTION pressure measurement display.
4. Rotate the operation-mode selector to the Auto H position.
5. Press the Eco Mode switch to the OFF position.
6. Rotate the mode switch to the AUTO L position.
7. Disengage the parking brake.
8. Move the gear-shift lever to FORWARD position.
9. Slowly push the accelerator pedal to the fully forward position.

10. Have another person slowly closing the flow control valve until you see the InfoCenter displays 69 bar (1000 PSI) in the FRONT TRACTION or REAR TRACTION pressure measurement.

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

11. Have the other person observe flow gauge.

    Note: Flow indication should be approximately 113 LPM (30 GPM).

12. Release traction pedal, move the shift lever to the NEUTRAL position, have the other person open flow control valve on tester, and shut off engine. Record test results.

13. Remove the flow meter and connect the hoses to the drive motor.

Troubleshooting the Traction Circuit

- If flow is less than 113 LPM (30 GPM)., consider the following:
  - The tow valve may not be fully closed—close the bypass valves, refer to Towing the Machine instructions in *Operator's Manual* for the machine.
  - The pressure transducer is worn or damaged.
  - The tandem piston (traction) pump is worn.
- If flow is 113 LPM (30 GPM) or higher, consider the following:

The axle-drive motor is worn or damaged, refer to Axle Motors (page 5–92).

Testing the High Traction Pump (P1) and (P2) Pressure Relief Valves

Test Equipment:

- Hydraulic Pressure Testing Kit (Toro Part No. TOR47009)
- 1 high pressure hoses 13 mm (0.5 in) x 244 cm (8 ft) with -16 female O-ring face seal fittings at each end. Hose specification: Parker 787TC or equivalent.

Each pump includes two pressure relief valves (forward and reverse flow) set to open at 33,095 kPa (4800 psi). Relief valve testing involves increasing the traction circuit load, verifying the relief valve opens at or near the specified pressure. A procedure for testing the relief valve(s) operation for this machine is being developed. Contact your local Toro Distributor for assistance.

1. Ensure that the hydraulic tank is full.
2. Block the tires so that the machine is immobilized.
3. Remove the test fitting from the tee fitting at the inboard side of the filter head for the charge circuit filter.

Testing the High Traction Pump (P1) and (P2) Pressure Relief Valves (continued)

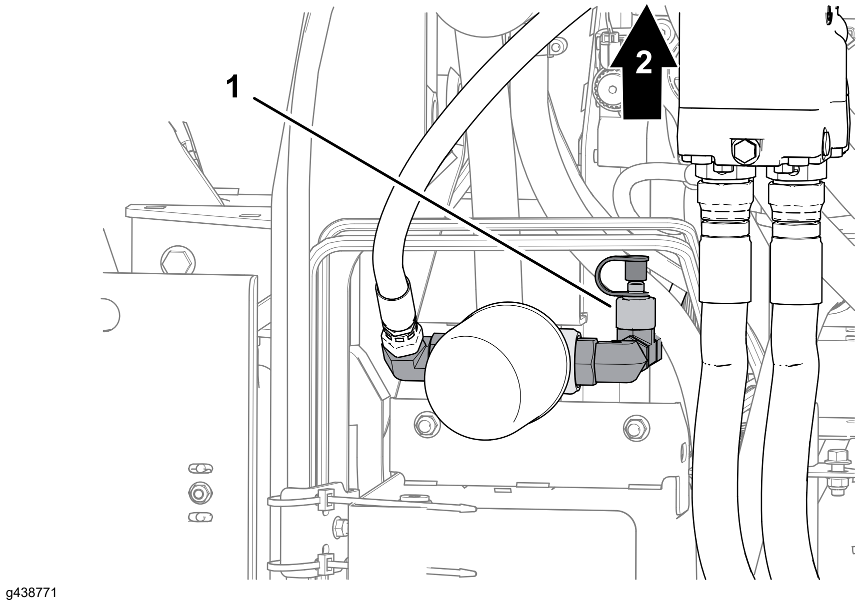


Figure 66

1. Test fitting
2. Front of the machine

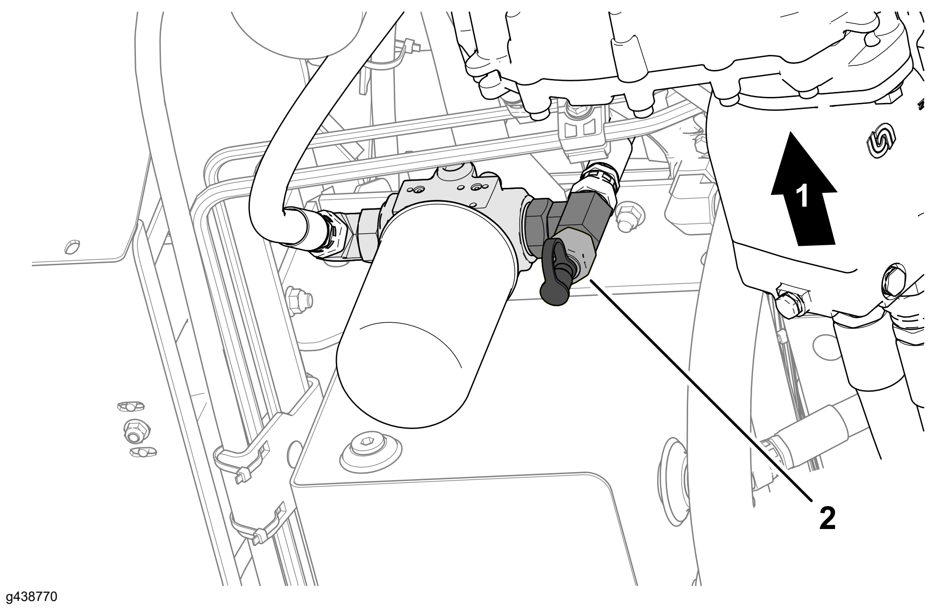


Figure 67

1. Front of the machine
2. Test fitting

4. Install the specified hose to the tee fitting, and a hose adapter between the hose and the pressure gauge.
5. Select the 34,474 kPa (5000 psi) pressure gauge and install it to the hose with an adapter from the kit.
6. Locate the gauge where you or another person sitting on the seats of the machine can read it.
7. Start the engine.
8. Rotate the operation-mode selector to the Auto H position.

Testing the High Traction Pump (P1) and (P2) Pressure Relief Valves (continued)

9. Watch the pressure gauge while driving the machine forward against the tire blocking.

   Note: The hydraulic pressure should rise to approximately 33,094 kPa (4800 psi) and stop

   Troubleshoot the following components if the pressure relief value is out of range:

   - A partially open tow valve
   - The tandem piston (traction) pump (P1—front axle-motor circuit) or (P2—rear axle-motor circuit).
     - A worn or damaged pressure relief valve.
     - A worn or damaged pressure sensor.

10. Remove the pressure gauge and install the test fitting.

Steering/Hitch Cylinder Circuit Testing – Steering Relief Valve (RV1) Pressure Test

Steering Relief Valve (RV1) Pressure Test Diagram

Model/Serial Table (Figure 68)

Model	Serial Range
07511AA, 07511BA, and 07511DA	400000000 through 405799999
07511CA	400000000 through 404700000

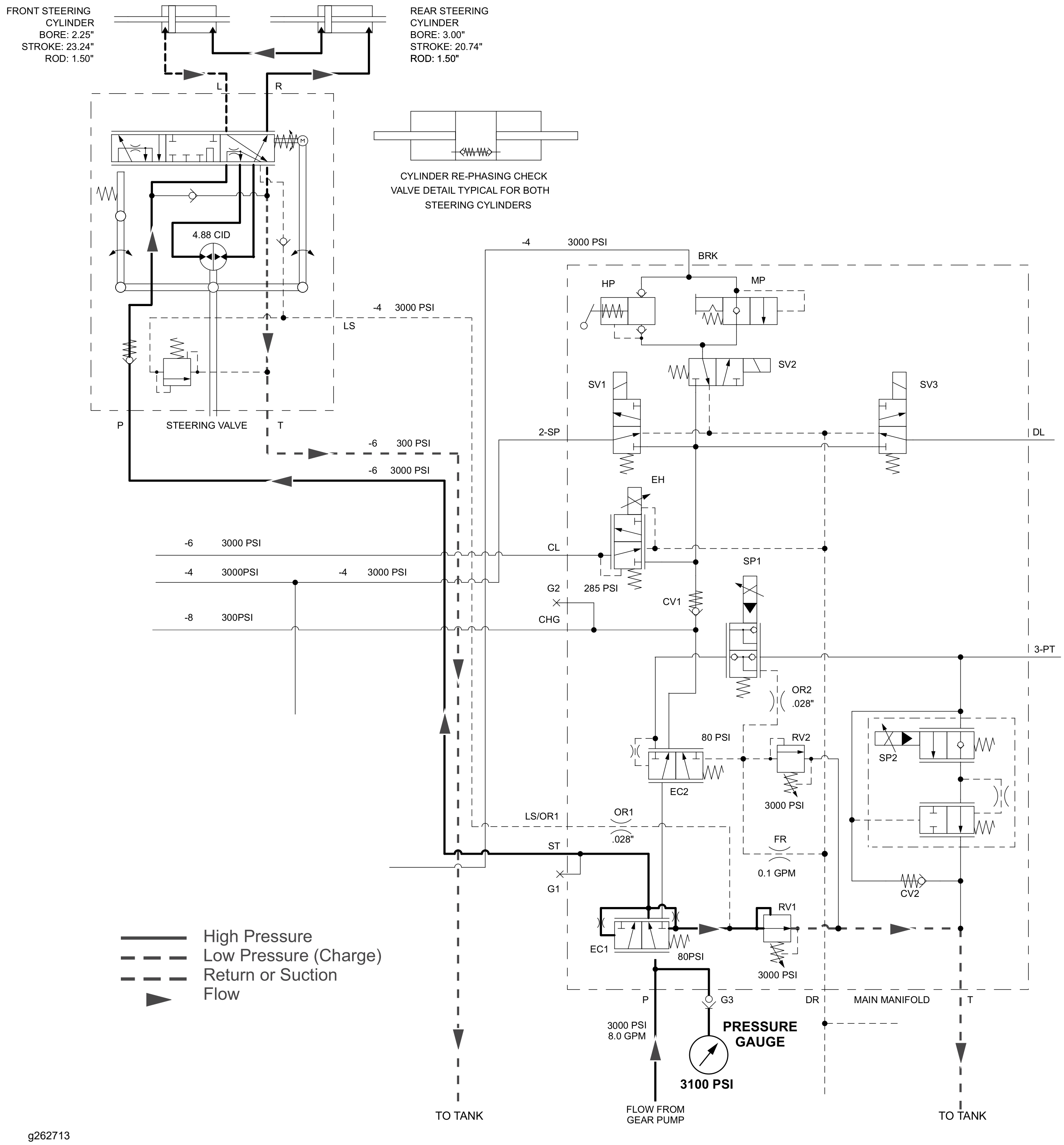


Figure 68

Turning to the right shown.

Model/Serial Table (Figure 69)

Model	Serial Range
07511AA, 07511BA, and 07511DA	405800000 and later
07511CA	404700001 and later

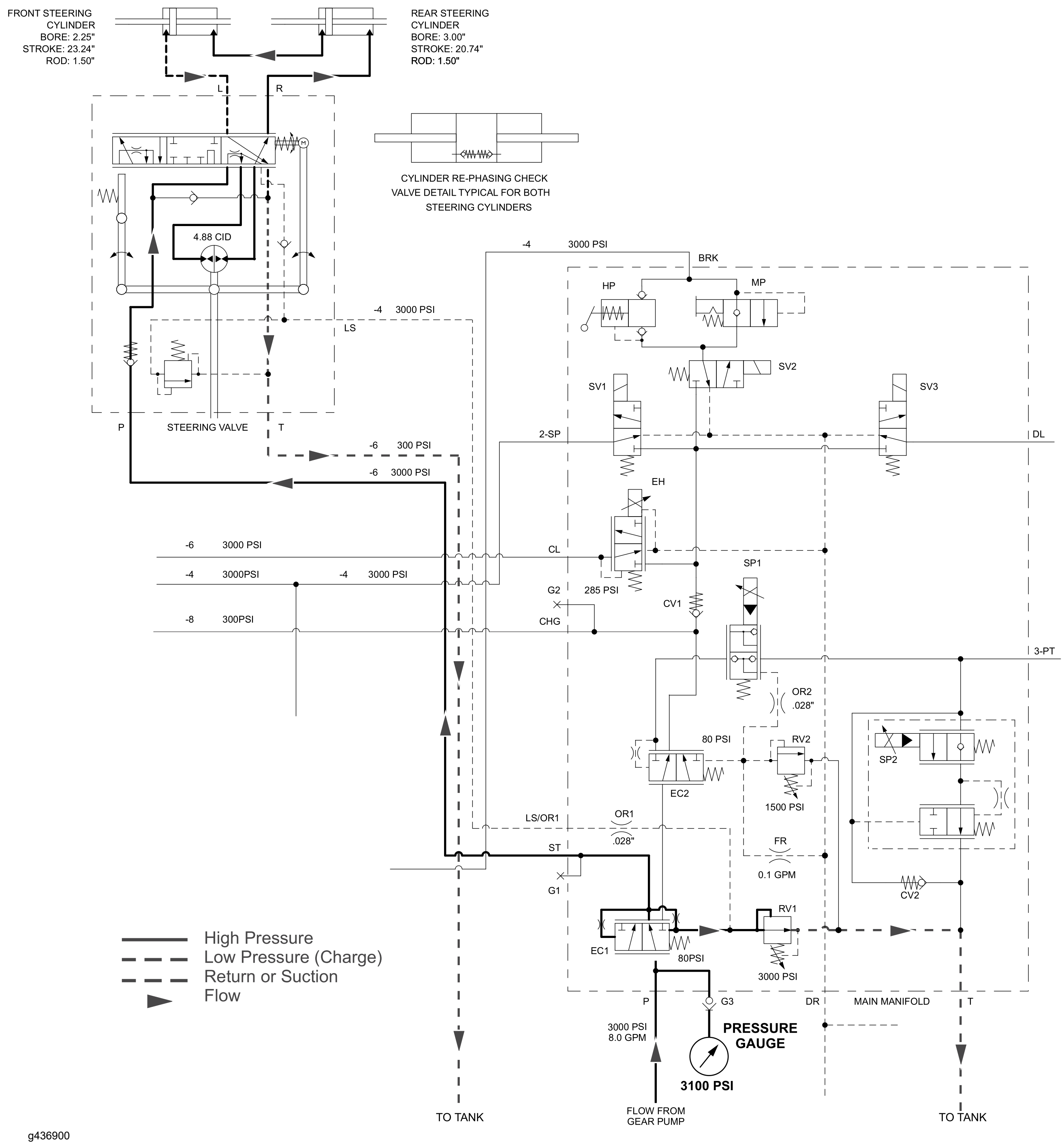


Figure 69

Turning to the right shown.

Steering/Hitch Cylinder Circuit Testing – Steering Relief Valve (RV1) Pressure Test

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately ten (10) minutes.
2. Park the machine on a level surface, lower the attachments and stop the engine. Remove the key from the key switch.
3. Make sure the hydraulic tank is full.
4. Open the main instrument panel.

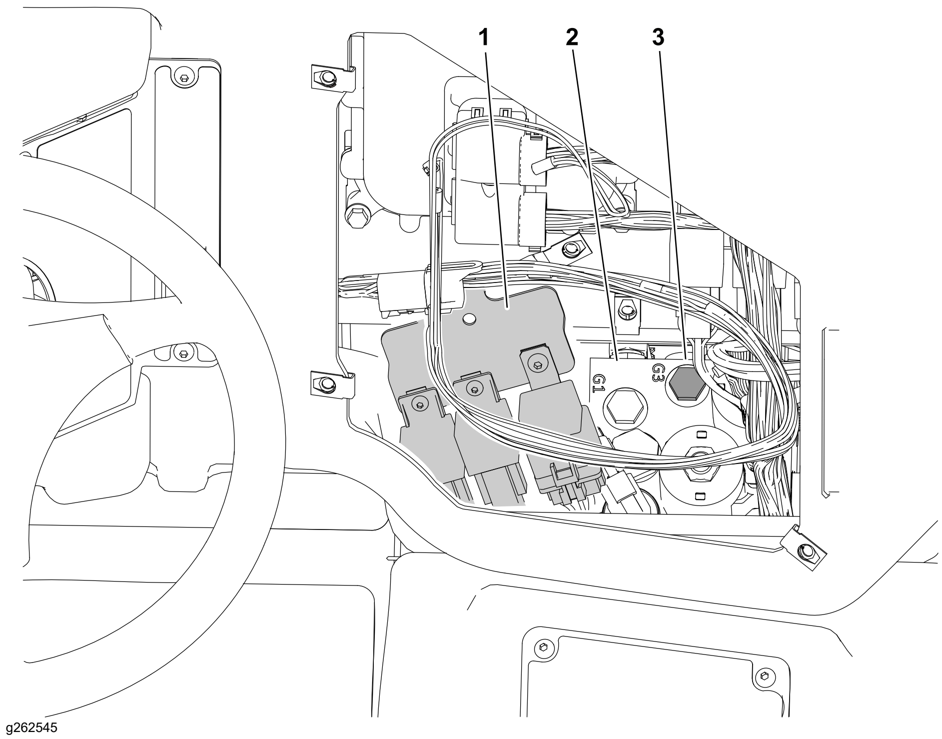


Figure 70

1. Relay assembly
2. Main hydraulic manifold
3. G3 port

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5. Remove the relay mounting plate from the dash frame without disconnecting any of the relays from the wire harness. Move the relay assembly to one side.
6. Thoroughly clean the main hydraulic manifold and plug at the G3 port.
7. Remove the plug from the G3 port of the main manifold and install a size 6 SAE-ORB (9/16–18) diagnostic connector and cap (Toro part nos. 59–7410 and 354–79).
8. Connect a 34,475 kPa (5000) pressure gauge with hydraulic hose attached to test fitting in port G3 port of main manifold.
9. Start engine and idle at low speed. Check for hydraulic leakage at test connection and correct any issues before proceeding with test.
10. Increase engine speed to 2300 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.

Steering/Hitch Cylinder Circuit Testing – Steering Relief Valve (RV1) Pressure Test (continued)

11. Turn steering wheel all the way in one direction (turning to the right shown) and momentarily hold the steering wheel against resistance.

    Gauge reading should indicate approximately: 21,373 kPa (3100 psi).

12. Release steering wheel, stop engine and record test results.
13. If steering relief pressure reading is incorrect:
    - If 3-point hitch raise/lower problems also exist, gear pump (P4) 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.
    - Clean, repair or replace relief valve (RV1); refer to Cartridge Valve Service (page 5–109).
    - Replace the relief valve (RV1); refer to Main Manifold Service (page 5–107).
14. When testing is complete, disconnect pressure gauge from manifold and install the test fitting cap.

Steering/Hitch Cylinder Circuit Testing – Hitch Cylinder Relief Valve (RV2) Pressure Test

Model/Serial Table (Figure 71)

Model	Serial Range
07511AA, 07511BA, and 07511DA	400000000 through 409999999
07511CA	400000000 through 404700000

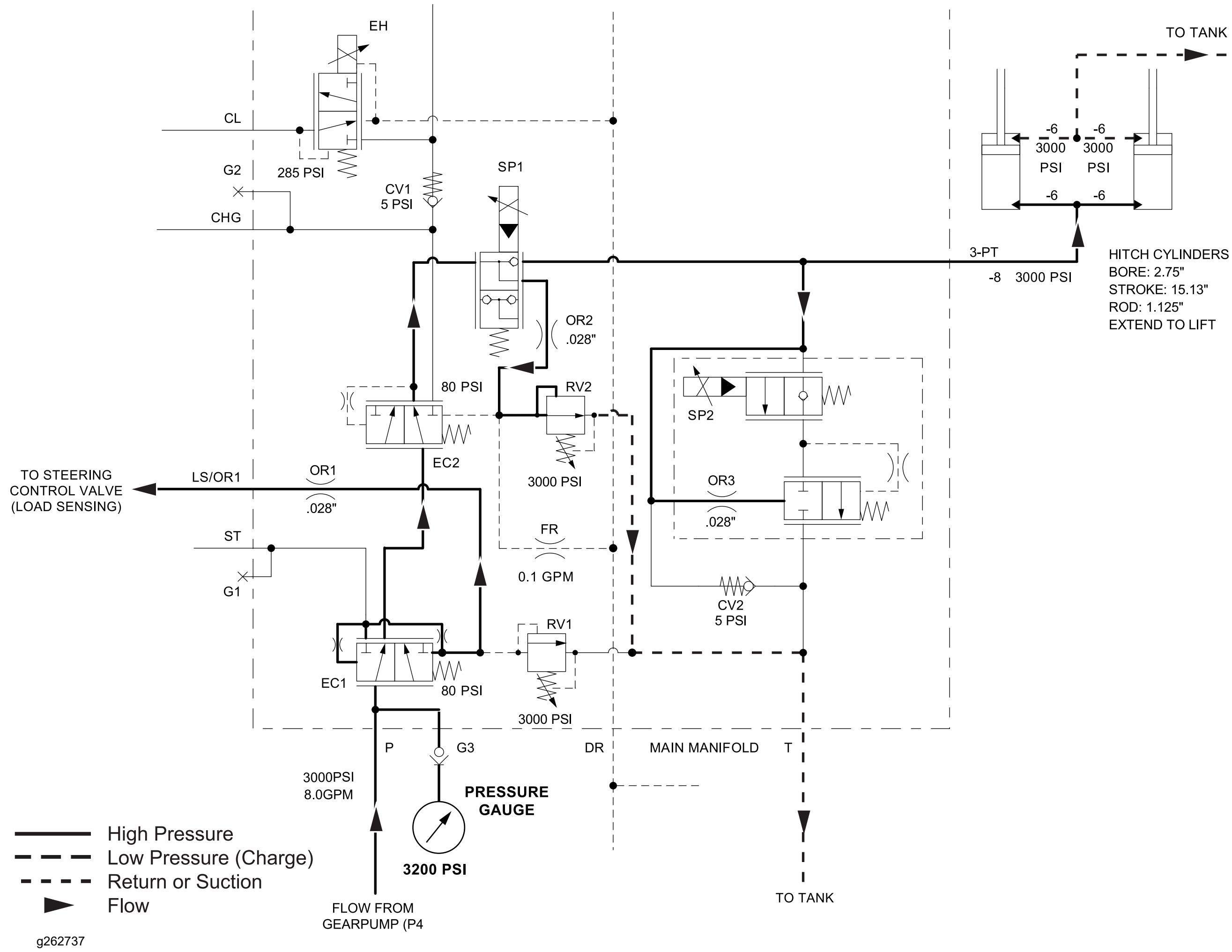


Figure 71

Hitch Cylinder Relief Valve (RV2) Pressure Test

Steering/Hitch Cylinder Circuit Testing – Hitch Cylinder Relief Valve (RV2) Pressure Test (continued)

Model/Serial Table (Figure 72)

Model	Serial Range
07511AA, 07511BA, and 07511DA	405800000 and later
07511CA	404700001 and later

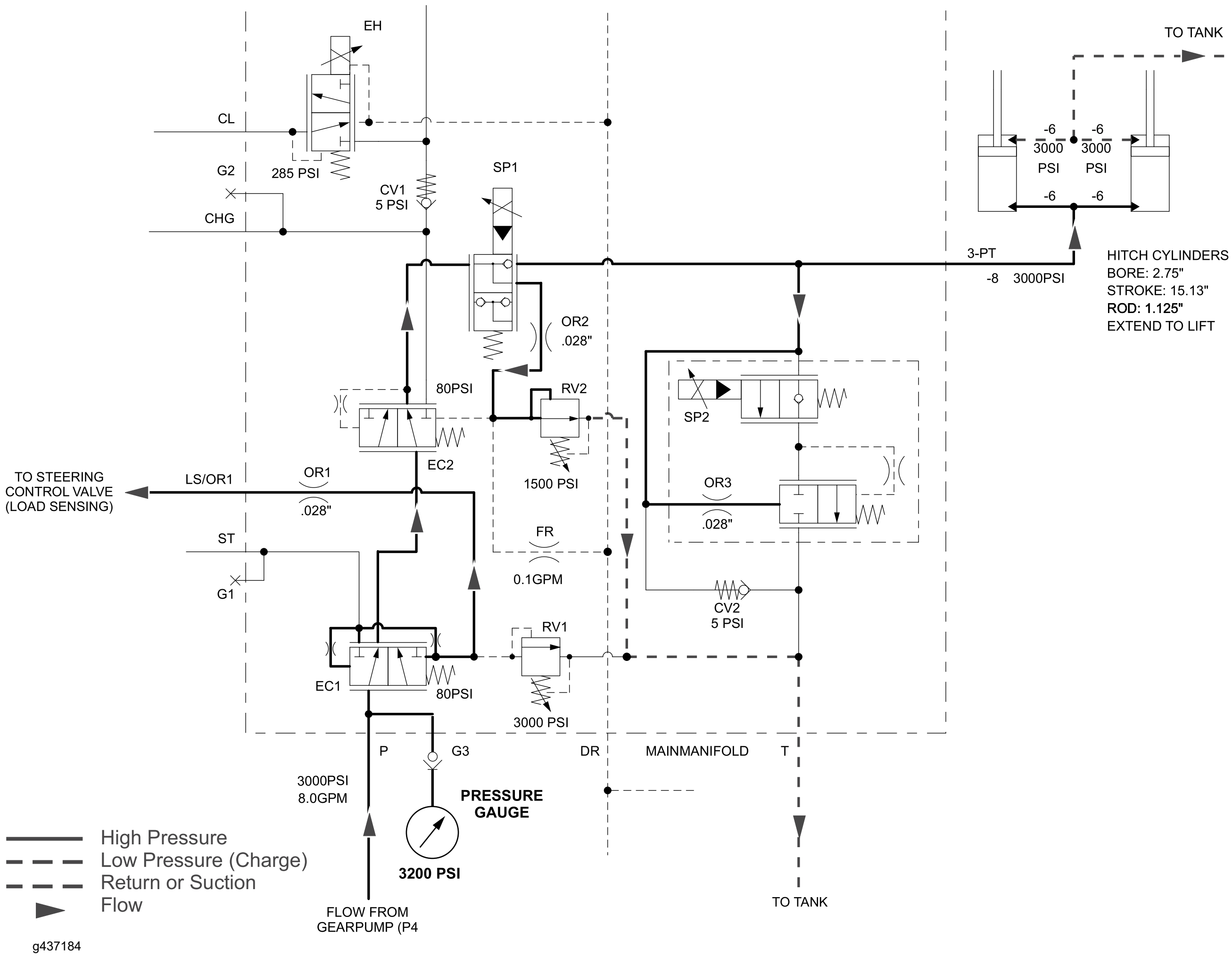


Figure 72

Hitch Cylinder Relief Valve (RV2) Pressure Test

⚠ CAUTION ⚠

For machines with an optional cargo bed installed, remove the cargo bed before testing the hitch cylinder relief valve. The hitch cylinder lift stroke is limited electrically on machines with an optional cargo bed installed.

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately ten (10) minutes.

Steering/Hitch Cylinder Circuit Testing – Hitch Cylinder Relief Valve (RV2) Pressure Test (continued)

2. Park the machine on a level surface, lower the attachments and stop the engine. Remove the key from the key switch.
3. Make sure the hydraulic tank is full.
4. Open the main instrument panel.

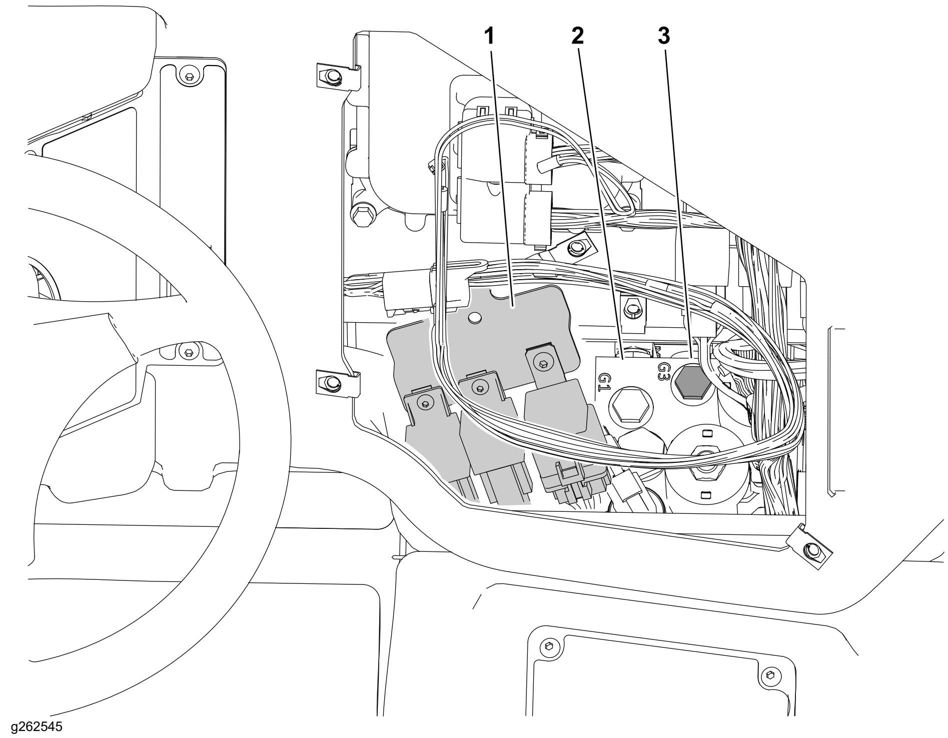


Figure 73

1. Relay assembly
2. Main hydraulic manifold
3. G3 port

5. Remove the relay mounting plate from the dash frame without disconnecting any of the relays from the wire harness. Move the relay assembly to one side.
6. Thoroughly clean the main hydraulic manifold and plug at the G3 port.
7. Remove the plug from the G3 port of the main manifold and install a size 6 SAE-ORB (9/16–18) diagnostic connector and cap (Toro part nos. 59–7410 and 354–79).
8. Connect a 34,475 kPa (5000) pressure gauge with hydraulic hose attached to test fitting in port G3 port of main manifold.
9. Start the engine and idle at low speed. Check for hydraulic leakage at test connection and correct any issues before proceeding with test.
10. Select AUTO LOW mode and increase engine speed to 2300 RPM.

IMPORTANT

Hold paddle switch at full raise position only long enough to get a system pressure reading. Holding the paddle switch at full raise position for an extended period may damage lift circuit components.

Steering/Hitch Cylinder Circuit Testing – Hitch Cylinder Relief Valve (RV2) Pressure Test (continued)

11. Raise the hitch cylinders all the way up and momentarily hold the paddle switch in the raise position while observing the pressure gauge.

    Note: Machine fault C153C may appear during testing as there will be no hitch movement while lift valve (SP1) is energized.

12. Release the paddle switch, stop the engine, and record the test results.
13. Compare the measurement that you recorded in Step 12 with the Raise Hydraulic Pressure Table.

Raise Hydraulic Pressure Table

Model	Serial Range	Hydraulic Pressure (approximate)
07511AA, 07511BA, and 07511DA	400000000 through 405799999	22,063 kPa (3200 psi)
07511CA	400000000 through 404700000	
07511AA, 07511BA, and 07511DA	405800000 and later	11,031 kPa (1600 psi)
07511CA	404700001 and later	

14. If lift cylinder relief pressure reading is incorrect:
    - If steering problems also exist, gear pump (P4) should be suspected of wear and inefficiency.
    - Clean, repair or replace relief valve (RV2); refer to Cartridge Valve Service (page 5–109).

      Replace the relief valve (RV2); refer to Main Manifold Service (page 5–107).
15. When testing is complete, disconnect pressure gauge from manifold and install the test fitting cap.

Steering/Hitch Cylinder Circuit Testing – Gear Pump (P4) Flow

Poor steering performance or poor 3-point hitch lift performance indicate that hydraulic flow from the gear pump (P4) is below the 30 lpm(8.0 gpm) rate. Refer to Gear Pump (P3) and (P4) (page 5–86) for removal and installation instructions, and Gear Pump (P3) and (P4) Service (page 5–88) for service instructions.

Attachment/Loader Circuit Testing – Relief Valve Pressure Test

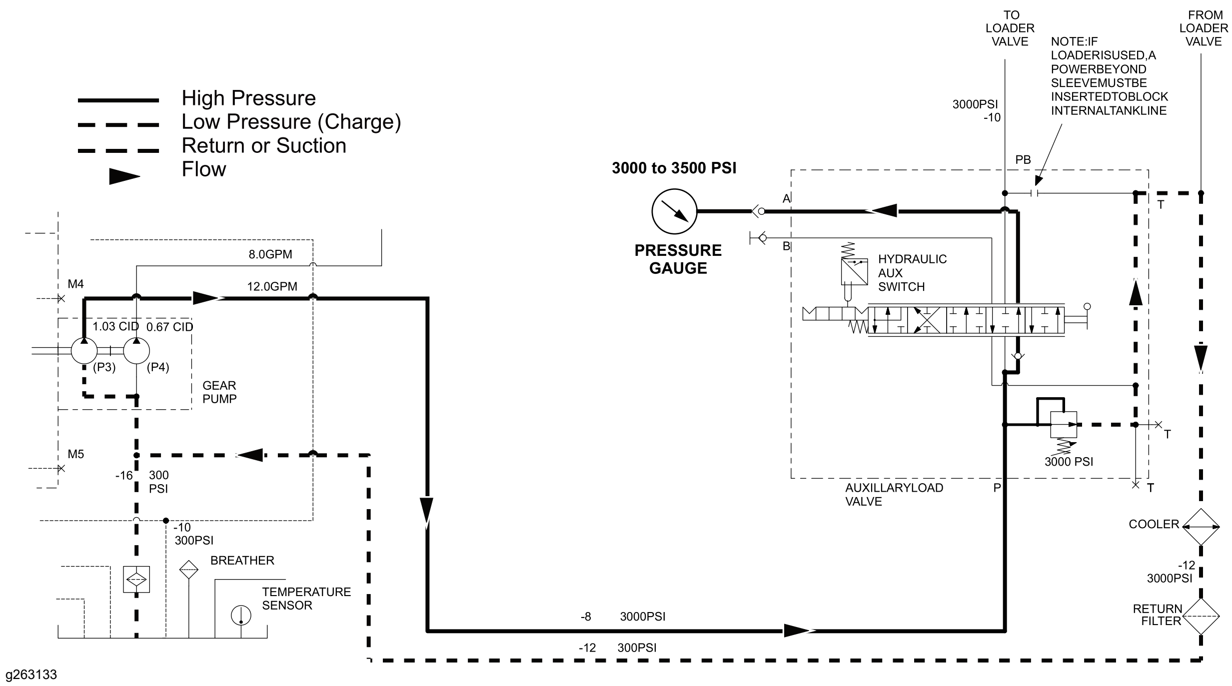


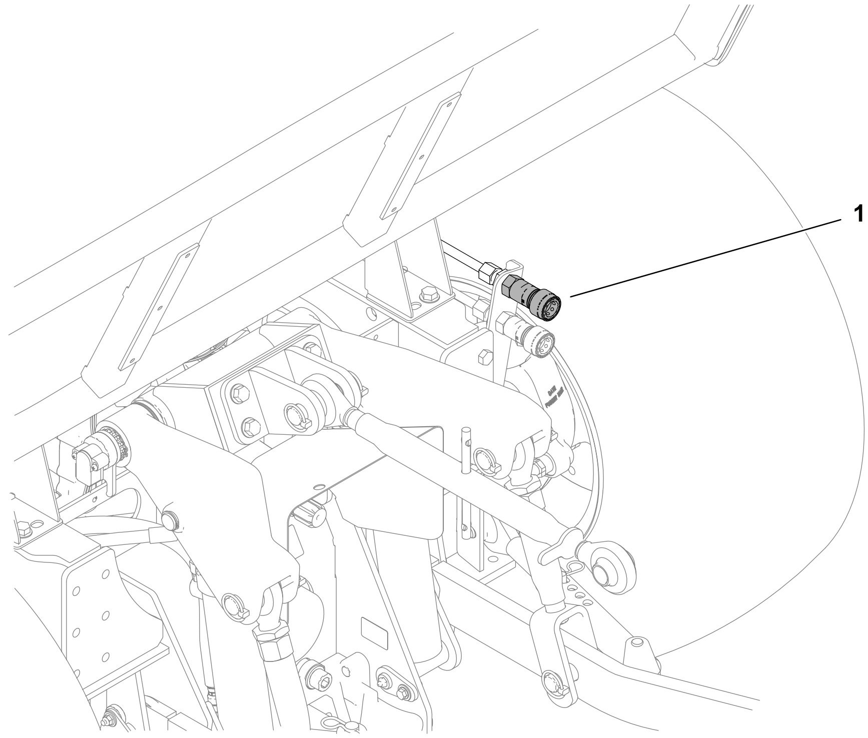
Figure 74

Auxiliary Load Valve Relief Valve Pressure Test

Note: The relief valve for the attachment and the loader hydraulic circuit is in the auxiliary load valve.

1. Park the machine on a level surface, lower the attachments and stop the engine. Remove the key from the key switch.
2. Disconnect any attachment from the rear hydraulic supply lines.

Attachment/Loader Circuit Testing – Relief Valve Pressure Test (continued)



g263149

Figure 75

1. rear attachment upper quick-disconnect (A or retract port)

3. Remove the cap and connect a **34,500 kPa (5000)** pressure gauge to the rear attachment upper quick-disconnect (A or retract port) at the rear of the machine.
4. Start engine and increase engine speed to (**2300 RPM**).
5. Shift the auxiliary load valve into the A position (rearward).
6. The pressure gauge reading should be **20,684 to 24,131 kPa (3000 to 3500)**.
7. Release the joystick, stop the engine, and record the test results.
8. If circuit relief pressure reading is incorrect, clean, repair or replace the auxiliary load valve relief valve; refer to Auxiliary Load Valve Service (page 5–133).
9. After testing, remove the pressure gauge and install the supply line cap.

Attachment/Loader Circuit Testing – Gear Pump (P3) Flow Test

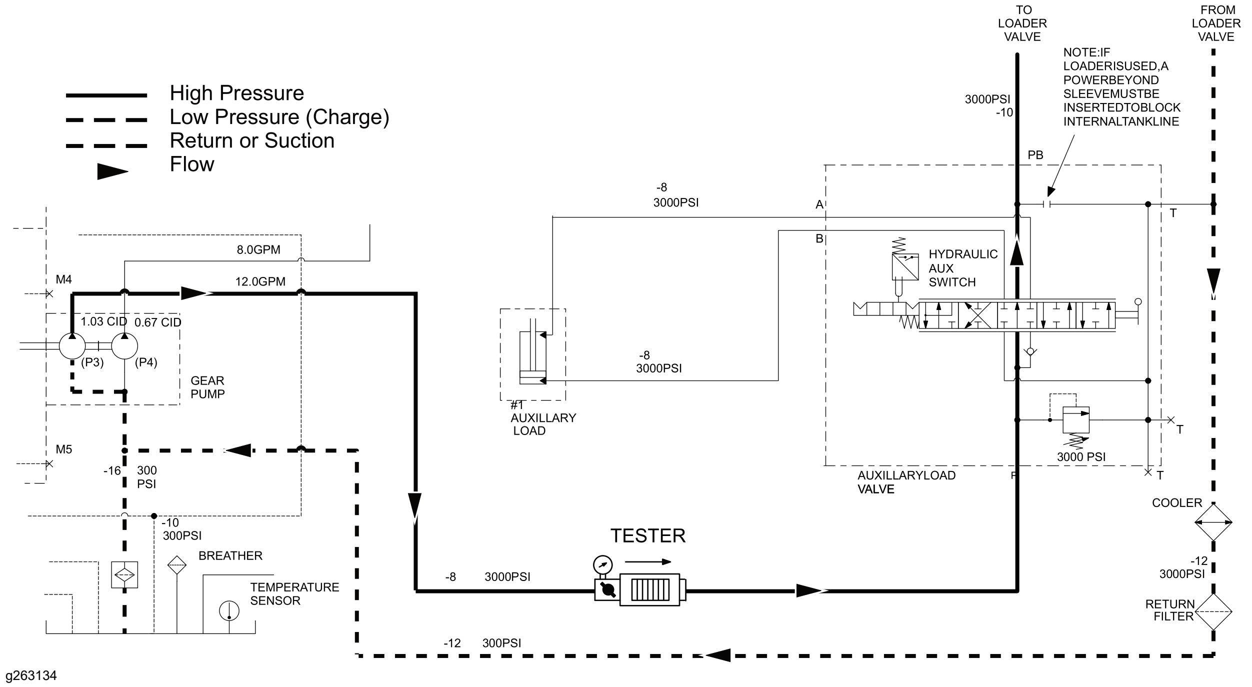


Figure 76

Gear Pump (P3) Flow Test

A gear pump flow test should be performed to make sure that the circuits being supplied by the pump have adequate hydraulic flow. Over time, the gears and wear plates in a 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., attachment performance issues or the loader stalling when lifting heavy loads). Continued operation with a worn, inefficient gear pump can generate excessive heat and cause damage to seals and other components in the hydraulic system.

IMPORTANT

To prevent hydraulic tester damage, use a 57 LPM (15 gpm) Hydraulic Tester (pressure and flow) and additional hoses and fittings for this test; refer to Special Tools (page 2–14).

1. Park the machine on a level surface, lower the attachments and stop the engine. Remove the key from the key switch.

Attachment/Loader Circuit Testing – Gear Pump (P3) Flow Test (continued)

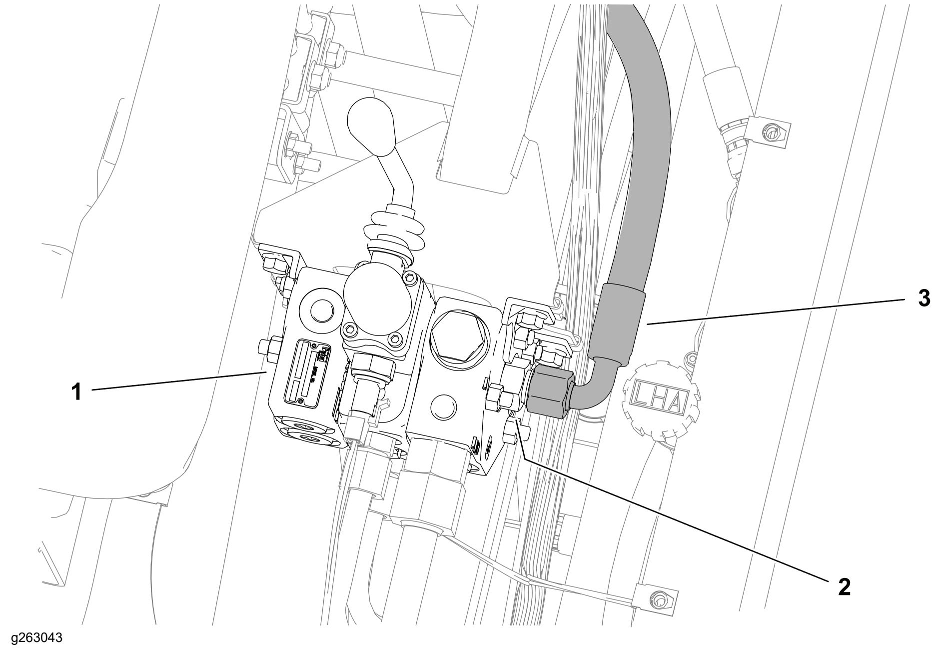


Figure 77

1. Auxiliary load valve
2. P port fitting
3. Hydraulic hose assembly

2. Remove the operator's console; refer to Removing and Installing the Operator's Console (page 8–30).
3. Connect the wire harness to the key switch if previously removed.
4. Thoroughly clean the junction of the hydraulic hose and the fitting at the auxiliary load valve P port and disconnect the hydraulic hose from the fitting.

IMPORTANT

To prevent hydraulic tester damage, make sure that the oil flow direction indicator on the tester is installed so the oil will flow from the disconnected hydraulic hose, through the tester and into the auxiliary load valve P fitting.

5. Install 15 gpm hydraulic tester (flow and pressure) in series with the disconnected hose and hydraulic fitting.
6. Make sure the flow control valve on the tester is fully open.
7. Start engine and increase engine speed to high idle speed (**3000 RPM**). Check for hydraulic leakage at test connection and correct before proceeding with test.
8. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately ten (10) minutes. Make sure the hydraulic reservoir is full.

Attachment/Loader Circuit Testing – Gear Pump (P3) Flow Test (continued)

IMPORTANT

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

9. Watch pressure gauge carefully while slowly closing the flow control valve until **6895 kPa (1000 psi)** is obtained. Verify with the Status Display that the engine is still running at the correct high idle speed (**3000 RPM**).
10. Record the tester flow reading then open the tester flow control valve and stop the engine.
11. Gear pump (P3) flow should be between **44 LPM (12 gpm) and 41 LPM (10.5 gpm)**.
12. If a pressure of **6895 kPa (1000)** cannot be obtained or flow was less than **41 LPM (10.5 gpm)**, check for a restriction in the pump inlet line. If inlet line is not restricted, the gear pump section is worn or damaged and should be service or replaced.

    Note: Gear pumps (P3) and (P4) must be serviced or replaced together.
13. The hydraulic tester can be used to test the circuit relief pressure:
    A. Disconnect any attachment from the rear hydraulic supply lines.
    B. Make sure the flow control valve on the tester is fully open.
    C. Start engine and increase engine speed to (**2300 RPM**).
    D. Shift the auxiliary load valve into the A or B position (forward or reverse).
    E. The hydraulic tester pressure reading should be **20,684 to 24,131 kPa (3000 to 3500)**.
    F. Release the joystick, stop the engine, and record the test results.
    G. If circuit relief pressure reading is incorrect, clean, repair or replace the auxiliary load valve relief valve; refer to Auxiliary Load Valve Service (page 5–133).
14. After testing is complete, remove the hydraulic tester and any additional hoses or fittings installed for testing. Install the disconnected hydraulic hose; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–9).

Service and Repairs

General Precautions for Removing and Installing the Hydraulic System Components

Before Repairing or Replacing the Components

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

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

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

WARNING

Before disconnecting or doing any work on the hydraulic system, release all the pressure in the system; refer to Relieving Pressure from the Hydraulic System (page 5–3).

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

After Repairing or Replacing the Components

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

IMPORTANT

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

2. Lubricate the O-rings and seals with clean hydraulic fluid before installing the hydraulic components.
3. Remove all the caps or plugs from the hydraulic tubes, hydraulic fittings, and components before connecting them again.
4. Use proper tightening procedures when installing the hydraulic hoses and fittings; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal)

After Repairing or Replacing the Components (continued)

(page 5–9) and Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–11).

5. After you complete the repairs, check the control linkages or cables for proper adjustment, binding, or broken parts.
6. Whenever hydraulic fluid has been drained from the pumps (system drain, flush, or pump removal/installation) it is important to properly prime the hydraulic pumps, refer to Priming the Hydraulic Pumps (page 5–75).
7. After you disconnect or replace any hydraulic component, operate the machine functions slowly until the air is out of the system; refer to Charging the Hydraulic System (page 5–76).
8. Check for hydraulic-fluid leaks. Shut off the engine and repair leaks if necessary.

Checking the Hydraulic Lines and Hoses

⚠ WARNING ⚠

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

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

IMPORTANT

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

Flushing the Hydraulic System

IMPORTANT

If a component failure occurs in the traction circuit; refer to Filtering the Closed-Loop Traction Circuit (page 5–70) for additional information.

IMPORTANT

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

1. Park the machine on a level surface, lower any attachments and stop the engine. Remove the key from the key switch.
2. Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–65).

CAUTION

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

IMPORTANT

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

3. Drain the hydraulic tank into a suitable container; refer to the traction unit *Operator's Manual*.
4. Drain the hydraulic system hoses, tubes, lift cylinders and other components from low points in the system.
5. Remove and replace the hydraulic-fluid filters; refer to the traction unit *Operator's Manual*.
6. Inspect and clean hydraulic tank. Remove the hydraulic tank if necessary; refer to Removing and Installing the Hydraulic Tank (page 5–79).
7. Connect all the hydraulic hoses, tubes, and components that were disconnected while draining the system; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–9).

IMPORTANT

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

Flushing the Hydraulic System (continued)

8. Fill the hydraulic tank with the correct type and quantity of new hydraulic fluid; refer to the traction unit *Operator's Manual*.
9. Prime the hydraulic pumps; refer to Priming the Hydraulic Pumps (page 5–75).
10. Charge the hydraulic system; refer to Charging the Hydraulic System (page 5–76).

Filtering the Closed-Loop Traction Circuit

The traction circuit of the Outcross 9060 machine consists of two closed-loop circuits, each with its own piston (traction) pump, axle drive motor, and control valves. The two traction pumps (P1) and (P2) are part of the tandem piston (traction) pump. Pump (P1) supplies the front traction circuit, and pump (P2) supplies the rear traction circuit. If a component in one of the traction circuits should fail, unwanted material and contamination from the damaged component will circulate throughout that traction circuit. This contamination can damage other components in that circuit. The contamination must be removed as soon as possible to prevent additional component failure.

Filtering of a closed-loop hydraulic system after a major component failure (e.g., traction (piston) pump or drive motor) is required to prevent debris from transmitting throughout the system. If a filtering tool is not used (to ensure system cleanliness), repeat failures and subsequent damage to other hydraulic components in the system will occur. To effectively remove contamination from the closed-loop traction circuit, use of a Toro bidirectional high flow hydraulic filter and hydraulic hose kit is recommended; refer to High Flow Hydraulic Filter Kit (page 2–17).

1. Park machine on a level surface with attachments lowered, engine stopped, and key removed from key switch.
2. Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–65).

WARNING

Review and follow Jacking Instructions (page 1–8) before jacking up the machine.

3. Raise all four wheels off the floor and support with jack stands.
4. Install a temporary hydraulic filter directly upstream of the new component as follows:
   A. If the front drive motor was serviced or replaced, disconnect the hydraulic hose at the M1 port (left) of the front drive motor.

Filtering the Closed-Loop Traction Circuit (continued)

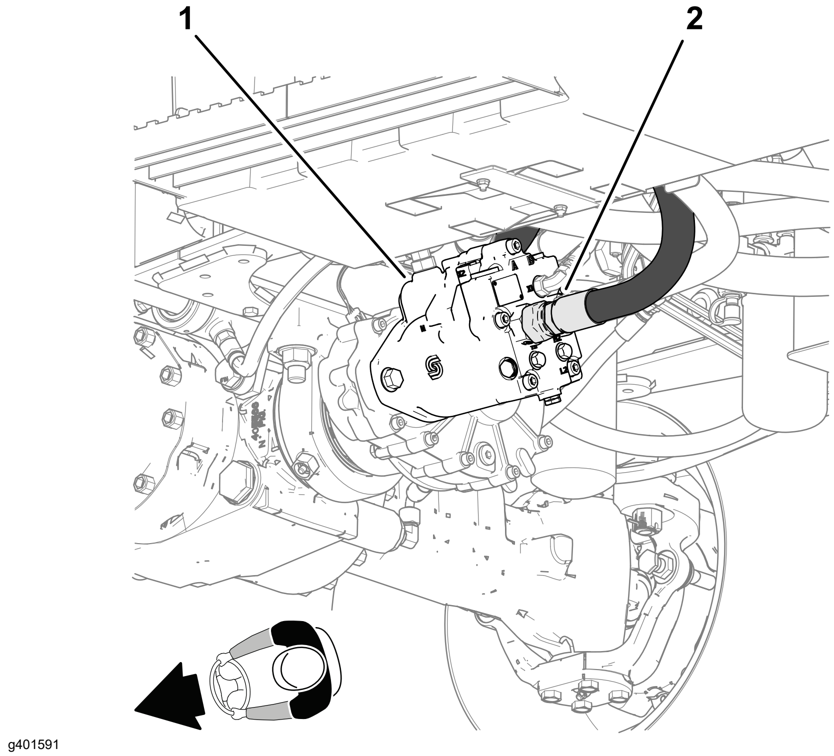


Figure 78

Front Circuit Connection—Machines with an Axle-Drive Gearbox

1. Front drive motor
2. M1 port

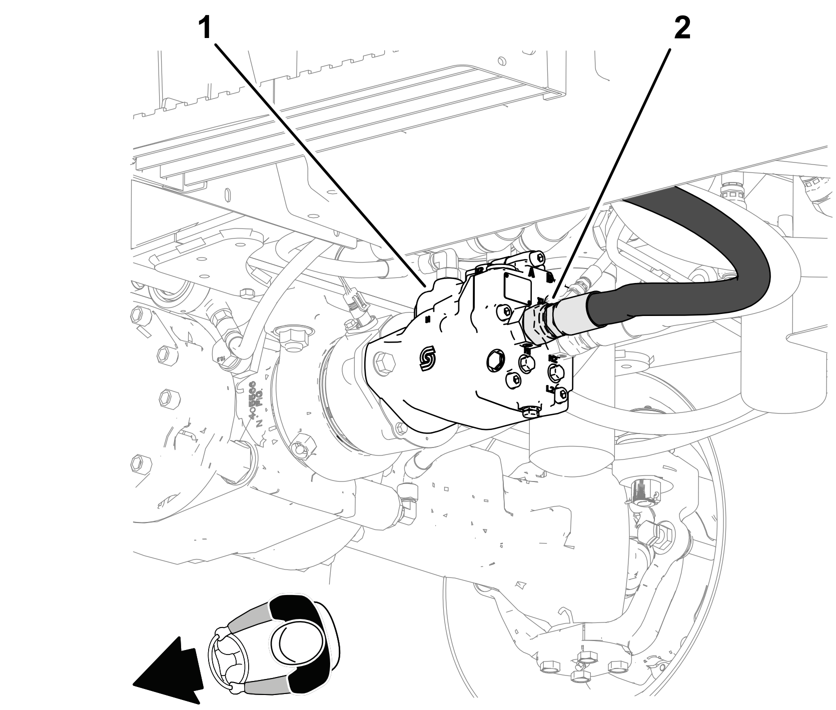


Figure 79

Front Circuit Connection—Machines without an Axle-Drive Gearbox

1. Front drive motor
2. M1 port

Filtering the Closed-Loop Traction Circuit (continued)

B. If the rear drive motor was serviced or replaced, disconnect the hydraulic hose at the M1 port (right) of the rear drive motor.

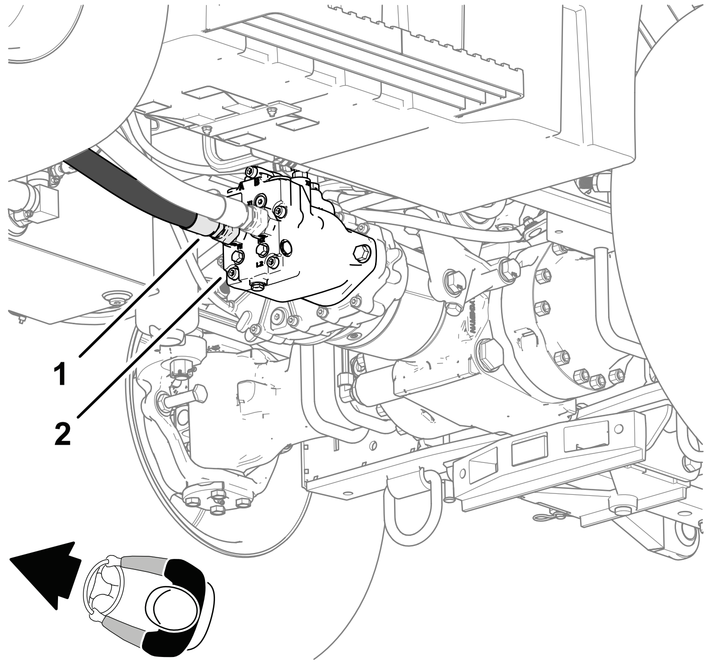


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Figure 80

Rear Circuit Connection—Machines with an Axle-Drive Gearbox

1. M1 port
2. Rear drive motor

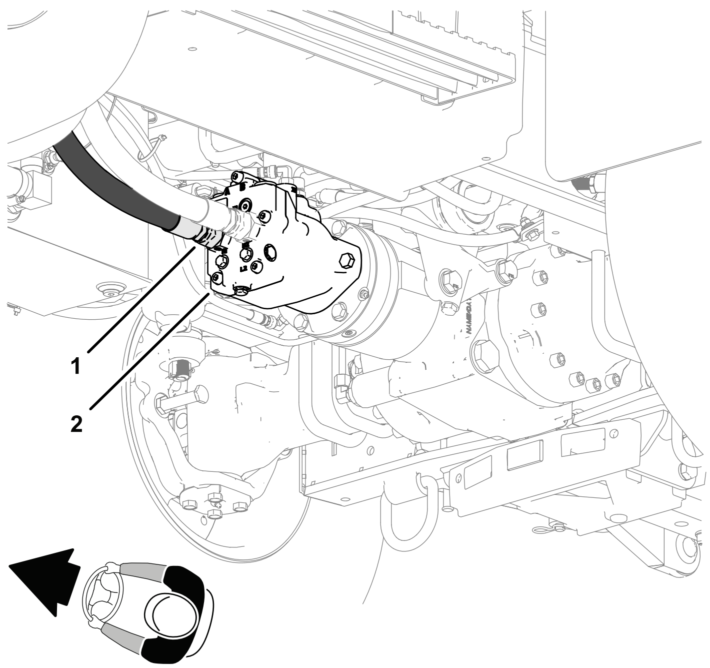

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Figure 81

Rear Circuit Connection—Machines without an Axle-Drive Gearbox

1. M1 port
2. Rear drive motor

Filtering the Closed-Loop Traction Circuit (continued)

C. If the tandem piston (traction) pump (P1) and (P2) was serviced or replaced, remove the front drive motor, drive coupler and motor mount to access the desired filter connection; refer to Axle Motors (page 5–92). Leave the hydraulic lines connected to the drive motor.

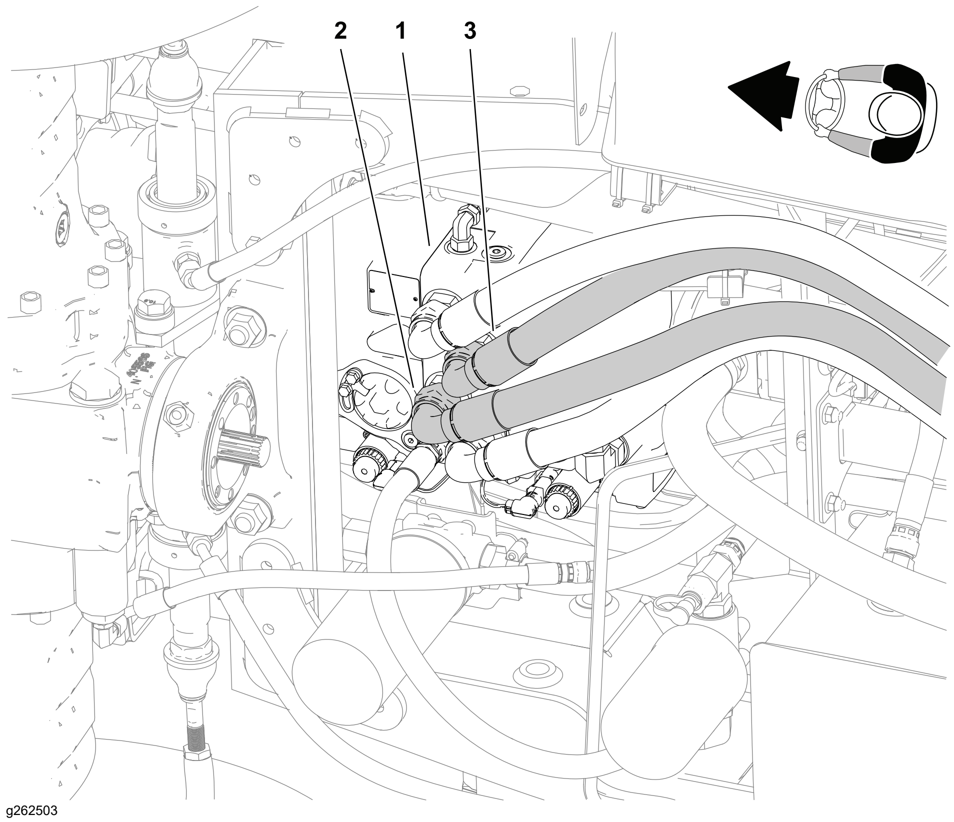

Figure 82

Shown with front axle drive motor removed for clarity.

1. Tandem piston (traction) pump (P1) and (P2)
2. B port
3. D port

D. If the front drive circuit is contaminated because front traction pump (P1) failed, disconnect the hydraulic hose at the B port (middle right) of the tandem piston (traction) pump.

E. If the rear drive circuit is contaminated because rear traction pump (P2) failed, disconnect the hydraulic hose at the D port (middle left) of the tandem piston (traction) pump.

5. Connect the temporary hydraulic filter in series between the disconnected fitting and hose. Use a High Flow Hydraulic Filter Kit (page 2–17) and make sure that fittings and hose connections are properly tightened.
6. Fill the hydraulic tank with the correct type and quantity of new hydraulic fluid; refer to the traction unit *Operator's Manual*.
7. Start engine and run at low idle speed. Check for and correct any hydraulic leaks before proceeding.

Filtering the Closed-Loop Traction Circuit (continued)

⚠ CAUTION ⚠

Use extreme caution when performing this test. The wheels will be rotating during the test.

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.

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8. With engine running at low idle speed, select the FORWARD direction and slowly depress the traction pedal to allow flow through the traction circuit and high flow filter. Keep traction circuit engaged for five (5) minutes while gradually increasing both forward pressure on traction pedal and engine speed. Monitor filter indicator to make sure that green color is showing during operation.

IMPORTANT

If using a hydraulic filter that is not bidirectional, do not select reverse or operate the machine in the reverse direction. If flow is reversed when using a filter that is not bidirectional, debris from the filter will re-enter the traction circuit.

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9. With a bidirectional hydraulic filter installed and the engine running at high idle speed, alternately select forward and reverse direction. Continue this process for an additional five (5) minutes while monitoring filter indicator.
10. Shut the engine OFF and remove the key from key switch.
11. Remove the temporary hydraulic filter from the machine and install any disconnected hydraulic hoses or tubes; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–9).
12. Lower machine to ground.
13. Check the hydraulic fluid level in the tank and adjust as necessary; refer to the traction unit *Operator's Manual*.
14. Operate the machine and check for leaks before returning the machine to service.

Priming the Hydraulic Pumps

IMPORTANT

Cranking the engine to priming the hydraulic pumps requires the use of engine diagnostic software. Contact your authorized Toro Distributor.

IMPORTANT

Perform this procedure each time the hydraulic lines to the tandem piston (traction) pump are removed and installed, including when the engine, PTO gearbox, and tandem piston (traction) pump have been removed from the machine. It is important to properly prime the hydraulic pumps. Priming the hydraulic pumps ensures that the tandem piston (traction) pump and gear pumps have sufficient fluid while charging the hydraulic system.

IMPORTANT

If the tandem piston (traction) pump was rebuilt or replaced, make sure that the traction pump housing is at least half full of clean hydraulic fluid after installation.

1. Make sure all hydraulic connections and lines are secured tightly.
2. Ensure that the fuel tank has fuel in it.
3. Check the hydraulic-fluid level in the hydraulic tank and add correct type and quantity of fluid if necessary; refer to the traction unit *Operator's Manual*.
4. **Distributor Technician Instructions:**
   A. Connect the engine diagnostic cable between the laptop computer and engine harness connector P20 labeled YANMAR CAN CHECKER.
   B. Start the engine diagnostic software.
   C. Rotate the key switch to the ON position.

      Note: Select the 250k data rate.

   D. Navigate to the following screen: DIAGNOSTICS (EXECUTION)>DIAGNOSTIC TESTS>DIGITAL OUT.
   E. On the laptop, scroll to and click the ON/OFF button for the ENGINE STARTER INTERLOCK RELAY option to crank the engine.

      Note: The engine cranks while the electric fuel pump runs, but the fuel injectors do not energize.

      Repeat Step E two more times.

   F. Wait 30 seconds to allow the starter motor and starter solenoid to cool.
   G. Repeat Steps and .
   H. Rotate the key switch to the Off position, unplug the engine diagnostic cable from the engine harness connector, and stow the connector.
5. Charge the hydraulic system; refer to Charging the Hydraulic System (page 5–76).

Charging the Hydraulic System

IMPORTANT

Air must be purged from the system to reduce the chance of component damage.

When initially starting the hydraulic system with new or rebuilt components such as motors, pumps, or cylinders, it is important that the hydraulic system is charged properly to remove air from the system.

IMPORTANT

Flush the hydraulic system whenever there is a severe component failure or the system is contaminated; refer to Flushing the Hydraulic System (page 5–68).

1. Ensure that the machine is parked on a level surface and turn the engine shut off.
2. Ensure that all hydraulic connections, lines, and components are secured tightly.
3. Ensure that the hydraulic tank is full. Add the correct quantity and type of hydraulic fluid if necessary; refer to the traction unit *Operator's Manual*.
4. Check the traction control components for proper adjustment, binding, or damaged parts.
5. Prime the hydraulic pumps; refer to Priming the Hydraulic Pumps (page 5–75).

WARNING

Review and follow Jacking Instructions (page 1–8) before jacking up the machine.

6. Raise the wheels off the floor and support the machine with jack stands.

IMPORTANT

Check hydraulic tank fluid level frequently while charging the system and add fluid as necessary.

7. Start the engine and let it idle at low speed.

   Note: The hydraulic pumps should pick up hydraulic fluid and fill the hydraulic system. If there is no indication of the system filling within 30 seconds, stop the engine, and determine the cause.
8. After the hydraulic system starts to show signs of filling, operate the hitch lift cylinders up and down the full distance several times. If the cylinders do not move after 15 seconds or the pump emits abnormal sounds:
   A. Shut off the engine OFF immediately.
   B. Make sure that one of the hydraulic fluid filters or the suction line is not loose.
   C. Check for incorrect hose routing.

Charging the Hydraulic System (continued)

D. Ensure the suction line is not blocked.

E. Make sure that the charge relief valve (CV1) is not blocked or damaged (closed).

F. Test gear pump (P3) for damage.

9. Operate the traction pedal in the forward and reverse directions. Make sure the wheels are turning in the proper direction and allow the wheels to turn slowly for ten (10) minutes.
10. Lower the machine to the ground.
11. For machines with an optional hydraulically operated equipment attached (rear attachments or a front loader) operate the attachment controls to fully cycle the attachment a few times.
12. Operate the traction unit by gradually increasing its workload to full over a ten (10) minute period.
13. Stop the machine, check the hydraulic components for leaks and tighten any loose connections.
14. Check the level and condition of the hydraulic fluid and adjust if necessary; refer to the traction unit *Operator's Manual*.

    Note: If new fluid shows any signs of contamination, flush hydraulic system again until the fluid is clean; refer to Flushing the Hydraulic System (page 5–68).

Hydraulic Tank

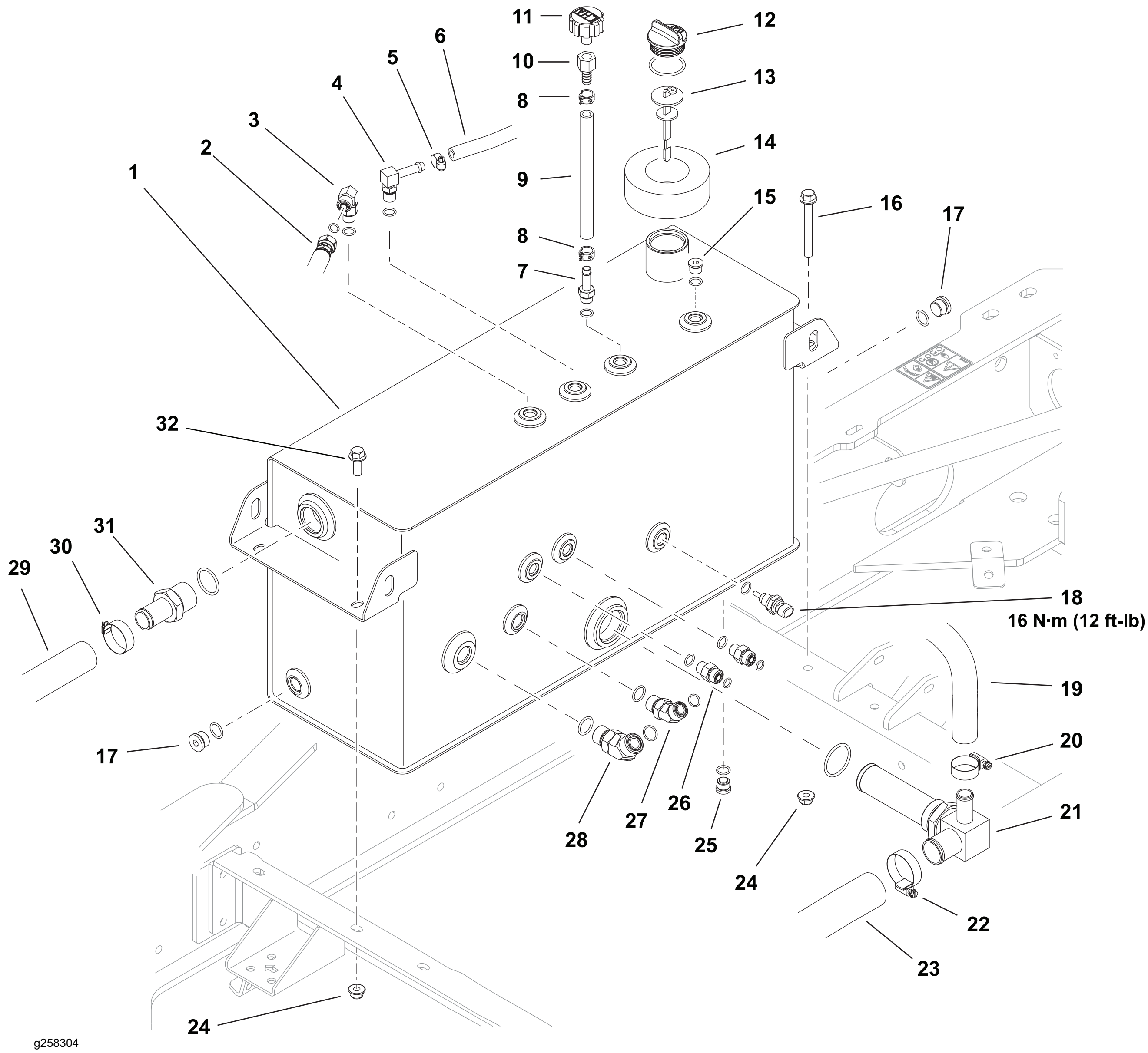

Figure 83

1. Hydraulic tank
2. Hydraulic hose assembly (breather from front PTO gearbox)
3. Elbow fitting
4. Elbow barb fitting
5. Hose clamp
6. Hydraulic hose (breather from rear PTO gearbox)
7. Straight barb fitting
8. Hose clamp (2 each)
9. Breather hose
10. Adapter fitting
11. Breather
12. Cap
13. Dipstick
14. Seal ring
15. Plug
16. Capscrew (2 each)
17. Plug
18. Temperature sender
19. Hydraulic hose (from main filter)
20. Hose clamp
21. Strainer assembly
22. Hose clamp
23. Suction hose (to pump assembly)
24. Flange nut (4 each)
25. Magnetic plug
26. Straight fitting (2 each)
27. Elbow fitting
28. Elbow fitting
29. Hydraulic hose (return from front PTO gearbox)
30. Hose clamp
31. Straight barb fitting
32. Capscrew (2 each)

Removing and Installing the Hydraulic Tank

1. Remove the operator’s platform; refer to Preparing the Machine (page 8–8).

IMPORTANT

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

2. Empty the hydraulic tank (approximate total volume 48 L (12.8 gal)).
3. Thoroughly clean the exterior of the reservoir, fittings, and hoses to prevent contamination of the hydraulic system.
4. To ease assembly, label all the hydraulic hoses to identify their correct position on the tank.
5. Disconnect the hydraulic hoses. Install caps and plugs on the fittings and hoses to prevent contamination of the hydraulic system.
6. Remove the 4 capscrews and flange nuts and remove the hydraulic tank from the machine.
7. Remove the hydraulic fittings as necessary and discard O-rings.
8. To install the hydraulic tank, follow this procedure in reverse order.
9. Lubricate new O-rings and place them onto the fittings. If previously removed, install the fittings into the tank ports using alignment marks made during removal; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–11).
10. Connect all hydraulic hoses previously removed. Tighten the hydraulic hoses as specified in Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–9).
11. Fill the tank with new hydraulic fluid and check for leaks before returning the machine to service.

Hydraulic Fluid Cooler

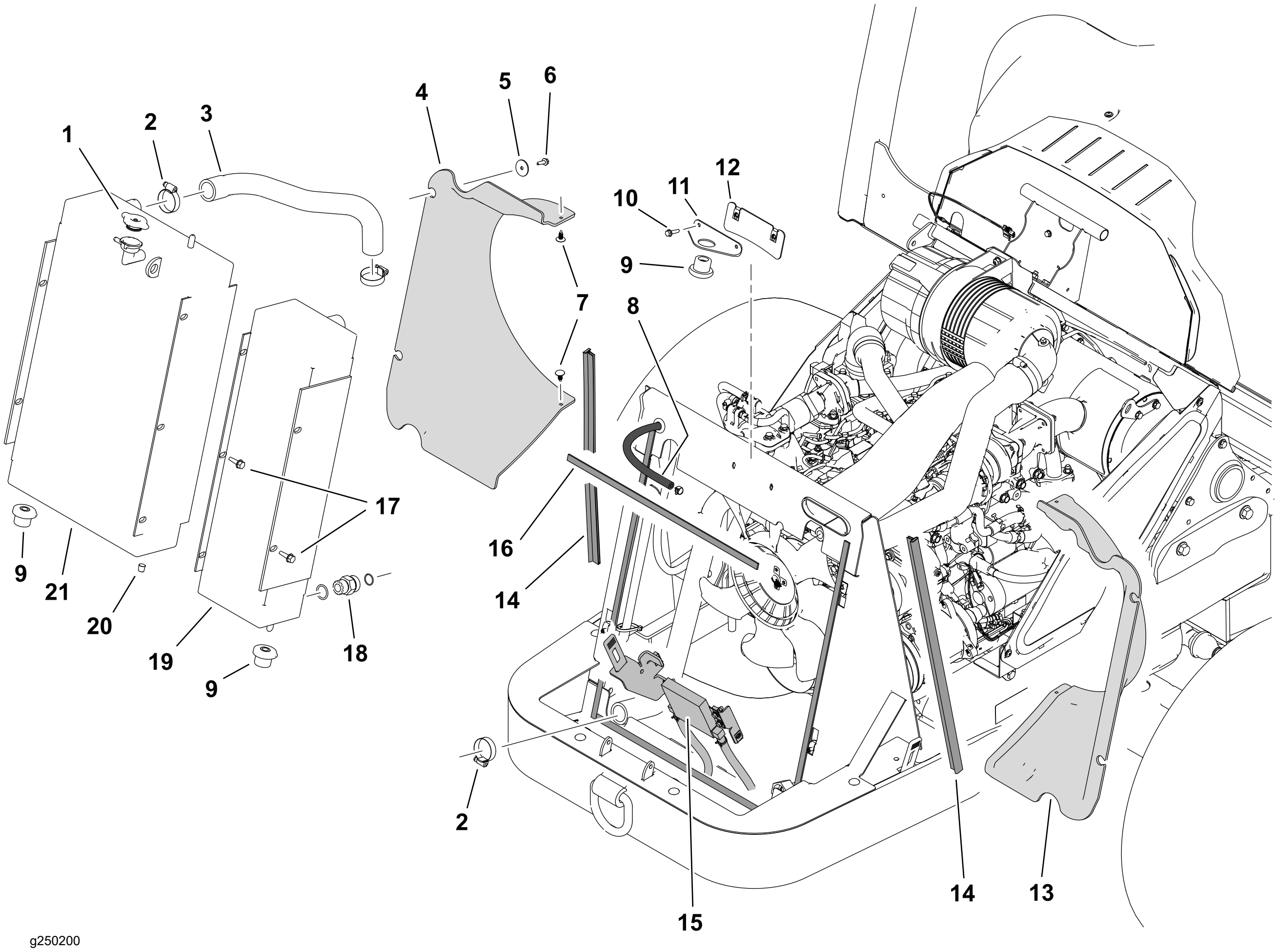

Figure 84

1. Radiator cap
2. Hose clamp (2 each)
3. Upper radiator hose
4. Fan shroud – right
5. Flat washer (4 each)
6. Flange-head screw (4 each)
7. Panel fastener (2 each)
8. Hose – coolant reservoir
9. Isolator mount (3 each)
10. Flange-head screw(2 each)
11. Bracket – top
12. Nut plate – top
13. Fan shroud – left
14. Bulb seal (2 each)
15. Fuel cooler assembly
16. Foam seal (4 each)
17. Flange-head screw (4 each)
18. Straight hydraulic fitting (2 each)
19. Hydraulic fluid cooler
20. Pipe plug
21. Radiator

The hydraulic fluid cooler on your Outcross 9060 is combined with the radiator. The procedures for removing and installing the radiator and hydraulic fluid cooler as an assembly are provided; refer to Radiator (page 4–11).

Note: If desired, the radiator and hydraulic fluid cooler may be separated in the machine and removed individually.

Tandem Piston (Traction) Pump (P1) and (P2)

IMPORTANT

In the event of a traction pump or hydraulic motor failure, you must drain the hydraulic tank and flush all debris from the hydraulic system. For hydraulic tank-draining instructions, refer to the *Operator's manuals* for the machine.

Removing the Tandem Piston (Traction) Pump (P1) and (P2)

CAUTION

Use an appropriate lift to support and lift the tandem piston (traction) pump. The traction pump assembly weighs approximately 68 kg (150 lbs).

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–65) prior to removing hydraulic system components.

1. Remove the engine, PTO gearbox, and tandem piston (traction) pump as an assemble, refer to Removing the Engine, PTO Gearbox, and Tandem Piston (Traction) Pump. (page 4–17).

   Note: To remove the traction pump, it is removed with the engine and PTO gearbox—in the procedures the following components are disconnected, separated, or removed:

Fuel hoses	Driveshaft	Axle drive motor
Cables and engine harness	Dual gear pump	Hydraulic hoses
Operator's platform or cab	Axle drive motor hoses	Main harness electrical connectors

2. Support the tandem piston (traction) pump.

Removing the Tandem Piston (Traction) Pump (P1) and (P2) (continued)

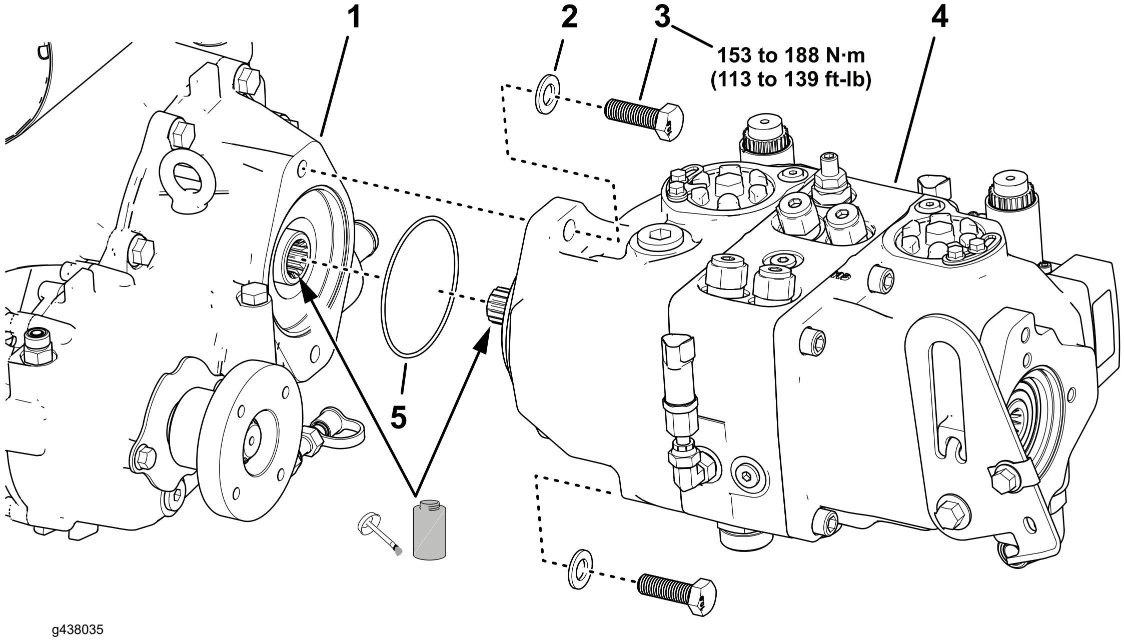

Figure 85

1. PTO gearbox
2. Washer
3. Capscrew
4. Tandem piston (traction) pump
5. O-ring

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3. Remove the 2 capscrews that secure the tandem piston (traction) pump to the PTO gearbox, and separate the pump from the gearbox.
4. Locate and discard the O-ring between the piston pump and the front PTO gearbox.
5. Ensure that the fittings are plugged or capped to prevent contaminating the hydraulic system.
6. If fitting removal is necessary, mark the fitting orientation to allow for correct assembly, then remove the fittings from the tandem piston (traction) pump and discard the O-rings.

Removing the Tandem Piston (Traction) Pump (P1) and (P2) (continued)

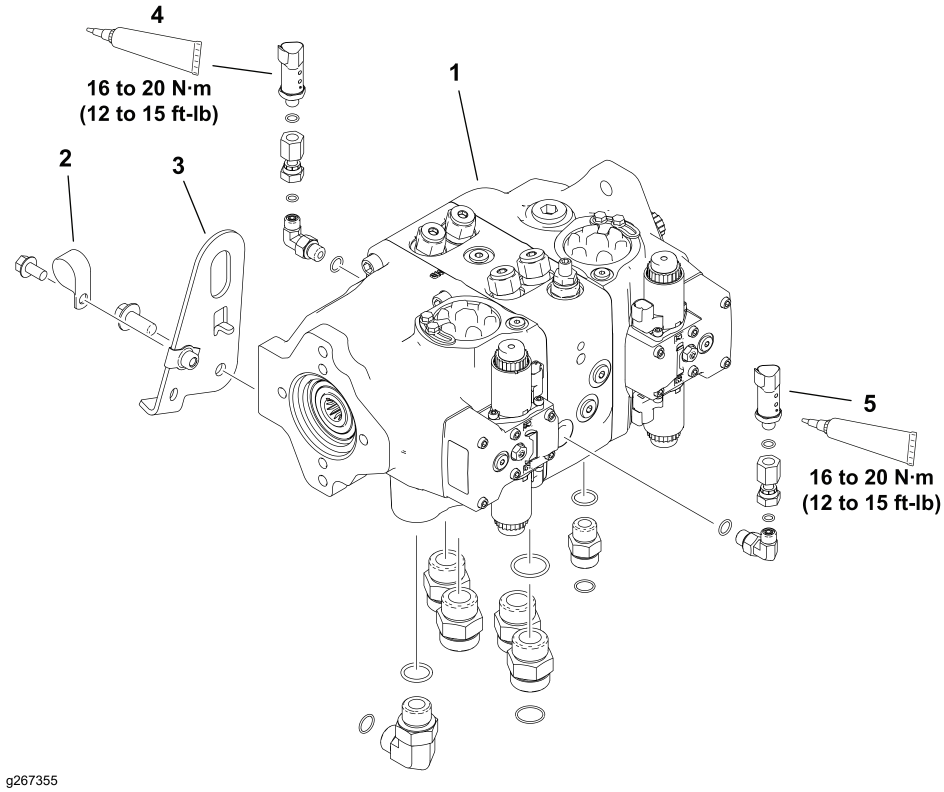
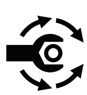


Figure 86

1. Tandem piston (traction) pump
2. R-clamp
3. Hanger plate
4. Traction pressure sensor – front
5. Traction pressure sensor – rear

Installing the Tandem Piston (Traction) Pump (P1) and (P2)

1. If the fittings were removed, lubricate new O-rings and place them onto the fittings. Install the fittings into the pump ports, adjusting their position to the alignment marks made during removal; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–11).
2. Apply clean petroleum jelly or light grease to a new O-ring (item 10 in Figure 85) and position the O-ring onto the piston pump flange.
3. Apply anti-seize lubricant to the splines of the piston pump shaft.
4. Align the piston pump shaft and slide the piston pump into the front PTO gearbox coupler.



5. Secure the piston pump to the front PTO gearbox with 2 capscrews and plain washers. Tighten the capscrews from **153 to 188 N·m (113 to 139 ft-lb)**.
6. Install the engine, PTO gearbox, and traction pump; refer to Installing the Engine, PTO Gearbox, and Traction Pump (page 4–32).

Tandem Piston (Traction) Pump (P1) and (P2) Service

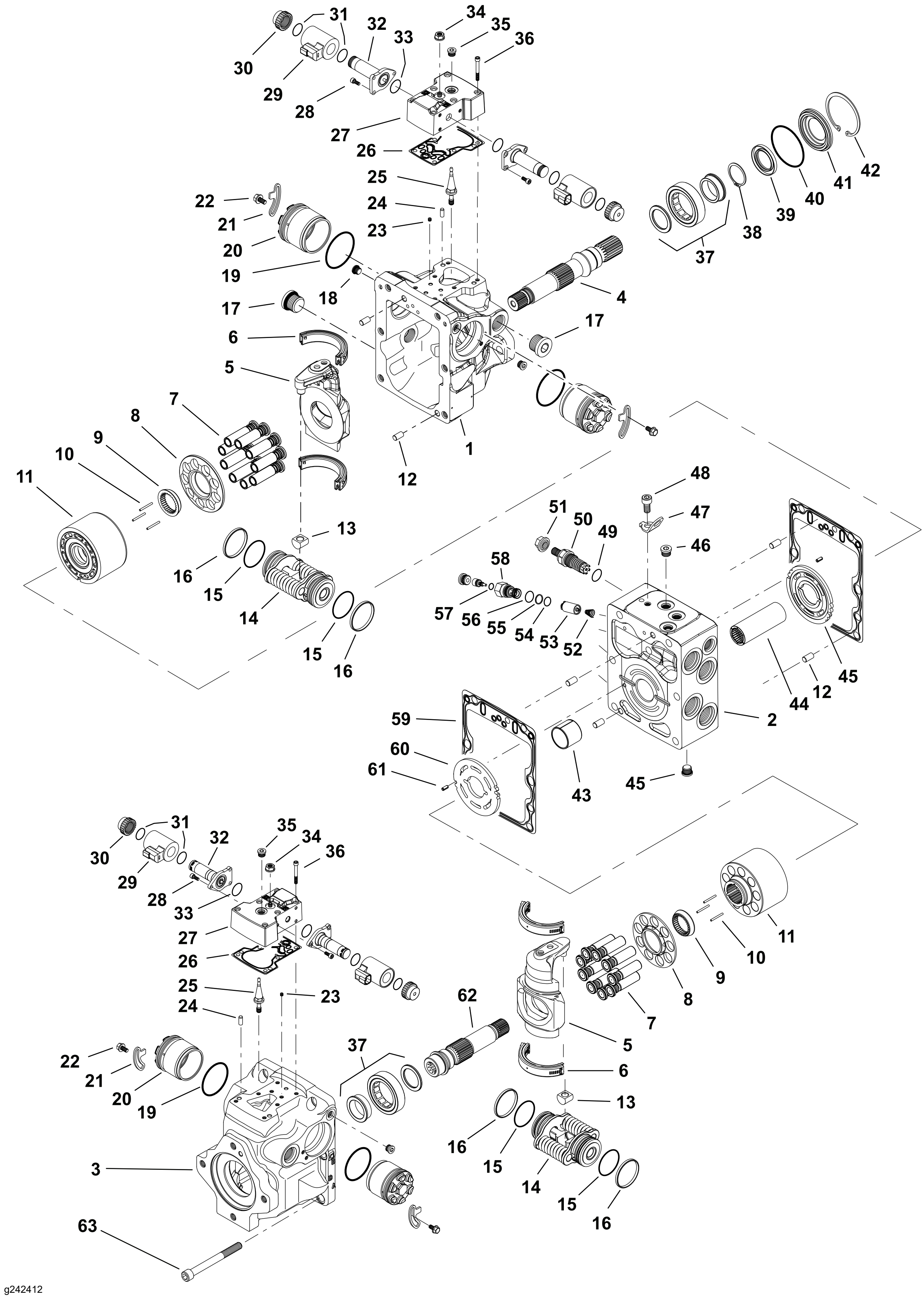


Figure 87

Figure 87 (continued)

1.	Housing (front)	22.	Capscrew (4 each)	43.	Bearing (2 each)
2.	Center section assembly	23.	Orifice (4 each)	44.	Coupling
3.	Housing (rear)	24.	Dowel pin (4 each)	45.	Valve plate CW
4.	Shaft (front)	25.	EDC feedback link (2 each)	46.	Plug with O-ring (6 each)
5.	Swashplate bearing kit (2 each)	26.	Gasket (2 each)	47.	Lifting lug
6.	Swashplate (2 each)	27.	EDC housing (2 each)	48.	Screw
7.	Piston assembly (2 each)	28.	Screw (12 each)	49.	O-ring
8.	Slipper retainer (2 each)	29.	Servo control solenoid coil (4 each)	50.	Charge pressure relief valve
9.	Slipper retainer guide (2 each)	30.	Coil nut (4 each)	51.	Nut
10.	Slipper hold-down pin (6 each)	31.	O-ring (8 each)	52.	Spring (4 each)
11.	Cylinder block assembly (2 each)	32.	Servo control solenoid valve (4 each)	53.	SCR valve (4 each)
12.	Dowel pin (4 each)	33.	O-ring (4 each)	54.	O-ring (4 each)
13.	Slider block (2 each)	34.	Nut (2 each)	55.	Backup ring (4 each)
14.	Servo piston assembly (2 each)	35.	Plug with O-ring (2 each)	56.	O-ring (4 each)
15.	O-ring (4 each)	36.	Screw (12 each)	57.	O-ring (4 each)
16.	Piston ring (4 each)	37.	Roller bearing assembly (2 each)	58.	SCR valve plug (4 each)
17.	Plug with O-ring (2 each)	38.	Retaining ring	59.	Gasket (2 each)
18.	Plug with O-ring (4 each)	39.	Lip seal	60.	Valve plate CCW
19.	O-ring (4 each)	40.	O-ring	61.	Pin (2 each)
20.	Servo Cylinder (4 each)	41.	Shaft seal	62.	Shaft (rear)
21.	Locking plate (2 each)	42.	Retaining ring	63.	Screw (6 each)

IMPORTANT

If a tandem piston (traction) pump failure occurred, refer to Filtering the Closed-Loop Traction Circuit (page 5–70) for information regarding the importance of removing contamination from the traction circuit.

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

For servo control solenoid coil service information, refer to Tandem Traction (Piston) Pump Control Solenoid Coils (page 6–77).

Note: The forward and reverse solenoid valves and coils for both the front and rear pump are identical.

Gear Pump (P3) and (P4)

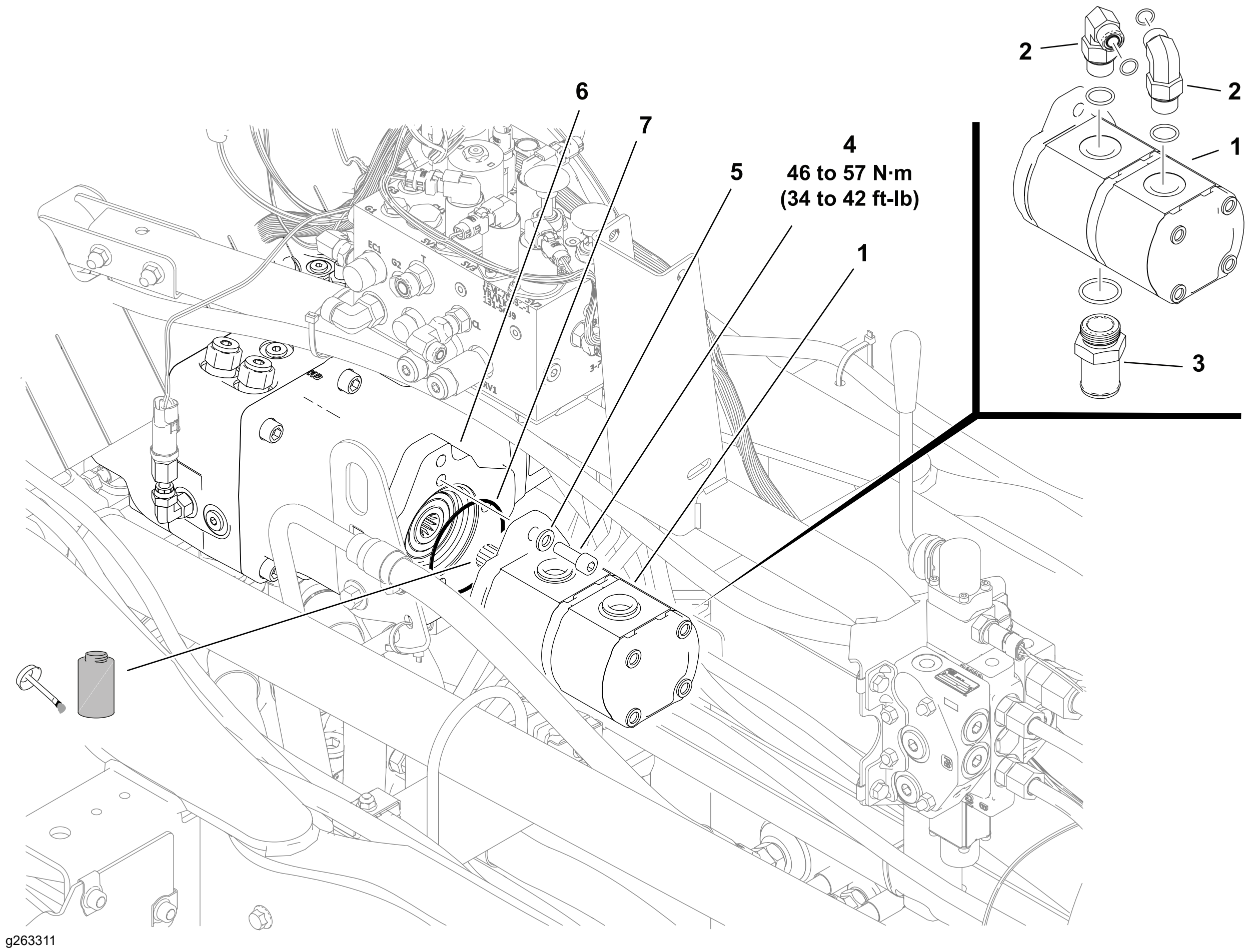


Figure 88

1. Gear pump (P3) and (P4)
2. Elbow fittings (2 each)
3. Suction hose fitting
4. Capscrew (2 each)
5. Plain washer (2 each)
6. Piston (traction) pump
7. O-ring

Removing the Dual Gear Pump (P3) and (P4)

WARNING

Removing the suction hose from the dual gear pump while there is hydraulic fluid in the tank will cause and uncontrolled discharge of hydraulic fluid.

Drain the hydraulic tank before disconnecting the suction hose from the gear pump.

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–65) prior to removing hydraulic system components.

1. Remove the operator’s platform; refer to Preparing the Machine (page 8–8)
2. Drain the hydraulic tank into a suitable container; refer to the traction unit *Operator’s Manual*.

Removing the Dual Gear Pump (P3) and (P4) (continued)

3. To prevent contamination of the hydraulic system during pump removal, thoroughly clean the exterior of the pump and fittings.
4. Disconnect the suction hose from the bottom of the gear pump and the pressure hose from the top of the gear pump. Plugs in open hydraulic hoses and cap the pump fittings. Label disconnected hydraulic hoses for proper reassembly.
5. Mark the fitting orientation to allow for correct assembly then remove the fittings from the pump and discard the O-rings.
6. Remove the 2 capscrews and plain washers that secure the gear pump to the piston pump.
7. Slide the gear pump rearward then upward and out of the machine to the left of the manifold support.
8. Plug the gear pump ports, then locate and discard the O-ring between the gear pump and the piston pump.

Installing the Gear Pump (P3) and (P4)

1. Apply clean petroleum jelly or light grease to a new O-ring (item 7 in Figure 88) and position the O-ring onto the gear pump flange.
2. Apply anti-seize lubricant to the splines of the gear pump shaft. Align the gear pump shaft and slide the gear pump into the piston pump coupler.
3. Remove the plugs from the gear pump ports and secure the gear pump to the piston pump with 2 socket head screws and plain washers. Tighten the socket head screws from **46 to 57 N·m (34 to 42 ft-lb)**.
4. Install and lubricate new gear pump fitting O-rings. Install the fittings into pump ports using alignment marks made during removal and tighten the fittings; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–11).
5. Remove the plugs from the hydraulic hoses and install the hydraulic hoses to the gear pump; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–9). Tighten suction hose clamp to **10 N·m (90 in-lb)**.
6. Install the operator's platform; refer to Installing the Operator's Platform or Cab (page 8–16).
7. Replace the hydraulic filters.
8. Fill the hydraulic reservoir with new hydraulic oil.
9. Prime the hydraulic pump; refer to Priming the Hydraulic Pumps (page 5–75).
10. Charge the hydraulic system; refer to Charging the Hydraulic System (page 5–76).
11. Stop engine then check for and correct any hydraulic oil leaks. Check hydraulic fluid level and adjust it if necessary.

Gear Pump (P3) and (P4) Service

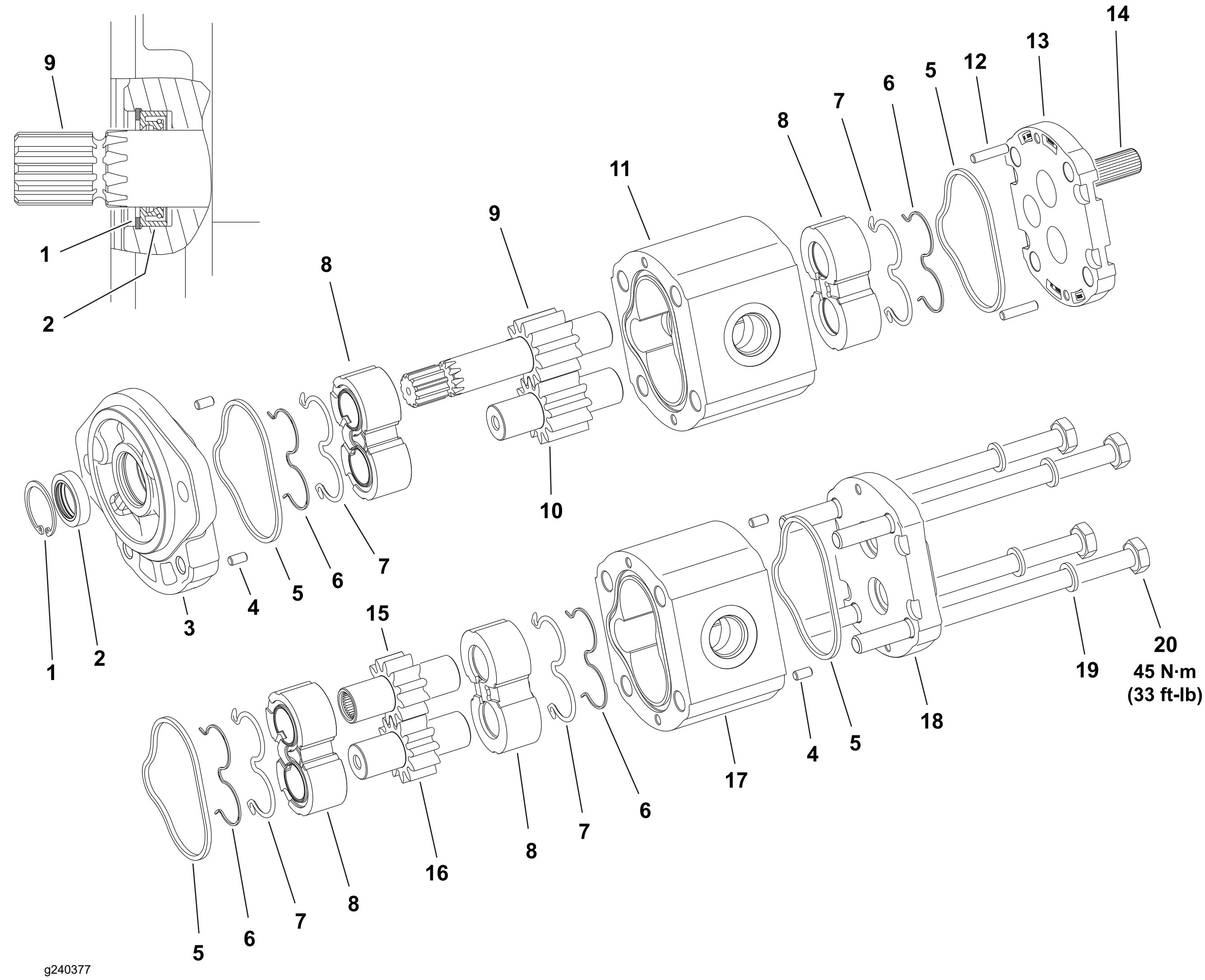


Figure 89

1. Retaining ring
2. Shaft seal
3. Front cover
4. Dowel pin (4 each)
5. Seal (4 each)
6. Uni-ring (4 each)
7. Pressure seal (4 each)
8. Thrust plate (4 each)
9. Driveshaft/gear
10. Driven shaft/gear
11. Pump body (P3)
12. Dowel pin (2 each)
13. Flange
14. Drive hub
15. Driveshaft/gear
16. Driven shaft/gear
17. Pump body (P4)
18. Rear cover
19. Washer (4 each)
20. Capscrew (4 each)

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, inspect, and assemble gear pump for cleaning, inspection, and seal replacement only.

IMPORTANT

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

Disassembling the Gear Pump

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

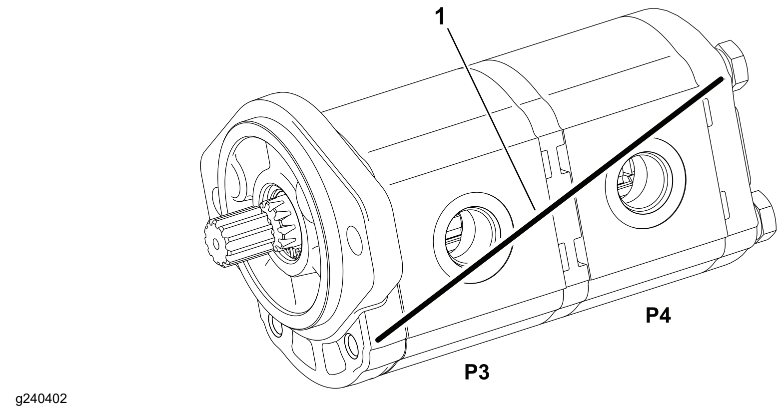


Figure 90

1. Marker line

2. Use a marker to make diagonal lines across the gear pump sections for assembly purposes; refer to Figure 90.

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 driveshaft pointing down.
4. Loosen the four (4) capscrews that secure the pump sections (P3) and (P42) to the front cover.
5. Remove the pump from the vise and remove the fasteners.

   Note: Be careful to not drop parts or disengage gear mesh when separating pump sections.
6. Support the pump assembly and gently tap the pump bodies with a soft face hammer to loosen the pump sections.

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.

7. Remove the thrust plates and the seals from each pump section. Before removing each gear set, apply marking dye to the mating teeth to retain the ”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.

Inspecting the Gear Pump

If internal parts are found to be worn or damaged, gear pump replacement is necessary.

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

Inspecting the Gear Pump (continued)

CAUTION

Use eye protection such as goggles when using compressed air.

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

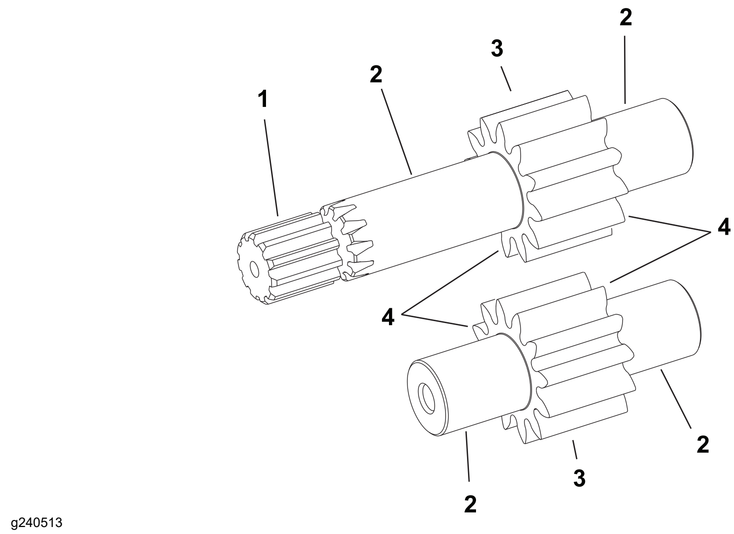


Figure 91

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

3. Inspect the drive gears and idler gears for the following:
   A. The gear shafts should be free of rough surfaces and excessive wear at the thrust plate points and sealing areas.
   B. The gear teeth should be free of excessive scoring and wear.
   C. Inspect each gear face edge for sharp edges or burrs. Remove sharp edges or burrs from the gear faces with emery cloth.
4. Inspect the thrust plates for the following:
   A. The bearing areas should not have excessive wear or scoring.
   B. The face of the thrust plates that are in contact with the gears should be free of wear, roughness, or scoring.
   C. The thickness of the thrust plates should be equal.
5. Inspect the front flange and the rear cover for damage or wear.

Assembling the Gear Pump

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

1. Lubricate the body seals, pressure seals, uni-rings, and the thrust plate grooves with a thin coat of petroleum jelly. Lubricate all other internal parts freely with clean hydraulic oil.
2. Install a new seal and retaining ring in the front cover; refer to Figure 89.
3. Place the front flange, seal side down, on a flat surface.
4. Assemble the front gear pump section (P3) as follows:

Assembling the Gear Pump (continued)

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 driveshaft/gear with clean hydraulic oil. Insert the drive end of the driveshaft 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. Fit the driveshaft/gear into the front cover.

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

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

F. Install the dowel pins in the body.

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

IMPORTANT

Do not dislodge seals during installation.

H. Align the marker lines and slide the body over the gear assembly.

5. Install the dowel pins in the flange.
6. Align the marker lines and install the flange over the shaft ends.
7. Install the drive hub and repeat step 4 for the rear gear pump section (P4).
8. Install dowel pins in rear cover.
9. Align the marker lines and slide the rear cover over the shaft ends.
10. Install the 4 capscrews with washers and hand tighten.
11. Place the front cover of the pump into a vise with soft jaws and alternately tighten the capscrews to **45 N·m (33 ft-lb)**.
12. Place a small amount of clean hydraulic oil in the pump inlet and rotate the driveshaft clockwise one revolution. If any binding is noted, disassemble the pump and check for assembly problems.

Axle Motors

Removing the Axle Drive Motor (Machines with an Axle-Drive Gearbox)

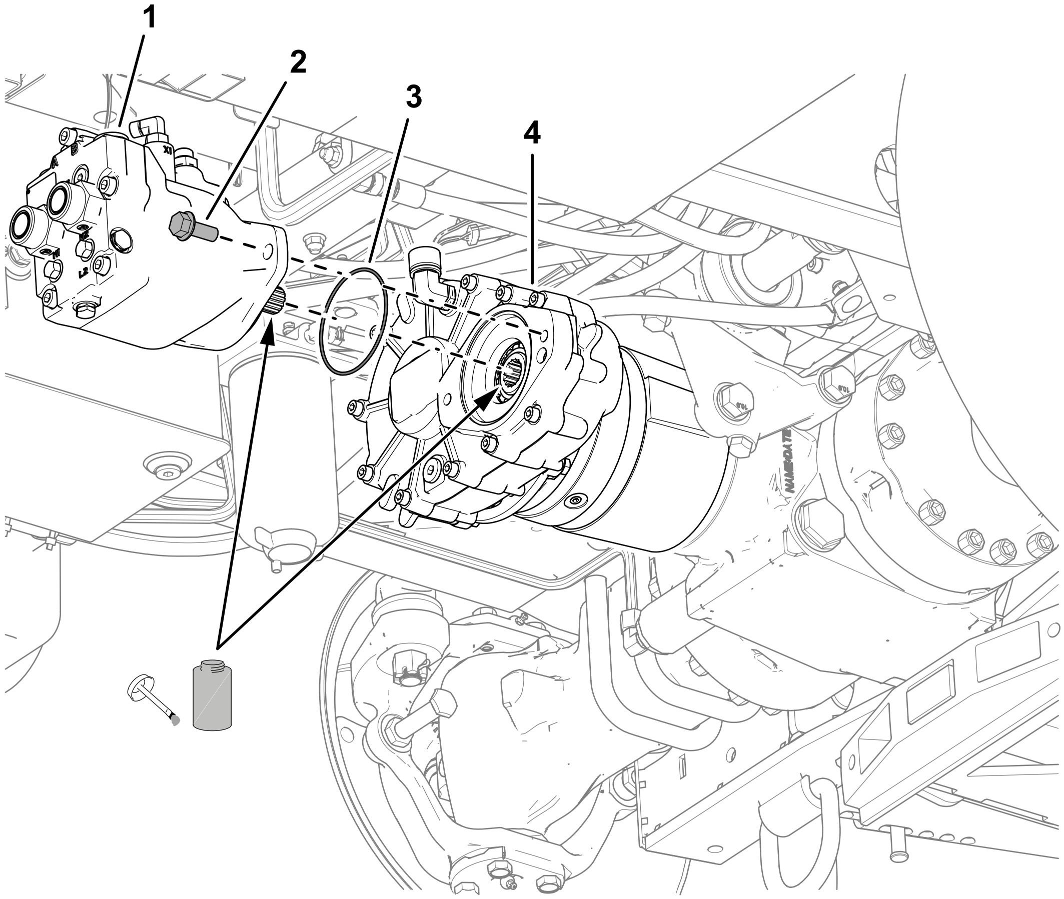


Figure 92

Rear axle shown; the front axle is similar.

1. Axle drive motor
2. Flange capscrew
3. O-ring
4. Axle-drive gearbox

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–65) prior to removing hydraulic system components.

1. To prevent contamination of the hydraulic system during axle drive motor removal, thoroughly clean the exterior of the drive axle motor and fittings.
2. Label and disconnect the hydraulic hoses from the axle drive motor. To prevent contamination of hydraulic the system, plug the disconnected hoses and cap the fittings.

IMPORTANT

The axle drive motor weighs approximately 16 kg (34 lbs).

3. Remove the front axle drive motor from the axle-drive gearbox.
4. Remove the O-ring from the housing of the motor, and inspect the O-ring for wear or damage.

   Note: Replace the O-ring if it is worn or damaged.

Removing the Axle Drive Motor (Machines with an Axle-Drive Gearbox) (continued)

5. If fitting removal is necessary, mark the fitting orientation to allow for correct assembly then remove the fittings from the pump and discard the O-rings.

Installing the Axle Drive Motor (Machines with an Axle-Drive Gearbox)

1. Lubricate new O-rings and place them onto the fittings. If previously removed, install the fittings into the motor ports using alignment marks made during removal; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–11).
2. Apply anti-seize lubricant to the splines of the axle drive gearbox.
3. Ensure that the O-ring is assembled onto the housing of the axle drive motor.
4. Apply anti-seize lubricant to the splines of the rear axle drive motor, and align the drive motor splines to the splines of the axle-drive gearbox. Assemble the motor to the gearbox with the 2 flange-head screws, and torque the screws to **91 to 113 N·m (67 to 83 ft-lb)**.
5. Remove caps and plugs from hydraulic fittings and hoses and install the hydraulic hoses to the axle drive motor; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–9).
6. Test axle drive motor operation before returning the machine to service:
   A. Check the hydraulic fluid level and adjust it if necessary.
   B. Operate the machine slowly at first.
   C. Stop the engine then check for and correct any hydraulic leaks.
   D. Check the hydraulic fluid level and adjust it if necessary.

Removing the Axle Drive Motor (Machines without an Axle-Drive Gearbox)

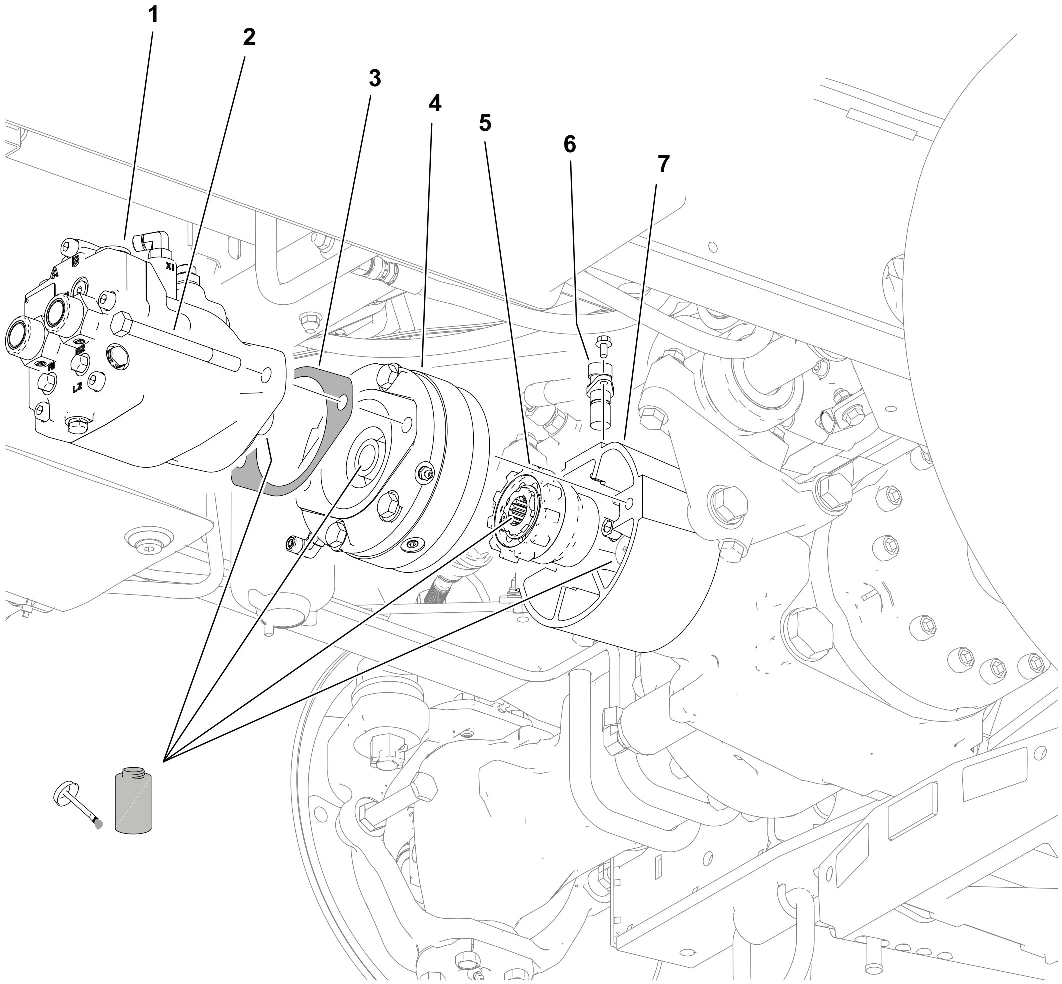


Figure 93

(Rear axle shown)

1.	Axle drive motor	4.	Hydraulic brake assembly (rear axle only)	7.	Motor mount
2.	Capscrew (2 each)	5.	Drive coupler		
3.	Gasket (rear axle only)	6.	Speed sensor		

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–65) prior to removing hydraulic system components.

1. To prevent contact between the face of the speed sensor and the drive coupling during axle drive motor removal, remove the speed sensor from the motor mount.
2. To prevent contamination of the hydraulic system during axle drive motor removal, thoroughly clean the exterior of the drive axle motor and fittings.
3. Label and disconnect the hydraulic hoses from the axle drive motor. To prevent contamination of hydraulic the system, plug the disconnected hoses and cap the fittings.

Removing the Axle Drive Motor (Machines without an Axle-Drive Gearbox) (continued)

IMPORTANT

The axle drive motor weighs approximately 16 kg (34 lbs) and the brake assembly weighs approximately 11 kg (24 lbs).

Note: The 2 capscrews that secure the rear axle drive motor to the motor mount also secure the hydraulic brake assembly.

4. Remove the 2 capscrews that secure the axle drive motor to the motor mount (front axle drive motor) or the brake assembly (rear axle drive motor). Separate the motor from the motor mount or brake, and remove the motor from the machine.

IMPORTANT

Support the brake assembly.

5. Remove and discard the gasket between the axle drive motor and the hydraulic brake assembly.
6. Remove and inspect the front drive coupler, or remove and support the hydraulic brake assembly then remove and inspect the rear drive coupler.
7. If fitting removal is necessary, mark the fitting orientation to allow for correct assembly then remove the fittings from the pump and discard the O-rings.

Installing the Axle Drive Motor (Machines without an Axle-Drive Gearbox)

1. Lubricate new O-rings and place them onto the fittings. If previously removed, install the fittings into the motor ports using alignment marks made during removal; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–11).
2. Apply anti-seize lubricant to the splines of the drive coupler. Align the drive coupler splines and slide the drive coupler all the way onto the axle input shaft.
3. If installing the rear axle drive motor:
   A. Apply anti-seize lubricant to the splines of the hydraulic brake assembly.
   B. Align the hydraulic brake splines and slide the brake assembly shaft into the drive coupler.
   C. Install a new gasket between the hydraulic brake assembly and the rear axle drive motor.
4. Apply anti-seize lubricant to the splines of the axle drive motor shaft. Align the drive motor splines, and slide the motor shaft into the drive coupler (front axle drive motor) or brake assembly (rear axle drive motor).
5. Assemble the axle drive motor to the motor mount (front axle drive motor) or the brake assembly (rear axle drive motor) with the 2 flange-head screws, and torque the screws to **91 to 113 N·m (67 to 83 ft-lb)**.
6. Remove caps and plugs from hydraulic fittings and hoses and install the hydraulic hoses to the axle drive motor; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–9).
7. Test axle drive motor operation before returning the machine to service:
   A. Check the hydraulic fluid level and adjust it if necessary.
   B. Operate the machine slowly at first.

Installing the Axle Drive Motor (Machines without an Axle-Drive Gearbox) (continued)

C. Stop the engine then check for and correct any hydraulic leaks.

D. Check the hydraulic fluid level and adjust it if necessary.

Axle Motor Service

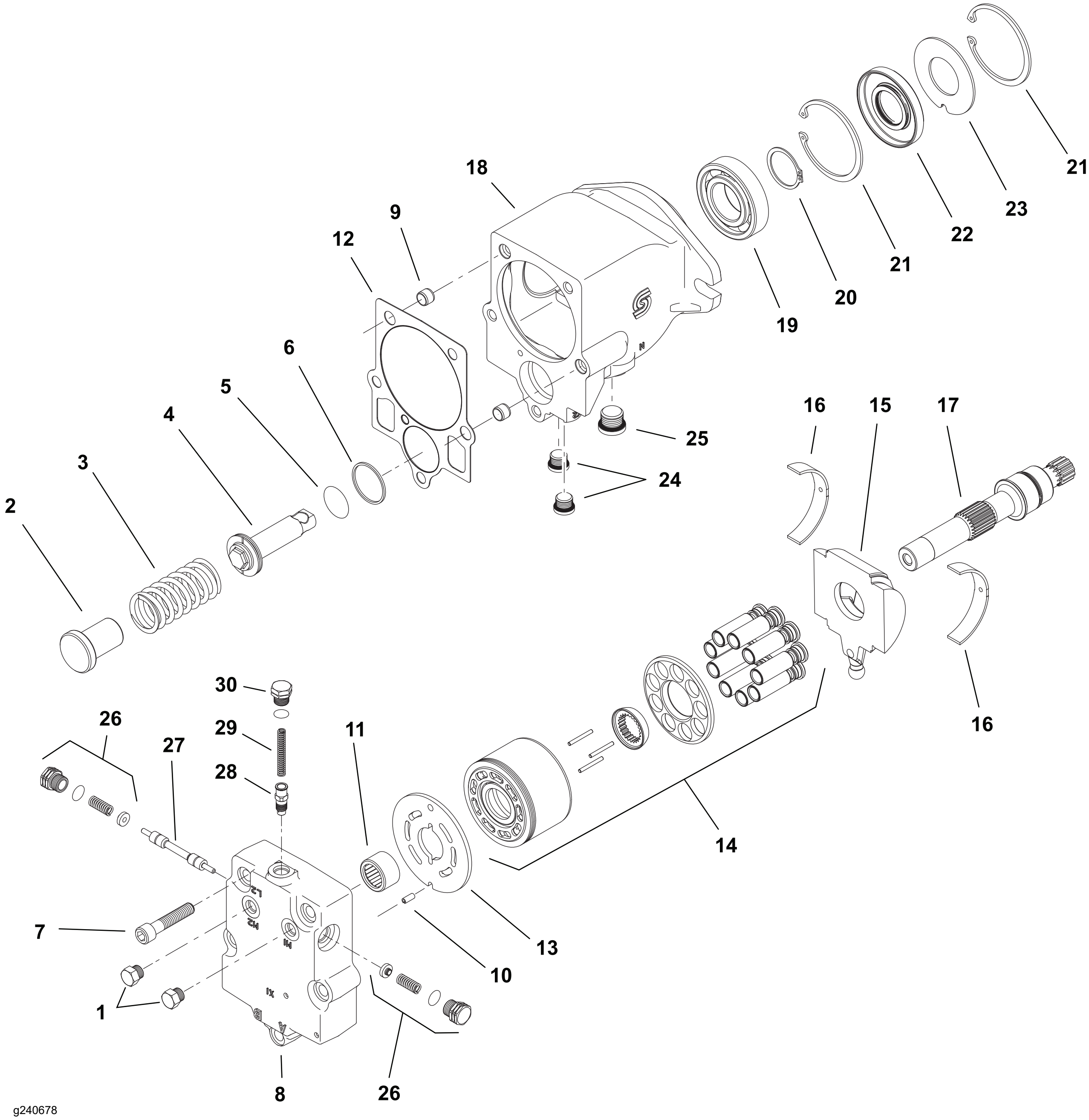


Figure 94

1. Plug with O-ring (2 each)
2. Minimum angle stop
3. Bias spring
4. Servo piston
5. O-ring
6. O-ring
7. Socket head screw (5 each)
8. End cap
9. Dowel
10. Dowel pin
11. Bearing
12. Gasket
13. Valve plate
14. Cylinder block kit
15. Swashplate
16. Swashplate bearing
17. Output shaft
18. Housing
19. Bearing
20. Retaining ring
21. Retaining ring (2 each)
22. Seal
23. Support washer
24. Plug with O-ring (2 each)
25. Plug with O-ring
26. Plug and spring (2 each)
27. Spool
28. Relief valve poppet
29. Spring
30. Plug

The front and rear axle drive motors are identical. The motors include a flushing valve to help keep the hydraulic fluid in the closed-loop traction circuit cool.

Axle Motor Service (continued)

Refer to the Danfoss K and L Frame Variable Motors Service Manual for axle drive motor service information.

Axle Differential Locks

The hydraulically actuated differential lock assemblies are incorporated into the axle assemblies; refer to the Carraro DriveTech Model 26.09M Axle Repair Manual for additional information.

Hydraulic Brake Assembly

Rear Axle Only

Removing the Brake Assembly

Machines with an Axle-Drive Gearbox

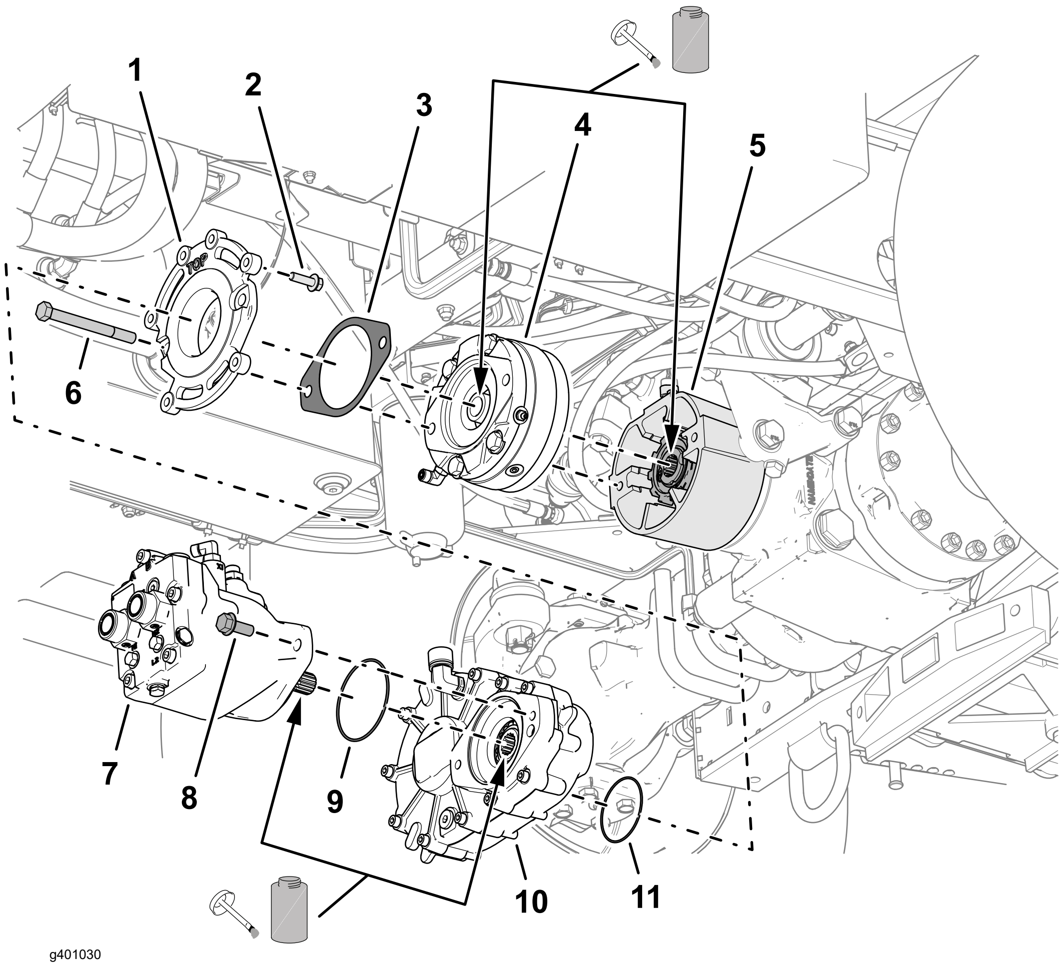


Figure 95

1. Gearbox adapter
2. Capscrew (2 each)
3. Gasket (rear axle only)
4. Hydraulic brake assembly
5. Rear hydraulic-motor mount and coupler assembly
6. Capscrew (2 each)
7. Axle drive motor
8. Capscrew (2 each)
9. O-ring
10. Axle-drive gearbox
11. O-ring

---

1. Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–65) prior to removing hydraulic system components.

Removing the Brake Assembly (continued)

IMPORTANT

The axle drive motor weighs approximately 16 kg (34 lbs).

2. Remove the rear axle drive motor from the axle-drive gearbox, and support the drive motor.

IMPORTANT

The gearbox assembly weighs approximately 20 kg (44 lbs).

3. Remove the axle-drive gearbox from the gearbox adapter; refer to Removing the Axle-Drive Gearbox (page 7–22).
4. To prevent contamination of the hydraulic system during brake removal, thoroughly clean the exterior of the brake assembly and fittings.
5. Disconnect the hydraulic hose from the brake assembly. To prevent contamination of hydraulic the system, plug the disconnected hose and cap the fitting.
6. Remove the gearbox adapter and the brake assembly from the rear hydraulic-motor mount.
7. If fitting removal is necessary, mark the fitting orientation to allow for correct assembly then remove the fitting from the brake assembly and discard the O-rings.

Installing the Brake Assembly

Machines with an Axle-Drive Gearbox

1. Lubricate new O-rings and place them onto the fitting. If previously removed, install the fitting into the brake port using alignment mark made during removal; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–11).
2. Apply anti-seize lubricant to the splines of the brake assembly, and assemble the brake to the coupler assembly.
3. Align a new gasket between the gearbox adapter and the brake assembly. Assemble the adapter, gasket, and brake to the hydraulic-motor mount with the 2 capscrews. Torque the screws to **91 to 113 N·m (67 to 83 ft-lb)**.
4. Connect the hydraulic hose to the brake assembly.
5. Ensure that the O-ring is assembled onto the case of the axle-drive gearbox.
6. Apply anti-seize lubricant to the splines of the axle-drive gearbox shaft, and install the gearbox; refer to Installing the Axle-Drive Gearbox (page 7–22).
7. Ensure that the O-ring is assembled onto the housing of the axle drive motor.
8. Install the axle drive motor; refer to Installing the Axle Drive Motor (Machines with an Axle-Drive Gearbox) (page 5–93).
9. Check the hydraulic brake oil level and adjust if necessary; refer to the traction unit *Operator's Manual*.
10. Test the hydraulic brake operation before returning the machine to service.

Removing the Brake Assembly

Machines without an Axle-Drive Gearbox

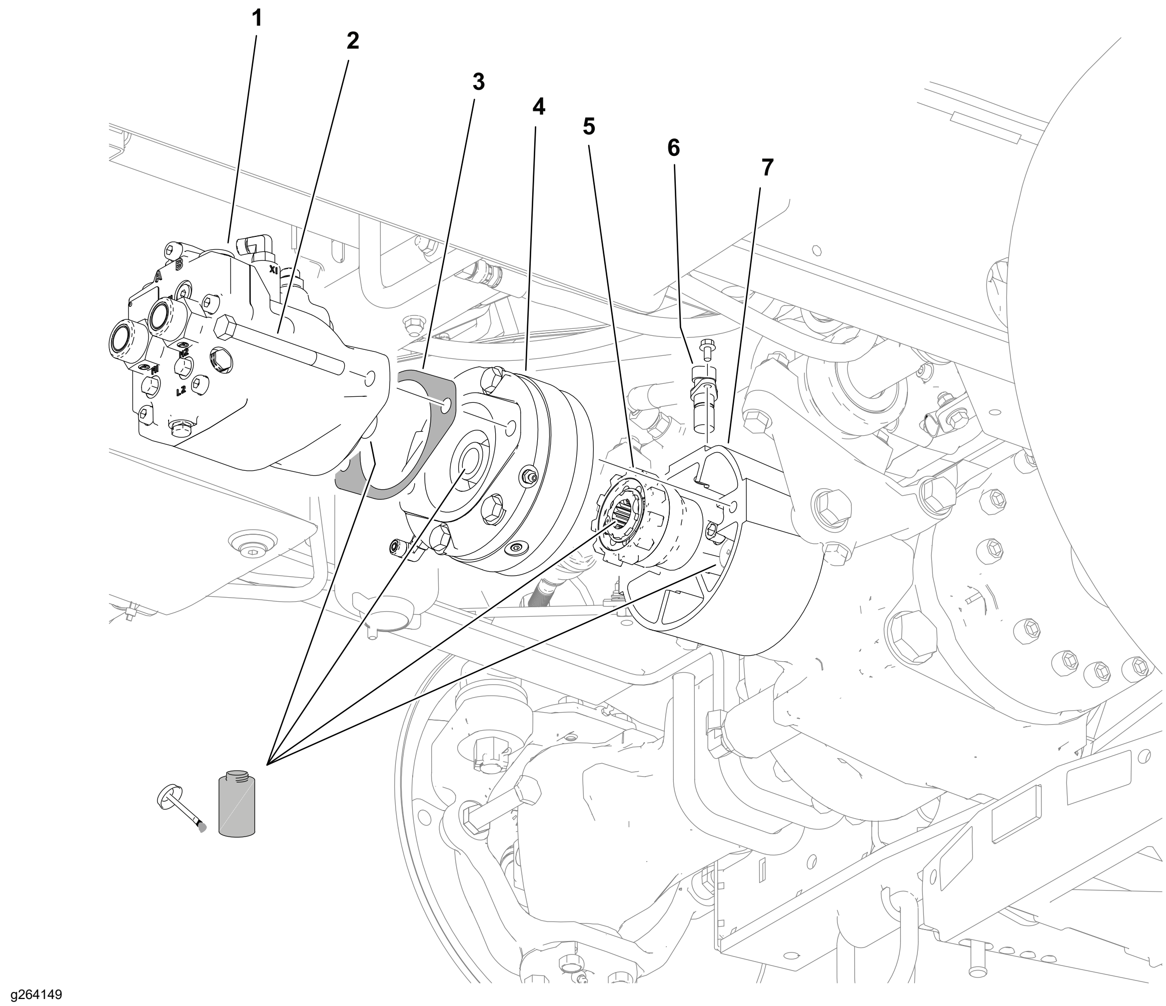


Figure 96

1. Axle drive motor
2. Capscrew (2 each)
3. Gasket
4. Hydraulic brake assembly
5. Drive coupler assembly
6. Speed sensor
7. Rear hydraulic-motor mount

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–65) prior to removing hydraulic system components.

IMPORTANT

The axle drive motor weighs approximately 16 kg (34 lbs).

1. Remove the axle drive motor; refer to the following:
   - Removing the Axle Drive Motor (Machines with an Axle-Drive Gearbox) (page 5–92)
   - Removing the Axle Drive Motor (Machines without an Axle-Drive Gearbox) (page 5–94)
2. To prevent contamination of the hydraulic system during brake removal, thoroughly clean the exterior of the brake assembly and fittings.

Removing the Brake Assembly (continued)

3. Disconnect the hydraulic hose from the brake assembly. To prevent contamination of hydraulic the system, plug the disconnected hose and cap the fitting.

IMPORTANT

The brake assembly weighs approximately 11 kg (24 lbs).

4. Separate the hydraulic brake assembly from the motor mount and remove the brake from the machine.
5. Remove and inspect the rear drive coupler.
6. If fitting removal is necessary, mark the fitting orientation to allow for correct assembly then remove the fitting from the brake assembly and discard the O-rings.

Installing the Brake Assembly

Machines without an Axle-Drive Gearbox

1. Lubricate new O-rings and place them onto the fitting. If previously removed, install the fitting into the brake port using alignment mark made during removal; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–11).
2. Apply anti-seize lubricant to the splines of the drive coupler. Align the drive coupler splines and slide the drive coupler all the way onto the axle input shaft.
3. Apply anti-seize lubricant to the splines of the hydraulic brake assembly.
4. Align the splines of the brake with the drive coupler splines, and assemble the brake shaft into the coupler.
5. Install a new gasket between the hydraulic brake assembly and the axle drive motor.
6. Install the axle drive motor; refer to Installing the Axle Drive Motor (Machines without an Axle-Drive Gearbox) (page 5–95).
7. Check the hydraulic brake oil level and adjust if necessary; refer to the traction unit *Operator’s Manual*.
8. Test the hydraulic brake operation before returning the machine to service.

Hydraulic Brake Service

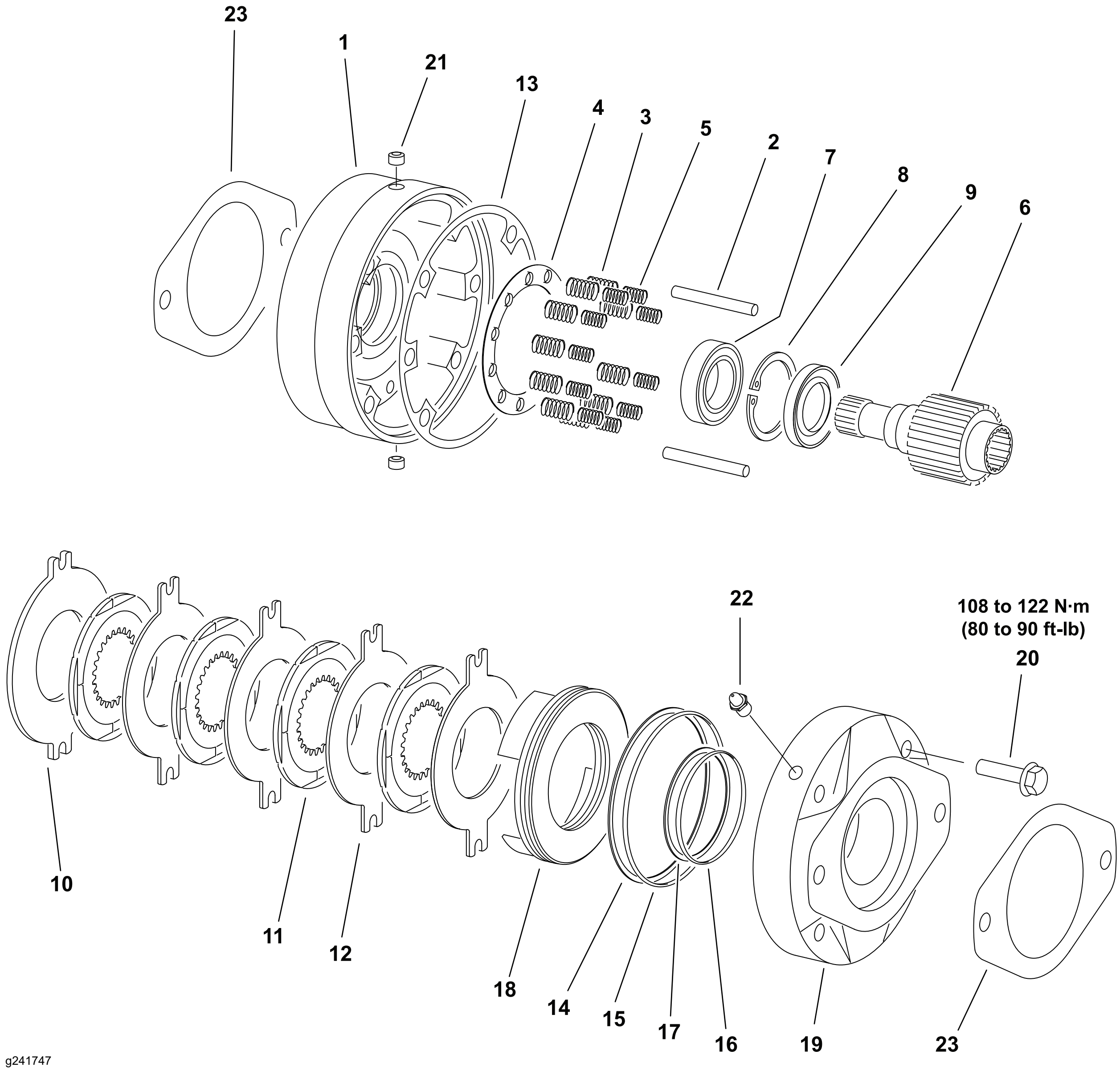


Figure 97

1. Housing
2. Torque pin (2 each)
3. Compression spring (10 each)
4. Spring retainer
5. Compression spring (10 each)
6. Shaft
7. Bearing
8. Snap ring
9. Oil seal
10. Primary disc
11. Rotating disc (4 each)
12. Stationary disc (4 each)
13. Gasket
14. Backup ring
15. O-ring
16. O-ring
17. Backup ring
18. Power plate
19. Piston
20. Hex head screw (4 each)
21. Fill/drain plug (2 each)
22. Bleeder
23. Gasket (2 each)

Disassembling the Hydraulic Brake

1. Remove one of the fill/drain plugs and drain the oil from the brake housing.
2. Loosen the 4 hex head screws alternately and separate the power plate from the housing.
3. Remove the piston from the power plate with low pressure (103 kPa (15 psi)) compressed air through the hydraulic port.

Disassembling the Hydraulic Brake (continued)

4. Remove and discard the O-rings and backup washers.

IMPORTANT

If the shaft seal or bearing are removed for any reason, both must be replaced.

5. Press the shaft from the bearing and remove the shaft seal, retaining ring, and bearing.

Assembling the Hydraulic Brake

1. If previously removed, install a new bearing and retaining ring. Install a new shaft seal in the housing with the face of the seal toward the bearing. Press the shaft into the bearing while supporting the bearing inner race.
2. Install new piston O-rings and backup rings. The backup rings should be installed closest to the brake discs.

CAUTION

Piston installation depth is critical, or the piston may cock—resulting in loss of braking. The surface of the piston at the base of the cutouts must be flush to 3.05 (0.12 inch) below the surface of the power plate.

3. Lubricate the piston and power plate bore with clean hydraulic oil and use a press to fit the piston into the power plate. Visually align the cutouts in the piston with the torque pin holes in the power plate.
4. Ensure the brake discs are clean and dry and install the discs as shown.
5. Use a new gasket and fit the power plate assembly over the housing. Install the 4 hex head screws and tighten them sequentially one turn at a time until the power plate assembly in properly seated. Tighten the screws from **108 to 122 N·m (80 to 90 ft-lb)**.

Main Hydraulic Manifold

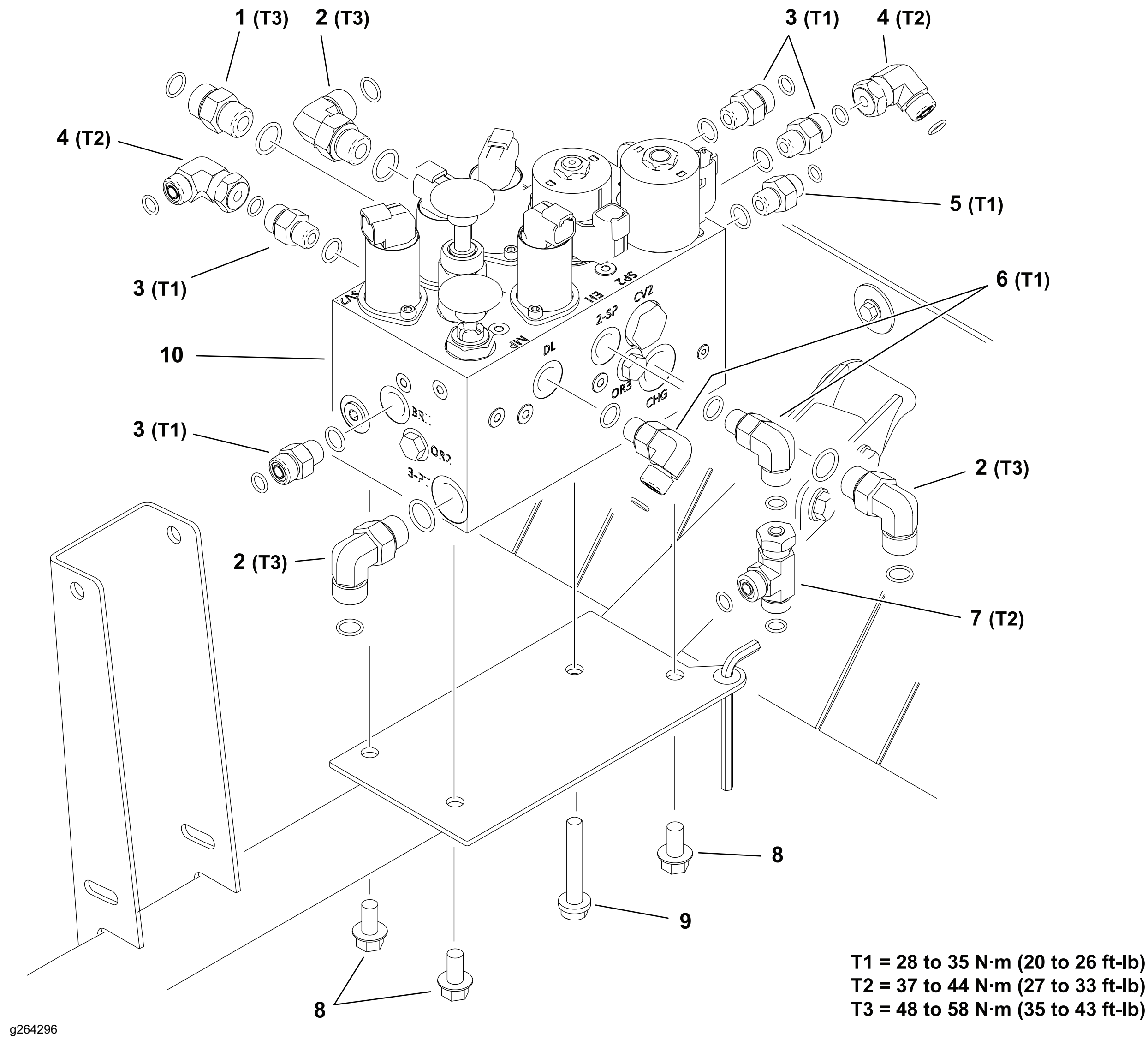


Figure 98

1. Straight fitting
2. Elbow fitting (3 each)
3. Straight fitting (4 each)
4. Swivel elbow fitting (2 each)
5. Straight fitting
6. Elbow fitting (2 each)
7. Swivel tee fitting
8. Flange-head screw (3 each)
9. Flange-head screw
10. Manifold block

The ports on the main manifold are marked for easy identification of components and connections. Example: P is the pressure connection port from gear pump (P4) and SV1 is the location for the high/low speed solenoid valve; refer to the hydraulic schematic in Appendix A (page A–1) to identify the function of the hydraulic lines and cartridge valves at each port.

Removing the Main Hydraulic Manifold

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–65) prior to removing hydraulic system components.

1. Remove the operator's platform; refer to Preparing the Machine (page 8–8).
2. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold and fittings.

Removing the Main Hydraulic Manifold (continued)

3. Label and disconnect wire harness connectors from the solenoid valves.
4. Label and disconnect the hydraulic lines from the manifold and put caps or plugs on open hydraulic lines and fittings to prevent system contamination.
5. Remove the main manifold from the machine.
6. If hydraulic fittings are to be removed from the manifold, mark the fitting orientation to allow for correct assembly. Remove the fittings from the manifold and discard the O−rings.

Installing the Main Hydraulic Manifold

Note: The main hydraulic manifold is aluminum.

1. Lubricate new O-rings and place them onto the fittings. If previously removed, install the fittings into the manifold ports using alignment marks made during removal; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–11).
2. Position the manifold to the frame and secure with 4 capscrews.
3. Remove the caps and plugs from the fittings and hoses. Properly connect the hydraulic lines to the manifold; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–9).
4. Connect the wire harness connectors to the cartridge valve solenoids.
5. Install the operator's platform; refer to Installing the Operator's Platform or Cab (page 8–16).

Main Manifold Service

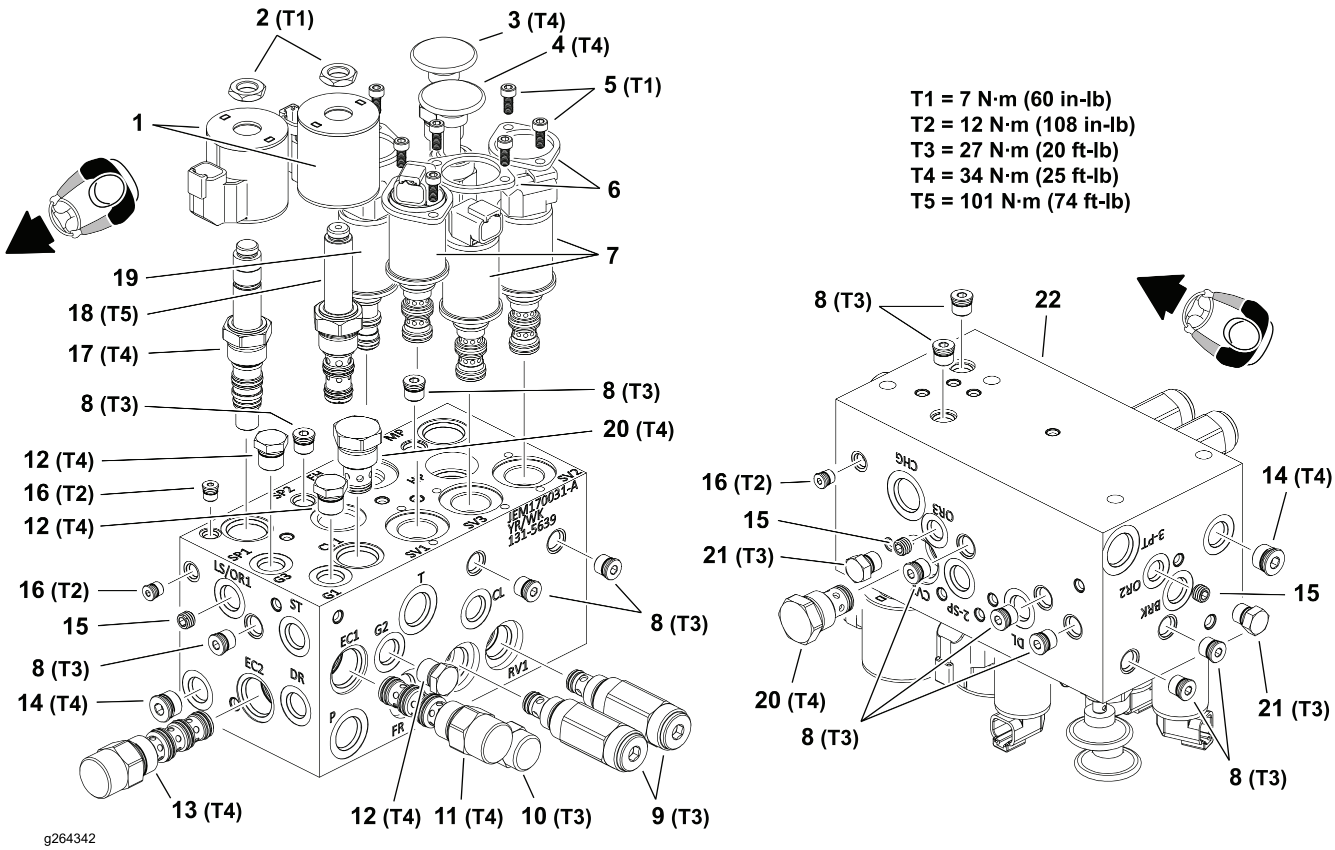


Figure 99

1. Solenoid coil (2 each)
2. Coil nut (2 each)
3. Manual valve – pull to open
4. Hand pump
5. Socket head screw (8 each)
6. Mounting plate (4 each)
7. Solenoid valve – SV1/SV2/SV3 (3 each)
8. #4 zero-leak plug with O-ring (12 each)
9. Relief valve – RV1/RV2 (2 each)
10. Flow regulator – FR
11. Pressure compensating valve – EC1
12. #6 zero-leak plug with O-ring (3 each)
13. Pressure compensating valve – EC2
14. #6 zero-leak plug with O-ring (2 each)
15. Orifice – 0.028 inch – OR1/OR2/OR3 (3 each)
16. #2 zero-leak plug with O-ring (3 each)
17. Solenoid valve – SP1
18. Proportional valve – SP2
19. Solenoid valve – EH
20. Check valve – CV1/CV2 (2 each)
21. #4 zero-leak plug with O-ring (2 each)
22. Manifold block

The ports on the main manifold are marked for easy identification of components and connections. Example: P is the pressure connection port from gear pump (P4) and SV1 is the location for the high/low speed solenoid valve; refer to the hydraulic schematic in Appendix A (page A–1) to identify the function of the hydraulic lines and cartridge valves at each port.

The main hydraulic 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 removing a zero-leak plug is necessary, lightly rap the plug head using a punch and hammer before using a hex wrench to remove the plug: the impact will allow plug removal with less chance of damage to the socket head of the plug. Tighten the plugs to the torque value provided.

Main Manifold Service (continued)

IMPORTANT

A removable control orifice exists under the fitting in the LS/OR1 port, and under the plugs in the OR2 and OR3 ports of the main hydraulic manifold. If the fitting or plug is removed, remove the orifice for cleaning and label its position for assembly purposes.

Note: For cartridge valve service procedures, refer to Cartridge Valve Service (page 5–109).

Cartridge Valve Service

Note: For solenoid style cartridge valve coil testing information; refer to Hydraulic Solenoid Valve Coils (page 6–75).

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–65) prior to removing hydraulic system components.

1. Park the machine on a level surface. Lower any attachments, stop the engine, and remove the key from the key switch.
2. Ensure that the manifold is clean before you remove the cartridge valve from the manifold.
3. Remove the cartridge valve:
   A. For solenoid style valves, disconnect the wire harness connector and remove the nut that secures the solenoid coil to the cartridge valve. Carefully slide the coil off the valve.

IMPORTANT

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

   B. Use a deep socket wrench to remove the cartridge valve from the manifold.
4. Record the correct location of the O-rings, the sealing rings, and the back-up rings. Remove and discard the seal kit from the cartridge valve.
5. Visually inspect the manifold port and the cartridge valve:
   A. Check for damaged threads on the cartridge valve and in the manifold block.
   B. If valve sealing surfaces appear pitted or damaged, the hydraulic system may be overheating or there may be water in the system.
   C. Contamination may cause valves to stick or hang up. Contamination can become lodged in small valve orifices or seal areas causing valve malfunction.

CAUTION

Use eye protection such as goggles when using compressed air.

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

6. Clean the cartridge valve.
   A. For non-solenoid operated valves: Submerge the valve in clean mineral spirits to flush out contamination. If the valve design allows, use a non–metallic probe to push the internal spool in and out 20 to 30 times to flush out contamination. Clean and dry the cartridge valve with compressed air.
   B. For solenoid operated valves: Temporarily install the solenoid on the cartridge valve and connect a 12-volt power source to the solenoid. While energized, flush out any contamination with a nonflammable aerosol brake cleaner. De-energize the solenoid. Repeat the flushing the valve

Cartridge Valve Service (continued)

while energized procedure 5 or 6 times. Remove the solenoid from the cartridge.

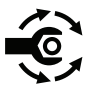
7. Install the cartridge valve:

   A. Lubricate the new O-rings and the backup rings of the seal kit with clean hydraulic fluid and install them on the cartridge valve. The O-rings and the backup rings must be arranged correctly on the cartridge valve for proper operation and sealing; refer to notes taken during the seal removal.

IMPORTANT

Use care when installing the cartridge valve. Slight bending or distortion of the stem tube can cause binding and malfunction. Make sure that deep well socket fully engages the valve base.

   B. Lubricate the threads on the cartridge valve with clean hydraulic fluid. Thread the cartridge valve carefully into the correct manifold port. The valve should thread in easily without binding.



   C. Tighten the cartridge valve using a deep well socket to the torque specification shown.

   D. For solenoid valves, slide the solenoid coil onto the cartridge valve. Tighten the coil nut to the torque specification shown.

8. If a problem still exists, remove the valve and clean it again, or replace the valve.

Steering Control Valve

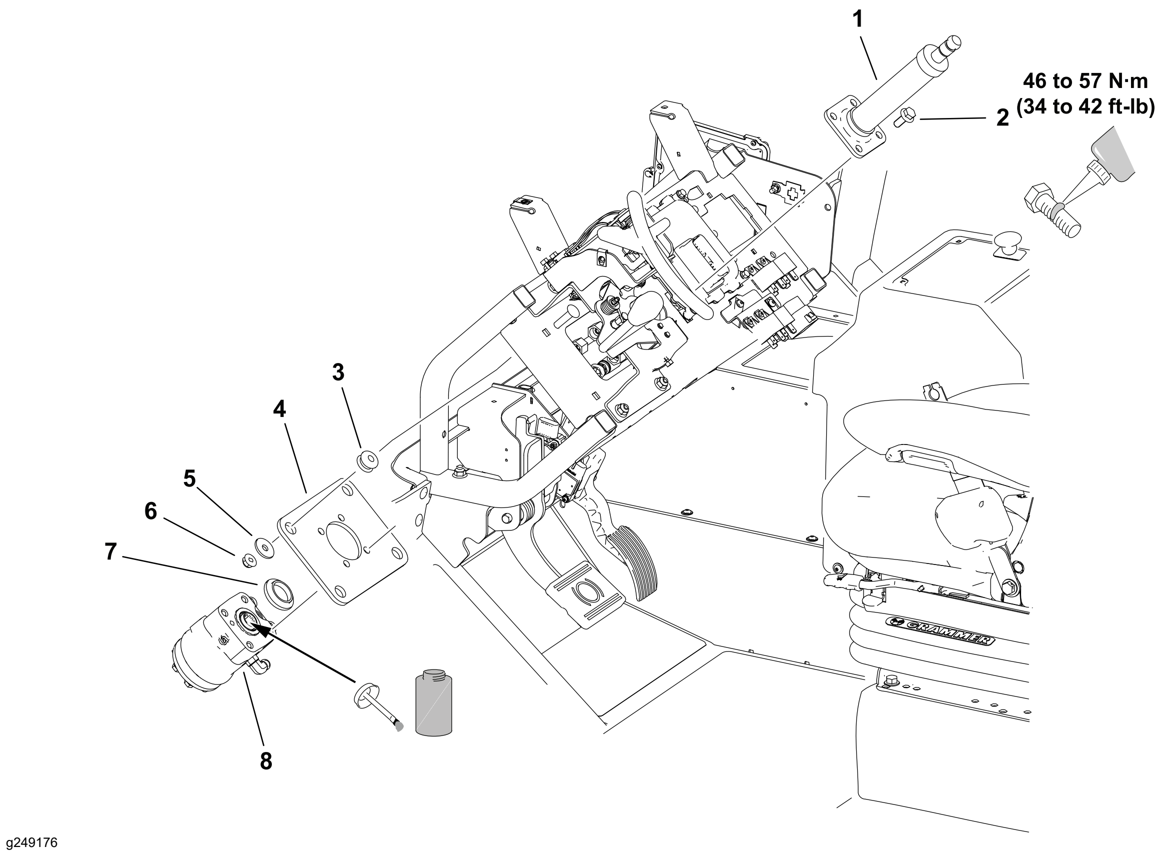


Figure 100

1. Steering column
2. Flange-head screw (4 each)
3. Mount (4 each)
4. Plate
5. Washer (4 each)
6. Flange nut (4 each)
7. Alignment bushing
8. Steering control valve

Removing the Steering Control Valve

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–65) prior to removing hydraulic system components.

1. Remove the steering wheel and dash cover; refer to Removing the Dash Cover (page 8–25).
2. Clean the fittings and hydraulic line connections before disconnecting the hydraulic lines to prevent system contamination.
3. Disconnect the hydraulic hoses and tubes from the steering control valve. Cap the fittings and plug the lines to prevent contamination from entering the system.
4. Remove the four flange-head screws securing the steering column and steering control valve to the plate.
5. Remove the steering column and steering control valve and retrieve the alignment bushing (item 7).
6. Inspect the four neoprene mounts between the plate and frame for damage and replace as necessary.
7. If fitting removal is necessary, mark the fitting orientation to allow for correct assembly then remove the fittings from the valve and discard the O-rings.

Installing the Steering Control Valve

1. Lubricate new O-rings and place them onto the fittings. If previously removed, install the fittings into the valve ports using alignment marks made during removal; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–11).
2. Apply anti-seize to the splines of the steering control valve and the bottom splines of the steering column. Apply Loctite to the four flange-head screws (item 2 in Figure 100). Install the alignment ring, then hold the steering control valve and steering column to the plate and install the four flange-head screws. Tighten the screws from **46 to 57 N·m (34 to 42 ft-lb)**.

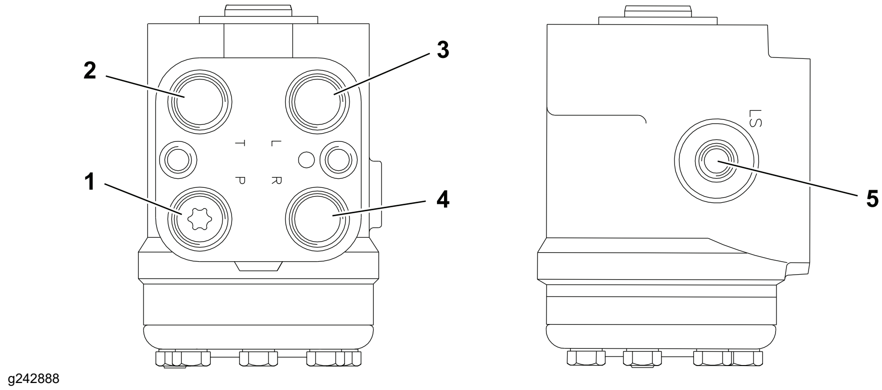


Figure 101

1. Pressure (in) port – P
2. Tank (out) port – T
3. Left turn port – L
4. Right turn port – R
5. Load sensing port – LS

---

3. Connect the hydraulic hoses and lines to the steering control valve.
4. Install the dash cover and steering wheel; refer to Finishing the Steering Wheel, Instrument Panels and Dash Cover Installation (page 8–29).

Steering Control Valve Service

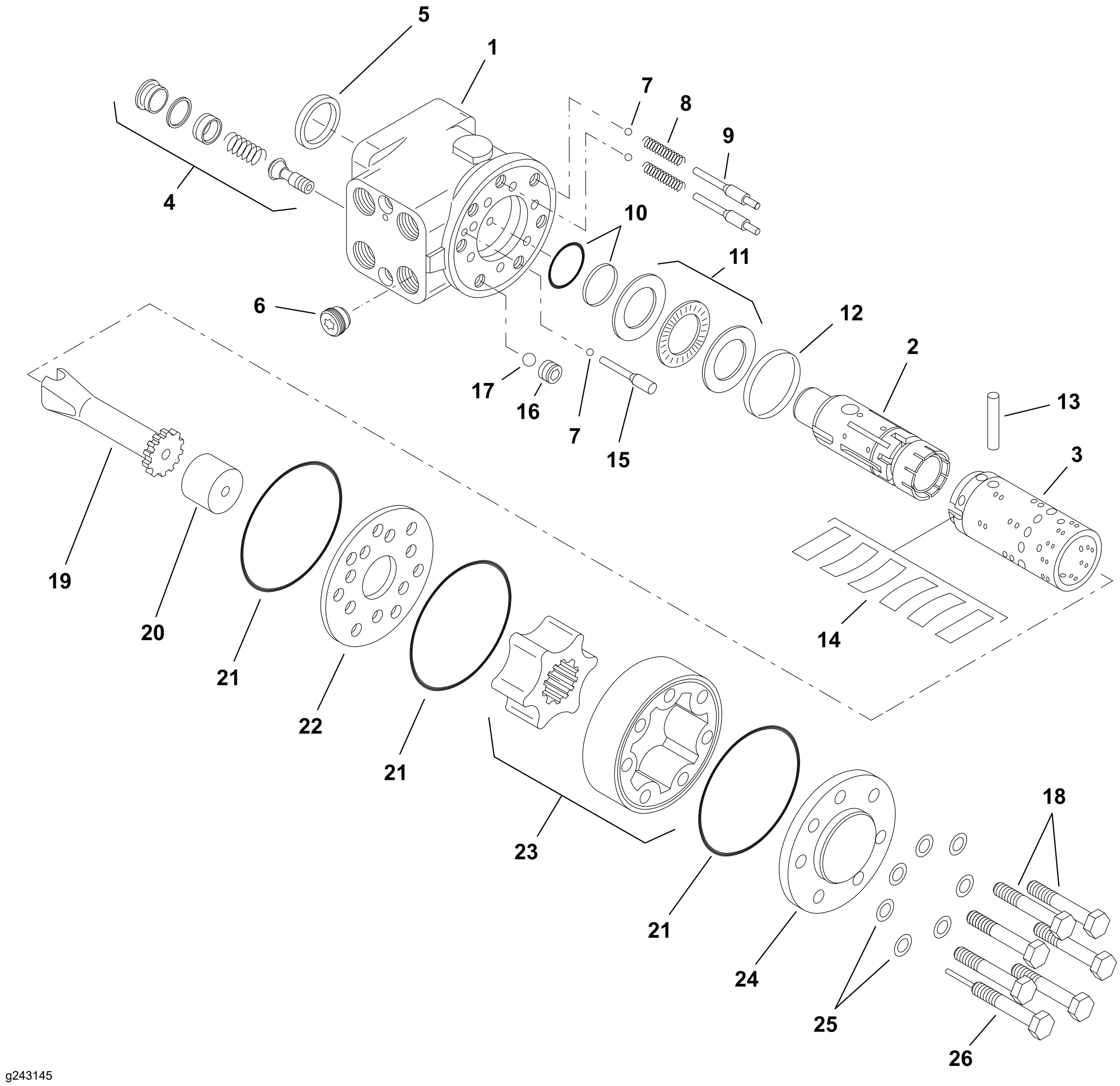


Figure 102

1. Housing
2. Spool
3. Sleeve
4. Relief valve
5. Dust seal
6. Check valve
7. Ball (3 each)
8. Spring (2 each)
9. Pin (2 each)
10. Shaft seal
11. Bearing
12. Ring
13. Cross pin
14. Spring set
15. LS check valve
16. Threaded bushing
17. Ball
18. Screw (6 each)
19. Cardan shaft
20. Spacer
21. O-ring (3 each)
22. Distributor plate
23. Gearwheel set
24. End cover
25. Washer (7 each)
26. Special screw

The Outcross 9060 uses a Danfoss type OSPC steering control valve. For steering control valve repair procedures, refer to the Danfoss Steering Unit Type OSPB, OSPC and OSPF Service Manual.

Steering Cylinders

Removing the Front Steering Cylinder

WARNING

The front axle assembly weighs approximately 231 kg (510 lbs).

1. Raise the front of the machine and support it with jackstands; refer to the *Operator's Manual* for the machine.
2. Remove the front wheels.
3. Remove the cotter pin and slotted nut that secure the left and right tie rods to the steering hubs of the axle. Discard the cotter pins.

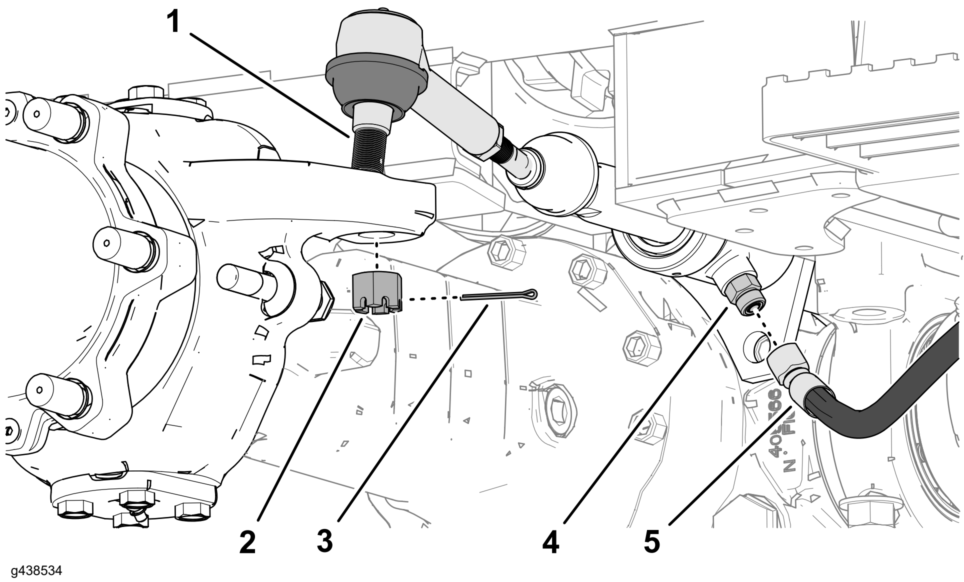


Figure 103

1. Tie- rod
2. Slotted nut
3. Cotter pin
4. Steering-cylinder fitting
5. Steering hose

4. Separate the tie rods from the steering hubs.
5. Disconnect the left and right steering hoses from the steering-cylinder fittings.
6. Unplug main harness connector P25 (labeled FRONT SPEED) from the axle speed sensor in the hydraulic-motor mount.

IMPORTANT

Unplug the speed sensor to prevent damaging the harness.

Model/Serial Table (Figure 111)

Model	Serial Range
07511AA, 07511BA, and 07511DA	400000000 through 409999999
07511CA	400000000 through 409999999

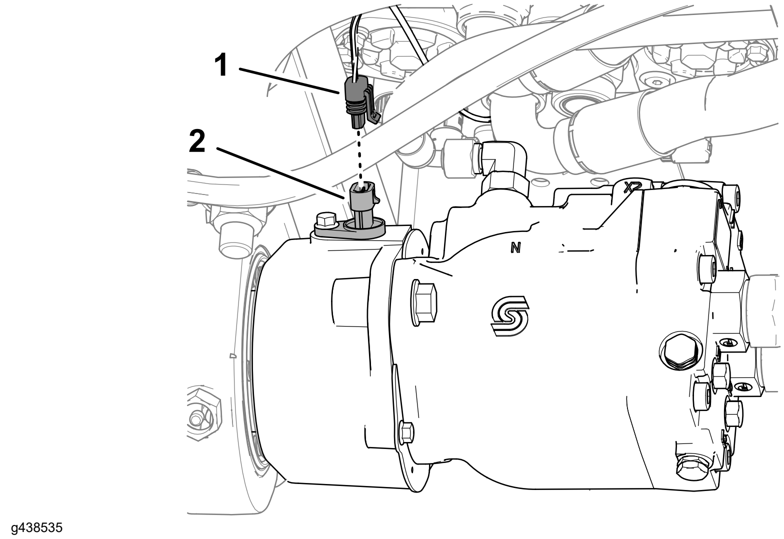


Figure 104

1. Main harness connector P25 (FRONT SPEED)
2. Axle speed sensor

Model/Serial Table (Figure 105)

Model	Serial Range
07511AA, 07511BA, 07511CA, and 07511DA with Gearbox Reduction Kit 144-9700	400000000 through 409999999
07511AA, 07511BA, 07511CA, and 07511DA	410000000 and Higher

Removing the Front Steering Cylinder (continued)

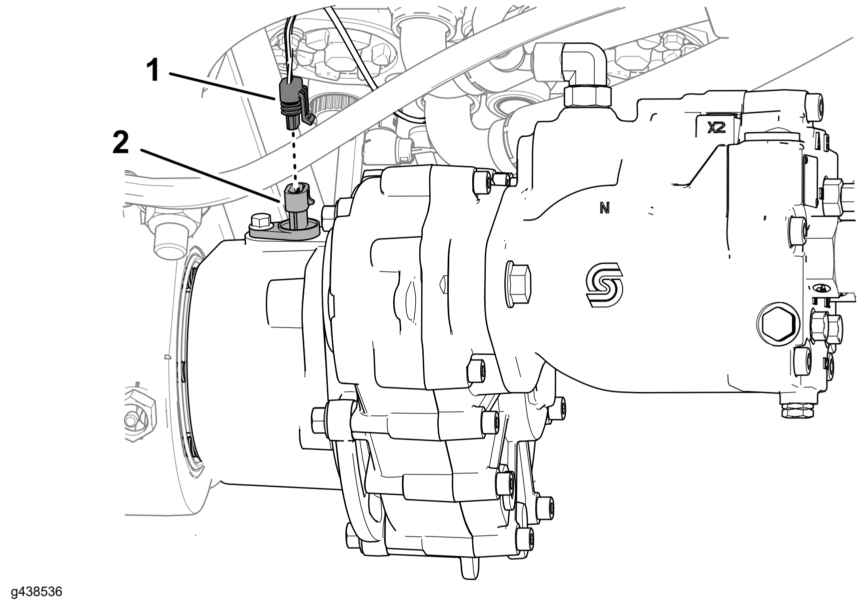


Figure 105

1. Main harness connector P25 (FRONT SPEED)
2. Axle speed sensor

7. Support the center of the front axle with a trolley jack.
8. Remove the 4 flange locknuts securing the front axle to the frame.

   Note: The axle mounting bolts are held in position (captured) to the machine frame.

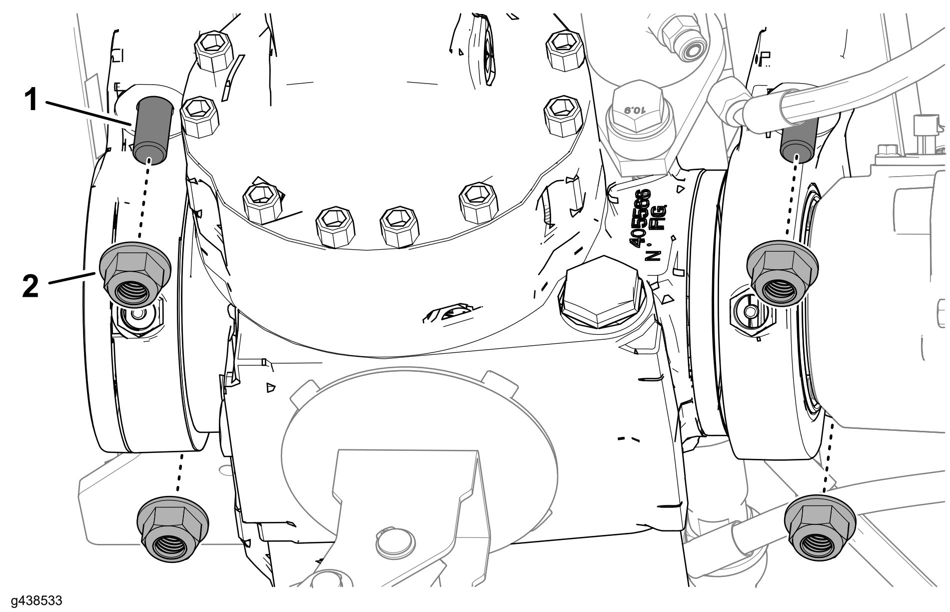


Figure 106

1. Axle mounting bolts
2. Flange locknuts

9. Carefully lower the axle until you have clearance to remove the steering cylinder.
10. Support the axle and front axle drive motor with jack stands.

Removing the Front Steering Cylinder (continued)

11. Remove the 4 capscrews, plain washers, spacers that secure the mounting flange of the steering cylinder to the axle, and remove the cylinder from the machine.

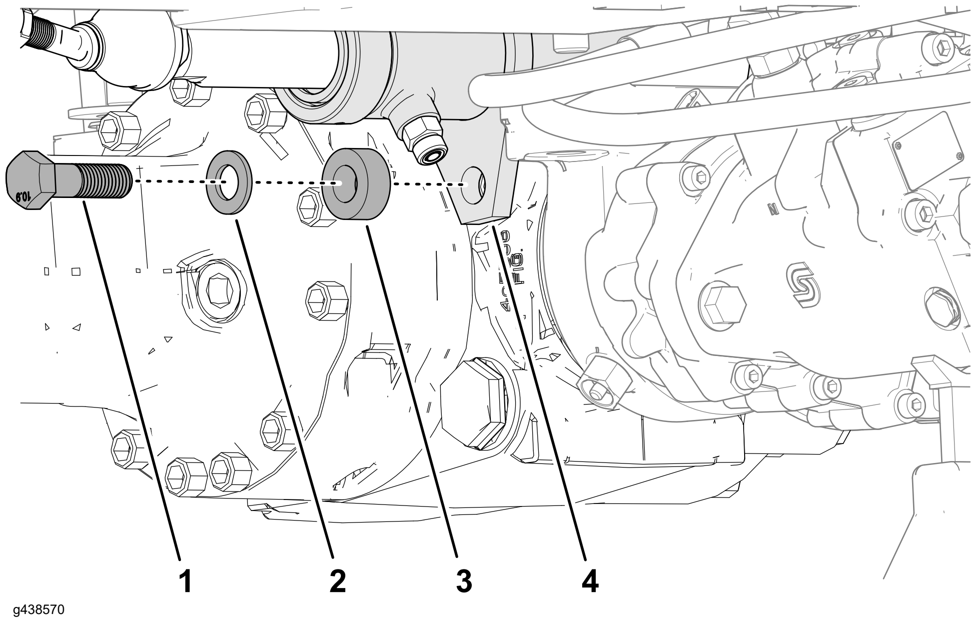


Figure 107

1. Capscrew
2. Plain washer
3. Spacer
4. Steering cylinder mounting flange

Installing the Front Steering Cylinder

1. If removed, install the tie rod assemblies to the steering cylinder; refer to Installing the Tie Rods (page 7–5).

   Assemble the steering cylinder to the axle with 4 capscrews, plain washers, and spacers. Tighten the capscrews to **359 to 386 N·m (265 to 285 ft-lb)**.

Installing the Front Steering Cylinder (continued)

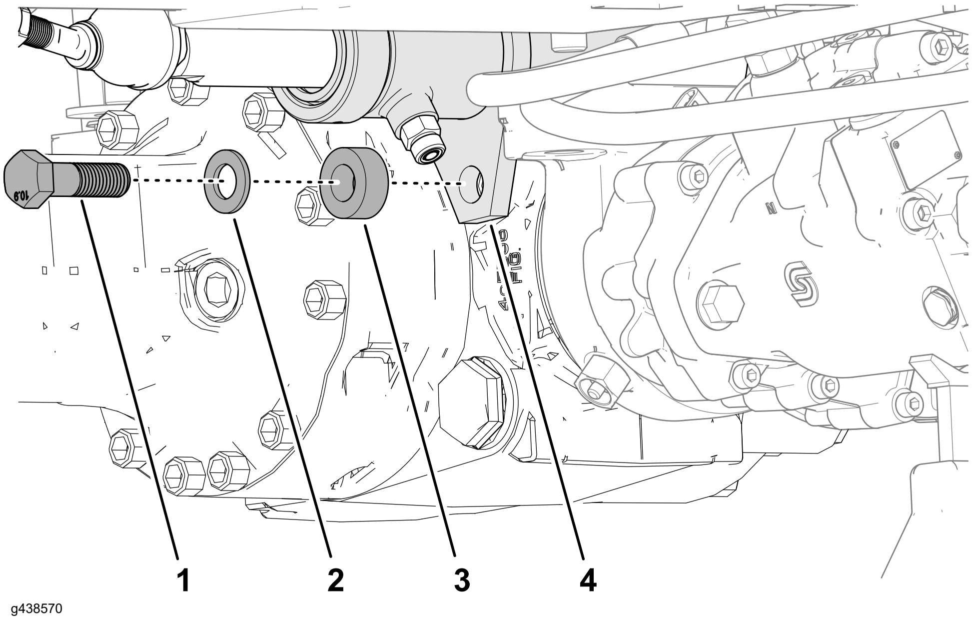


Figure 108

1. Capscrew
2. Plain washer
3. Spacer
4. Steering cylinder mounting flange

2. Raise the axle to machine and align the tie rod assemblies through openings in the frame. Secure the axle to machine with 4 flange locknuts.

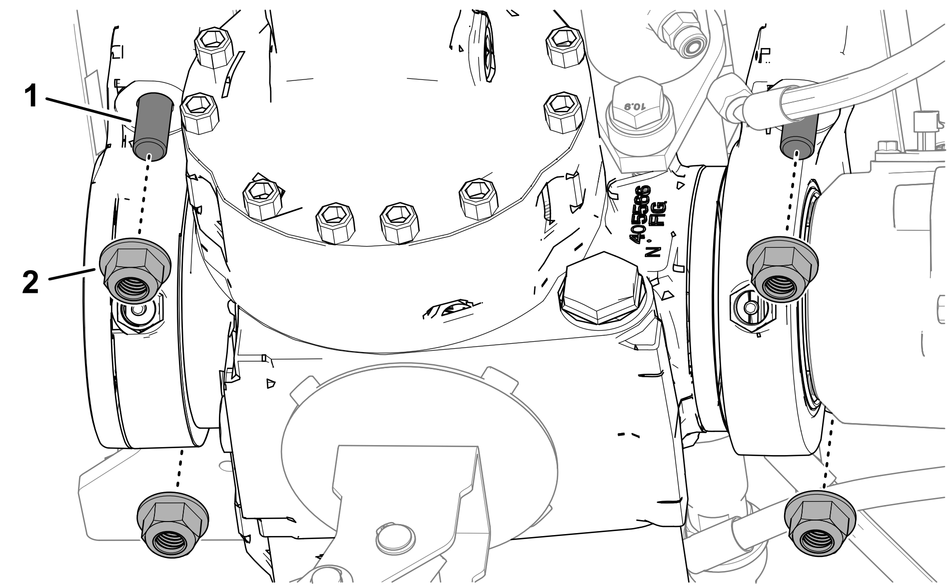


Figure 109

1. Axle mounting bolts
2. Flange locknuts

3. Install the left and right tie rods to the axle with the slotted nuts. Torque the slotted nuts to **129 to 150 N·m (95 to 110 ft-lb)**, and secure the nuts to the ties with new cotter pins.

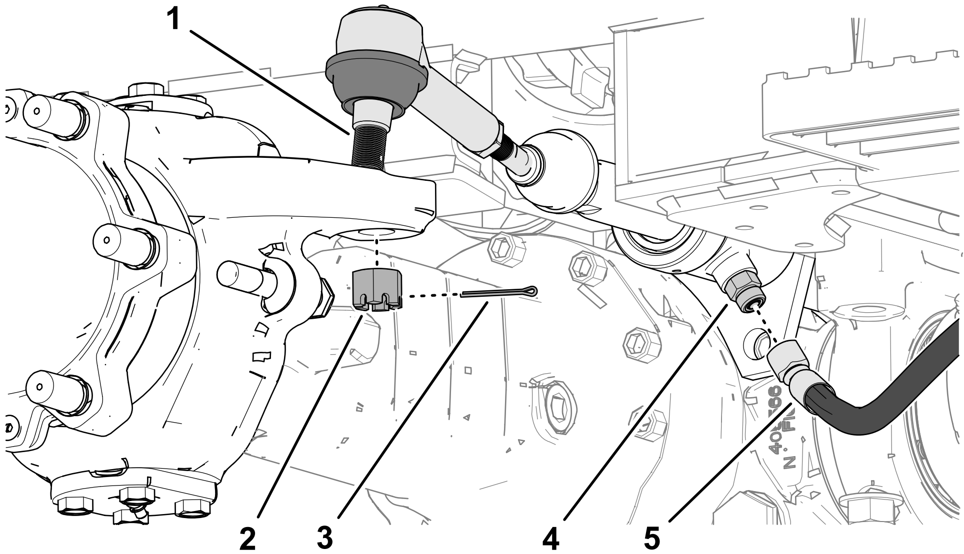


Figure 110

1. Tie- rod
2. Slotted nut
3. Cotter pin
4. Steering-cylinder fitting
5. Steering hose

4. Connect the left and right steering hoses to the steering-cylinder fittings.
5. Plug main harness connector P25 (labeled FRONT SPEED) into the axle speed sensor in the hydraulic-motor mount.

Model/Serial Table (Figure 111)

Model	Serial Range
07511AA, 07511BA, and 07511DA	400000000 through 409999999
07511CA	400000000 through 409999999

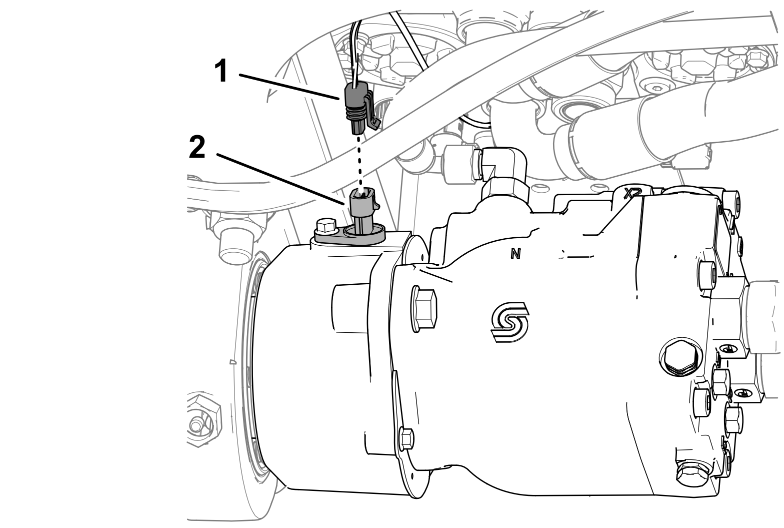


Figure 111

1. Main harness connector P25 (FRONT SPEED)
2. Axle speed sensor

Installing the Front Steering Cylinder (continued)

Model/Serial Table (Figure 112)

Model	Serial Range
07511AA, 07511BA, 07511CA, and 07511DA with Gearbox Reduction Kit 144-9700	400000000 through 409999999
07511AA, 07511BA, 07511CA, and 07511DA	410000000 and Higher

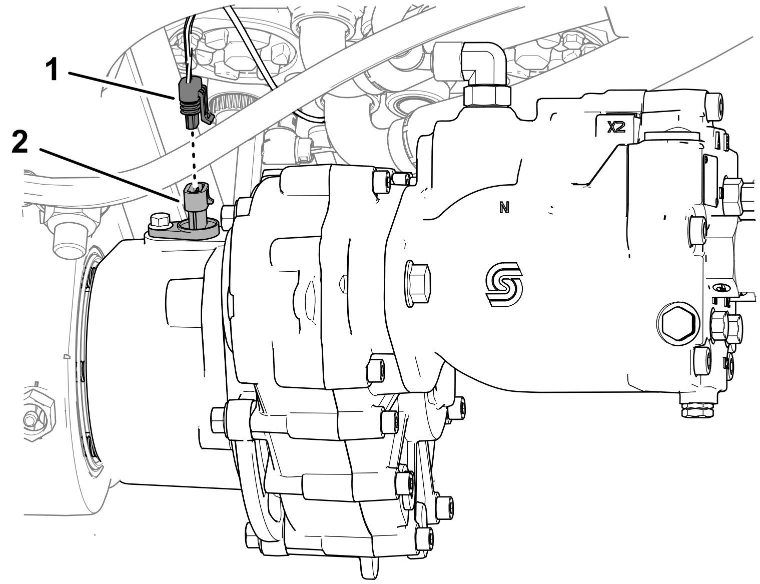


Figure 112

1. Main harness connector P25 (FRONT SPEED)
2. Axle speed sensor

6. Check and adjust all 4 axle stop bolts as necessary; refer to Adjusting Axle Stop Bolts (page 7–3).
7. Check the oil level in each wheel hub and the front axle, and adjust the oil level as necessary; refer to the traction unit *Operator's Manual*.
8. Grease the front axle with Mobil high-temperature XHP-222 grease or equivalent; refer to the traction unit *Operator's Manual*.
9. Apply anti-seize lubricant to the inner edge of the wheel and install the wheel. Tighten the lug nuts in a crossing pattern from **380 to 434 N·m (280 to 320 ft-lb)**.
10. Check and adjust front tire air pressure as necessary.

Removing the Rear Steering Cylinder

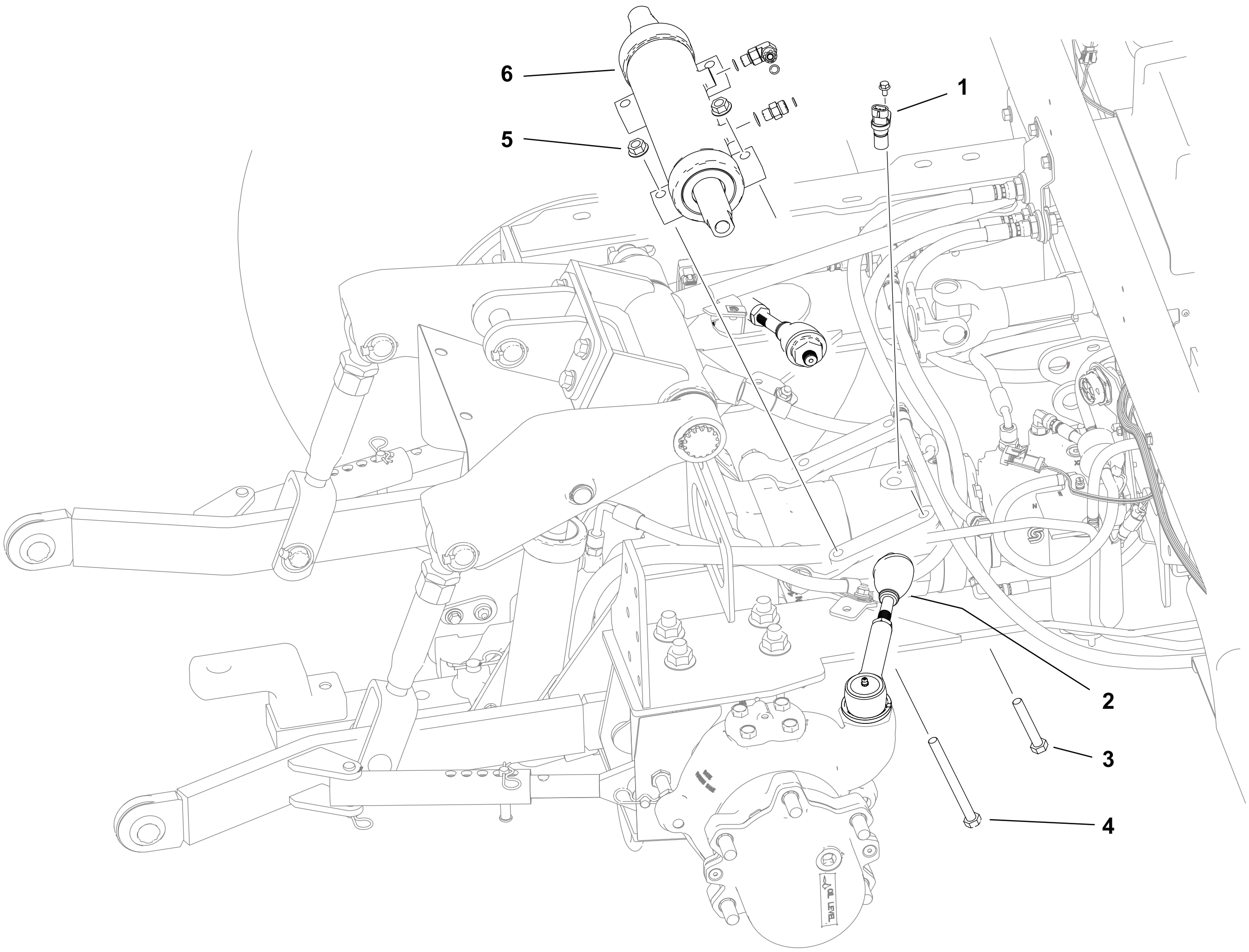


Figure 113

1. Rear speed sensor
2. Tie rod (2 each)
3. Capscrew (2 each)
4. Capscrew (2 each)
5. Flange nut (4 each)
6. Rear steering cylinder

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–65) prior to removing hydraulic system components.

1. Remove the bed; refer to Standard Utility Box (page 8–35).
2. Disconnect the rear speed sensor from the frame wire harness and remove the rear speed sensor. Cover the speed sensor face and plug or cover the sensor hole in the axle drive motor mount.
3. Remove the rear PTO gearbox; refer to Removing the rear PTO Gearbox (page 7–30).
4. Raise the rear of the machine; refer to Jacking Instructions (page 1–8).
5. Disconnect the tie rods from the rear steering cylinder.
6. Clean the fitting and hydraulic line connections before disconnecting the hydraulic lines to prevent system contamination.
7. Disconnect the hydraulic hoses. Cap the fittings and plug the hoses to prevent system contamination.
8. Remove the fasteners securing the cylinder to the cylinder supports and remove the cylinder from the machine.

Removing the Rear Steering Cylinder (continued)

9. If hydraulic fittings will be removed, mark fitting orientation for proper assembly. Discard fitting O-rings.

Installing the Rear Steering Cylinder

1. Lubricate new O-rings and place them onto the fittings. If previously removed, install the fittings into the cylinder ports using alignment marks made during removal; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–11).
2. Install the steering cylinder to the machine and secure with 4 capscrews and flange nuts.
3. Remove the caps and plugs from the fittings and hoses and connect the hydraulic lines to the cylinder; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–9).
4. Install the tie rods to the rear steering cylinder; refer to Installing the Tie Rods (page 7–5).
5. Lower the machine to the ground.
6. Operate the steering cylinder. Check for hydraulic leaks and correct if necessary.
7. Install the rear PTO gearbox; refer to Installing the Rear PTO Gearbox (page 7–31).
8. Install the rear speed sensor and connect the wire harness to the sensor.
9. Install the bed; refer to Standard Utility Box (page 8–35).
10. Check the hydraulic fluid level, and adjust it if necessary before returning the machine to service.

Steering Cylinder Service

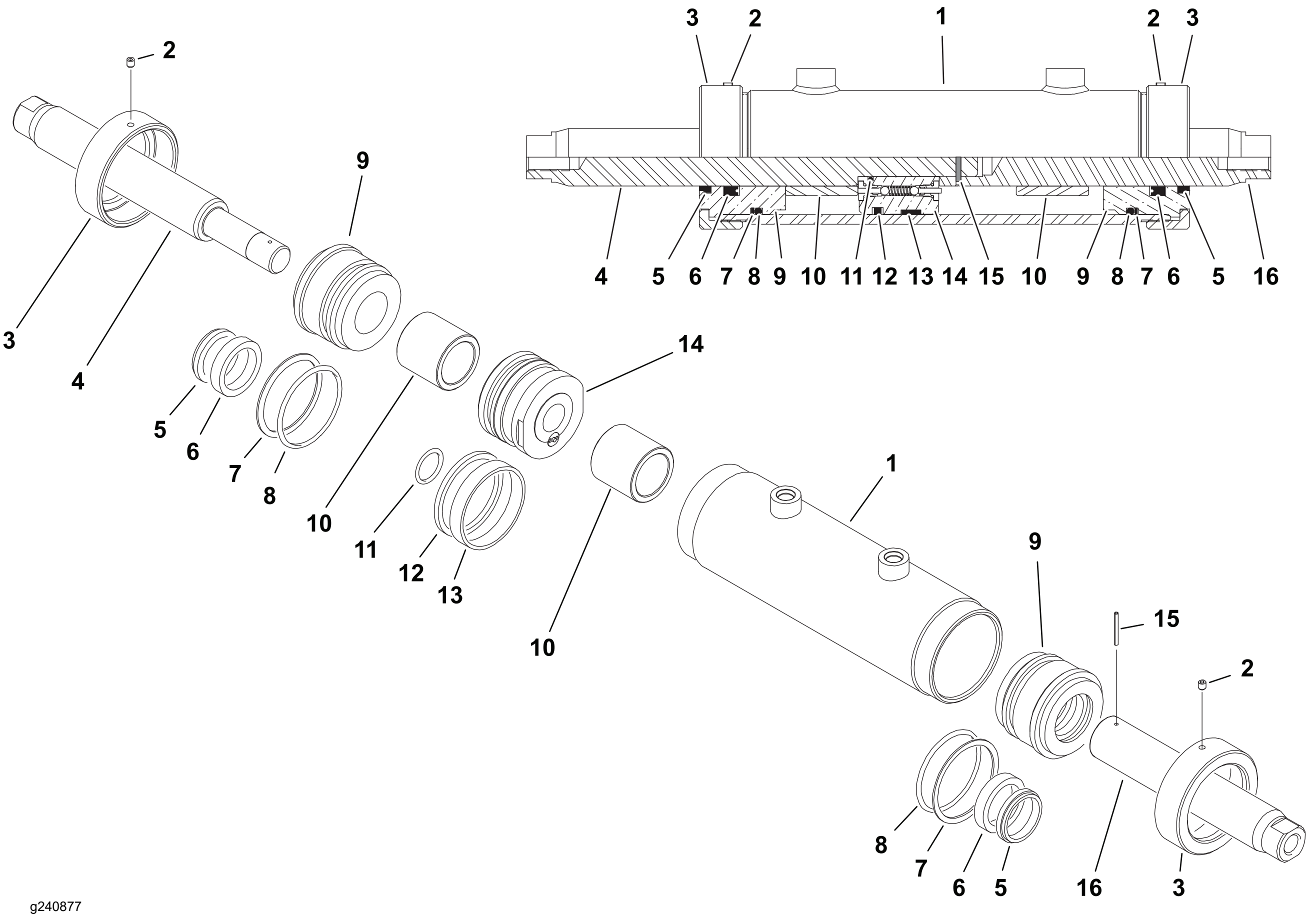


Figure 114

1. Barrel
2. Set screw (2 each)
3. External collar (2 each)
4. Rod (male)
5. Dust seal (2 each)
6. Head seal (2 each)
7. Back-up ring (2 each)
8. O-ring (2 each)
9. Head (2 each)
10. Spacer (2 each)
11. O-ring
12. Piston seal
13. Wear ring
14. Piston assembly
15. Roll pin
16. Rod (female)

The front and rear cylinder bores, strokes and mounting brackets are different, but the cylinder design is the same. Use the same service procedure for either cylinder. The following service procedure assumes both tie rod assemblies have been previously removed from the cylinder assembly.

Disassembling the Steering Cylinder

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

IMPORTANT

When you clamp the steering cylinder in a vise, clamp against the mounting brackets only to prevent damage. Do not clamp the vise onto the barrel or rod.

Disassembling the Steering Cylinder (continued)

2. Mount the steering cylinder securely in a vise by clamping on the mounting brackets.
3. Remove the collar set screws, and use a strap, chain, or spanner wrench to remove the collars from each end of the barrel.
4. Use a twisting motion to carefully pull the rod, piston, and head assemblies from the barrel.
5. Carefully push the remaining head assembly from the barrel.
6. Remove and discard the roll pin that secures the rods together. Separate (unscrew) the rods and remove the spacers and the piston assembly.
7. Remove and discard the seals, O-rings, and wear rings from the piston and heads.

Inspecting the Steering Cylinder

CAUTION

Use eye protection such as goggles when using compressed air.

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

Assembling the Steering Cylinder

IMPORTANT

Avoid pinching, cutting, or otherwise damaging the O-rings, seals, and the wear ring during assembly. Lubricate the O-rings, seals, and the wear ring with clean hydraulic fluid prior to assembly.

1. Use a new seal kit and replace all the seals, O-rings, and the wear ring on the piston and heads.
2. Carefully fit the piston assembly over the male rod.
3. Thread the rods together until the roll pin holes in the rods align and install the roll pin.

IMPORTANT

When you clamp the steering cylinder in a vise, clamp against the mounting brackets only to prevent damage. Do not clamp the vise onto the barrel or rod.

Assembling the Steering Cylinder (continued)

4. Mount the steering cylinder barrel in a vise by clamping on the cylinder mounting brackets.
5. Coat the inner bore of the cylinder with clean hydraulic fluid and fit the piston and rod assembly into the cylinder barrel.
6. Install the 2 spacers and the 2 head assemblies.
7. Secure the heads in the barrel with the external collars. Tighten the external collars with a strap, chain, or spanner wrench.
8. Install and tighten the set screws in the external collars.

3-Point Hitch Cylinders

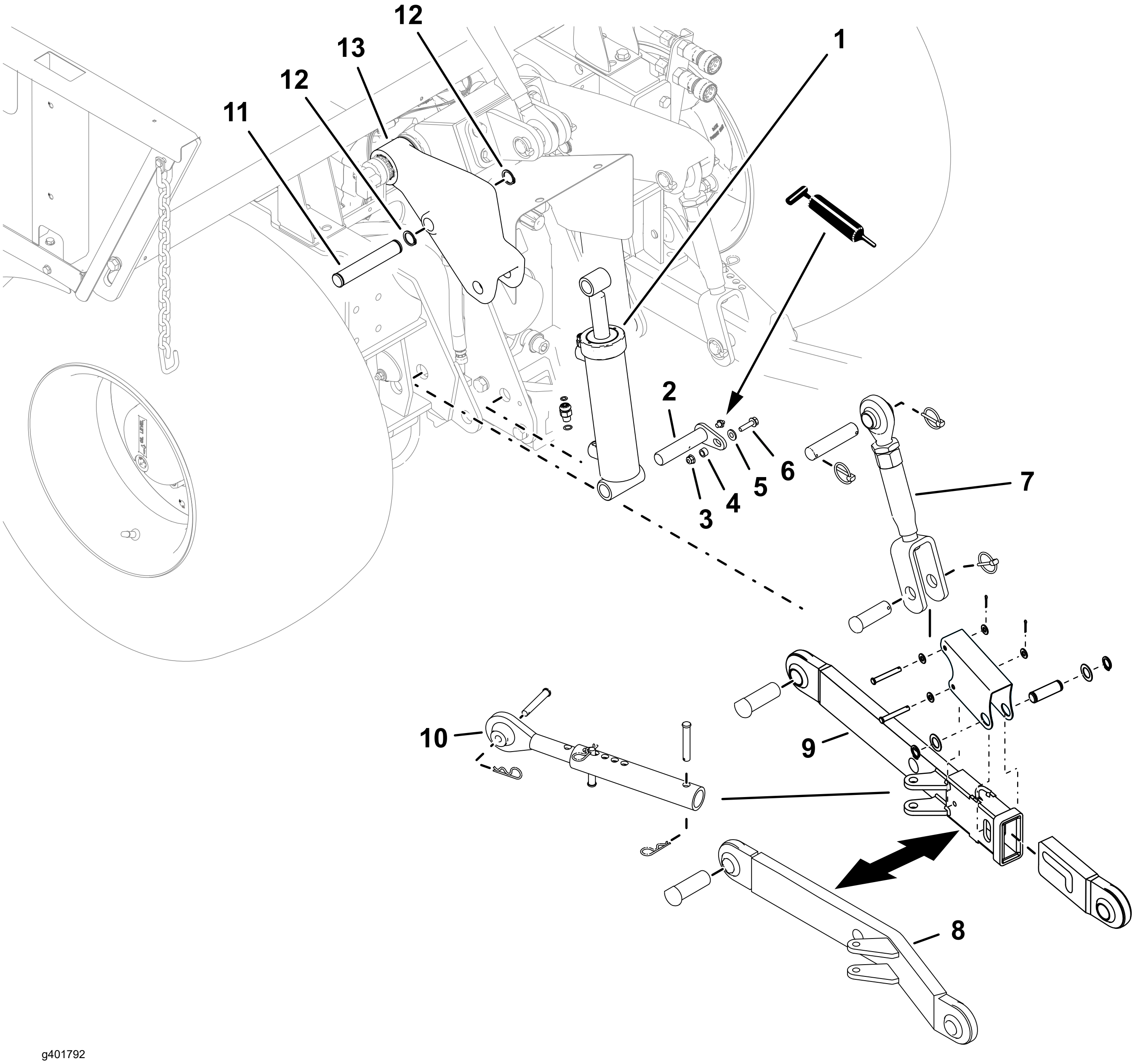


Figure 115

1. 3-point hitch cylinder
2. Lower pin
3. Flange nut
4. Spacer
5. Flat washer
6. Capscrew
7. Lift link assembly
8. Standard arm assembly
9. Extendable arm assembly
10. Stabilizer assembly
11. Upper pin
12. Retaining ring (2 each)
13. Lift arm

Removing the 3-Point Hitch Cylinder

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–65) prior to removing hydraulic system components.

1. Remove any attachments from the 3-point hitch.
2. Remove the stabilizer assembly, lift link assembly, and standard arm assembly.

Removing the 3-Point Hitch Cylinder (continued)

3. Clean the fitting and hydraulic line connections before disconnecting the hydraulic lines to prevent system contamination.
4. Remove the upper pin securing the hitch cylinder to the lift arm.
5. Tilt the hitch cylinder rearward and disconnect the hydraulic hoses. Cap the fittings and plug the hoses to prevent contamination from entering the system.
6. Remove the lower pin securing the hitch cylinder to the frame and remove the cylinder from the machine.

Installing the 3-Point Hitch Cylinder

1. Lubricate new O-rings and place them onto the fittings. If previously removed, install the fittings into the cylinder ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–11).
2. Apply general purpose grease to the lower cylinder clevis. Position the hitch cylinder to the machine frame and install the lower pin.
3. Remove the caps and plugs from the fittings and hoses and connect the hydraulic lines to the cylinder; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–9).
4. Install the upper pin securing the cylinder to the lift arm.
5. Install the standard arm assembly, lift link assembly, and stabilizer assembly.
6. Grease the lower cylinder pin fitting with Mobil high-temperature XHP-222 or equivalent.
7. Operate the 3-point hitch. Check for hydraulic leaks and correct if necessary.
8. Check the hydraulic fluid level, and adjust it if necessary before returning the machine to service.

3-Point Hitch Cylinder Service

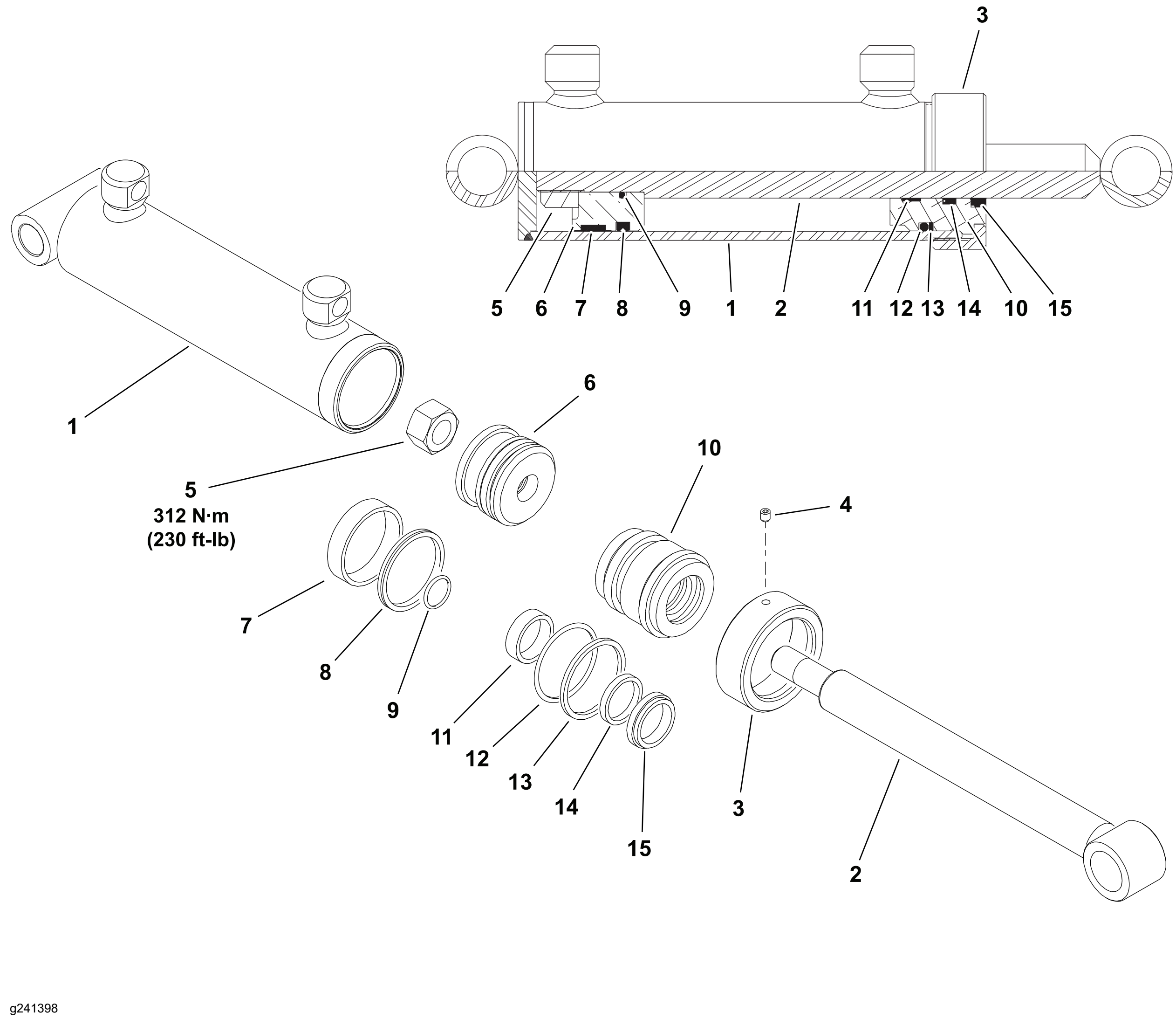


Figure 116

1.	Barrel	7.	Wear ring*	13.	Backup washer*
2.	Rod	8.	Piston seal*	14.	Shaft seal*
3.	External collar	9.	O-ring*	15.	Dust seal*
4.	Set screw	10.	Head	16.	Set screw
5.	Lock nut	11.	Wear ring*		
6.	Piston	12.	O-ring*		

*Seal Repair Kit

Disassembling the Hitch Cylinder

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

IMPORTANT

When you clamp the cylinder in a vise, clamp against the cylinder clevis only to prevent damage. Do not clamp the vise onto the barrel.

Disassembling the Hitch Cylinder (continued)

2. Mount the cylinder in a vise by clamping on the cylinder clevis.
3. Remove the set screw then use a strap, chain, or spanner wrench to loosen and remove the external collar.
4. Extract the shaft with head and piston by carefully twisting and pulling on the shaft.

IMPORTANT

When you clamp the shaft in a vise, clamp against the shaft clevis only to prevent damage. Do not clamp the vise onto the shaft.

5. Mount shaft securely in a vise and remove lock nut from the shaft. Slide the piston, head, and external collar 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.

Inspecting the Hitch Cylinder

CAUTION

Use eye protection such as goggles when using compressed air.

1. Wash all the cylinder components in clean solvent and dry them with compressed air.
2. Inspect the internal surface of the barrel for deep scratches, out-of-roundness, and bending.
3. Inspect the head, shaft, and piston for excessive pitting, scoring, and wear.
4. Replace the cylinder if the internal components are worn or damaged.

Assembling the Hitch Cylinder

IMPORTANT

Avoid pinching, cutting, or otherwise damaging the O-rings, seals, and the wear ring during assembly. Lubricate the O-rings, seals, and the wear ring with clean hydraulic fluid prior to assembly.

1. Use a new seal kit and replace all the seals, O-rings, and the wear ring on the piston and head.

IMPORTANT

When you clamp the shaft in a vise, clamp against the shaft clevis only to prevent damage. Do not clamp the vise onto the shaft.

2. Mount shaft securely in a vise and slide the external collar, head, and piston onto the shaft.

Assembling the Hitch Cylinder (continued)

3. Install the locknut and tighten to **312 N·m (230 ft-lb)**.
4. Slide cylinder barrel carefully over shaft assembly and install the external collar.

IMPORTANT

When you clamp the cylinder in a vise, clamp against the cylinder clevis only to prevent damage. Do not clamp the vise onto the barrel.

---

5. Mount the cylinder in a vise by clamping on the cylinder clevis.
6. Use a strap, chain, or spanner wrench to tighten the external collar. Install and tighten the set screw.

PTO Clutch

The hydraulically actuated PTO clutch assembly is incorporated into the front gearbox assembly. If the PTO clutch is worn or damaged, replace the front PTO gearbox; refer to Front PTO Gearbox (page 7–24).

Auxiliary Load Valve

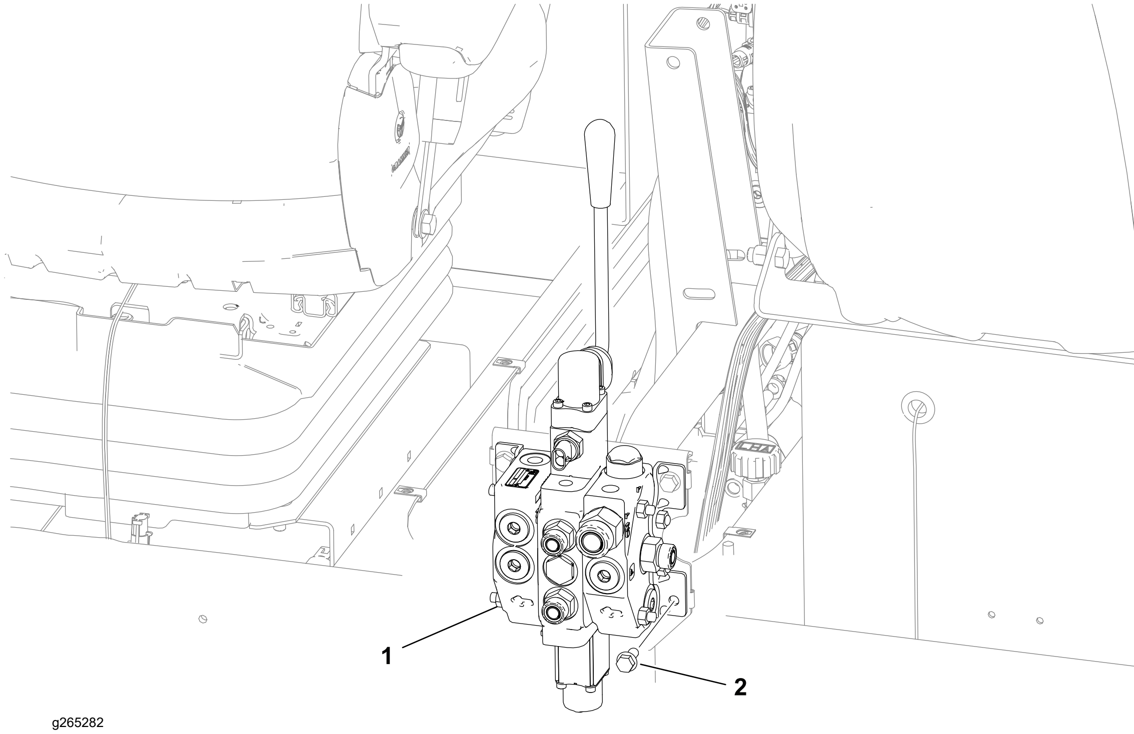


Figure 117

1. Auxiliary load valve assembly
2. Capscrew (4 each)

Removing the Auxiliary Load Valve

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–65) prior to removing hydraulic system components.

1. Remove the operator's console: refer to Removing and Installing the Operator's Console (page 8–30).
2. Disconnect the frame wire harness from the hydraulic (AUX) switch.
3. Clean the fitting and hydraulic line connections before disconnecting the hydraulic lines to prevent system contamination.
4. Disconnect the hydraulic lines at the valve assembly. Cap the fittings and plug the lines to prevent contamination from entering the system.
5. Remove the 4 capscrews securing the valve assembly to the machine and remove the valve assembly.
6. Remove and discard fitting O-rings.

Installing the Auxiliary Load Valve

1. Lubricate new O-rings and place them onto the fittings. If previously removed, install the fittings into the valve ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–11).
2. Secure the valve assembly to the machine with 4 capscrews.
3. Remove the caps and plugs from the fittings and hydraulic lines and connect the hydraulic lines to the valve; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–9).
4. Connect the frame wire harness to the hydraulic (AUX) switch.

Installing the Auxiliary Load Valve (continued)

5. Operate the auxiliary load valve. Check for hydraulic leaks and correct if necessary.
6. Install the operator's console; refer to Removing and Installing the Operator's Console (page 8–30).
7. Test the attachment/loader circuit relief valve pressure before returning the machine to service; refer to Attachment/Loader Circuit Testing – Relief Valve Pressure Test (page 5–60).
8. Check the hydraulic fluid level, and adjust it if necessary before returning the machine to service.

Auxiliary Load Valve Service

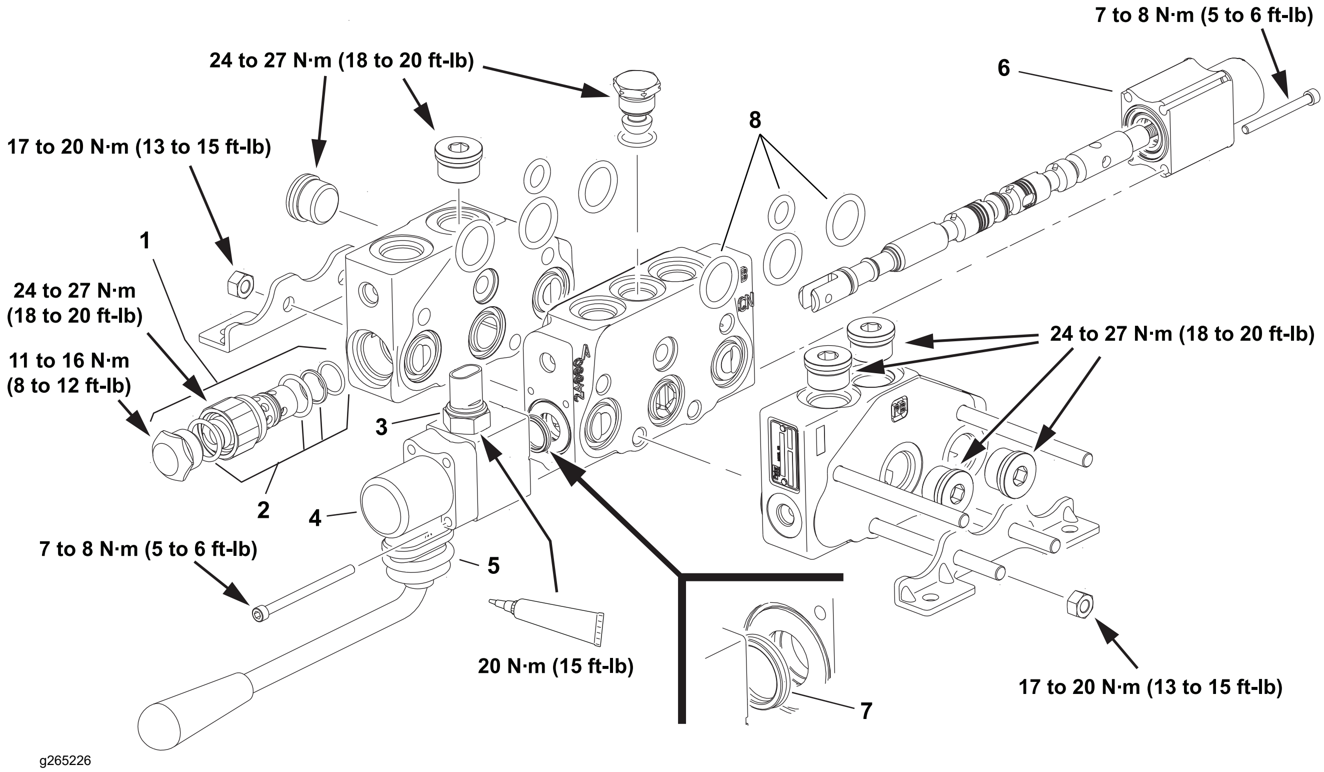


Figure 118

1. Relief valve assembly
2. Seal kit
3. Hydraulic (AUX) switch
4. Extended handle assembly
5. Dust boot
6. 5-position float spool positioner
7. Spool seal
8. Section seal kit (2 each)

Servicing the Auxiliary Load Valve

For complete service information; refer to the Gresen/Parker Hydraulics Model V10 Sectional Body Directional Control Valve Service Manual.

1. Disassemble the auxiliary load valve as necessary.
2. Clean and inspect the section housings.
3. Install new seals where available.

Front Loader Control Valve

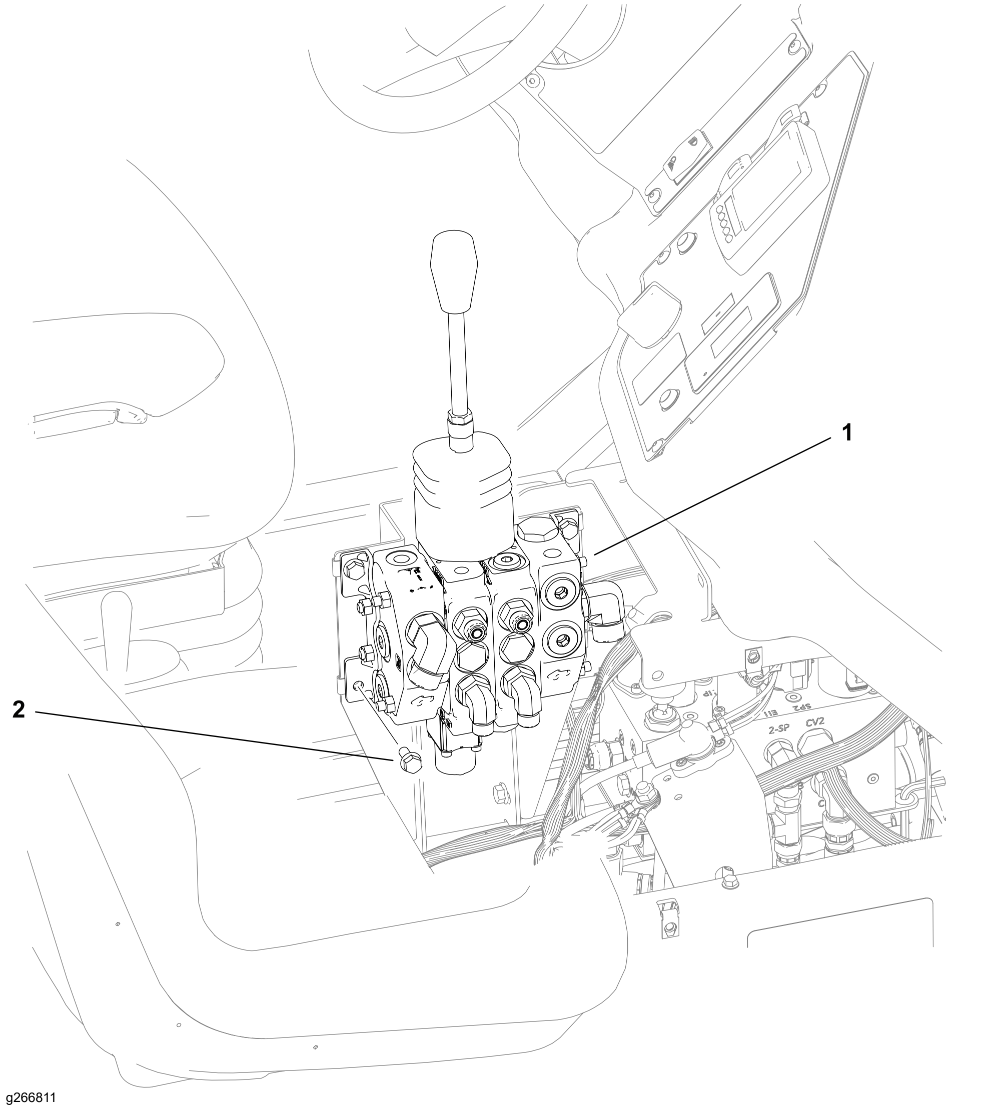


Figure 119

1. Front loader control valve
2. Capscrew (4 each)

Removing the Front Loader Control Valve

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–65) prior to removing hydraulic system components.

1. Remove the operator's console: refer to Removing and Installing the Operator's Console (page 8–30).
2. Clean the fitting and hydraulic line connections before disconnecting the hydraulic lines to prevent system contamination.
3. Disconnect the hydraulic lines at the valve assembly. Cap the fittings and plug the lines to prevent contamination from entering the system.
4. Remove the 4 capscrews securing the valve assembly to the machine and remove the valve assembly.
5. If hydraulic fittings will be removed, mark fitting orientation for proper assembly. Discard fitting O-rings.

Installing the Front Loader Control Valve

1. Lubricate new O-rings and place them onto the fittings. If previously removed, install the fittings into the valve ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–11).
2. Secure the valve assembly to the machine with 4 capscrews.
3. Remove the caps and plugs from the fittings and hydraulic lines and connect the hydraulic lines to the valve; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–9).
4. Operate the front loader control valve. Check for hydraulic leaks and correct if necessary.
5. Install the operator's console; refer to Removing and Installing the Operator's Console (page 8–30).
6. Check the hydraulic fluid level, and adjust it if necessary before returning the machine to service.

Front Loader Control Valve Service

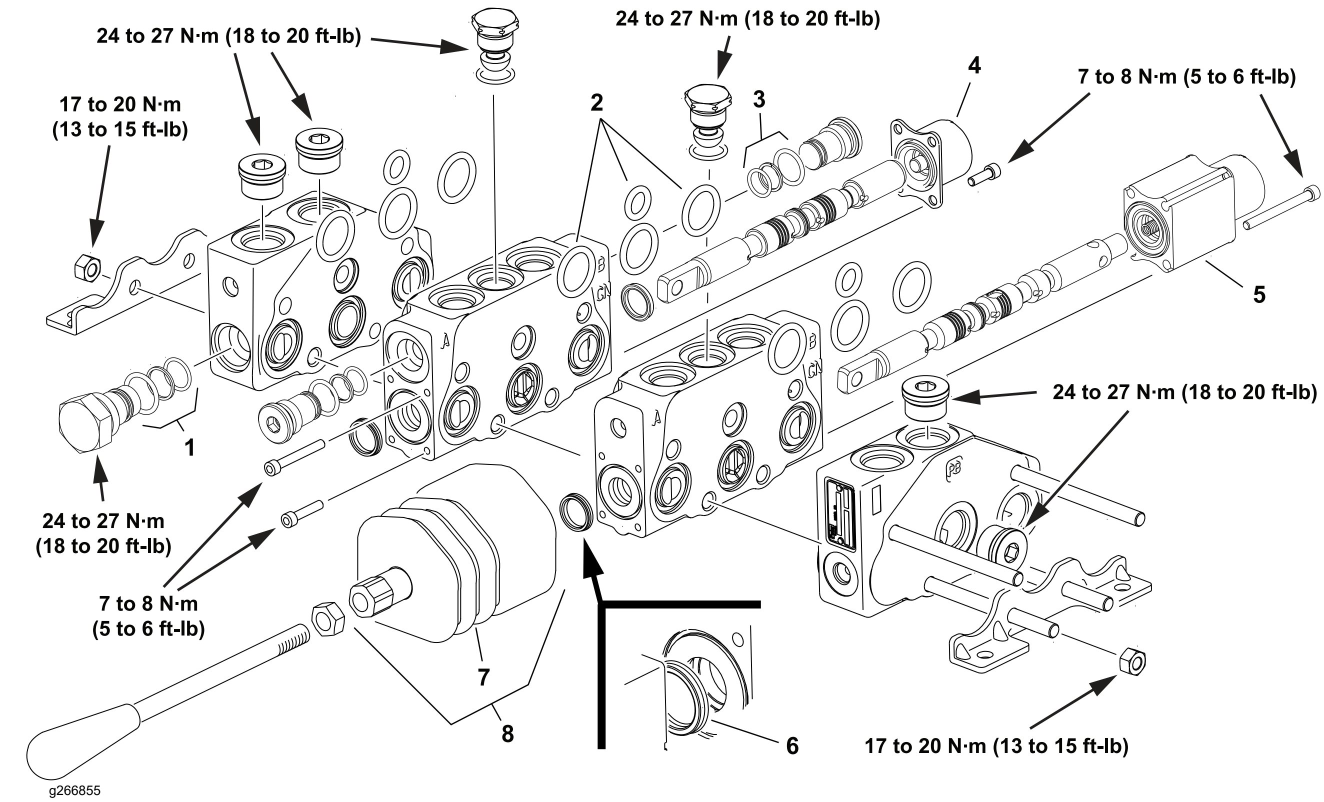


Figure 120

1. Relief plug seal kit
2. Section seal kit (3 each)
3. Work port cavity plug seal kit (2 each)
4. Spring return spool positioner
5. 4-position float spool positioner
6. Spool seal (3 each)
7. Dust boot
8. Joystick assembly

Servicing the Loader Control Valve

For complete service information; refer to the Gresen/Parker Hydraulics Model V10 Sectional Body Directional Control Valve Service Manual.

1. Disassemble the auxiliary load valve as necessary.
2. Clean and inspect the section housings.
3. Install new seals where available.

Selector Control Valve Manifolds (optional)

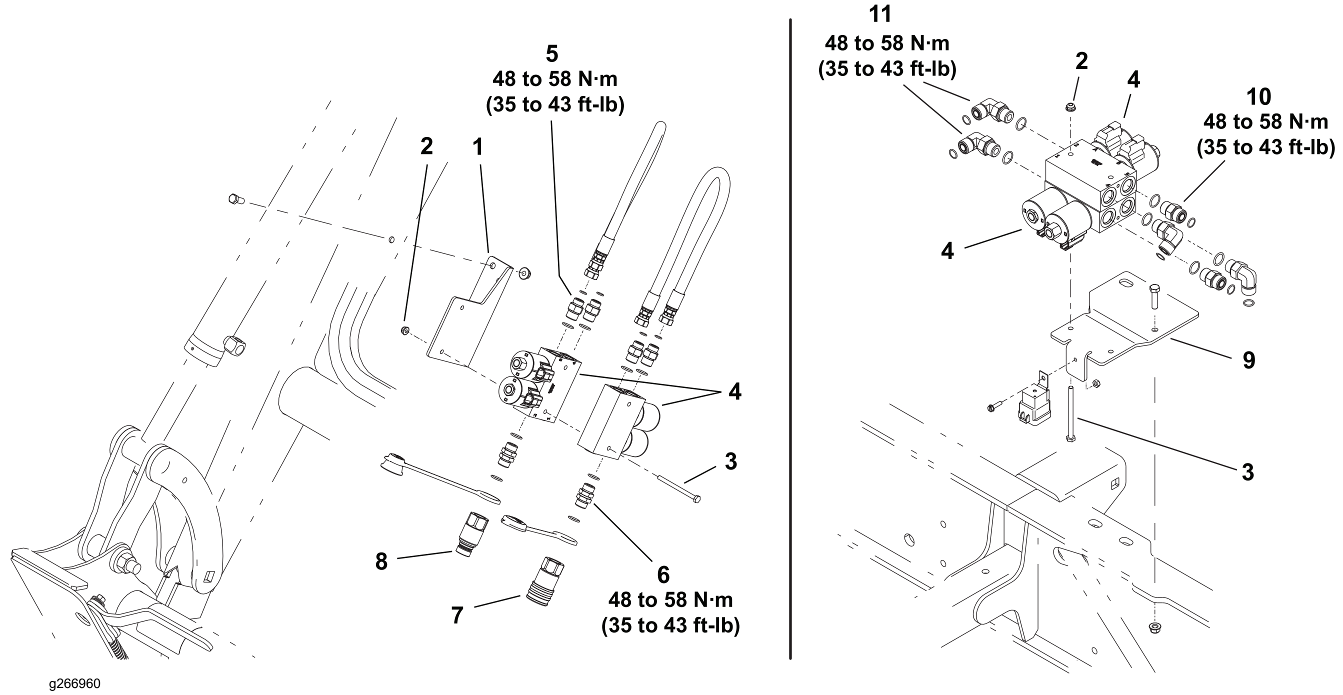


Figure 121

1. Loader kit manifold bracket
2. Flange nut (2 per kit)
3. Capscrew (2 per kit)
4. Selector control valve manifold (2 per kit)
5. Straight fitting (4 each)
6. Union fitting (2 each)
7. Quick disconnect fitting – female
8. Quick disconnect fitting – male
9. Rear kit manifold bracket
10. Straight fitting (2 each)
11. Elbow fitting (4 each)

Two different optional selector control valve kits are available. The loader selector control valve kit expands the loader or front hydraulic capability, and the rear selector control valve kit expands the rear or auxiliary hydraulic capability.

The ports on the manifolds are marked for easy identification of components and connections; refer to the hydraulic schematic in Appendix A (page A–1) to identify the function of the hydraulic lines and cartridge valves at each port.

Removing the Selector Control Valve Manifolds

Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–65) prior to removing hydraulic system components.

1. The loader selector control valve manifolds are located at the right-side loader arm. The rear selector control valve manifolds are located at the right-side frame rail behind the operator’s platform. Remove the bed to access the rear selector control valve manifolds; refer to Standard Utility Box (page 8–35).
2. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold and fittings.
3. Label and disconnect wire harness connectors from the solenoid valves.
4. Label and disconnect the hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings to prevent system contamination.
5. Remove the manifold from the machine.
6. If hydraulic fittings are to be removed from the manifold, mark the fitting orientation to allow for correct assembly. Remove the fittings from the manifold and discard the O−rings.

Installing the Selector Control Valve Manifolds

1. Lubricate new O-rings and place them onto the fittings. If previously removed, install the fittings into the valve ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–11).
2. Position the manifolds to the bracket and secure with 2 capscrews.
3. Remove the caps and plugs from the fittings and hoses. Properly connect the hydraulic lines to the manifold; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal) (page 5–9).
4. Connect the wire harness connectors to the cartridge valve solenoids.

Selector Control Valve Manifold (optional) Service

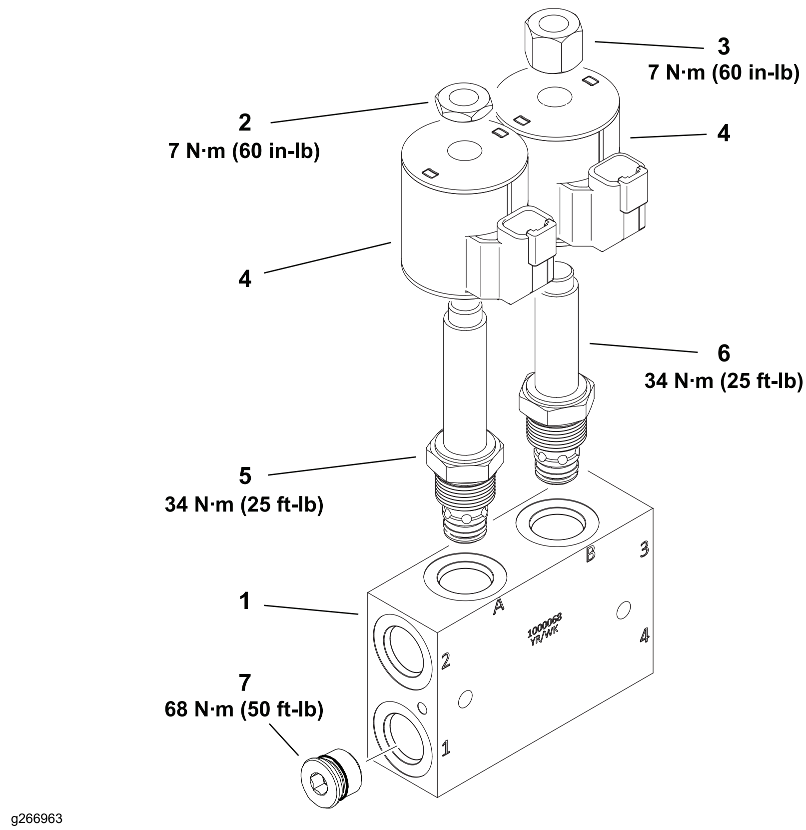


Figure 122

1. Manifold block
2. Coil nut
3. Coil nut
4. Solenoid coil (2 each)
5. Solenoid valve – normally closed
6. Solenoid valve – normally open
7. #8 zero-leak plug with O-ring

The ports on the selector control valve manifolds are marked for easy identification of components and connections; refer to the hydraulic schematic in Appendix A (page A–1) to identify the function of the hydraulic lines and cartridge valves at each port.

The selector control valve manifolds include a zero−leak plug. This plug has a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero−leak plug also has an O−ring as a secondary seal. If removing a zero−leak plug is necessary, lightly rap the plug head using a punch and hammer before using a hex wrench to remove the plug: the impact will allow plug removal with less chance of damage to the socket head of the plug. Tighten the plug to the torque value provided.

Note: For cartridge valve service procedures, refer to Cartridge Valve Service (page 5–109).

Electrical System

Table of Contents

General Information

IMPORTANT

Before performing any welding on the machine, turn the key switch to the OFF position. To prevent damage to the machine electrical system, disconnect the ground (-) cable to the frame when welding on the frame, or disconnect the ground (-) cable to the operator platform when welding on the operator platform.

Traction Unit Operator’s Manual and Accessory Installation Instructions

The traction unit *Operator’s Manual* and accessory *Installation Instructions* provide information regarding the operation, general maintenance and maintenance intervals for the machine and its accessories. Refer to the traction unit *Operator’s Manual* and accessory *Installation Instructions* for additional information.

Yanmar Engine Electrical Components

When servicing or troubleshooting the engine electrical components, use the correct engine service manual and troubleshooting manual. Yanmar engine service and troubleshooting manuals are available online.

InfoCenter Display

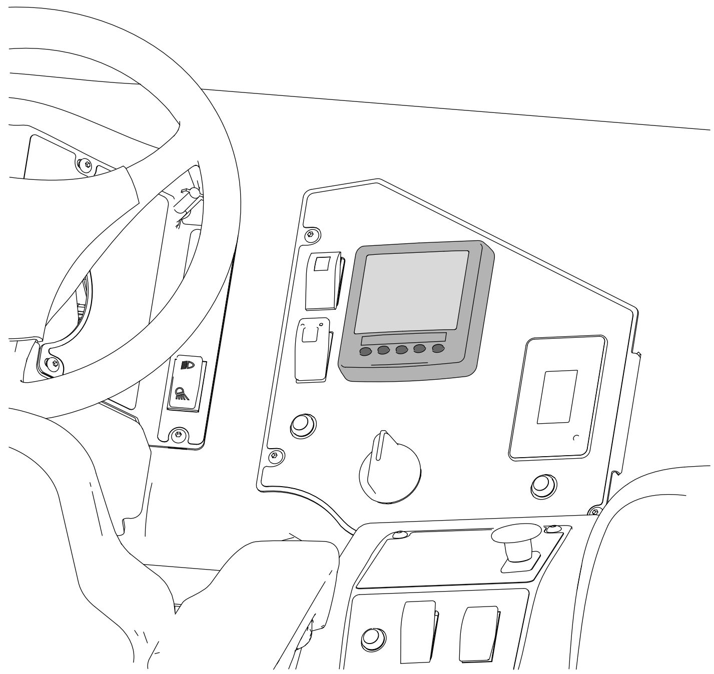


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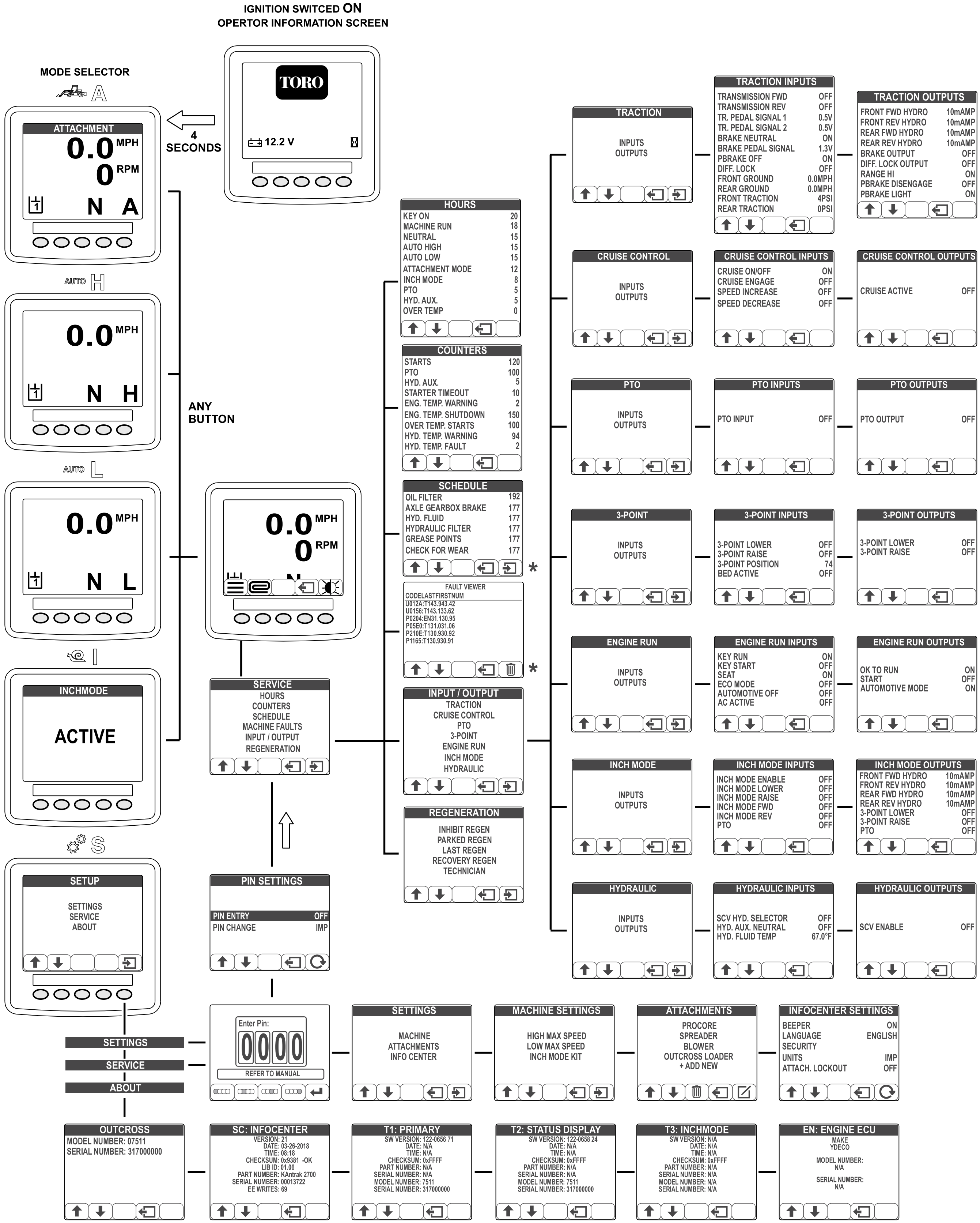
Figure 123

The InfoCenter display is a five button LCD device located on the main instrument panel. The InfoCenter provides information to the machine operator during machine operation, provides electrical system diagnostic assistance for technicians and allows access to adjustable machine and attachment settings. Power for the InfoCenter is available when the main power relay is energized (key switch is in the ON or START position). A 2 Amp fuse (F−B3) protects the InfoCenter power circuit.

The primary controller (T1: TEC), the status display controller (T2: TDM), the Yanmar Engine Control Unit (ECU), the InfoCenter display, and the optional InchMode controller (T3: TEC) used on the Outcross 9060 machine communicate with each other on a Controller Area Network (CAN) bus system.

Note: The InfoCenter display, TECs, TDM and the engine ECU used on the Outcross 9060 machine are matched for correct machine operation. If any of these components are replaced for any reason, system software needs to be reloaded (contact an Authorized Toro Distributor for assistance).

InfoCenter Display (continued)



***Item not visible until PIN has been entered** **Software Version 122-0656 H shown**

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Figure 124

InfoCenter Screens

Primary Controller (T1: TEC)

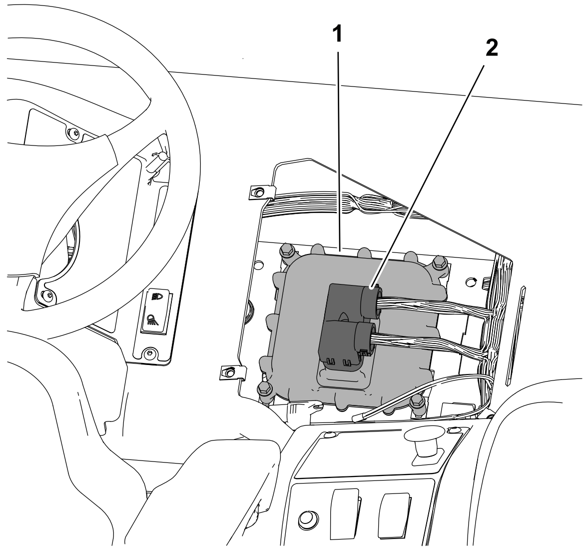

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Figure 125

Main instrument panel removed for clarity.

1. Primary controller (T1: TEC)
2. Platform harness connector

Outcross 9060 machines use a primary controller (T1: TEC) to manage machine electrical functions. The T1: TEC is a 5004 series 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. The T1: TEC works in conjunction with the T2: TDM to manage the engine start and run signals, the electric fuel pump, and the various hydraulic solenoid valves. The status of inputs to the controller as well as outputs from the controllers can be monitored with the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23).

The T1: TEC is attached to the machine under the main instrument panel. Power for the T1: TEC logic and memory is constantly available (unswitched). The logic and memory circuit are protected by a 2 Amp fuse (F−B2). Power for the T1: TEC outputs is available when the main power relay is energized (key switch is in the ON or START position). A series of four 7.5 Amp fuses (F−A1, B1, C1, and D1) protect the T1: TEC output circuits.

The primary controller (T1: TEC), the status display controller (T2: TDM), the Yanmar Engine Control Unit (ECU), the InfoCenter display, and the optional InchMode controller (T3: TEC) used on the Outcross 9060 machine communicate with each other on a Controller Area Network (CAN) bus system.

Note: The InfoCenter display, TECs, and the TDM used on the Outcross 9060 machine are matched for correct machine operation. If any of these components are replaced for any reason, system software needs to be reloaded (contact an Authorized Toro Distributor for assistance).

Status Display Controller (T2: TDM)

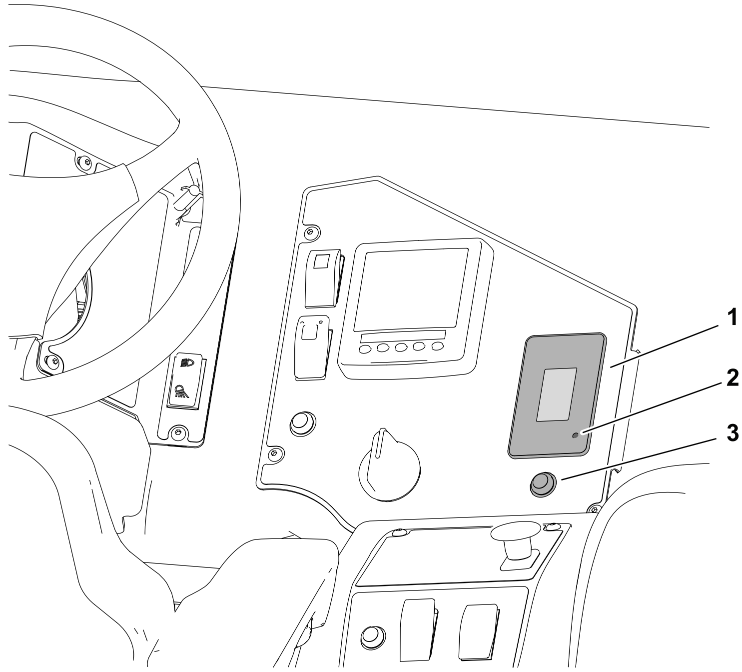

Figure 126

1. Status display module (T2: TDM)
2. LED fault active indicator
3. Status display screen select button

The status display module (T2: TDM) is an LCD device located on the main instrument panel that presents operating hours, fuel level, engine coolant temperature, hydraulic oil temperature, electrical system voltage, engine RPM, 3-point hitch position, and active faults. A single button located near the T2: TDM is used to select the various display screens. A red LED active fault indicator is also part of the T2: TDM. The fault indicator flashes when one or more active machine or engine faults exist. Power for the TDM is available when the main power relay is energized (key switch is in the ON or START position). A 2 Amp fuse (F–A4) protects the TDM power circuit.

Status Display Controller (T2: TDM) (continued)

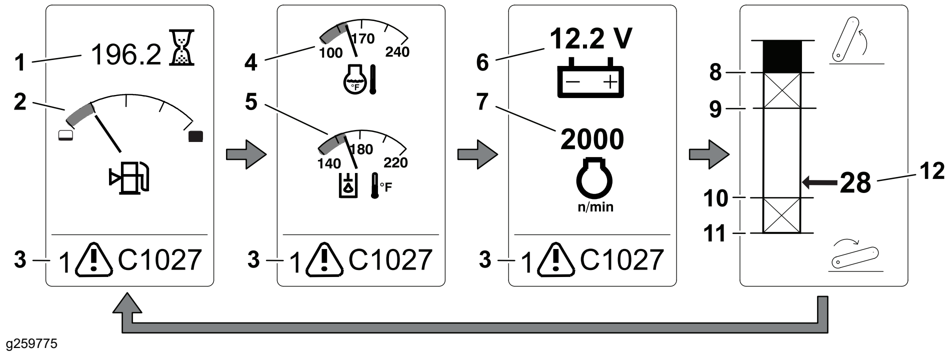

Figure 127
Status Display Screens

1. Engine hour meter
2. Fuel level
3. Active fault
4. Engine coolant temperature
5. Hydraulic fluid temperature
6. System voltage
7. Engine RPM
8. Hitch raise limit
9. Hitch maximum work height (PTO disengage)
10. Hitch minimum work height (PTO disengage)
11. Hitch lower limit
12. Current hitch position

The T2: TDM is also a 2002 series microcontroller that monitors the condition of various machine switches and sensors (inputs) and communicates the status of these inputs to the T1: TEC via the CAN. The status of inputs to the controller can be monitored with the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23).

The primary controller (T1: TEC), the status display controller (T2: TDM), the Yanmar Engine Control Unit (ECU), the InfoCenter display, and the optional InchMode controller (T3: TEC) used on the Outcross 9060 machine communicate with each other on a Controller Area Network (CAN) bus system.

Note: The InfoCenter display, TECs, and the TDM used on the Outcross 9060 machine are matched for correct machine operation. If any of these components are replaced for any reason, system software needs to be reloaded (contact an Authorized Toro Distributor for assistance).

Engine Electronic Control Unit (ECU)

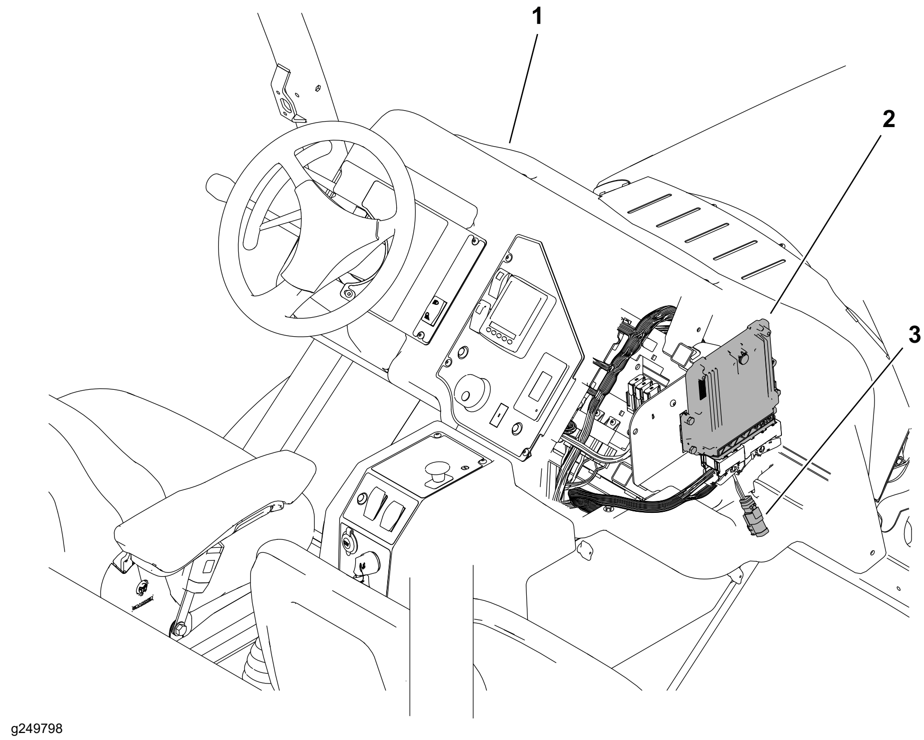

Figure 128

1. Dash cover
2. Engine ECU
3. Yanmar SA-D connector

The Yanmar engine that powers your Outcross 9060 machine uses an Electronic Control Unit (ECU) for engine management. The engine ECU is located under the right side of the dash cover. 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 primary controller (T1: TEC), the status display controller (T2: TDM), the Yanmar Engine Control Unit (ECU), the InfoCenter display, and the optional InchMode controller (T3: TEC) used on the Outcross 9060 machine communicate with each other on a Controller Area Network (CAN) bus system.

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 SmartAssist–Direct tool (SA-D) must be used to update the ECU program which will ensure correct engine operation. The Yanmar SA-D connector is located near the engine ECU, just under the dash cover. Contact your Toro distributor for assistance.

If the engine ECU identifies that an engine problem exists, the engine speed may be reduced, or the engine might stop. The *Yanmar Tier 4 and Stage V TNV Troubleshooting Manual* and the Yanmar SmartAssist–Direct tool (SA-D) should be used to assist when identifying the cause of the problem and the repairs that may be necessary.

IMPORTANT

Do not disconnect the engine ECU for 60 seconds after the machine key switch is turned off. The engine ECU may remain energized even though the key switch is in the OFF position.

InchMode Controller (T3: TEC) (optional)

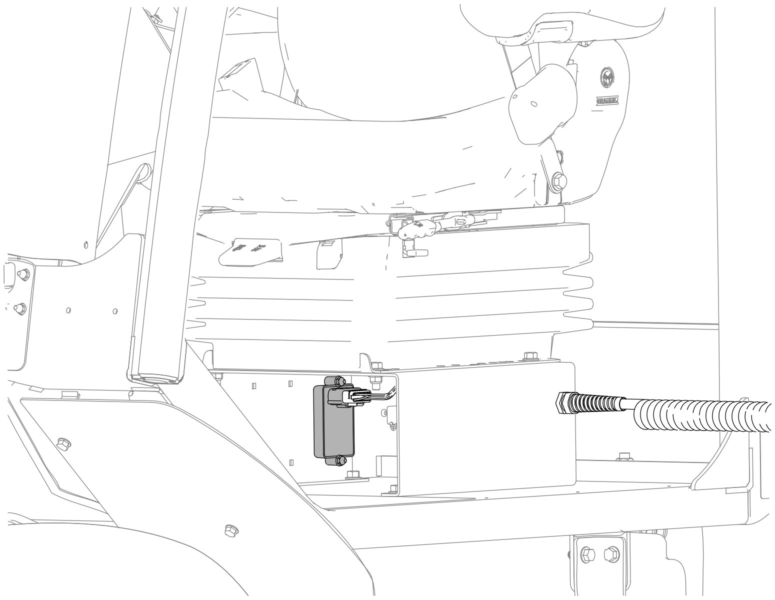

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Figure 129

The optional InchMode feature includes the InchMode controller (T3: TEC) to manage traction, hitch lift, and PTO functions while standing next to the machine. The T3: TEC is a 2002 series microcontroller that monitors the condition of various machine switches and sensors (inputs) and communicates the status of these inputs to the T1: TEC via the CAN. The status of inputs to the controller can be monitored with the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23).

The T3: TEC is attached to the operator seat base. Power for the T3: TEC is available when the main power relay is energized (key switch is in the ON or START position). A 10 Amp fuse (F–C5) protects the T3: TEC power circuit.

The primary controller (T1: TEC), the status display controller (T2: TDM), the Yanmar Engine Control Unit (ECU), the InfoCenter display, and the optional InchMode controller (T3: TEC) used on the Outcross 9060 machine communicate with each other on a Controller Area Network (CAN) bus system.

Note: The InfoCenter display, TECs, and the TDM used on the Outcross 9060 machine are matched for correct machine operation. If any of these components are replaced for any reason, system software needs to be reloaded (contact an Authorized Toro Distributor for assistance).

CAN bus Communications

The primary controller (T1: TEC), the status display controller (T2: TDM), the Yanmar Engine Control Unit (ECU), the InfoCenter display, and the optional InchMode controller (T3: TEC) used on the Outcross 9060 machine 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 machine 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 InfoCenter 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 specially designed, twisted wires form the CAN bus. These wires provide the data pathways between the components on the network. The engineering term for these cables are CAN High and CAN Low. The CAN bus wires are yellow (CAN-High) and green (CAN Low). At each end of the twisted pair of bus cables is a 120-ohm termination resistor; refer to CAN bus Terminator Resistors (page 6–73).

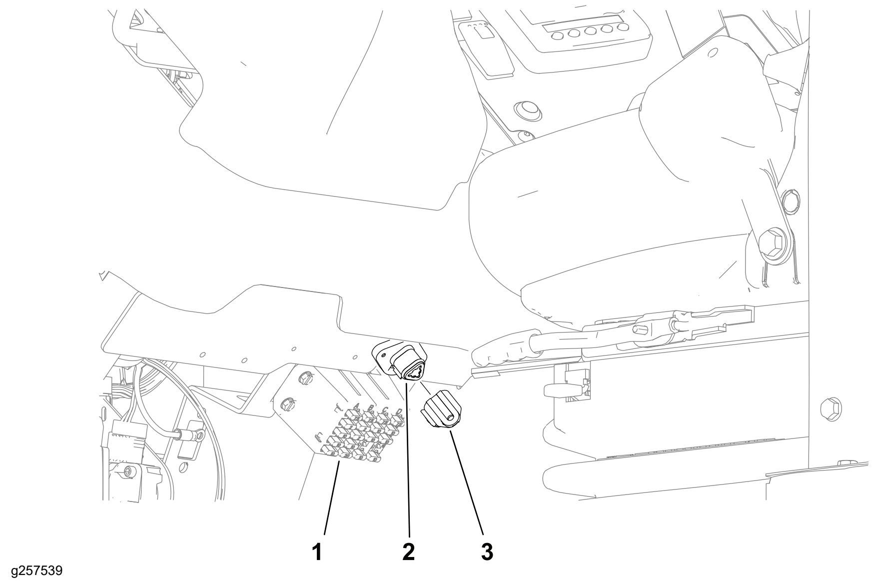


Figure 130

1. Main fuse block
2. Toro DIAG connector
3. Connector cover

The Toro DIAG electronic control diagnostics service system is available to Authorized Toro Distributors to support machine fault diagnosis and maintenance services of the machine electrical control devices. The Toro DIAG connector is located below the dash next to the main fuse block.

Electrical Drawings

The electrical schematic and wire harness drawings for the Outcross 9060 machine are in Appendix A (page A–1).

Electrical System Quick Checks

Testing the Charging System

The Outcross 9060 uses a single 12-volt maintenance-free battery mounted below the left side of the operator's platform. The battery is charged by an 80-amp. 12-volt alternator mounted to the engine, which is driven by a single row V-belt.

Use the T2: TDM display to monitor the 12-volt electrical system. It will tell you if the 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 ON position and set the T2: TDM display to view the voltmeter.
3. Record the initial system voltage.
4. Start the engine and warm the engine to normal operating temperature.
5. Set the engine RPM to 2300 RPM.
6. Turn on all additional system loads (e.g., lights, blower).
7. The system voltage should be at least 0.5 volt higher than the initial voltage recorded in step 3.
8. If the charging system performance is less than desired, refer to the Yanmar Service Manual or Troubleshooting Manual for additional information.

Checking the Operation of the 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 Outcross 9060 is equipped with a primary (T1: TEC) and a (T2: TDM) which monitor interlock switch operation. If all interlock switches necessary to allow a specific machine operation are not in their desired position, the machine alarm will sound and an Operator's Advisory may appear on the InfoCenter display; refer to Operator Advisories (page 3–3).

The machine interlocks include:

- Operator seat switch
- Parking brake switch
- Traction pedal
- Transmission lever switches
- Paddle (3-point hitch) switches
- Auxiliary hydraulic lever
- PTO switch
- InchMode switches (optional)

Use the InfoCenter display to test the various interlock switches (inputs) before physically testing the switch and its circuitry; refer to Using the InfoCenter display for Troubleshooting (page 3–23). Procedures for physically testing individual interlock switches is included in Electrical Component Testing (page 6–14).

Electrical Component Testing

Fuses

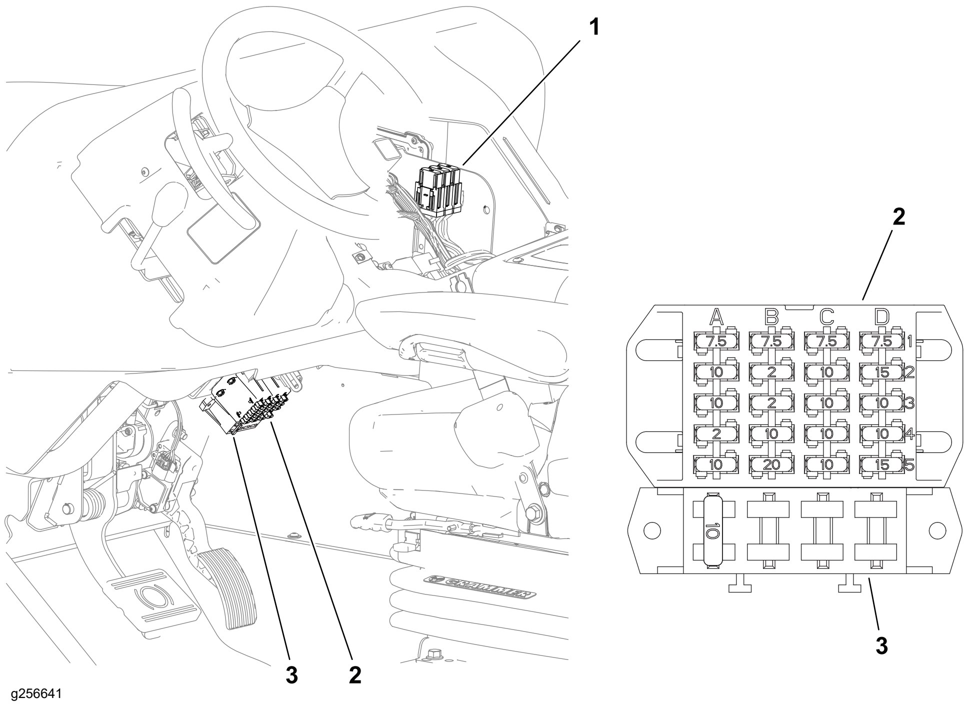


Figure 131

Main instrument panel removed for clarity.

1. 60 Amp Maxi fuse (3 each)
2. Main fuse block
3. Accessory fuse block

The main power supply, cab power supply, and rear attachment power supply are protected by three separate 60 Amp maxi fuses. The maxi fuse holders are part of the operator platform wire harness and are located under the main instrument panel. The individual control circuits are protected by a variety of smaller amperage fuses found in the main fuse block located in the driver foot well above the traction and decelerator pedals. An accessory fuse block may be mounted below the main fuse block. Machines with a cab include additional control circuits protected by fuses found in the cab fuse block located in the cab control panel above the passenger seat. Machines with an optional Road Light kit include lighting circuits protected by fuses found in the kit wire harness under the roof. Refer to the Electrical Schematic and Wire Harness Drawings/Diagrams in Appendix A (page A–1) for specific circuit information.

Fuse Identification, Location and Function

Main Fuse Block

- Fuse F−A1 (7.5 Amp) supplies power to the T1: TEC outputs 1 thru 4.
- Fuse F−B1 (7.5 Amp) supplies power to the T1: TEC outputs 9 thru 12.
- Fuse F−C1 (7.5 Amp) supplies power to the T1: TEC outputs 5 thru 8.
- Fuse F−D1 (7.5 Amp) supplies power to the T1: TEC outputs 13 thru 16.
- Fuse F−A2 (10 Amp) supplies unswitched power to the engine ECU.
- Fuse F−B2 (2 Amp) supplies unswitched power to the key switch and logic power to the T1: TEC
- Fuse F−C2 (10 Amp) supplies unswitched power to expansion ports #1 and #2.

- Fuse F−D2 (15 Amp) supplies unswitched power to the cab control panel for an optional radio, and to the International (EC) road light kit.
- Fuse F−A3 (10 Amp) supplies power to the optional hour meter, optional bed active switch, backup alarm, traction speed sensors, cruise control auto off switch, and ECO mode switch bulb.
- Fuse F−B3 (2 Amp) supplies power to the InfoCenter display.
- Fuse F−C3 (10 Amp) supplies power to the headlights/work lights.
- Fuse F−D3 (10 Amp) supplies power to the power point, USB charge port, and optional selector control valve (SCV) kit.
- Fuse F−A4 (2 Amp) supplies power to the T2: TDM outputs 1 thru 3.
- Fuse F−B4 (10 Amp) supplies power to the North American (NA) road light kit.
- Fuse F−C4 (10 Amp) supplies power to the horn.
- Fuse F−D4 (10 Amp) supplies power to the optional beacon.
- Fuse F−A5 (10 Amp) supplies power to the air-ride seat compressor.
- Fuse F−B5 (20 Amp) supplies power to the optional trailer brake controller.
- Fuse F−C5 (10 Amp) supplies switched power to expansion ports #1 and #2.
- Fuse F−D5 (15 Amp) supplies switched power to the rear attachment connector.

Accessory Fuse Block

• Fuse (10 Amp) supplies power to the loader selector control valve (SCV) kit.

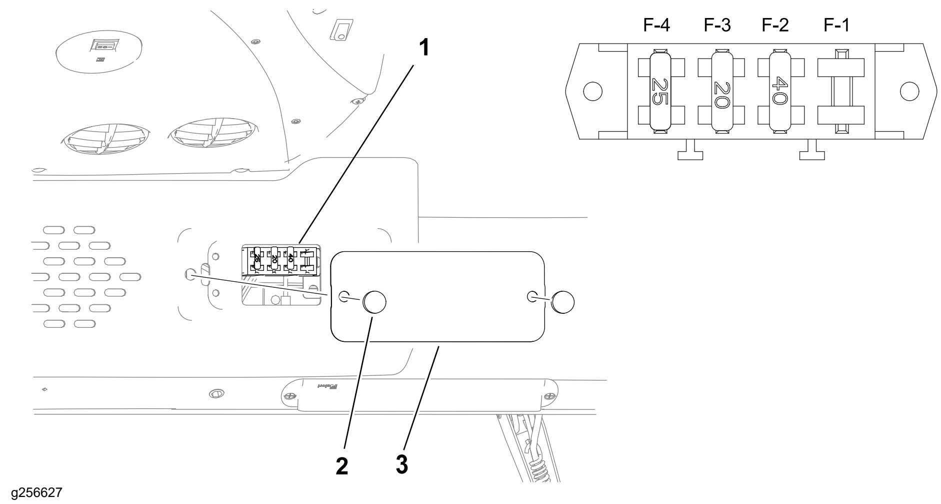


Figure 132

1. Cab fuse block
2. Knob (2 each)
3. Access panel

Cab Fuse Block

- Fuse IF-1 is unused and available for optional equipment.
- Fuse IF-2 (40 Amp) supplies power to the mixing box blower and the defroster blower.
- Fuse IF-3 (20 Amp) supplies power to the windshield wipers.
- Fuse IF-4 (25 Amp) supplies power to the condenser fans.

Fuse Identification, Location and Function (continued)

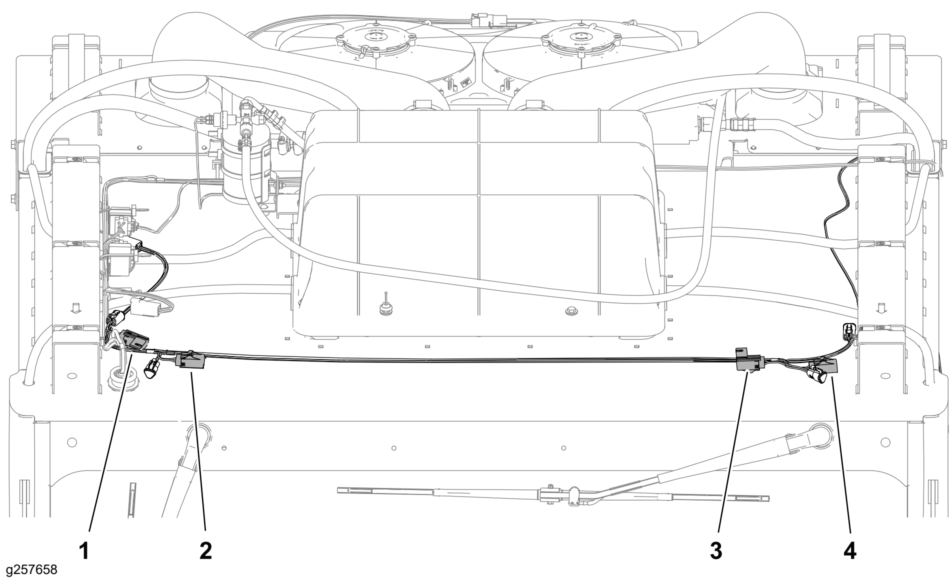


Figure 133

Shown with roof removed.

1. Fuse – RH taillight
2. Fuse – RH brake/turn
3. Fuse – LH brake/turn
4. Fuse – LH taillight

Optional Road Light Kit Wire Harness

• Four (5 Amp) fuses are integrated into the optional turn signal/hazard wire harness. Each fuse is in a separate covered fuse holder. The harness is located under the roof.

Testing Fuses

1. Make sure that key switch is OFF, and key is removed from switch.
2. Remove fuse from fuse block for testing. Fuse should have continuity across the terminals.

Fusible Link Harness

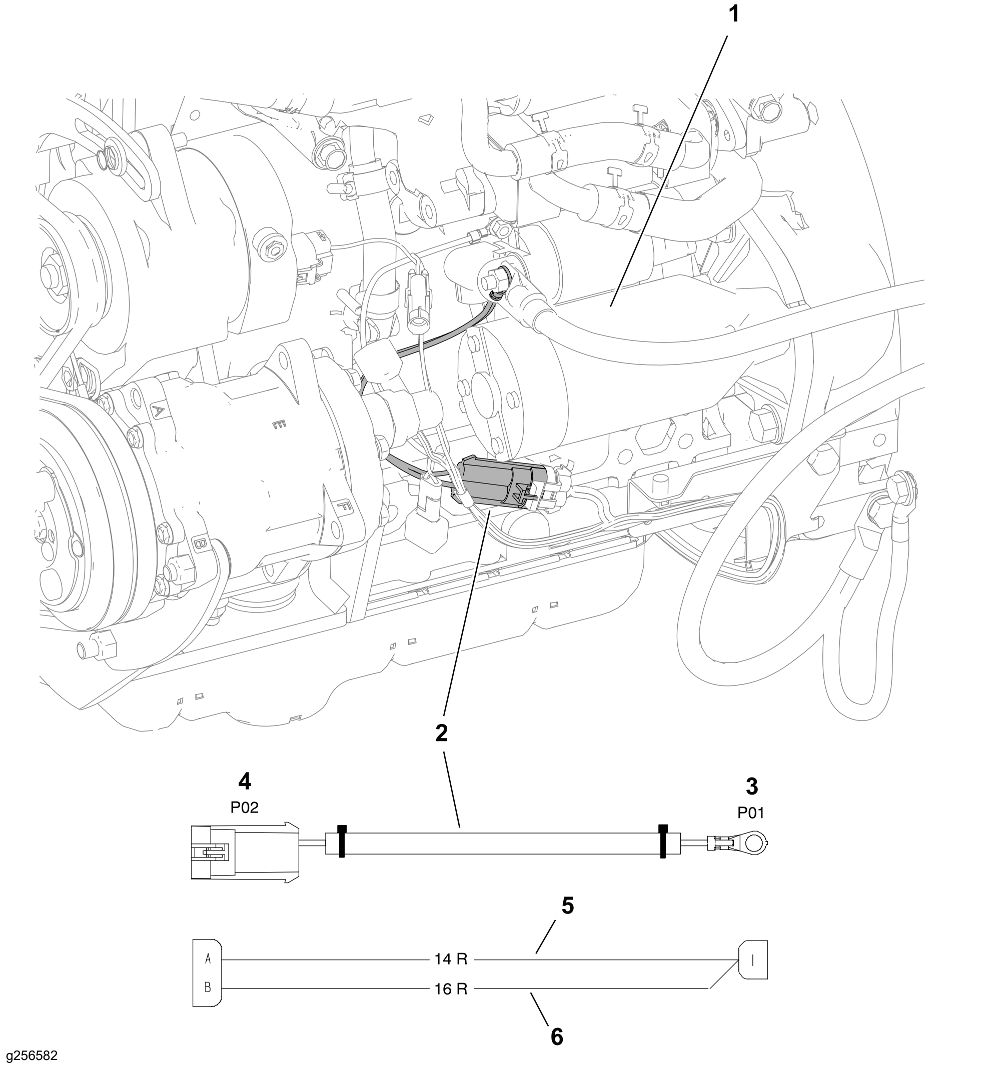


Figure 134

1. Starter motor
2. Fusible link harness
3. To starter B+ terminal
4. To engine wire harness P22 connector
5. Fusible link for glow plug circuit
6. Fusible link for starter circuit

The Outcross 9060 uses two (2) fusible links for circuit protection. These fusible links are in the harness that connects the starter B+ terminal to the engine wire harness. If either of these links should fail, current to the protected circuits will be interrupted.

Testing the Fusible Link Harness

1. Locate and unplug the fusible link harness connector from the engine wire harness.
2. Use a multimeter to make sure that continuity exists between the fusible link terminals.

   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.
3. If either fusible link is open, replace the fusible link harness.
4. After fusible link testing is complete, make sure that the fusible link harness is securely attached to starter B+ terminal and the engine wire harness.

CAN bus

The machine controllers communicate with each other on a Controller Area Network (CAN) bus system. Using this network allows full integration of all the different electrical components of the machine, allowing them to operate together as one. The integration of the controllers allows the InfoCenter display to assist with electrical system diagnostics.

Two specially designed, twisted wires form the CAN bus. These wires provide the data pathways between the components on the network. The engineering term for these cables are CAN High and CAN Low. The CAN bus wires are yellow (CAN-High) and green (CAN Low). At each end of the CAN bus is a 120-ohm termination resistor; refer to CAN bus Terminator Resistors (page 6–73).

Testing the CAN bus

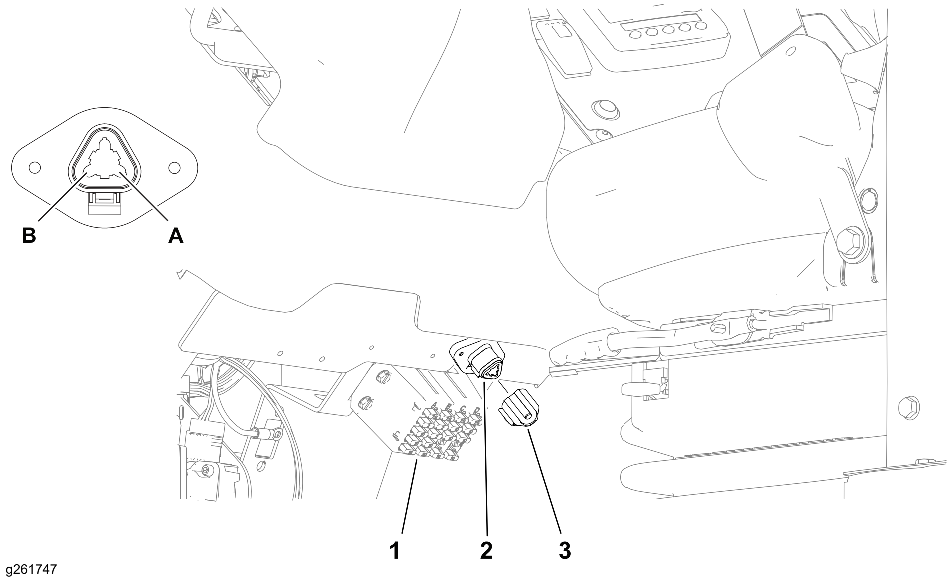


Figure 135

1. Main fuse block
2. Toro DIAG connector
3. Connector cover

1. Make sure that key switch is OFF, and key is removed from switch.
2. The Toro DIAG connector is part of the CAN bus and is located below the dash next to the main fuse block. Locate the Toro DIAG connector and remove the connector cover.
3. Use a multimeter (ohms setting) to measure the resistance across terminals A and B.
   - A reading of 54 to 66 ohms indicates the CAN bus is intact.
   - A reading of 120 ohms indicates one of the CAN bus terminator resistors is not connected, damaged, or the CAN bus wiring is damaged; refer to CAN bus Terminator Resistors (page 6–73) and/or Appendix A (page A–1).
4. Install the Toro DIAG connector cover after testing.

Primary Controller (T1: TEC)

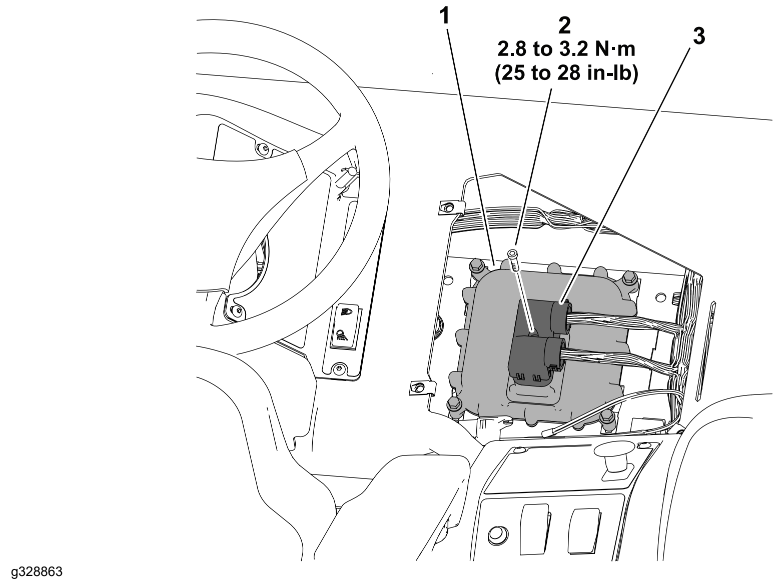


Figure 136

Main instrument panel removed for clarity.

1. Primary controller T1: TEC
2. Harness connector screw
3. Platform harness connector

Outcross 9060 machines use a primary controller (T1: TEC) to manage machine electrical functions. The T1: TEC is a 5004 series 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. The T1: TEC works in conjunction with the T2: TDM to manage the engine start and run signals, the electric fuel pump, and the various hydraulic solenoid valves. The status of inputs to the controller as well as outputs from the controllers can be monitored with the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23).

The T1: TEC is attached to the machine under the main instrument panel. Power for the T1: TEC logic and memory is constantly available (unswitched). The logic and memory circuit are protected by a 2 Amp fuse (F−B2). Power for the T1: TEC outputs is available when the main power relay is energized (key switch is in the ON or START position). A series of four 7.5 Amp fuses (F−A1, B1, C1, and D1) protect the T1: TEC output circuits.

Primary Controller (T1: TEC) (continued)

T1: TEC Inputs

INPUT NUMBER	DESCRIPTION
IN 1	Bed Active Switch
IN 2	AC (air conditioning) Active Switch
IN 3	Parking Brake Switch
IN 4	Seat Switch
IN 5	Transmission Forward Switch
IN 6	Transmission Reverse Switch
IN 7	Decelerator Neutral Switch
IN 8	3-Point Hitch Lower Switch
IN 9	3-Point Hitch Raise Switch
IN 10	PTO Enable Switch

INPUT NUMBER	DESCRIPTION
IN 11	Hydraulic AUX Switch
IN 12	SCV (Selector Control Valve) Switch
IN 13	Front Speed Sensor
IN 14	Rear Speed Sensor
AIN1	Traction Pedal – APS1
AIN2	Traction Pedal – APS2
AIN3	Decelerator Pedal
AIN4	3-Point Hitch Position Sensor
AIN5	Front Pressure Sensor
AIN6	Rear Pressure Sensor

T1: TEC Outputs

OUTPUT NUMBER	DESCRIPTION
OUT LS	Cab Power Relay
OUT 1	Engine ECU – START
OUT 2	Engine ECU – RUN
OUT 3	Parking Brake Solenoid (SV2)
OUT 4	High Range Traction Speed Solenoid (SV1)
OUT 5	Differential Lock Solenoid (SV3)
OUT 6	Electric Brake Controller (optional)
OUT 7	Not Used
OUT 8	SCV Enable Solenoid Valves (optional)

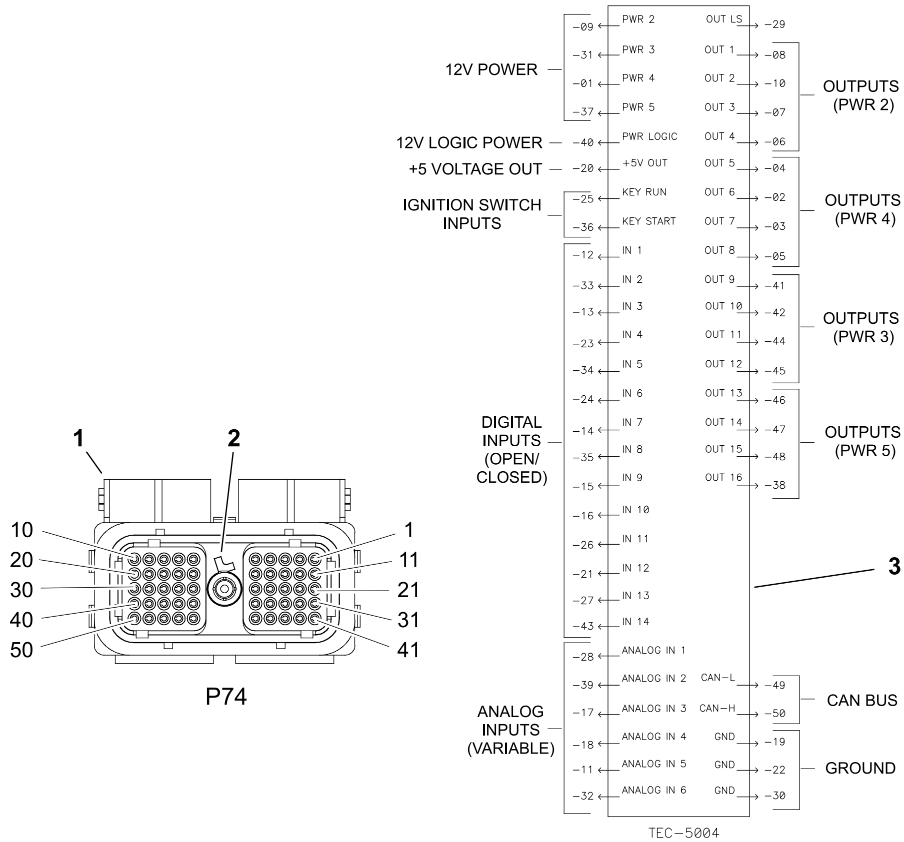
OUTPUT NUMBER	DESCRIPTION
OUT 9	Front Traction Pump – Forward Solenoid (AB-C1)
OUT 10	Front Traction Pump – Reverse Solenoid (AB-C2)
OUT 11	Rear Traction Pump – Forward Solenoid (CD-C1)
OUT 12	Rear Traction Pump – Reverse Solenoid (CD-C2)
OUT 13	PTO Enable Solenoid (EH)
OUT 14	3-Point Hitch Lower Solenoid (SP2)
OUT 15	3-Point Hitch Raise Solenoid (SP1)
OUT 16	Not Used

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 valve coils).

Primary Controller (T1: TEC) (continued)

IMPORTANT

When testing for wire harness continuity at the connector for the controller, 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.



g259215

Figure 137

1. Platform wire harness connector P74
2. Tab
3. Primary controller (T1: TEC)

A 50-pin platform wire harness connector is attached to the controller. The connection terminal function for the controller and the wire harness connector pins are shown above. If the wire harness connector is removed from the T1: TEC for any reason, tighten the harness connector screw from **2.8 to 3.2 N·m (25 to 28 in-lb)**.

Because of the solid-state circuitry built into the controller, 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 InfoCenter display, TECs, and the TDM used on the Outcross 9060 machine are matched for correct machine operation. If any of these components are replaced for any reason, system software needs to be reloaded (contact an Authorized Toro Distributor for assistance).

Status Display Controller (T2: TDM)

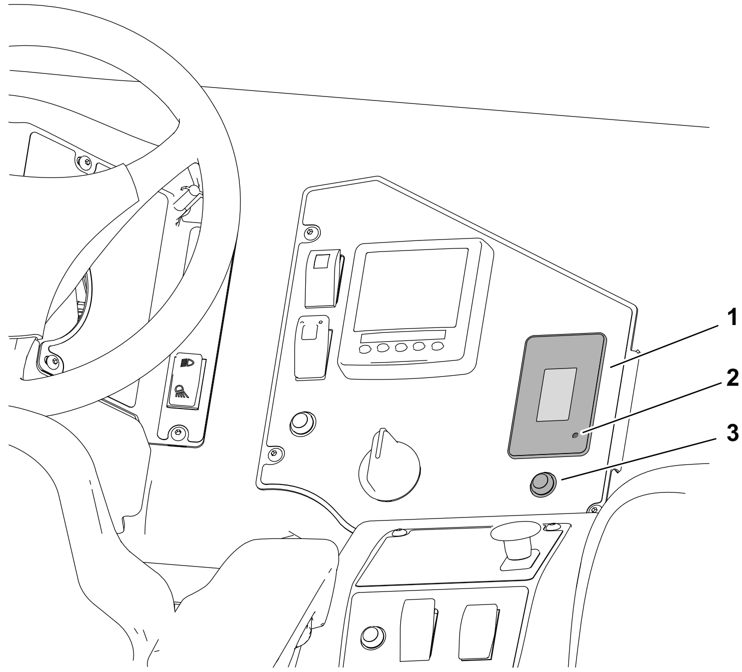


Figure 138

1. Status display module (T2: TDM)
2. Status display screen select button

The status display module (T2: TDM) is an LCD device located in the main instrument panel that presents operating hours, fuel level, engine coolant temperature, hydraulic oil temperature, electrical system voltage, engine RPM, 3-point hitch position, and active faults. The status display button located below the T2: TDM is used to select the various display screens. Refer to Status Display Controller (T2: TDM) (page 6–7) for a complete explanation of the TDM features. Power for the TDM is available when the main power relay is energized (key switch is in the ON or START position). A 2 Amp fuse (F–A4) protects the TDM power circuit.

The T2: TDM is also a 2002 series microcontroller that monitors the condition of various machine switches and sensors (inputs) and communicates the status of these inputs to the T1: TEC via the CAN. The status of inputs to the controller can be monitored with the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23).

The primary controller (T1: TEC), the status display controller (T2: TDM), the Yanmar Engine Control Unit (ECU), the InfoCenter display, and the optional InchMode controller (T3: TEC) used on the Outcross 9060 machine communicate with each other on a Controller Area Network (CAN) bus system.

Status Display Controller (T2: TDM) (continued)

T2: TDM Inputs

INPUT NUMBER	DESCRIPTION
IN 2	Cruise Speed Increase/Decrease Switch – Decrease
IN 3	Differential lock switch
IN 4	Economy (ECO) Mode Switch
IN 5	Cruise Control Off/On/Set Switch – ON (enable)
IN 6	Cruise Control Off/On/Set Switch – SET (engage)

INPUT NUMBER	DESCRIPTION
IN 7	Cruise Speed Increase/Decrease Switch – Increase
AIN1	Mode Selector Switch
AIN2	Status Display Button
AIN3	Hydraulic Fluid Temperature Sender
AIN4	Fuel Level Sender

T2: TDM Outputs

OUTPUT NUMBER	DESCRIPTION
OUT 1	Parking Brake Light
OUT 2	Not Used
OUT 3	Warning Buzzer

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.

IMPORTANT

When testing for wire harness continuity at the connector for the controller, 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.

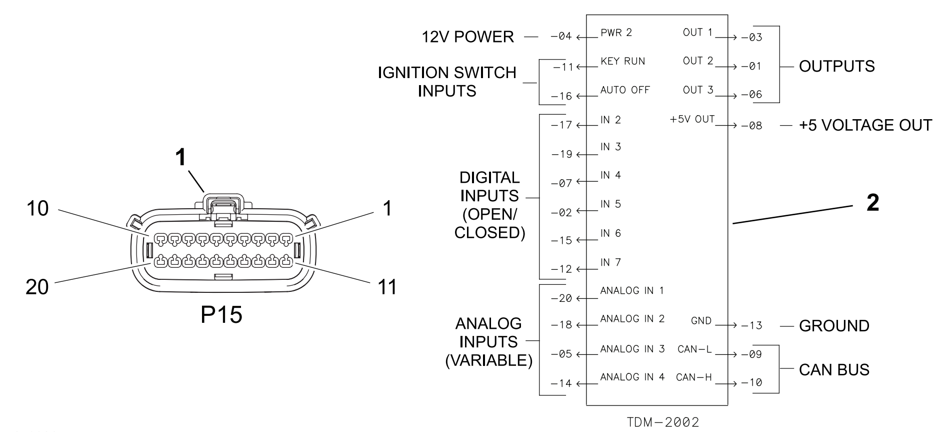


Figure 139

1. Platform wire harness connector P15
2. Status display controller (T2: TDM)

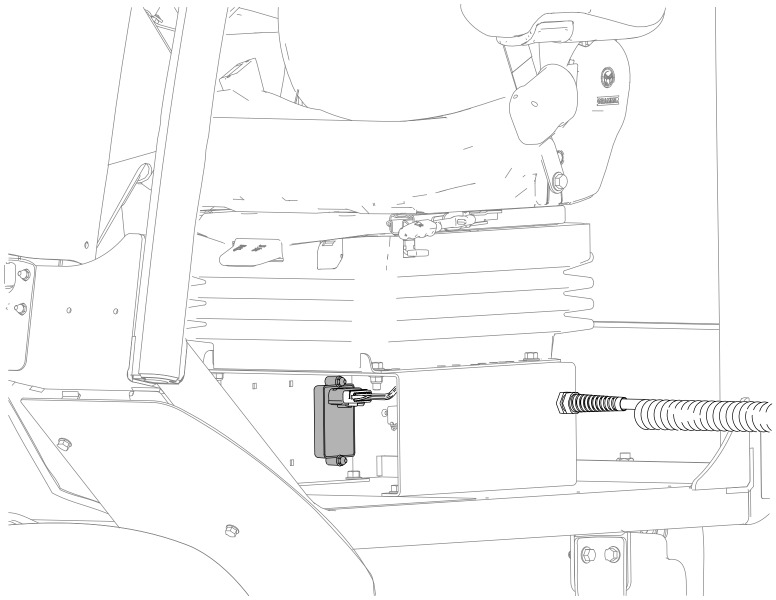
Status Display Controller (T2: TDM) (continued)

A 20-pin platform wire harness connector is attached to the controller. The connection terminal function for the controller and the wire harness connector pins are shown above.

Because of the solid-state circuitry built into the controller, 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 InfoCenter display, TECs, and the TDM used on the Outcross 9060 machine are matched for correct machine operation. If any of these components are replaced for any reason, system software needs to be reloaded (contact an Authorized Toro Distributor for assistance).

InchMode Controller (T3: TEC) (optional)



g259289

Figure 140

The optional InchMode feature includes the InchMode controller (T3: TEC) to manage traction, hitch lift, and PTO functions while standing next to the machine. The T3: TEC is a 2002 series microcontroller that monitors the condition of various machine switches and sensors (inputs) and communicates the status of these inputs to the T1: TEC via the CAN. The status of inputs to the controller can be monitored with the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23).

The T3: TEC is attached to the operator seat base. Power for the T3: TEC is available when the main power relay is energized (key switch is in the ON or START position). A 10 Amp fuse (F–C5) protects the T3: TEC power circuit.

The primary controller (T1: TEC), the status display controller (T2: TDM), the Yanmar Engine Control Unit (ECU), the InfoCenter display, and the optional InchMode controller (T3: TEC) used on the Outcross 9060 machine communicate with each other on a Controller Area Network (CAN) bus system.

T3: TEC Inputs

INPUT NUMBER	DESCRIPTION
IN 2	InchMode Enable Switch
IN 3	InchMode Raise/Lower Switch – Lower
IN 4	InchMode Raise/Lower Switch – Raise
IN 5	InchMode Forward/Reverse Switch – Forward
IN 6	InchMode Forward/Reverse Switch – Reverse

INPUT NUMBER	DESCRIPTION
IN 7	InchMode PTO Switch
AIN1	Not Used
AIN2	Not Used
AIN3	Not Used
AIN4	Not Used

T3: TEC Outputs

OUTPUT NUMBER	DESCRIPTION
OUT 1	Not Used
OUT 2	Not Used
OUT 3	Not Used

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.

IMPORTANT

When testing for wire harness continuity at the connector for the controller, 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.

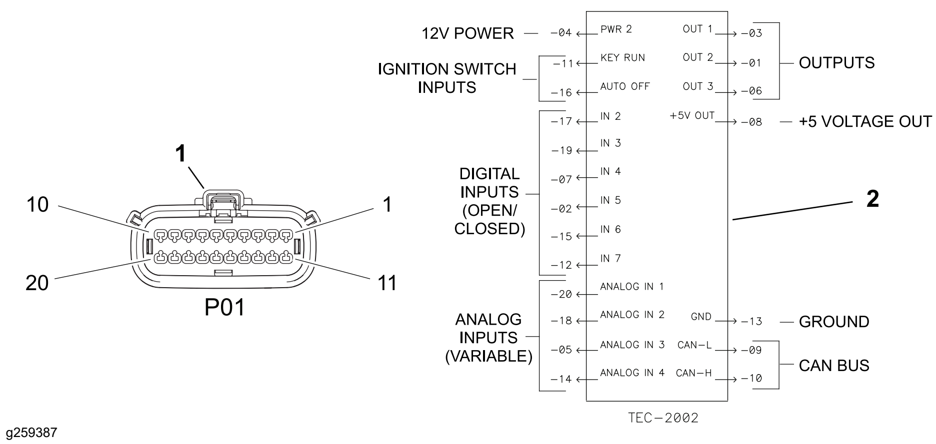


Figure 141

1. InchMode wire harness connector P01
2. InchMode controller (T3: TEC)

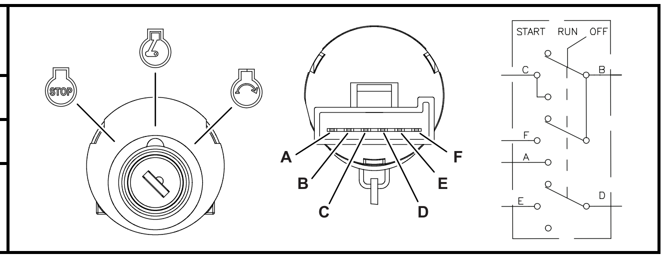
A 20-pin InchMode wire harness connector is attached to the controller. The connection terminal function for the controller and the wire harness connector pins are shown above.

Because of the solid-state circuitry built into the controller, 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 InfoCenter display, TECs, and the TDM used on the Outcross 9060 machine are matched for correct machine operation. If any of these components are replaced for any reason, system software needs to be reloaded (contact an Authorized Toro Distributor for assistance).

Key Switch

POSITION	CLOSED CIRCUITS
OFF	1 + 6, 4 + 5
RUN	1 + 3 + 4 + 5 + 6
START	1 + 2 + 4 + 5 + 6



The key switch on the console has three (3) positions − OFF, RUN and START. The key switch is an input used by the T1: TEC to manage various machine functions.

Testing the Key Switch

The key switch and its circuit wiring can be tested as a T1: TEC input using the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

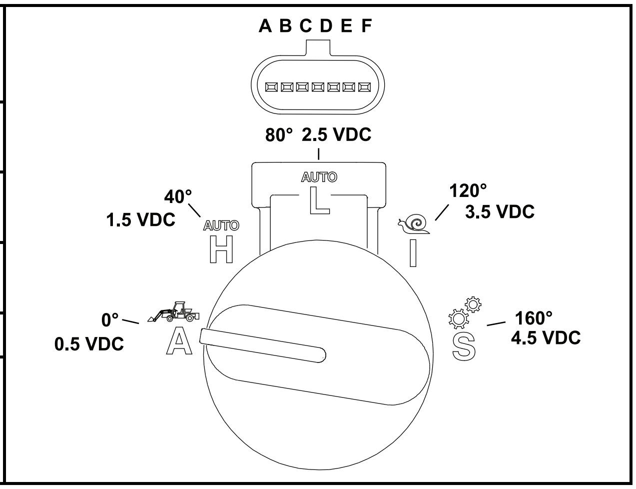
1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the instrument panel from the console.
4. Disconnect the wire harness connector from the switch and remove the switch from the instrument panel if necessary.

   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 the switch position.

5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. Replace the switch if necessary.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Install the switch, connect the wire harness, and install the instrument panel after testing.
9. Connect the battery negative (-) cable at the battery.

Mode Selector

POSITION	SIGNAL VOLTAGE (E) ±0.2 VDC
0° – A (attachment mode)	0.5 VDC
40° – H (auto high mode)	1.5 VDC
80° – L (auto low mode)	2.5 VDC
120° – I (InchMode)	3.5 VDC
160° – S (setup mode)	4.5 VDC



The mode selector is an analog hall effect sensor that communicates the desired mode of operation to the T2: TDM. The selector is located on the main instrument panel. The T2: TDM communicates the mode signals to the T1: TEC via the CAN network. The T1: TEC uses information from the mode selector to control numerous aspects of machine operation. The selector signals are also constantly monitored for fault detection. Refer to the machine *Outcross Traction Unit Software Guide* for additional operating mode information.

If a mode selector fault occurs, the machine will operate in Auto Low mode.

Note: The traction pedal must be at rest, the machine must be stationary, and the PTO and hydraulic AUX must be disabled before changing operating modes.

Testing the Mode Selector

The mode selector and its circuit wiring can be tested as a T2: TDM input using the InfoCenter display. The current operating mode should be displayed on the main screen, and the display should change with switch position changes. If testing determines that a sensor and its circuit wiring are not functioning correctly, proceed with the following test procedure:

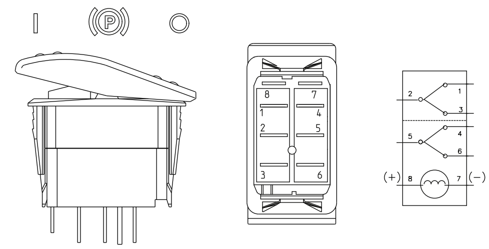
1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the instrument panel from the dash.
4. Disconnect the wire harness connector from the mode selector. Remove the knob and remove the selector from the instrument panel if necessary.

   Note: Pins A, B and C are not used in this application.

5. Connect pin F to a 5 VDC power supply, and connect pin D to ground.
6. Using a multimeter (DC voltage setting) check the signal voltage present at pin E as follows:
7. Replace the position sensor if necessary.
8. If the position sensor tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
9. Install the mode selector and connect the wire harness after testing.

Parking Brake Switch

POSITION	CLOSED CIRCUITS
ON	2 + 3, 5 + 6
OFF	1 + 2, 4 + 5



The parking brake switch is located on the main instrument panel. Push down on the top of the switch to engage the parking brake (switch light illuminated) and push down on the bottom of the switch to disengage the parking brake.

The T1: TEC monitors the position of the parking brake switch. The parking brake is spring loaded and engages automatically when hydraulic pressure is not present. When the engine is running and the parking brake switch is set to the OFF position, the T1: TEC energizes the hydraulic solenoid valve (SV2) to pressurize the brake circuit and disengage the brake.

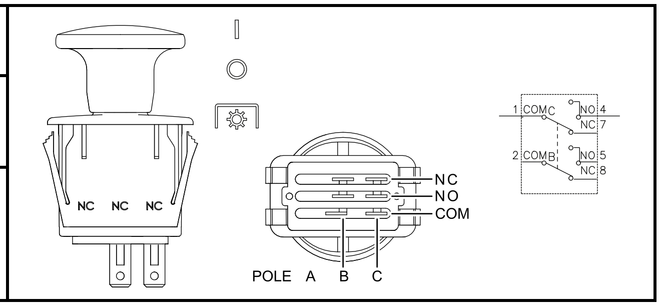
Testing the Parking Brake Switch

The parking brake switch and its circuit wiring can be tested as a T1: TEC input using the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the instrument panel from the dash.
4. Disconnect the wire harness connector from the switch and remove the switch from the instrument panel if necessary.
5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. The switch indicator light can be tested by applying (+) 12 VDC to terminal 8 and a (-) ground to terminal 7.
7. Replace the switch if necessary.
8. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
9. Install the switch, connect the wire harness, and install the instrument panel after testing.
10. Connect the battery negative (-) cable at the battery.

Power Take Off (PTO) Enable Switch

POSITION	CLOSED CIRCUITS
OFF (DOWN)	COM B + NC B COM C+ NC C
ON (UP)	COM B + NO B COM C+ NO C



The power take off (PTO) enable switch is located on the console. This switch is pulled up to engage the PTO shaft and pushed down to disengage the PTO shaft.

The T1: TEC monitors the position of the PTO switch. Using information from the PTO switch and other inputs, the T1: TEC energizes the hydraulic solenoid valve (EH) to engage the PTO clutch.

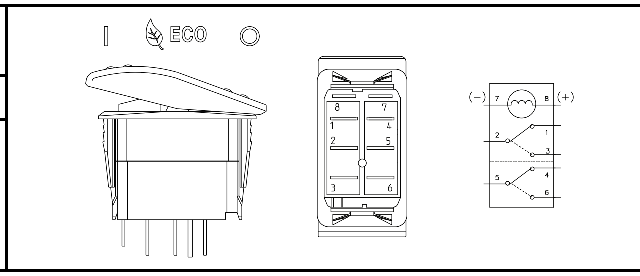
Testing the Power Take Off (PTO) Switch

The PTO enable switch and its circuit wiring can be tested as a T1: TEC input using the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the instrument panel from the console.
4. Disconnect the wire harness connector from the switch and remove the switch from the instrument panel if necessary.
5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. Replace the switch if necessary.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Install the switch, connect the wire harness, and install the instrument panel after testing.
9. Connect the battery negative (-) cable at the battery.

Economy (ECO) Mode Switch

POSITION	CLOSED CIRCUITS
ON	2 + 3, 5 + 6
OFF	1 + 2, 5 + 4



The ECO mode switch is located on the main instrument panel. Push down on the top of the switch to enable ECO mode (switch light illuminated) and push down on the bottom of the switch to disable ECO mode.

The T2: TDM monitors signals from the ECO mode switch. The T2: TDM communicates the switch position to the T1: TEC via the CAN network. When ECO mode is enabled, the maximum engine speed is reduced to 2300 RPM if the PTO or Hydraulic AUX function is not active.

Testing the Economy (ECO) Mode Switch

The ECO mode switch and its circuit wiring can be tested as a T2: TDM input using the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the instrument panel from the dash.
4. Disconnect the wire harness connector from the switch and remove the switch from the instrument panel if necessary.
5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. The switch indicator light can be tested by applying (+) 12 VDC to terminal 8 and a (-) ground to terminal 7.
7. Replace the switch if necessary.
8. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
9. Install the switch, connect the wire harness, and install the instrument panel after testing.
10. Connect the battery negative (-) cable at the battery.

Hydraulic Auxiliary (AUX) Switch

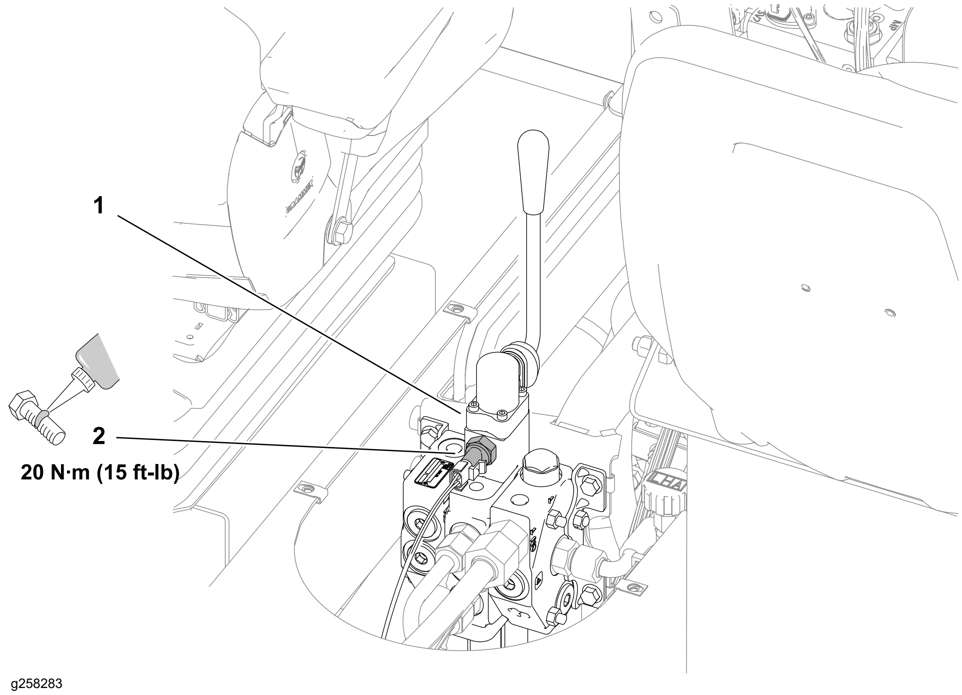


Figure 142

Shown with operator's console removed for clarity.

1. Auxiliary load valve assembly
2. Hydraulic Auxiliary (AUX) switch

Note: Hydraulic AUX switch functionality is dependent on attachment configuration.

The hydraulic AUX switch is a normally open ball switch that is held closed while the joystick is in the neutral position (N.O.H.C.). The switch is in the joystick assembly of the auxiliary load valve. While hydraulic flow to attachments is controlled mechanically by moving the joystick, the machine can be configured through the InfoCenter to use joystick movement (via the hydraulic AUX switch) to control the electrical demands of an attachment.

The T1: TEC monitors the position of the hydraulic AUX switch. Signals from the hydraulic AUX switch can be used by the T1: TEC to control ground speed and engine speed.

Testing the Hydraulic AUX Switch

The hydraulic AUX switch and its circuit wiring can be tested as a T1: TEC input using the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Remove the operator's console; refer to Removing and Installing the Operator's Console (page 8–30).
2. Disconnect the wire harness connector from the switch.
3. Check the continuity of the switch by connecting a multimeter (ohms setting) across the switch terminals.
4. When the joystick is in the neutral position there should be continuity (zero ohms resistance) between the switch terminals.
5. When the joystick is any of the forward or rearward positions there should be no continuity (infinite ohms resistance) between the switch terminals.

Testing the Hydraulic AUX Switch (continued)

6. Replace the switch if necessary.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Connect the wire harness and install the operator’s console after testing.

Seat Switch

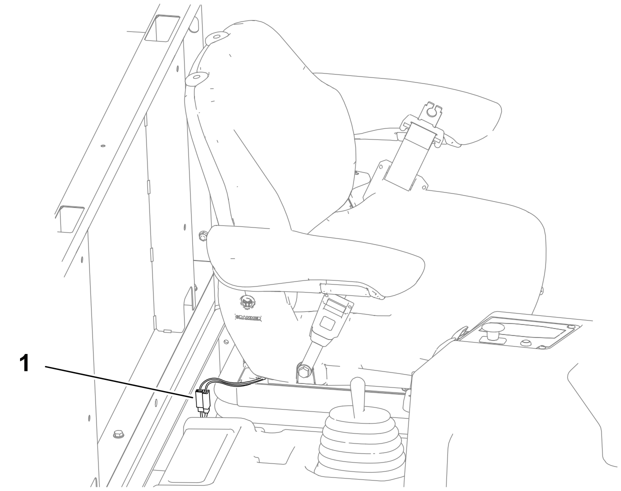


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Figure 143

1. Seat switch harness connector

The seat switch and its electrical connector are in the operator 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 platform wire harness.

The T1: TEC monitors the position of the seat switch. Using seat switch position (open or closed) and a variety of other inputs, the T1: TEC manages a variety of machine functions.

Testing the Seat Switch

The seat switch and its circuit wiring can be tested as a T1: TEC input using the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23). If testing determines that the switches and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the wire harness connector from the switch.
3. Check the continuity of the switch by connecting a multimeter (ohms setting) across the 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 necessary; refer to Servicing the Operator Seat (page 8–33).
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Connect the wire harness after testing.

Paddle (3-Point Hitch) and Transmission Lever Switches

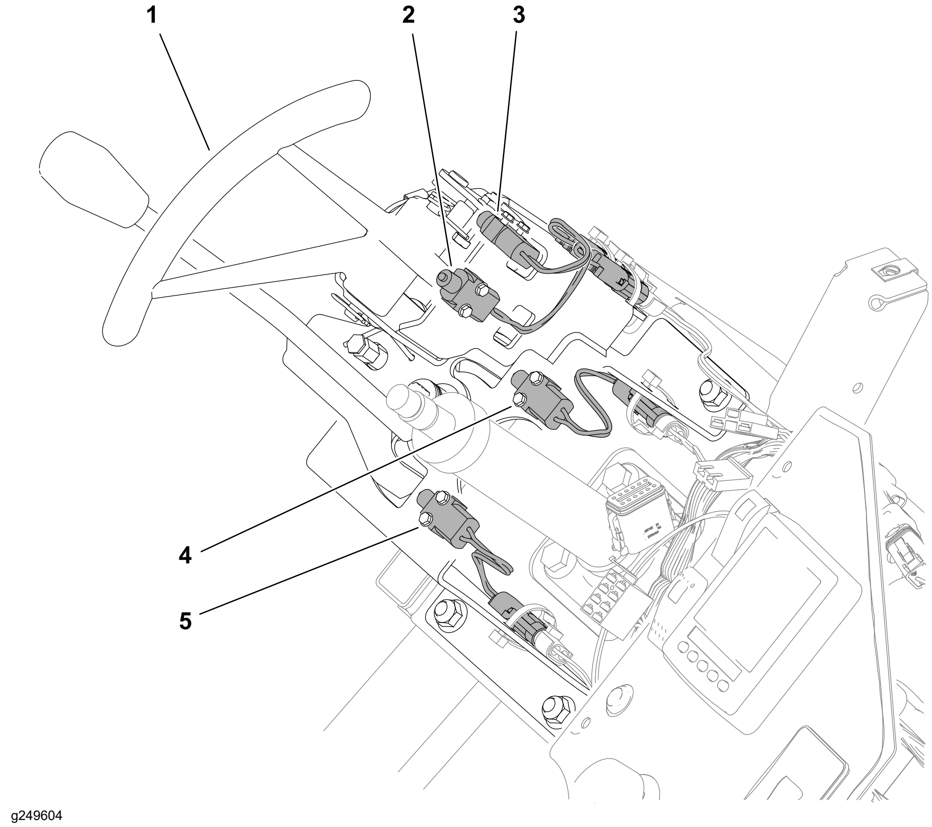


Figure 144

1. Paddle and transmission lever assembly
2. Paddle switch (closed with paddle in RAISE position)
3. Paddle switch (closed with paddle in LOWER position)
4. Transmission lever switch (closed with shift lever in FORWARD position)
5. Transmission lever switch (closed with shift lever in REVERSE position)

The paddle and transmission lever switches are attached to the paddle and transmission lever assembly located under the steering wheel to the left of the steering column. The 2 paddle switches are used to control the 3-point hitch (raise and lower). The 2 paddle switches may also be used to control additional machine functions when certain attachments are connected. The 2 transmission lever switches are used to control the tandem piston pump (forward and reverse). The switches are normally open TEC inputs. All 4 switches are identical.

Testing the Paddle and Transmission Lever Switches

The paddle and transmission lever switches and their circuit wiring can be tested as a T1: TEC input using the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23). If testing determines that any of the switches and their circuit wiring are not functioning correctly, proceed with the following test procedure:

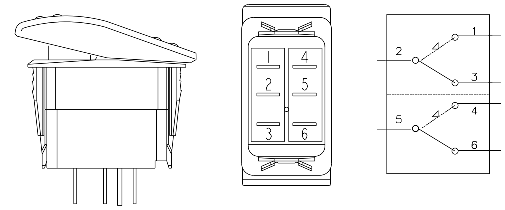
1. Remove the dash cover; refer to Removing the Dash Cover (page 8–25).
2. Disconnect machine wire harness connector from the switch being tested.
3. Use a multimeter (ohms setting) to test the switch function. Continuity (zero ohms resistance) should exist across the switch terminals when the switch is depressed. There should be no continuity (infinite ohms resistance) across the switch terminals when the switch is released.
4. Replace the switch if testing determines that it is faulty.

Testing the Paddle and Transmission Lever Switches (continued)

5. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
6. After testing is complete, connect machine wire harness connector to the switch.
7. Install the dash cover; refer to Finishing the Steering Wheel, Instrument Panels and Dash Cover Installation (page 8–29).

Headlight/Work Light Switch

POSITION	CLOSED CIRCUITS
HEADLIGHTS ON	2 + 3, 5 + 6
OFF	NONE
WORK LIGHTS ON	1 + 2, 4 + 5



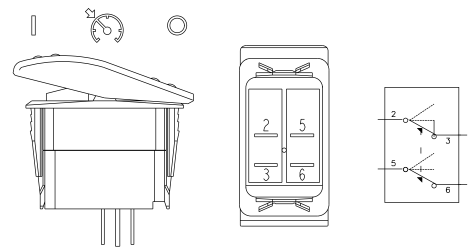
The headlight/work light switch is located on the steering instrument panel. Pushing down on the top of the switch energizes the headlights, and on machines with an optional North American Light Kit, energizes the hazard lights. Pushing down on the bottom of the switch energizes the headlights and the optional work lights.

Testing the Headlight/Work Light Switch

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the instrument panel from the steering column cover.
4. Disconnect the wire harness connector from the switch and remove the switch from the instrument panel if necessary.
5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. Replace the switch if necessary.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Install the switch, connect the wire harness, and install the instrument panel after testing.
9. Connect the battery negative (-) cable at the battery.

Cruise Control Off/On/Set Switch

POSITION	CLOSED CIRCUITS
OFF	NONE
CRUISE ON (enable)	2 + 3
CRUISE SET (engage)	2 + 3 5 + 6



The cruise control switch is located on the console. When the bottom of the 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 top of the switch is momentarily depressed, the cruise control feature is engaged, and the current traction speed will be maintained.

The T2: TDM monitors the position of the cruise control off/on/set switch. The T2: TDM communicates the switch position to the T1: TEC via the CAN network. Using inputs from the cruise control off/on/set switch and the traction pedal position sensors, the T1: TEC holds the tandem piston (traction) pump forward control solenoids in their current position. Once engaged, the cruising speed can be increased (+) or decreased (−) incrementally through the Cruise Control Speed Increase/Decrease Switch.

The cruise control function is disabled when the switch is set to OFF, the decelerator pedal is depressed, the shift lever is moved from the FORWARD position, the parking brake switch is engaged, a speed sensor or hydraulic pressure sensor fault is active, or when CAN communication between the T1: TEC and the T2: TDM is lost.

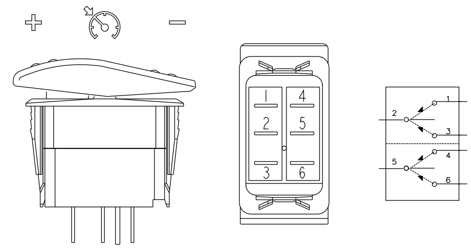
Testing the Cruise Control Off/On/Set Switch

The cruise control off/on/set switch and its circuit wiring can be tested as a T2: TDM input using the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the instrument panel from the console.
4. Disconnect the wire harness connector from the switch and remove the switch from the instrument panel if necessary.
5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. Replace the switch if necessary.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Install the switch, connect the wire harness, and install the instrument panel after testing.
9. Connect the battery negative (-) cable at the battery.

Cruise Control Speed Increase/Decrease Switch

POSITION	CLOSED CIRCUITS
INCREASE SPEED	2 + 3, 5 + 6
NEUTRAL	NONE
DECREASE SPEED	2 + 1, 5 + 4



The cruise control speed increase/decrease switch is located on the console. When the cruise control feature is engaged and top of the switch is depressed, the cruise control speed will increase. When the cruise control feature is engaged and bottom of the switch is depressed, the cruise control speed will decrease. The amount of change can be as low as 0.1 mph when in attachment-rate control mode, or as high as 1.0 mph in auto low or high mode.

The T2: TDM monitors signals from the cruise control increase/decrease switch. The T2: TDM communicates the increase/decrease requests to the T1: TEC via the CAN network. Using inputs from the cruise control off/on/set switch and the traction pedal position sensors, the T1: TEC adjusts the tandem piston (traction) pump forward control solenoids accordingly.

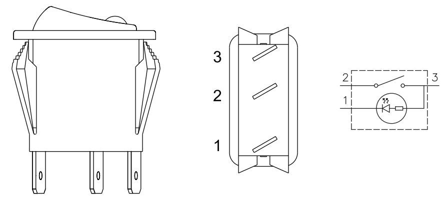
Testing the Cruise Control Speed Increase/Decrease Switch

The cruise control speed increase/decrease switch and its circuit wiring can be tested as a T2: TDM input using the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the instrument panel from the console.
4. Disconnect the wire harness connector from the switch and remove the switch from the instrument panel if necessary.
5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. Replace the switch if necessary.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Install the switch, connect the wire harness, and install the instrument panel after testing.
9. Connect the battery negative (-) cable at the battery.

Air Conditioning On/Off Switch

POSITION	CLOSED CIRCUITS
OFF	NONE
ON	1+ 2 + 3



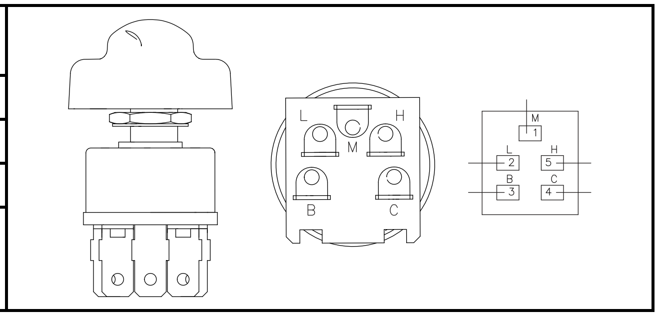
Testing the Air Conditioning On/Off Switch

The air conditioning on/off switch, working with the AC switch signal relay, and its circuit wiring can be tested as a T1: TEC input using the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23). If testing determines that the switch and its circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the roof from the cab.
4. Disconnect the wire harness connectors from the switch and remove the switch from the AC control panel if necessary.
5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. Replace the switch if necessary.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Install the switch and connect the wire harness.
9. Inspect and repair the roof seals as necessary, and install the roof after testing.
10. Connect the battery negative (-) cable at the battery.

Heater/Air Conditioning Blower Speed Switch

POSITION	CLOSED CIRCUITS
OFF	NONE
LOW	B + C + L
MED	B + C + M
HIGH	B + C + H

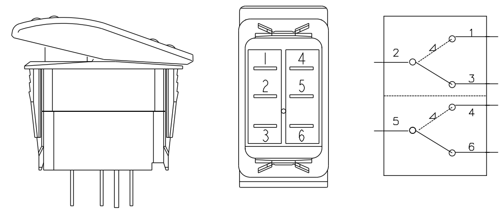


Testing the Heater/Air Conditioning Blower Speed Switch

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the roof from the cab.
4. Disconnect the wire harness connector from the switch and remove the switch from the AC control panel if necessary.
5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. Replace the switch if necessary.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Install the switch and connect the wire harness.
9. Inspect and repair the roof seals as necessary, and install the roof after testing.
10. Connect the battery negative (-) cable at the battery.

InchMode Enable Switch (optional)

POSITION	CLOSED CIRCUITS
OFF	2 + 3, 5 + 6
ON	2 + 1, 5 + 4



Note: Once the InchMode feature is enabled through the InfoCenter, the InchMode enable switch must be depressed before any of the InchMode operations will function.

The InchMode enable switch is located on the InchMode control box. Pushing down on the top of the switch supplies power to the InchMode raise/lower, forward/reverse, and PTO switches. The switch returns to the OFF position when released.

The T3: TEC monitors signals from the InchMode enable switch. The T3: TEC communicates the switch position to the T1: TEC via the CAN network. Using inputs from the InchMode enable switch, the mode selector, and the traction control lever and pedals, the system enables InchMode operation and waits for signals from the other InchMode switches.

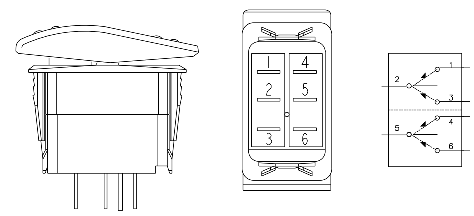
Testing the InchMode Enable Switch

The InchMode enable switch and its circuit wiring can be tested as a T3: TEC input using the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23). If testing determines that the switch and its circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the instrument panel from the InchMode control box.
4. Disconnect the wire harness connector from the switch and remove the switch from the instrument panel if necessary.
5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. Replace the switch if necessary.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Install the switch, connect the wire harness, and install the instrument panel after testing.
9. Connect the battery negative (-) cable at the battery.

InchMode Raise/Lower and Forward/Reverse Switches (optional)

POSITION	CLOSED CIRCUITS
RAISE or FORWARD	2 + 3, 5 + 6
OFF	NONE
LOWER or REVERSE	2 + 1, 5 + 4



Note: Once the InchMode feature is enabled through the InfoCenter, the InchMode enable switch must be depressed before any of the InchMode operations will function.

The InchMode raise/lower and forward/reverse switches are located on the InchMode control box. The T3: TEC monitors signals from the InchMode raise/lower and forward/reverse switches. The T3: TEC communicates the switch positions to the T1: TEC via the CAN network. With the traction control lever and pedals in the neutral position, the T1: TEC uses inputs from the InchMode switches to energize the tandem piston (traction) pump control solenoids or the hitch lift circuit hydraulic valves accordingly to move the machine.

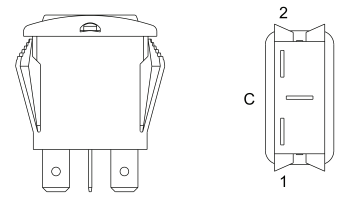
Testing the Raise/Lower and Forward/Reverse Switches

The InchMode raise/lower and forward/reverse switches and their circuit wiring can be tested as a T3: TEC input using the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23). If testing determines that a switch and its circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the instrument panel from the InchMode control box.
4. Disconnect the wire harness connector from the switch and remove the switch from the instrument panel if necessary.
5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. Replace the switch if necessary.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Install the switch, connect the wire harness, and install the instrument panel after testing.
9. Connect the battery negative (-) cable at the battery.

Loader Selector Control Valve (SCV) Switch (optional)

POSITION	CLOSED CIRCUITS
ON (forward)	2 + C
OFF	NONE
MOMENTARY (rearward)	1 + C



A 3-position rocker switch located on the loader control valve joystick is used to control the loader SCV valves. When the switch is in the OFF (center) position, all kit solenoid valves are de-energized and hydraulic flow is directed to the manifold ports marked 3. When the switch is in the ON (forward) position or MOMENTARY (rearward) position, all kit solenoid valves are energized, and hydraulic flow is directed to the manifold ports marked 2.

Testing the Loader Selector Control Valve (SCV) Switch

The loader selector control valve (SCV) switch and its circuit wiring can be tested as a T1: TEC input using the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23). If testing determines that a switch and its circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the battery negative (-) cable at the battery.
3. Remove the switch cap and switch from the joystick.
4. Disconnect the wire harness connectors from the switch.
5. Use a multimeter (ohms setting) and the preceding table to determine whether continuity exists between the various terminals for each switch position.
6. Replace the switch if necessary.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Connect the wire harness and install the switch and switch cap after testing.
9. Connect the battery negative (-) cable at the battery.

Traction Pedal Assembly

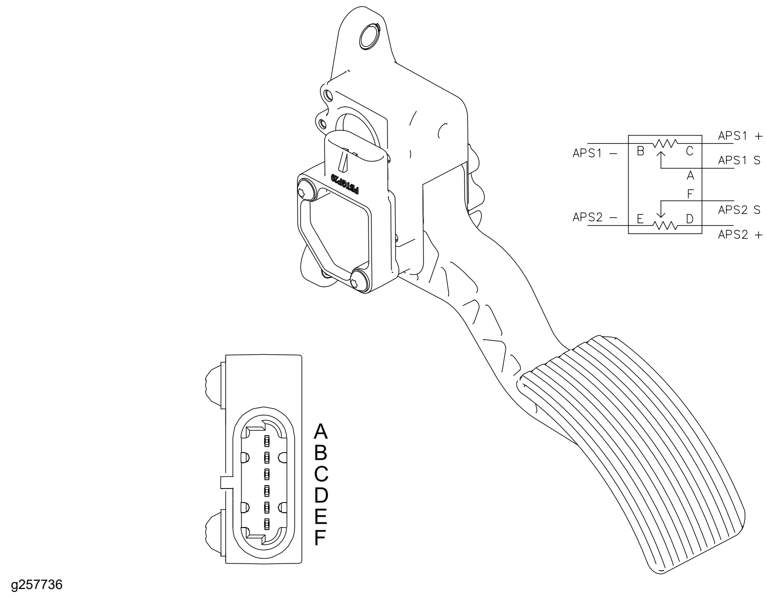


Figure 145

The traction pedal assembly includes 2 analog hall effect sensors that do not require calibration. The sensors operate on 5 VDC supplied by the T1: TEC. Signal voltage from the pedal sensors is used by the T1: TEC (along with information from additional inputs) to determine appropriate current flow to the tandem piston (traction) pump control valves. The sensor signals are also constantly monitored for traction fault detection.

If a traction pedal fault occurs while the machine is moving, the machine will slowly come to a stop. The decelerator pedal can be used to stop the machine sooner if necessary. A traction pedal fault will disable traction control until the ignition key is cycled OFF and ON.

Testing the Traction Pedal Assembly

The traction pedal assembly and its circuit wiring can be tested as a T1: TEC input using the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23). If testing determines that the assembly and its circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the platform wire harness from the traction pedal. Check the pedal and the harness connector for damage or corrosion.
3. Connect pins C and D to a 5 VDC power supply, and connect pins B and E to ground.
4. Using a multimeter (DC voltage setting) with the traction pedal at rest, less than 0.62 VDC should be present at pin A and less than 0.75 VDC should be present at pin F.
5. Using a multimeter (DC voltage setting) with the traction pedal fully depressed, 2.5 VDC should be present at pin A and 4.5 VDC should be present at pin F.
6. Replace the traction pedal assembly if necessary.
7. If the traction pedal tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).

Testing the Traction Pedal Assembly (continued)

8. Connect the pedal assembly to the platform wire harness.

Decelerator Pedal Position Sensor

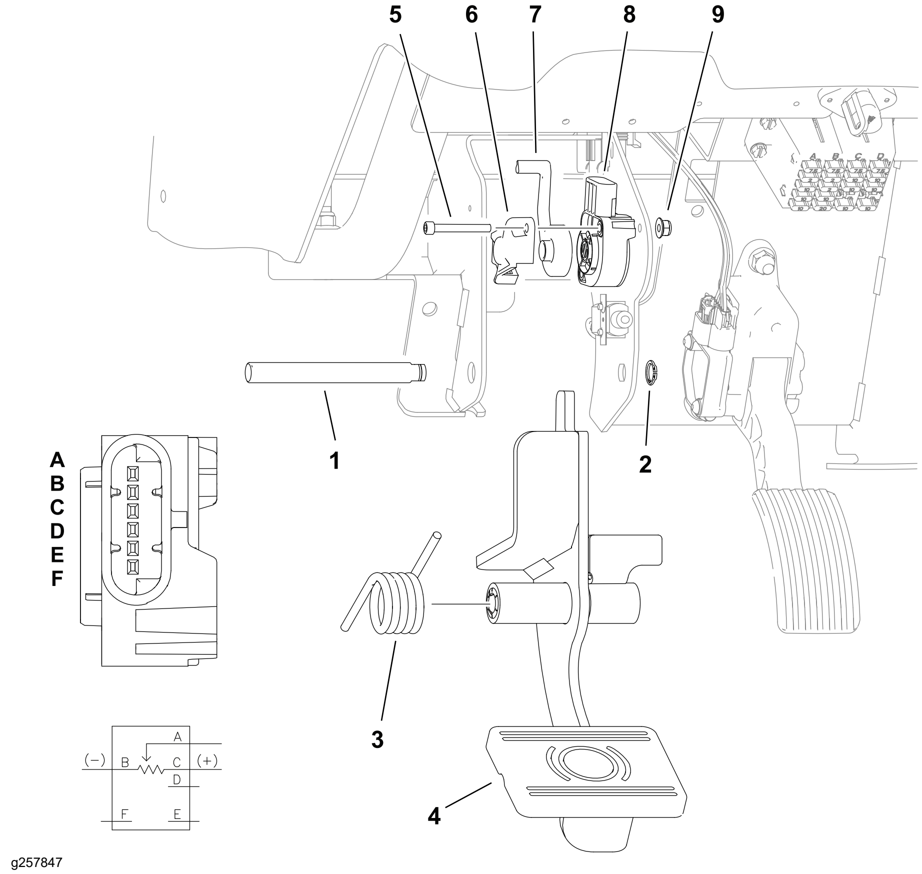


Figure 146

1. Pin
2. Retaining ring
3. Torsion Spring
4. Decelerator pedal assembly
5. Capscrew (2 each)
6. Retainer
7. Sensor pivot
8. Decelerator pedal sensor
9. Flange nut (2 each)

The decelerator pedal position sensor is a potentiometer (variable resistor). Signal voltage from the pedal sensor is used by the T1: TEC (along with information from additional inputs) to determine appropriate current flow to the tandem piston (traction) pump control valves. The decelerator pedal sensor works with the decelerator pedal neutral switch for decelerator fault detection.

If a decelerator pedal fault occurs while the machine is moving, the machine will quickly come to a stop. A decelerator pedal fault will disable traction control until the ignition key is cycled OFF and ON.

Testing the Decelerator Pedal Position Sensor

The decelerator pedal sensor and its circuit wiring can be tested as a T1: TEC input using the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23). If testing determines that the sensor and its circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Remove the decelerator pedal assembly.
3. Disconnect the machine wire harness connector from the decelerator pedal sensor, and remove the sensor from the machine.

Testing the Decelerator Pedal Position Sensor (continued)

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

4. Use a multimeter (ohms setting) and measure the resistances between the sensor terminals as follows:

   A. Check that the resistance between the terminals B and C is approximately 5,000 ohms.

   B. Measure the resistance between the terminals A and C and then measure the resistance between the terminals A and B. The total of the 2 measured resistances should be approximately 5,000 ohms.

   C. Rotate the decelerator pedal position sensor to other positions and repeat step B The total of the 2 measured resistances should always be approximately 5,000 ohms.

5. Replace the decelerator pedal sensor if necessary.

6. If the decelerator pedal sensor tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).

7. Install the decelerator pedal sensor and connect the wire harness after testing.

8. Install the decelerator pedal assembly.

Decelerator Pedal Neutral Switch

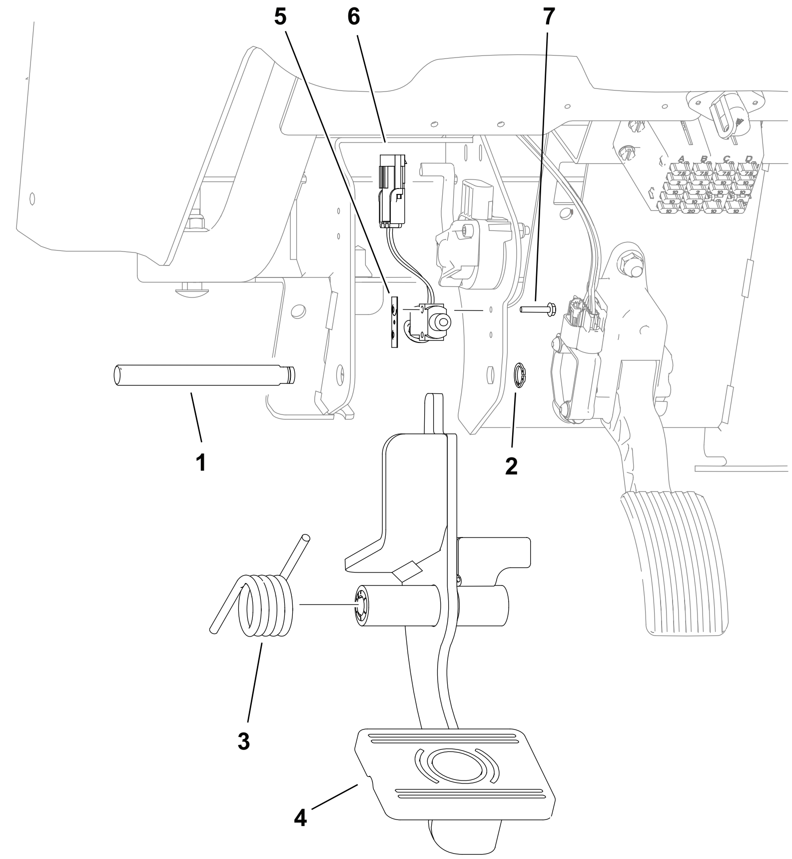


Figure 147

1. Pin
2. Retaining ring
3. Torsion Spring
4. Decelerator pedal assembly
5. Nut plate
6. Switch and connector
7. capscrew (2 each)

The decelerator pedal neutral switch is a normally open switch held closed when the decelerator pedal is at rest (N.O.H.C.). The switch is located directly above the decelerator pedal assembly. When the decelerator pedal is depressed, the switch plunger is extended, opening the switch contacts. The decelerator pedal neutral switch works in conjunction with the decelerator pedal position sensor for decelerator fault detection. The decelerator pedal neutral switch is monitored by the T1: TEC.

If a decelerator pedal fault occurs while the machine is moving, the machine will quickly come to a stop. A decelerator pedal fault will disable traction control until the ignition key is cycled OFF and ON.

Testing the Decelerator Pedal Neutral Switch

The decelerator pedal neutral switch and its circuit wiring can be tested as a T1: TEC input using the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.
2. Disconnect the wire harness connector from the switch.

Testing the Decelerator Pedal Neutral Switch (continued)

3. Check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.
4. When the switch plunger is depressed (decelerator pedal at rest) there should be continuity (zero ohms resistance) between the switch terminals.
5. When the switch plunger is extended (decelerator pedal depressed) there should be no continuity (infinite ohms resistance) between the switch terminals.
6. Replace the switch if necessary.
7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
8. Connect the wire harness after testing.

3-Point Hitch Position Sensor

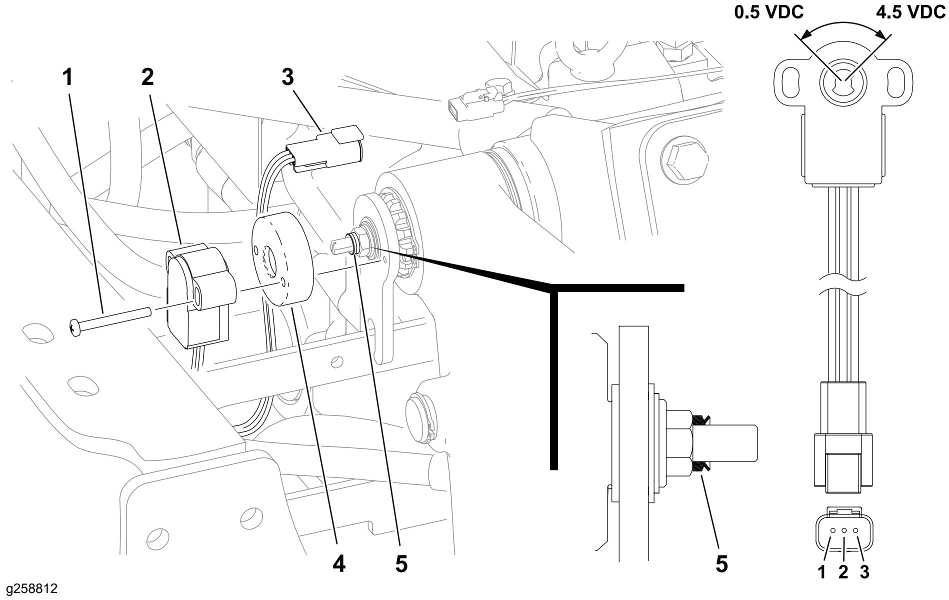


Figure 148

1. Screw (2 each)
2. Position sensor
3. Wire harness connector
4. Spacer
5. V-ring

The 3-point hitch position sensor is an analog hall effect sensor that communicates the height of the 3-point hitch to the T1: TEC. The sensor is located on the left end of the lift arm pivot shaft. The T1: TEC uses information from the sensor to control the attachment height while operating in attachment mode. The sensor signals are also constantly monitored for 3-point hitch fault detection.

If a 3-point hitch fault occurs, all automatic 3-point control is disabled and only momentary raise and lower is allowed via the paddle switches.

Note: When the optional cargo bed is installed, the 3-point hitch position sensor works in conjunction with the bed active switch to limit the maximum lift arm height.

Testing the 3-Point Hitch Position Sensor

The 3-point position sensor and its circuit wiring can be tested as a T1: TEC input using the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23). If testing determines that the sensor and its circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface and lower any attachments. Use the status display and record the hitch position number if possible before stopping the engine.
2. Disconnect the frame wire harness and remove the position sensor. Check the sensor and the harness connector for damage or corrosion.
3. Connect pin 1 to a 5 VDC power supply, and connect pin 2 to ground.
4. Using a multimeter (DC voltage setting) with the sensor rotated fully counterclockwise, approximately 0.5 VDC should be present at pin 3.
5. Using a multimeter (DC voltage setting) with the sensor rotated fully clockwise, approximately 4.5 VDC should be present at pin 3.
6. Replace the position sensor if necessary:

Testing the 3-Point Hitch Position Sensor (continued)

A. Ensure that the sensor shaft orientation is correct.

B. Loosen the jam nut.

C. Thread the sensor shaft into the lift arm pivot shaft until it bottoms out.

D. Turn the sensor shaft out until the scallops in the shaft align with the dimples in the lift arm.

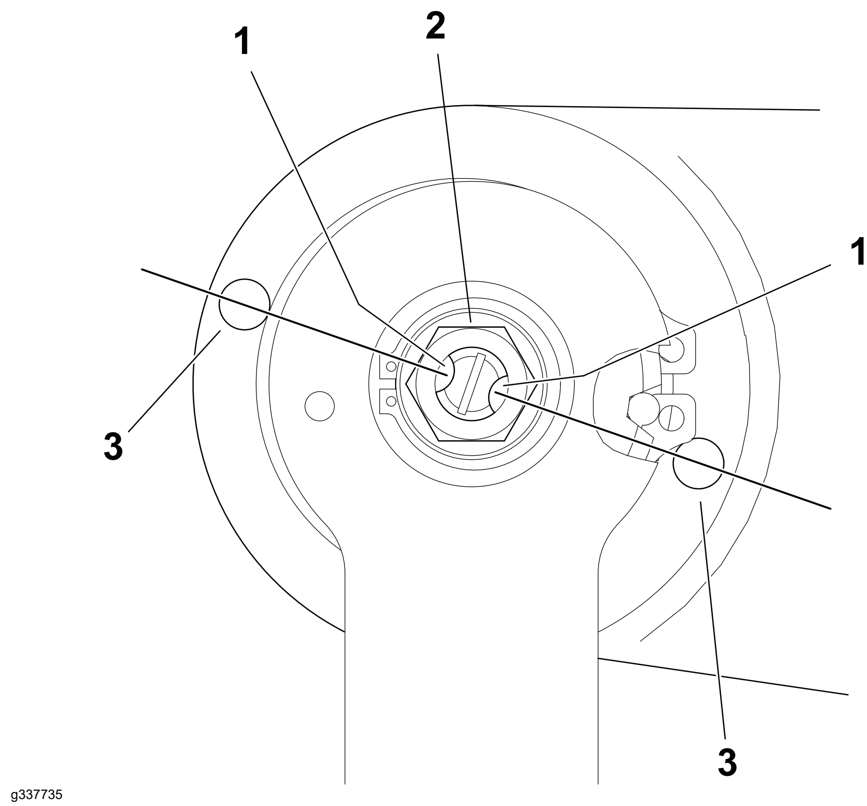


Figure 149

1. Sensor shaft “scallops”
2. Jam nut
3. Lift arm “dimples”

E. Tighten the jam nut to lock the sensor shaft in position.

F. Check the V-ring and replace it if it is worn or damaged. Install the V-ring in the correct orientation; refer to Figure 148.

G. Install the position sensor.

7. Connect the wire harness to the sensor.
8. If the position sensor tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).

Hydraulic Fluid Temperature Sender

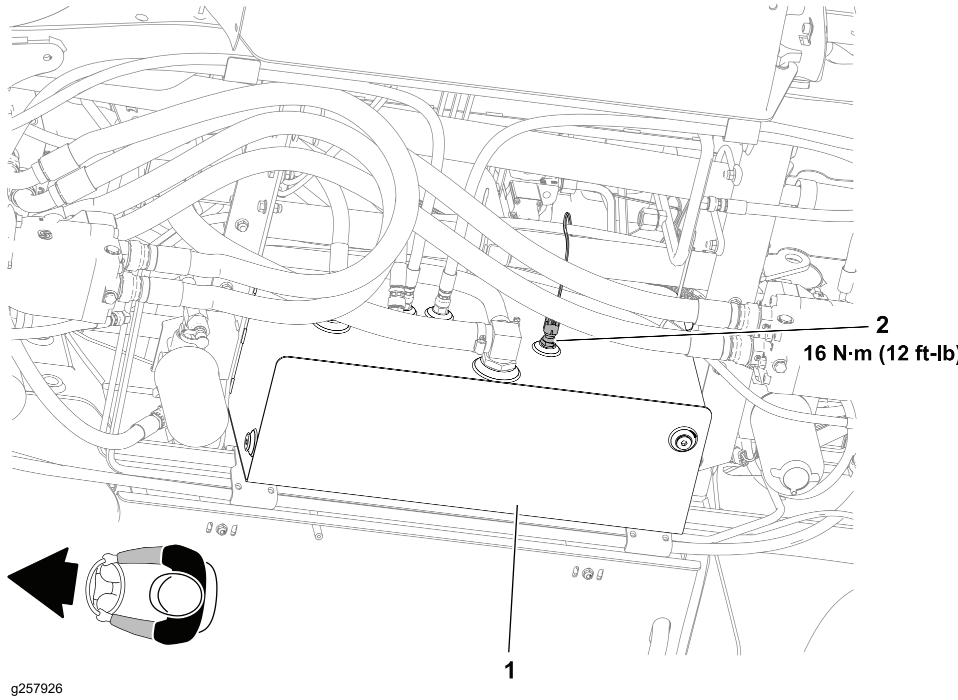


Figure 150

Bottom of the machine.

1. Hydraulic tank
2. Hydraulic temperature sender

The hydraulic fluid temperature sender is attached to the left side of the hydraulic tank. The resistance of the temperature sender decreases as the fluid temperature in the tank increases. The hydraulic fluid temperature sender is an input to the T2: TDM and provides information for the TDM hydraulic temperature gauge.

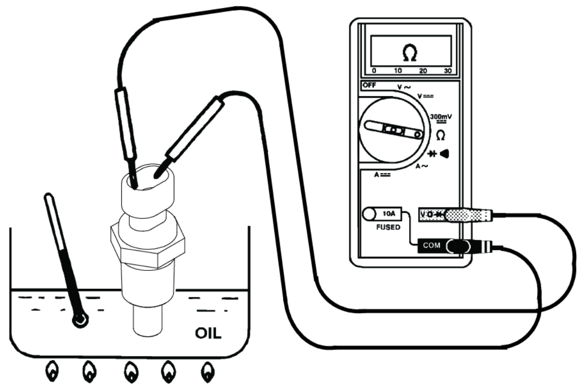
Testing the Hydraulic Fluid Temperature Sender

1. Drain or pump approximately 30 liters (8 gallons) of hydraulic tank fluid from the tank so the level is below the sender port.
2. Locate hydraulic oil temperature sender and disconnect wire harness connector.
3. Thoroughly clean the hydraulic tank around the temperature sender. Remove the sender from the tank and discard the O-ring.

CAUTION

Handle the hot oil with extreme care to prevent personal injury or fire.

Testing the Hydraulic Fluid Temperature Sender (continued)



g228834

Figure 151

4. Put the sensing end of the sender in a container of oil with a thermometer and slowly heat the oil.

   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.

5. 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 20C (68F).

   B. The meter should indicate 2.3 to 2.5 kilohms at 60C (140F).

   C. The meter should indicate 605 to 669 ohms at 100C (212F).

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

7. Use a new O-ring and install the sender in the hydraulic tank. Tighten the sender to **16 N·m (12 ft-lb)**.

8. Connect the sender to the frame wire harness.

9. Fill hydraulic system to the proper level.

Speed Sensors

Model/Serial Table (Figure 152)

Model	Serial Range
07511AA, 07511BA, and 07511DA	400000000 through 409999999
07511CA	400000000 through 409999999

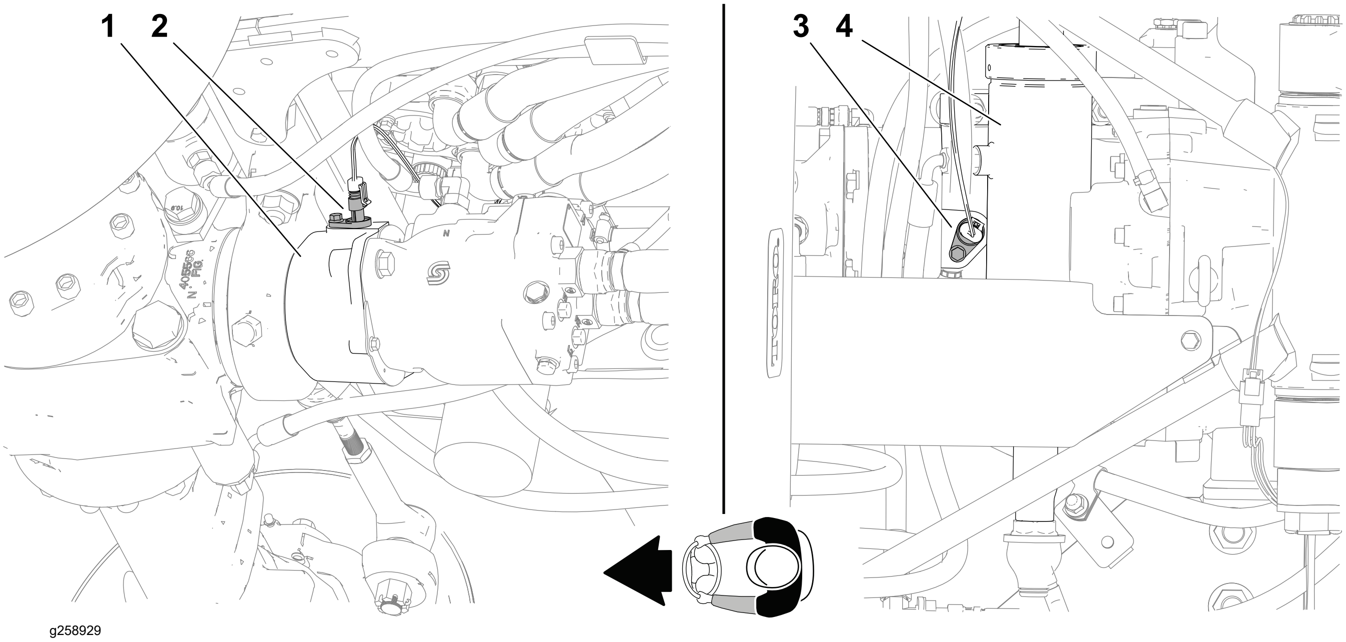


Figure 152

1. Front axle drive motor mount
2. Front speed sensor (view from underneath)
3. Rear speed sensor (view from above)
4. Rear steering cylinder

Model/Serial Table (Figure 153)

Model	Serial Range
07511AA, 07511BA, 07511CA, and 07511DA with Gearbox Reduction Kit 144-9700	400000000 through 409999999
07511AA, 07511BA, 07511CA, and 07511DA	410000000 and Higher

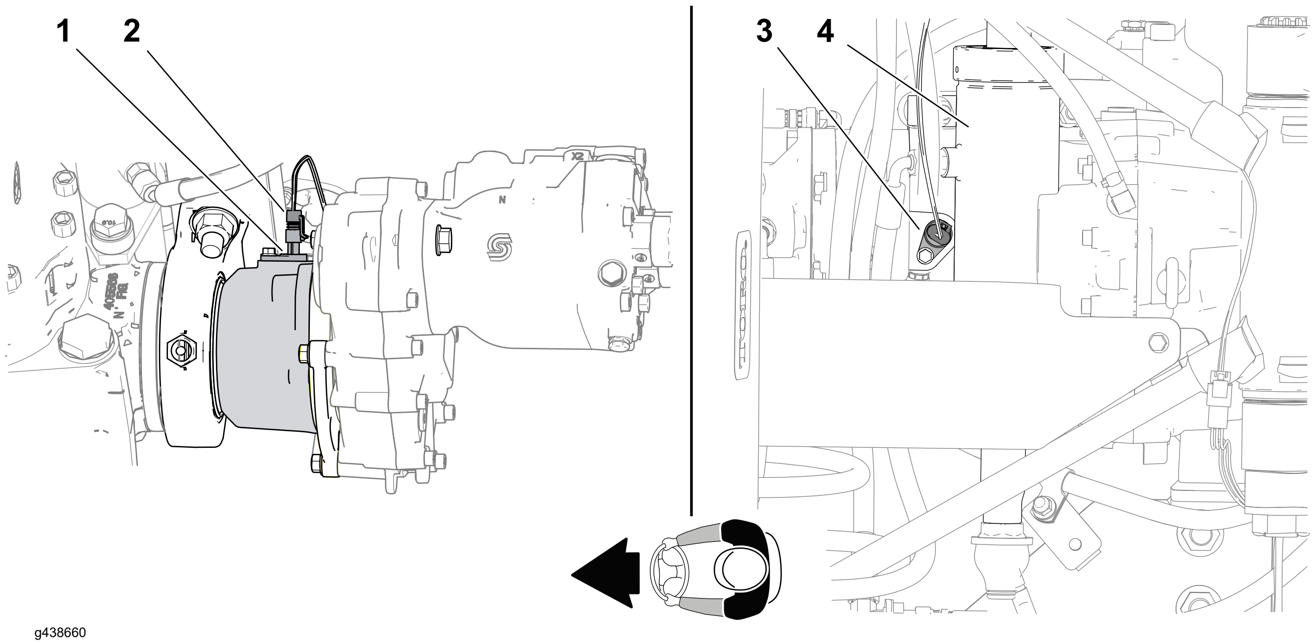


Figure 153

1. Front axle drive motor mount
2. Front speed sensor (view from underneath)
3. Rear speed sensor (view from above)
4. Rear steering cylinder

The traction system uses two speed sensors to monitor the ground speed of the machine. One speed sensor is in the front axle hydraulic-motor mount and the second speed sensor is in the rear axle hydraulic-motor mount. The T1: TEC compares information from the speed sensors and the tandem piston (traction) pump control solenoid valves to regulate traction speed. The sensor signals are constantly monitored for fault detection.

A speed sensor fault will disable the cruise control and PTO, and the machine will be forced to stop. Once the traction pedal is returned to the rest position, the machine will operate in limp home mode (reduced ground speed and PTO disabled) until the ignition key is cycled OFF and ON.

Testing the Speed Sensors

The speed sensors and their circuit wiring can be tested as a T1: TEC input using the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23). If testing determines that a sensor and its circuit wiring are not functioning correctly, proceed with the following test procedure:

Note: Testing the speed sensor requires the use of specialized equipment. In this procedure, visually inspect and clean the sensor then test the wire harnesses.

1. Park the machine on a level surface, lower any attachments and stop the engine.

   Note: It may be necessary to remove the bed to gain access the rear speed sensor.
2. Disconnect the wire harness connector from the sensor and remove the sensor from the hydraulic-motor mount.

Testing the Speed Sensors (continued)

3. Clean any corrosion from the sensor and wire harness connector contacts.
4. Check the face of the sensor for damage. Replace the sensor if the face is chipped or scratched.
5. Test the machine wire harness to the speed sensor:

   A. Set the key switch to the RUN position.

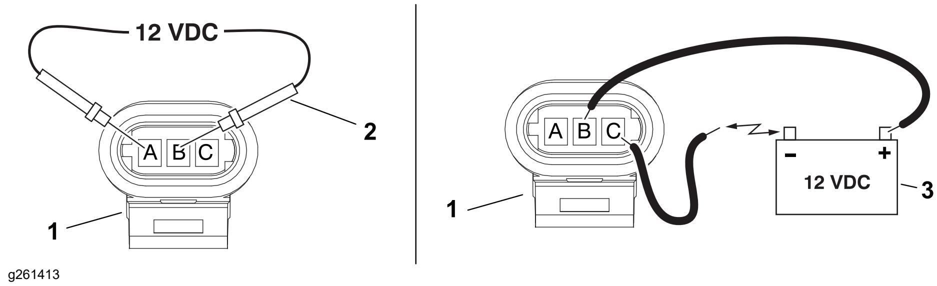


Figure 154

1. Frame harness connector
2. Multimeter probe
3. 12 VDC power supply

   B. Use a multimeter set to DC voltage and check for approximately 12 VDC across the supply (+) pin A and ground (−) pin B of the frame wire harness connector. This confirms the integrity of the circuit supply and ground wires.

   C. Navigate to the InfoCenter Traction Inputs screen and scroll down to display the Front Ground or Rear Ground readings.

   D. Connect a 12 VDC power supply across the signal (+) pin C and ground (−) pin B of the frame wire harness connector. Rapidly open and close the test circuit repeatedly. The InfoCenter speed reading should increase slightly. This confirms the integrity of the circuit ground and signal wires.

   E. Turn the key switch to OFF.

6. If the wire harness tests correctly and a circuit problem still exists, replace the speed sensor.

Traction Pressure Sensors

Model/Serial Table (Figure 155)

Model	Serial Range
07511AA, 07511BA, 07511CA, and 07511DA	400000000 through 409999999

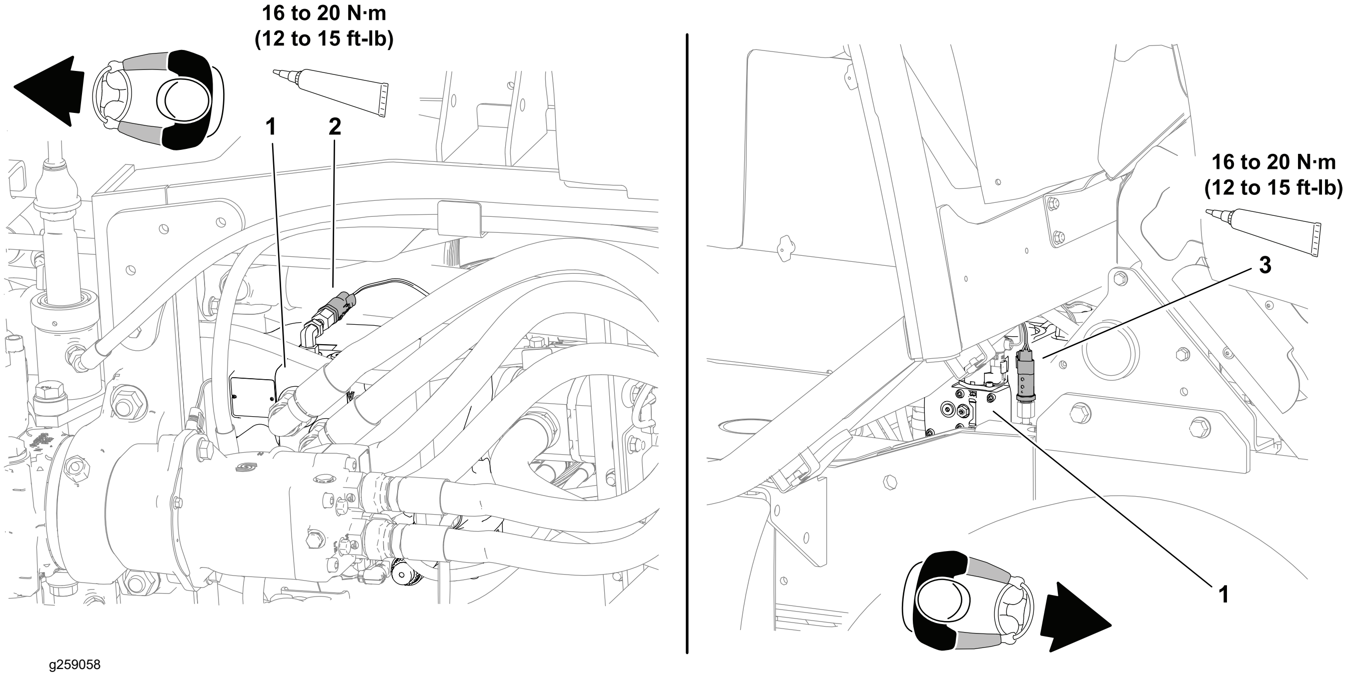


Figure 155

1. Tandem piston (traction) pump
2. Front axle pressure sensor (view from underneath)
3. Rear axle pressure sensor (view from right side of the machine)

Model/Serial Table (Figure 156)

Model	Serial Range
07511AA, 07511BA, 07511CA, and 07511DA	410000000 and higher

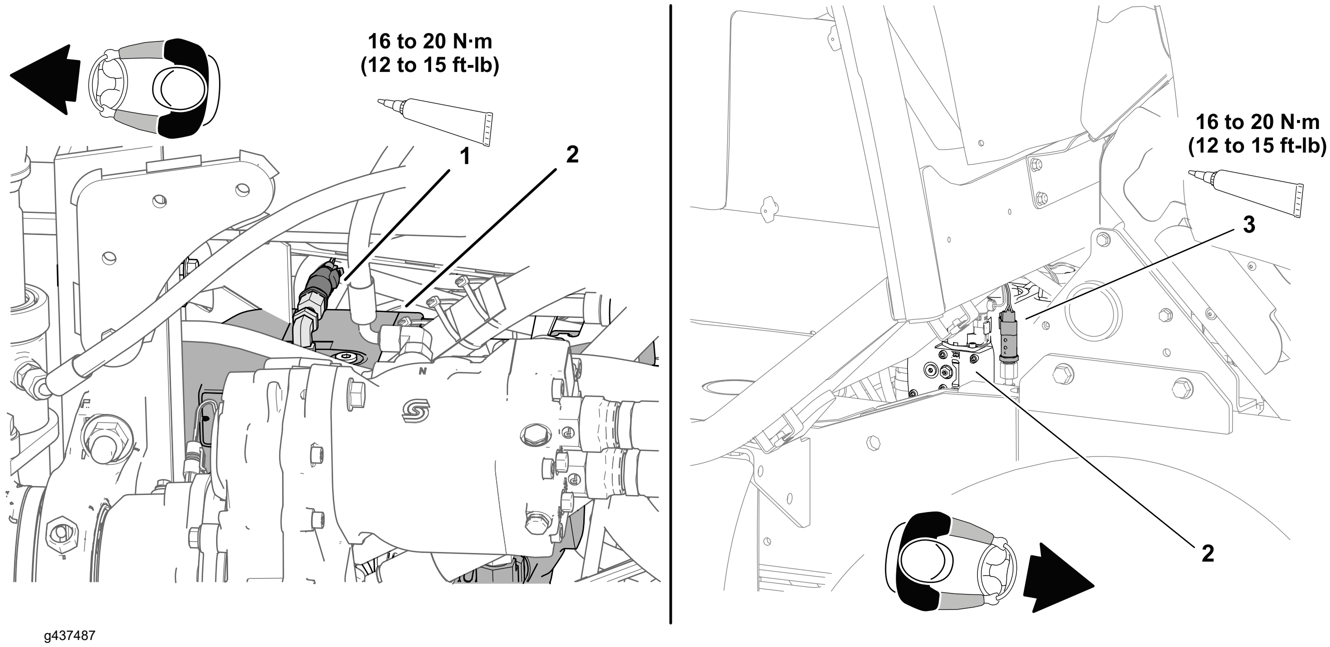


Figure 156

1. Front axle pressure sensor (view from underneath)
2. Tandem piston (traction) pump
3. Rear axle pressure sensor (view from right side of the machine)

Two pressure sensors are used to monitor the traction circuit hydraulic pressure when the machine is moving in the forward direction. The pressure sensor for the front axle drive motor circuit is located on the left side of the tandem piston pump, and the pressure sensor for the rear axle drive motor circuit is located on the right side of the tandem piston pump. The T1: TEC uses information from the sensors to assure each traction pump (front and rear) is doing the same amount of work based on system pressure. The sensor signals are constantly monitored for fault detection.

A pressure sensor fault will disable the cruise control and PTO, and the machine will be forced to stop. Once the traction pedal is returned to the rest position, the machine will operate in limp home mode (reduced ground speed and PTO disabled) until the ignition key is cycled OFF and ON.

Testing the Pressure Sensors

The pressure sensors and their circuit wiring can be tested as a T1: TEC input using the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23). If testing determines that a sensor and its circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park the machine on a level surface, lower any attachments and stop the engine.

   Note: Remove the right fender to gain access the rear axle pressure sensor.

2. Disconnect the wire harness connector from the sensor and clean any corrosion from the sensor and wire harness connector contacts.

3. Test the machine wire harness to the pressure sensor:

   A. Set the key switch to the RUN position.

Testing the Pressure Sensors (continued)

B. Navigate to the InfoCenter Traction Inputs screen and scroll down to display the Front Traction and Rear Traction readings.

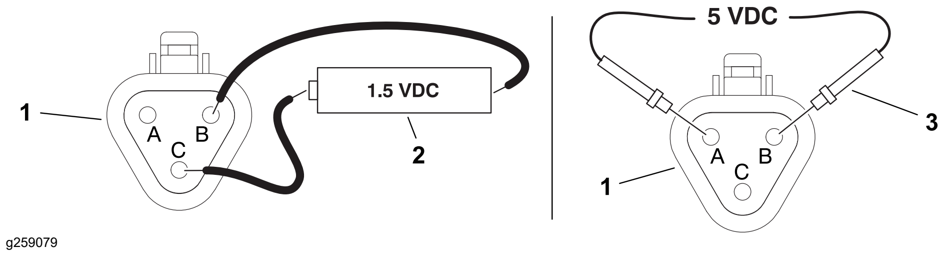


Figure 157

1. Frame harness connector
2. 1.5 V dry cell battery
3. Multimeter probe

C. Connect a 1.5 VDC dry cell battery across the signal (+) pin C and ground (−) pin B of the frame wire harness connector. A fully charged battery should produce a pressure reading of approximately 8960 kPa (1300 psi) on the InfoCenter display. This confirms the integrity of the circuit ground and signal wires.

D. Use a multimeter set to DC voltage and check for approximately 5 VDC across the supply (+) pin A and ground (−) pin B of the frame wire harness connector. This confirms the integrity of the circuit supply and signal wires.

E. Turn the key switch to OFF.

4. Test the pressure sensor:

   A. Remove the pressure sensor.

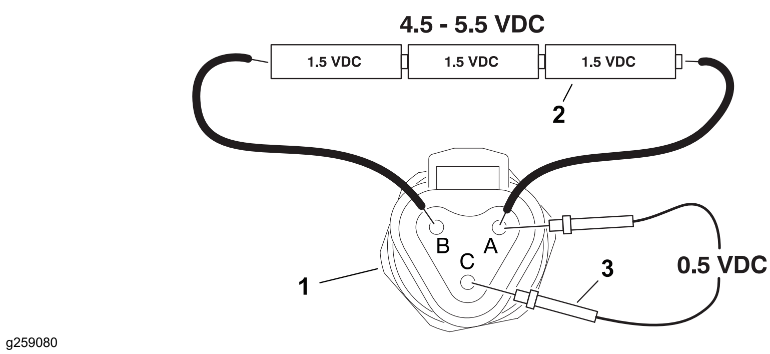


Figure 158

1. Pressure sensor
2. 4.5 to 5.5 VDC power supply
3. Multimeter probe

   B. Connect a 4.5 to 5.5 VDC power supply to the supply (+) pin A and ground (−) pin B of the sensor.

   C. Connect a multimeter set to DC voltage to the signal (+) pin C and ground (−) pin B of the sensor. A small amount of voltage (0.5 VDC) should be present on the multimeter display.

5. Replace pressure sensor if necessary. Apply thread sealant to the sensor threads prior to installation and tighten to **16 to 20 N·m (12 to 15 ft-lb)**.

6. Connect the frame wire harness to the pressure sensor after testing.

Fuel Pump

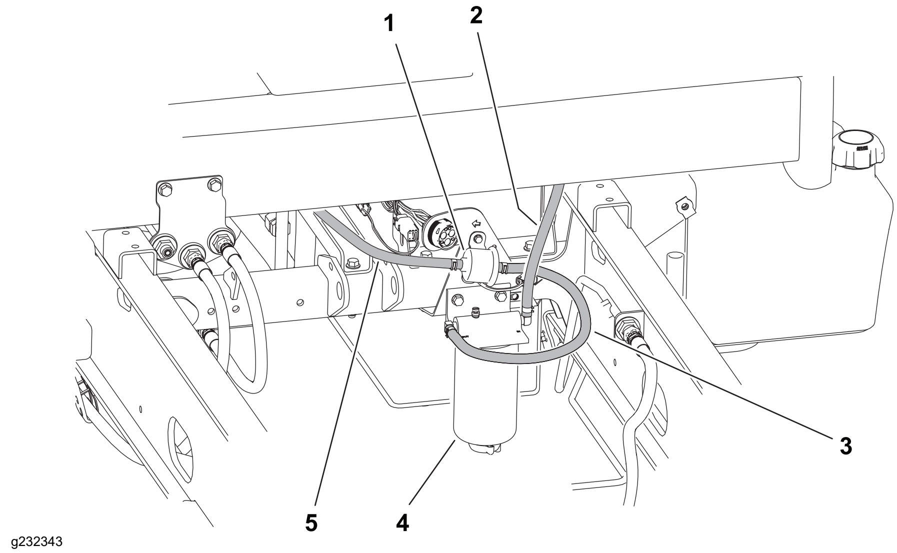


Figure 159

1. Fuel pump
2. Fuel hose (from tank)
3. Fuel hose (separator to pump)
4. Fuel/Water separator
5. Fuel hose (to engine)

Fuel Pump Specifications

Pump Capacity	700 ml (23.5 fluid ounces) per minute
Pressure	22.8 kPa (3.3 psi)
Current Draw	0.9 amp

Testing the Fuel Pump

The electric fuel pump is near the right frame rail behind the hydraulic reservoir. Testing the fuel pump involves measuring the amount of fuel an unrestricted pump can deliver over a fixed amount of time.

1. Park the machine on a level surface, lower any attachments and set the key switch to OFF.
2. Make sure fuel hoses are in good condition and free of obstructions.

   Note: Since the fuel/water separator is upstream of the fuel pump, the condition of the fuel/water separator will influence fuel pump performance.
3. Drain the fuel/water separator; refer to the traction unit *Operator's Manual*. Verify filter element age and condition and replace if necessary.
4. Disconnect the fuel hose coming from the fuel pump at the engine fuel filter.

Testing the Fuel Pump (continued)

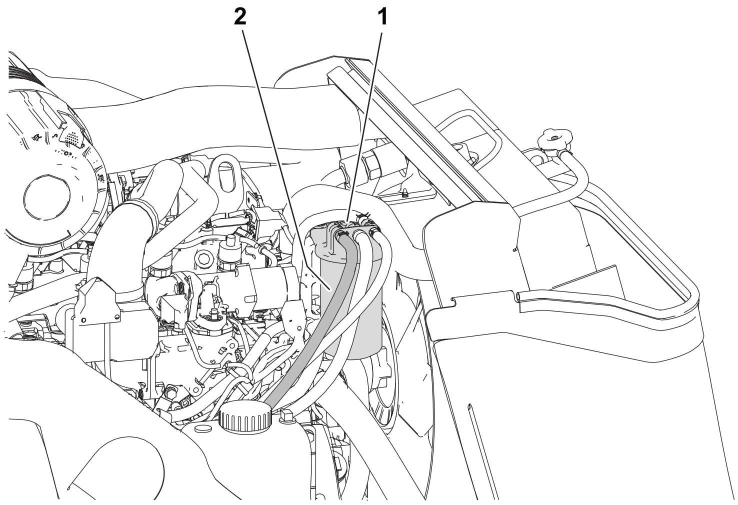


Figure 160

1. Engine fuel filter
2. Fuel hose (from pump)

IMPORTANT

When testing the fuel pump output, do not turn the key switch to the START position.

5. Place the disconnected hose end into a 0.95 liter (1 quart) graduated cylinder and set the key switch to the ON/RUN position for 30 seconds. The pump should deliver approximately **350 ml (11.8 ounces) in 30 seconds**. Replace the fuel pump if necessary.
6. Connect fuel hoses and secure with hose clamps.
7. Prime the fuel system; refer to Priming the Fuel System (page 4–15).

Fuel Level Sender

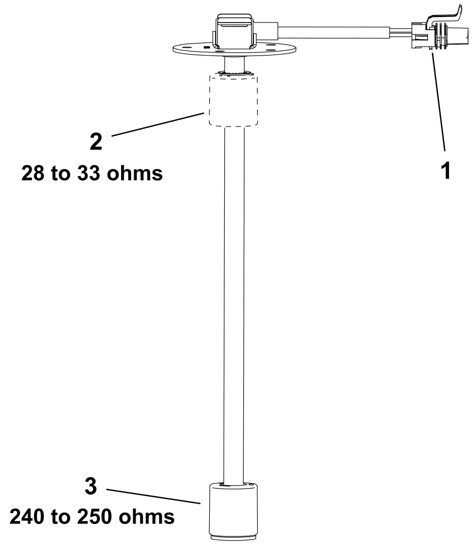


Figure 161

1. Wire harness connector
2. Float in full (up) position
3. Float in empty (down) position

The fuel level 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 T2: TDM and provides information for the TDM fuel gauge. The fuel sender is a sliding float design with a single wire harness connector.

Testing the Fuel Level Sender

1. Remove the fuel tank assembly; refer to Removing and Installing the Fuel Tank (page 4–15).
2. Remove screws and lock washers that secure the fuel sender to the fuel tank.
3. Carefully remove fuel sender and gasket from the fuel tank. Clean all fuel from the sender.
4. Inspect sender gasket for damage and replace if necessary.
5. Verify fuel sender float moves freely through its entire range of operation.

   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.

6. Using a multimeter (ohms setting), check the resistance of the sender at the harness connector with the float in the full (up) position, and in with the float in the empty (down) position.
7. Replace sender if testing determines that it is faulty.
8. If the sender tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
9. Carefully install sender into fuel tank and install fuel tank assembly.

Warning Buzzer

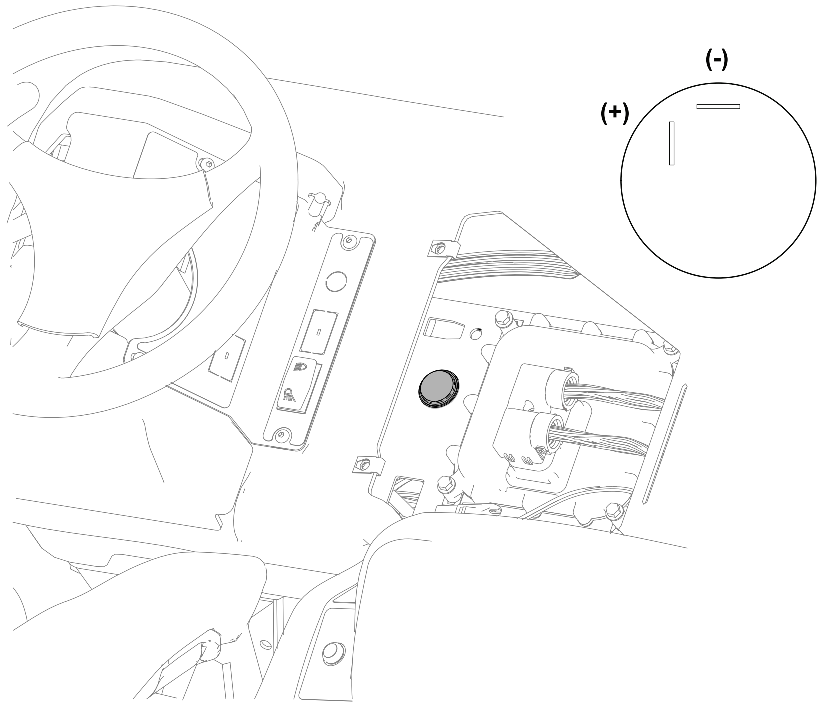


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Figure 162

Main instrument panel removed for clarity.

The warning buzzer sounds to notify the operator when a machine problem exists. Electrical current for the buzzer is provided as an output from the T2: TDM . The warning buzzer is attached to the machine under the main instrument panel.

Testing the Warning Buzzer

1. Remove the dash cover; refer to Removing the Dash Cover (page 8–25)
2. Disconnect the platform wire harness connector from the buzzer.

IMPORTANT

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

3. Connect a 12 VDC power supply to the buzzer (+) terminal and a ground to the (-) terminal. The buzzer should sound.
4. Replace the buzzer if necessary.
5. Connect the platform wire harness to the buzzer and install the dash cover.

Relays with 4 Terminals

Outcross 9060 machines uses several electrical relays that have four (4) terminals. A tag near the wire harness relay connector can be used to identify each relay.

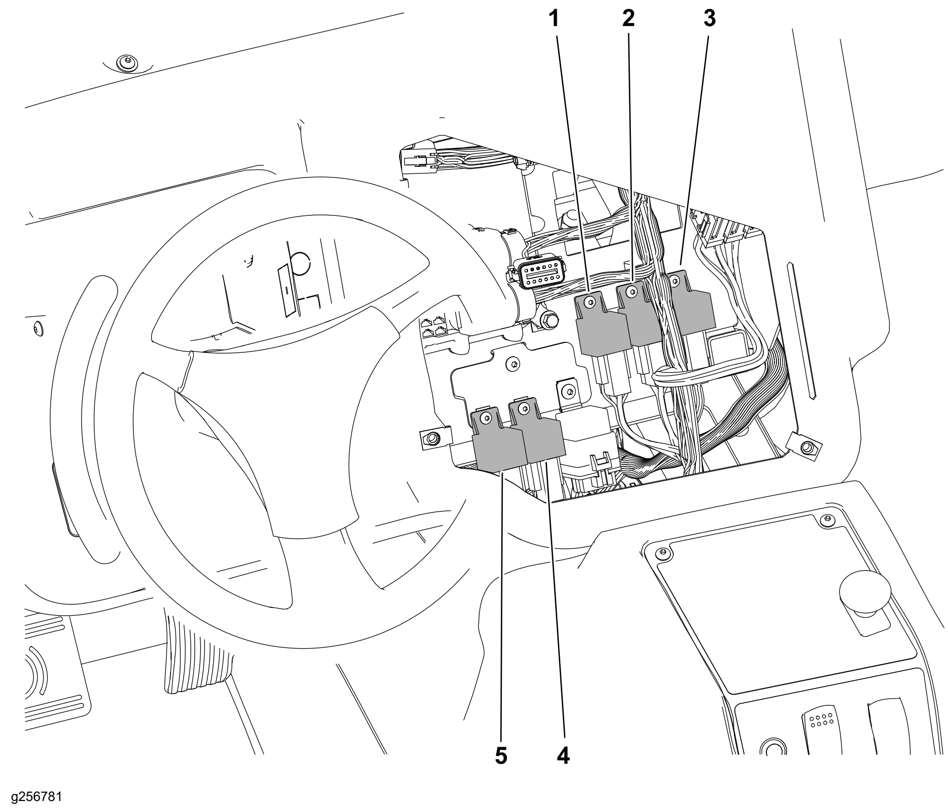

Figure 163

1. Main power relay
2. Rear attachment relay
3. Cab power relay
4. Start Relay
5. Glow plug relay

The following relays are located under the main instrument panel:

- The main power relay supplies power to the fuses (and all circuits protected by the fuses) in the main fuse block rows 1, 3, 4 and 5; refer to Fuse Identification, Location and Function (page 6–14). The main power relay is energized when the key switch is in the START or RUN position.
- The cab power relay supplies power to the fuses (and all circuits protected by the fuses) in the cab fuse block; refer to Fuse Identification, Location and Function (page 6–14). The cab power relay is energized when the key switch is in the START or RUN position.
- The rear attachment power relay supplies power to rear attachments via the 7-pin rear attachment harness connector. The rear attachment power relay is energized when the key switch is in the START or RUN position.
- The start relay supplies power to the engine starter. The start relay is energized by the Yanmar engine ECU.
- The glow plug relay supplies power to the engine glow plugs. The glow plug relay is energized by the Yanmar engine ECU.

Testing Relays with 4 Terminals

1. Make sure key switch is OFF. Remove key from key switch.

Testing Relays with 4 Terminals (continued)

2. Disconnect the ground cable at the battery; refer to Removing the Battery (page 6–83).
3. Access the relay to be tested and disconnect the wire harness connector from the relay. Remove the relay from the mounting bracket for testing.

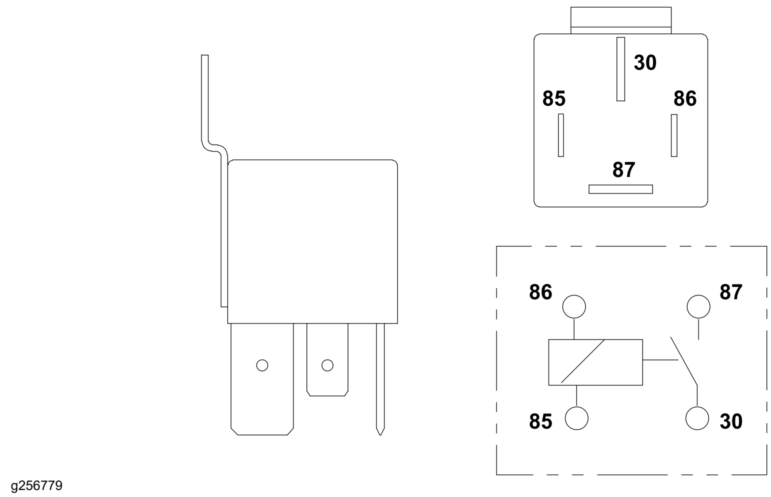

Figure 164

Relay with 4 Terminals

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.

4. Using a multimeter (ohms setting), measure coil resistance between terminals 85 and 86. Resistance should be between 70 and 100 ohms.
5. Verify infinite resistance (no continuity) exists between terminals 30 and 87.
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. Replace the relay as necessary.
8. If the relay tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
9. Connect the wire harness, install any items removed to access the relay, and connect the battery ground cable.

Relays with 5 Terminals

Outcross 9060 machines uses several electrical relays that have five (5) terminals. A tag near the wire harness relay connector can be used to identify each relay.

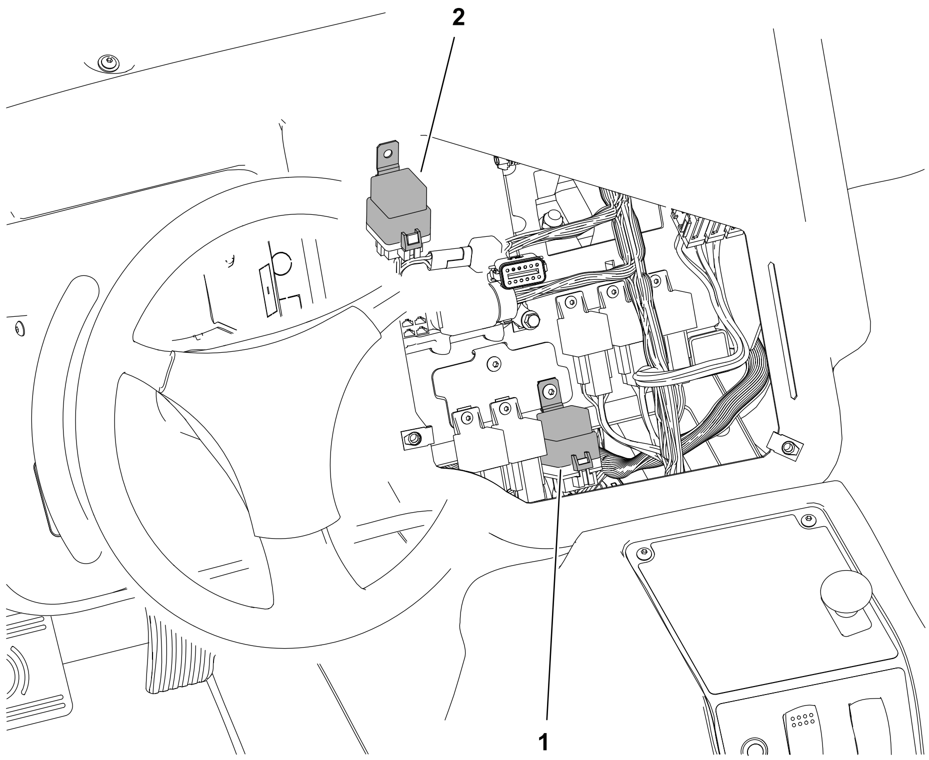

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Figure 165

1. EGR relay
2. Brake light relay (optional)

The Exhaust Gas Recirculation (EGR) relay is located under the main instrument panel. The EGR relay is used to provide current to the engine EGR valve. The EGR relay is energized by the Yanmar engine ECU.

The brake light relay for the optional International Road Light kit is located under the main instrument panel. The brake light relay is used to provide power to the brake lights on international machines only. The brake light relay is energized by the T1: TEC.

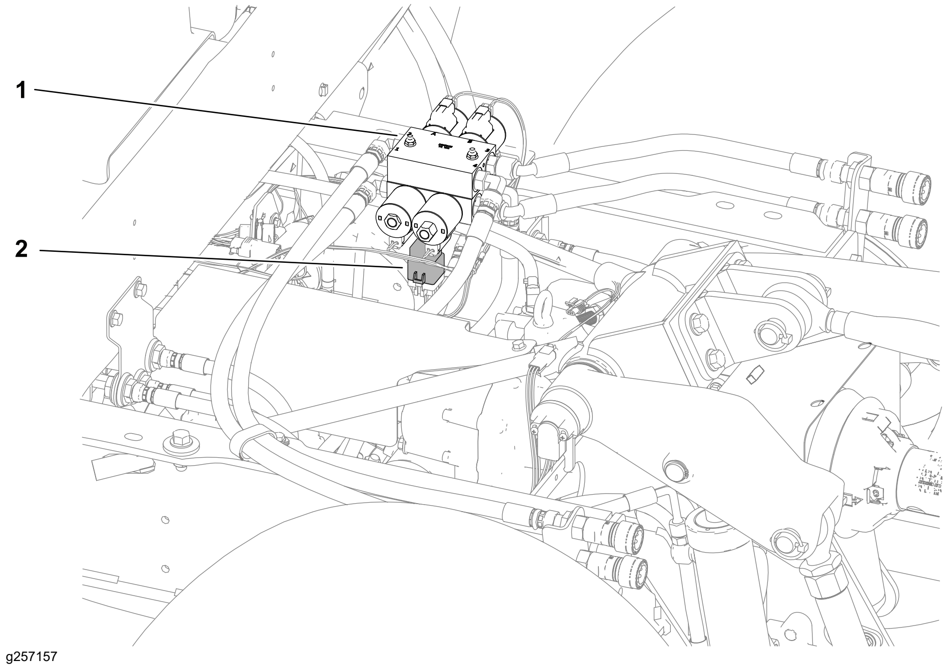


Figure 166

Shown with bed removed.

1. Rear SCV hydraulic manifolds
2. Rear SCV relay

The optional rear Selector Control Valve (SCV) relay is located below the rear SCV hydraulic manifolds. The rear SCV relay is used to provide current to the 4 rear SCV hydraulic solenoid valves. The rear SCV relay is energized by the T1: TEC.

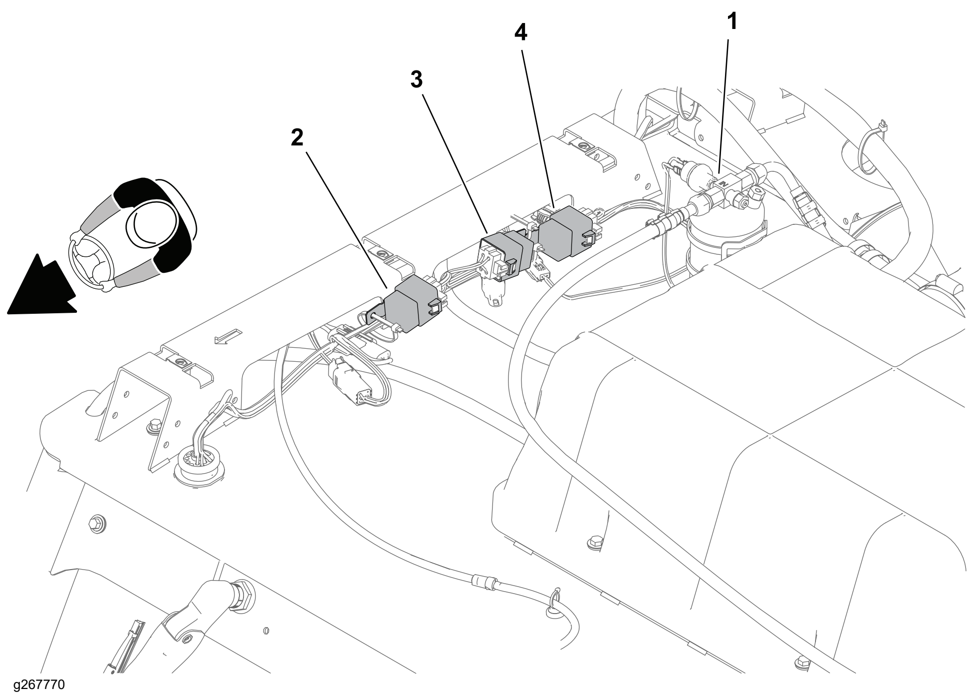


Figure 167

1. Refrigerant receiver drier
2. AC condenser fans relay
3. AC switch signal relay
4. AC clutch relay

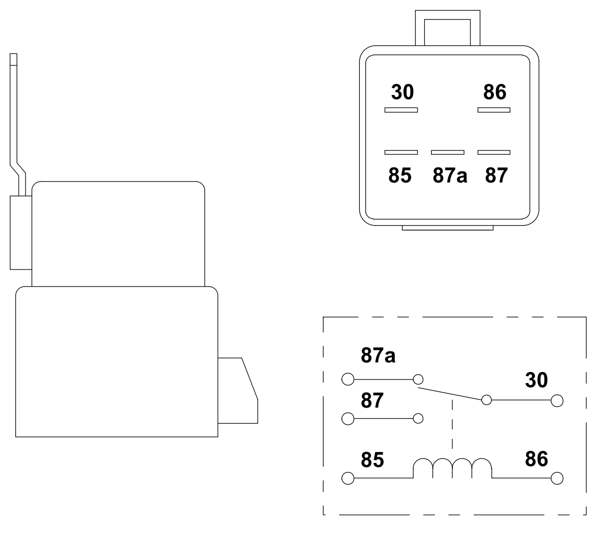
The three relays used to control the air conditioning (AC) system are located under the cab cover.

- The AC condenser fans relay provides current to both condenser fans and the AC clutch relay. The AC condenser fans relay is energized by the air conditioning system thermostat.
- The AC switch signal relay is an input to the T1: TEC. The relay is energized by the AC On/Off switch. The T1: TEC monitors the condition of the signal relay and increases the engine low idle RPM when the AC system is On.
- The AC clutch relay and the AC condenser fans relay must be energized to engage the compressor clutch. The AC clutch relay is energized by the thermostat if the minimum AC system pressure exists (AC pressure switch closed).

Testing Relays with 5 Terminals

The AC switch signal relay, working with the air conditioning on/off switch, and its circuit wiring can be tested as a T1: TEC input using the InfoCenter display; refer to Using the InfoCenter display for Troubleshooting (page 3–23). If testing determines that the relay and its 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 ground cable at the battery; refer to Removing the Battery (page 6–83).
3. Access the relay to be tested and disconnect the wire harness connector from the relay. Remove the relay from the mounting bracket for testing.



g256780

Figure 168

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, verify that coil resistance between terminals 85 and 86 is from 71 to 88 ohms.
5. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should

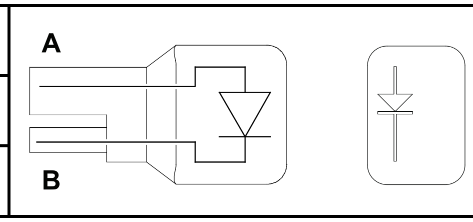
Testing Relays with 5 Terminals (continued)

make and break continuity between terminals 30 and 87 as +12 VDC is applied and removed from terminal 85.

6. 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.
7. Replace the relay as necessary.
8. If the relay tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
9. Connect the wire harness, install any items removed to access the relay, and connect the battery ground cable.

Diode Assemblies

Multimeter Red (+) Lead	Multimeter Black (-) Lead	Resistance
DIODE TERMINAL A	DIODE TERMINAL B	VERY LOW
DIODE TERMINAL B	DIODE TERMINAL A	VERY HIGH



Five (5) different diodes are used on the Outcross 9060 machines. The maximum current allowed through any of the diodes is 6 amps. The diodes can be identified by their black color and diode symbol on the end of the diode body.

- 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 starter motor.
- 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.
- A diode assembly (D3) is used for circuit protection from voltage spikes that occur when the optional horn is energized. The diode plugs into the engine wire harness near the Yanmar ECU.
- A diode assembly (D4) is used to control current flow between the hazard switch and the turn signal switch of the optional International Road Light Kit – right side lights. The diode plugs into the international road light wire harness behind the main instrument panel.
- A diode assembly (D5) is used to control current flow between the hazard switch and the turn signal switch of the optional International Road Light Kit – left side lights. The diode plugs into the international road light wire harness behind the main instrument panel.

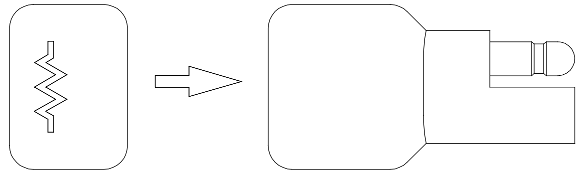
Testing the Diode Assemblies

1. Locate and remove the diode from the wire harness.
2. 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 table provided and a multimeter (ohms setting) to measure the resistance across the diode terminals.
3. Replace the diode if necessary.
4. If the diode tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).

Resistor Assembly



g257660

Figure 169

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. The resistor can be identified by its gray color and resistor symbol on the end of the resistor body.

Testing the Resistor Assembly

1. Disconnect the resistor from the wire harness.
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.
3. If the resistor tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).

CAN bus Terminator Resistors

System communication between various electrical components on Outcross 9060 machines is accomplished on a CAN bus communications network. Two specially designed, twisted wires form the CAN–bus. These wires provide the data pathways between the components on the network. The engineering term for these cables are CAN High and CAN Low. The CAN bus wires are yellow (CAN High) and green (CAN Low). A 120-ohm termination resistor is located at each end of the CAN bus.

One resistor is part of a short harness plugged into the platform wire harness #2 expansion port (external) and is replaceable separately. The expansion port is located near the rear attachment electrical connector below the right rear corner of the operator platform.

The second CAN bus termination resistor is part of the Yanmar engine ECU (integrated) and can be tested as part of the CAN bus wiring. The integrated termination resistor is not replaceable separately.

Note: Refer to Appendix A (page A–1) for additional information on the CAN bus wiring.

IMPORTANT

Both terminator resistors are required for proper electrical system operation.

Testing the CAN bus Terminator Resistors

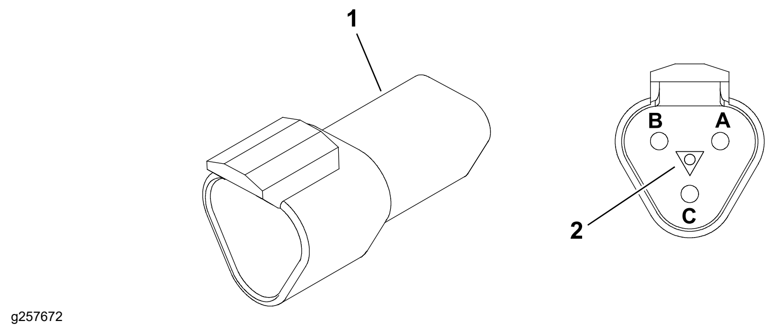


Figure 170

1. CAN bus terminator resistor (external)
2. Keyway

1. One terminator resistor is external (plugged into the platform wire harness #2 expansion port located near the rear attachment electrical connector below the right rear corner of the operator platform). Locate the external termination resistor and unplug it from the wire harness for testing.

   The insulator wedge in the external 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.

   A. Make sure that key switch is OFF, and key is removed from switch.

   B. Use a digital multimeter (ohms setting) to measure the resistance value for the external termination resistor. There should be 120 ohms resistance between terminals A and B.

   C. If testing determines the external termination resistor is faulty, replace the resistor.

   D. After testing is complete, make sure the external termination resistor is fully installed into the connector and secured to the wire harness.

Testing the CAN bus Terminator Resistors (continued)

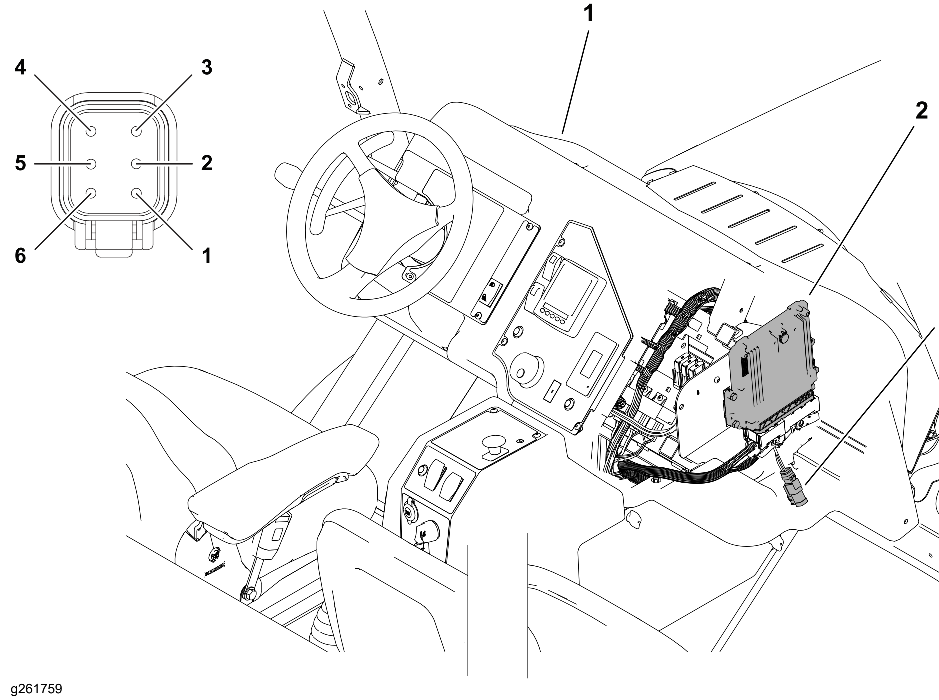


Figure 171

1. Dash cover
2. Engine ECU
3. Yanmar SA-D connector

---

2. One CAN bus termination resistor is integrated into the Yanmar engine ECU.
   A. Make sure that key switch is OFF, and key is removed from switch.
   B. Unplug the external terminator resistor from the platform wire harness (located near the rear attachment electrical connector below the right rear corner of the operator platform).
   C. Locate and remove the cap from the Yanmar SA-D connector.
   D. Use a digital multimeter (ohms setting) to measure the resistance value for the integrated termination resistor. There should be 120 ohms resistance between terminals 2 and 3 of the Yanmar SA-D connector.
   E. If testing determines the integrated termination resistor is faulty, replace the engine ECU; contact an Authorized Toro Distributor for assistance.
   F. After testing is complete, install the SA-D connector cap, and make sure the external termination resistor is fully installed into the connector and secured to the wire harness.
3. If the resistors test correctly and a circuit problem still exists, check the remainder of the CAN–bus; refer to Appendix A (page A–1) or contact an Authorized Toro Distributor for assistance.

Hydraulic Solenoid Valve Coils

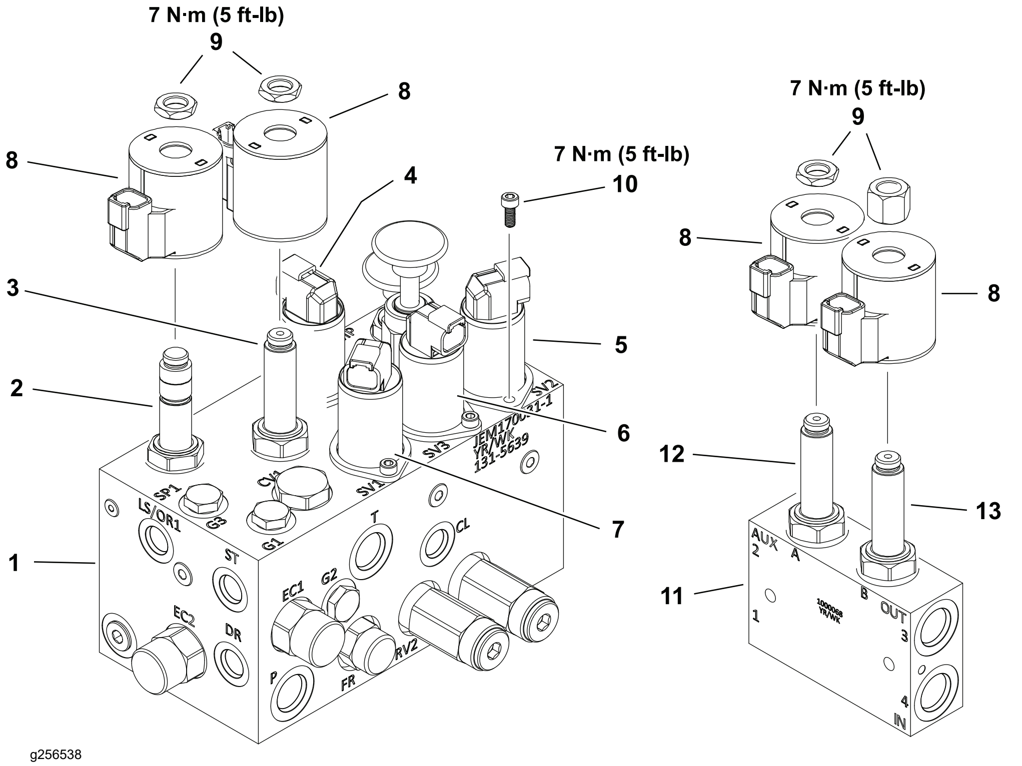


Figure 172

1. Main manifold
2. Solenoid valve SP1
3. Solenoid valve SP2
4. Solenoid valve EH
5. Solenoid valve SV2
6. Solenoid valve SV3
7. Solenoid valve SV1
8. Replaceable coil
9. Coil nut
10. Capscrew
11. SCV manifold (optional)
12. Solenoid valve SCV Enable (N.C.)
13. Solenoid valve SCV Enable (N.O.)

Electric coil actuated hydraulic valves are used on the main manifold and the optional Selector Control Valve (SCV) manifolds. When the coil or the coil relay is energized by the T1: TEC, the hydraulic valve shifts to control hydraulic flow.

The InfoCenter will not identify a faulty solenoid coil or solenoid circuit wiring problem. The InfoCenter display can be used to verify that output current from the appropriate controller is available for the solenoid coil, but the display will not verify that the solenoid coil and circuit wiring is functioning correctly; refer to Using the InfoCenter display for Troubleshooting (page 3–23). 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).

Testing the Hydraulic Solenoid Valve Coils

Typically, a failed solenoid coil will either be shorted (very low or no resistance) or open (infinite resistance).

1. Locate the hydraulic solenoid valve coil to be tested and disconnect the wire harness connector from the coil.

Testing the Hydraulic Solenoid Valve Coils (continued)

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 to obtain an accurate reading.

2. Using a multimeter (ohms setting), measure the resistance between the two (2) connector terminals on the solenoid coil. The resistance for the solenoid coils is identified below:

   A. The coils of solenoid valves SP1 and SP2 on the main manifold, and the optional SCV solenoid valve coils are the same. Resistance of these coils should be approximately **7.1 ohms when tested at 20 C (68 F)**. These are replaceable coils.

   B. The coils of solenoid valves SV1, SV2, SV3 and EH on the main manifold are the same. Resistance of these coils should be approximately **7.3 ohms when tested at 20 C (68 F)**. These are not replaceable coils. If one of these coils fail a resistance test, replace the entire valve assembly; refer to Cartridge Valve Service (page 5–109).

3. Replace serviceable coils as necessary:

   A. Remove the nut from the hydraulic valve.

   B. Slide the solenoid coil from the valve.

   C. Clean any corrosion or dirt from the valve stem.

   D. Install the coil and the nut onto the valve and tighten nut to **7 N·m (60 in-lb)**.

4. If the solenoid coil resistance is correct and a circuit problem still exists, check the wire harness; refer to Appendix A (page A–1).

5. After testing is completed, connect the wire harness connector to the solenoid coil.

Tandem Traction (Piston) Pump Control Solenoid Coils

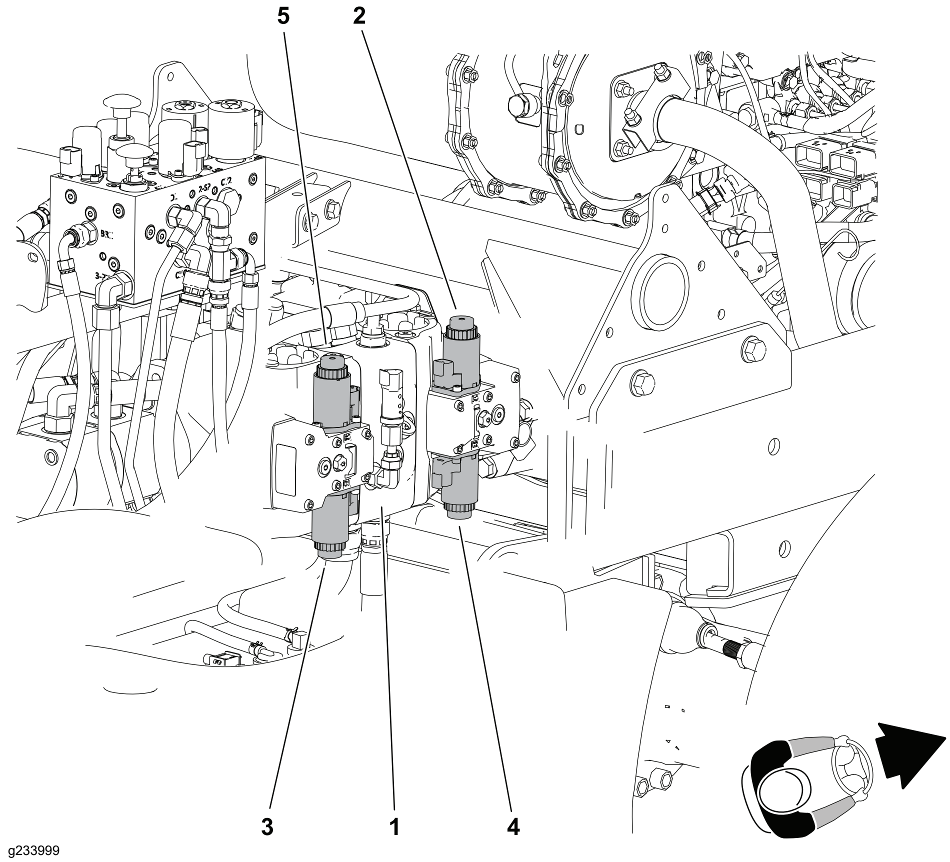


Figure 173

1. Tandem piston (traction) pump (P1 and P2)
2. Solenoid AB-C1 (front pump valve C1 – forward)
3. Solenoid CD-C1 (rear pump valve C1 – forward)
4. Solenoid AB-C2 (front pump valve C2 – reverse)
5. Solenoid CD-C2 (rear pump valve C2 – reverse)

The tandem traction (piston) pump uses two separate electronic control assemblies. One assembly controls the output for the front pump and one for the rear pump. Each control assembly includes two (2) electrically controlled solenoid valves. One solenoid valve controls the pump displacement in the forward direction, and the other controls the pump displacement in the reverse direction. The control assemblies are attached to the right side of the piston pump. Electrical outputs from the T1: TEC supplies power to the solenoid coils. The coils are named for the pump they control (AB = front pump and CD = rear pump) and their control function (C1 = forward direction and C2 = reverse direction).

Note: The InfoCenter will not identify a faulty solenoid coil or solenoid circuit wiring problem. The InfoCenter display can be used to verify that output current from the appropriate controller is available for the solenoid coil, but the display will not verify that the solenoid coil and circuit wiring is functioning correctly; refer to Using the InfoCenter display for Troubleshooting (page 3–23). 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, circuit wiring, hydraulic problem).

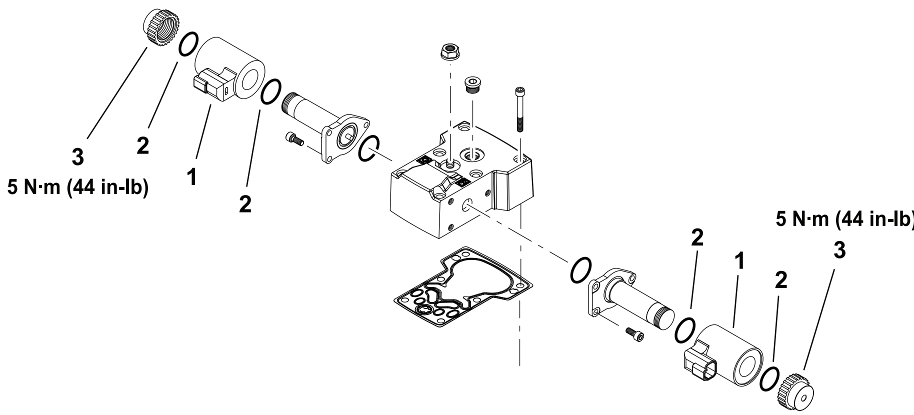
Testing the Pump Control Solenoid Coil

Typically, a failed solenoid coil will either be shorted (very low or no resistance) or open (infinite resistance).

1. Locate the pump control solenoid coil to be tested and disconnect the wire harness connector from the coil.

   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 to obtain an accurate reading.

2. Using a multimeter (ohms setting), measure the resistance between the two (2) connector terminals on the solenoid coil. Coil resistance should be **3.66 ohms when tested at 20 C (68 F)**.



g256511

Figure 174

1. Solenoid coil
2. O-ring (2 each)
3. Coil nut

---

3. Replace the coil as necessary:

   A. Use a 12-point, 26 mm socket to remove the coil nut.

   B. Slide the coil and O−rings from the 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 the new coil with O−rings onto the valve stem.

   D. Use a 12-point, 26 mm socket to install and tighten the coil nut from **5 N·m (44 in−lb)**. Do not over−tighten coil nut.

4. If the solenoid coil resistance is correct and a circuit problem still exists, check the wire harness; refer to Appendix A (page A–1).

5. After testing is completed, connect the wire harness connector to the solenoid coil.

Service and Repairs

Note: For engine component repair information, see the *Yanmar TNV (Tier 4) Series Service Manual* or *Yanmar Tier 4 and Stage V TNV Troubleshooting Manual.*

Caring for the Battery

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.**

---

1. When using a maintainable battery, the battery-electrolyte must be kept at the proper level.
2. The top of the battery must be kept clean.
3. If the machine is stored in a location where the temperatures are extremely high, the battery will discharge more rapidly than if the machine is stored in a location where the temperatures are cool.
4. Check battery condition weekly or after every 50 hours of operation. Keep terminals and entire battery case clean because a dirty battery will discharge slowly.

   IMPORTANT

   Do not remove fill caps while cleaning.

   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 Toro Part No. 107-0392 battery terminal protector or petroleum jelly to prevent corrosion.

WARNING

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

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

---

5. Tighten the battery cables on the battery terminals to provide a good electrical contact.
6. If corrosion occurs at the battery terminals, disconnect the battery cables. Always disconnect the negative (-) cable first. Clean the cable clamps and terminals separately. Connect the battery cables. Always connect the

Caring for the Battery (continued)

positive (+) cable first. Apply a coating of Toro Part No. 107-0392 battery terminal protector or a light coat of petroleum jelly to the terminals to reduce corrosion after you make the connections.

7. Check the battery-electrolyte level every 25 operating hours and every 30 days if machine is in storage.

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

8. Maintain the cell level with the distilled or demineralized water.

Storing the Battery

If you store the machine for more than 30 days:

1. Remove the battery and charge it fully; refer to Charging the Battery (page 6–86).
2. Store the battery:
   - on a shelf or on the machine
   - with cables disconnected if stored on the machine
   - in a cool atmosphere to avoid quick deterioration of the battery charge
   - in an environment that will not be below freezing for an extended period

Servicing the Battery

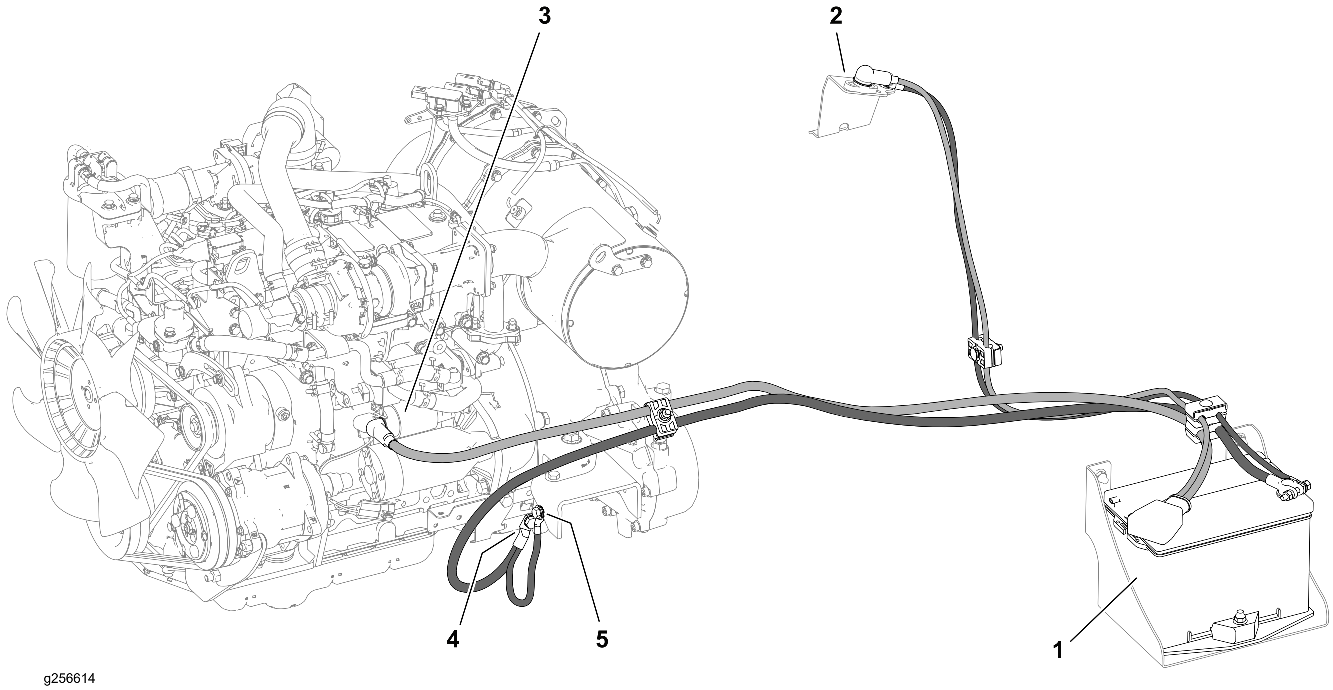


Figure 175

1. Battery
2. Operator platform terminal block
3. Starter motor
4. Engine ground connection
5. Chassis ground connection

Battery Specifications

Battery-electrolyte specific gravity	Fully Charged: 1.25 to 1.28 at 27°C (80°F) Discharged: less than 1.24
Battery specifications	BCI Group 34 690 CCA at -18°C (0°F) Reserve Capacity of 110 minutes at 27°C (80°F)
Battery dimensions (including terminal posts and caps)	Length 19.6 cm (10.9 inches) Width 13.2 cm (6.6 inches) Height 18.3 cm (8.0 inches)

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

CAUTION

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

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

Removing the Battery

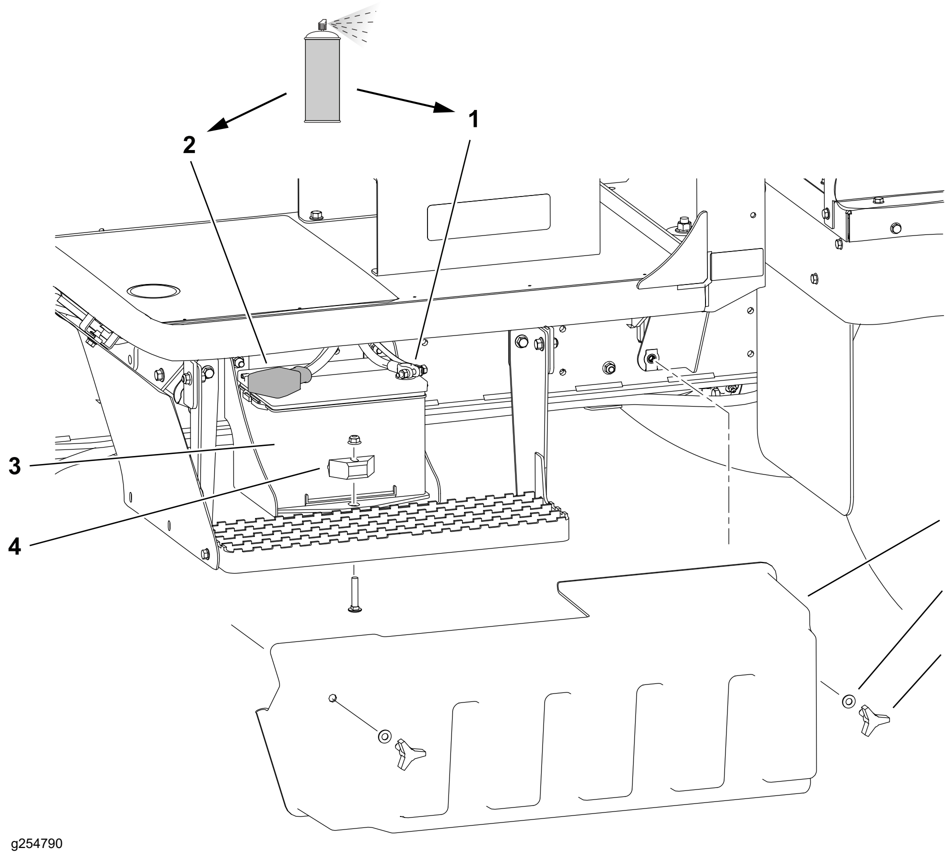


Figure 176

1. Negative (-) battery cable
2. Positive (+) battery cable
3. Battery
4. Battery retainer
5. Side cover
6. Washer (2 each)
7. Knob (2 each)

IMPORTANT

Be careful when removing the battery cables and ensure that you do not damage the terminal posts or cable connectors.

---

1. Ensure that the key switch and all accessories are in the OFF position.
2. Remove the knobs, washers, and side cover from the left side of the machine.
3. Disconnect the negative (-) cable from the battery terminal, then disconnect the positive (+) cable from the battery terminal.
4. Remove the two (2) wing nuts and the battery hold down rod.
5. Make sure that the battery filler caps are secure and remove the battery from the battery compartment.

Installing the Battery

IMPORTANT

To prevent possible electrical problems, install only a fully charged battery.

Installing the Battery (continued)

1. Ensure that the key switch and all accessories are in the OFF position.
2. Ensure that the battery tray is clean and install the battery and retainer.
3. Ensure that all the battery terminals, battery cables and battery hold down components are in good condition.
4. Connect the positive (+) cable connector onto the positive (+) battery terminal.
5. Connect a digital multimeter (set to A) between the negative (-) battery post and the negative (-) cable connector. Ensure that the reading is less than 0.1 A. A reading of more than 0.1 A usually indicates a damaged switch, a shorted circuit, or grounded wire. Identify and repair the electrical faults before returning the machine to service.
6. Connect the negative (-) cable connector to the negative (-) battery terminal.
7. After you make the connections, apply battery terminal protector Toro Part No. 107-0392 or a light layer of petroleum jelly to the battery terminals and cable connectors to reduce corrosion.
8. Make sure that rubber boot is properly placed over positive cable end and positive battery post.
9. Install the side cover.

Inspecting, Maintaining, and Testing the Battery

Temperature Correcting Specific Gravity

Cell Temperature	100°F
Cell Specific Gravity	1.245
38°C minus 27°C equals 11.0°C (100°F minus 80°F equals 20°F)	
11°C multiply by 0.004/5.5°C equals 0.008 (20°F multiply by 0.004/10°F equals 0.008)	
ADD (conversion above)	0.008
Correction to 27°C (80°F)	1.253

Minimum Voltage

Minimum Voltage	Battery-Electrolyte Temperature	
9.6	70°F (and up)	21°C (and up)
9.5	60°F	15°C
9.4	50°F	10°C
9.3	40°F	4°C
9.1	30°F	-1°C
8.9	20°F	-7°C
8.7	10°F	-12°C
8.5	0°F	-18°C

1. Inspect the battery as follows:
   A. Check for cracks. Replace the battery if cracked or leaking.
   B. Check the battery terminals for corrosion. Use the wire brush to clean corrosion from the posts.

IMPORTANT

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

C. Check for the signs of wetness or leakage on the top of the battery which might indicate a loose or missing filler cap, overcharging, loose terminal post, or overfilling. Also, check the battery case for dirt and oil. Clean the battery with a solution of baking soda (sodium bicarbonate) and water, then rinse it with clean water.

D. Check that the cover seal is not broken away. Replace the battery if the seal is broken or leaking.

IMPORTANT

Make sure the area around the battery caps is clean before opening the caps.

E. Check the electrolyte level in each cell. If the level is below the tops of the plates in any cell, fill all the cells with distilled water between the minimum and maximum fill lines. Charge at 15 to 25 A for 15 minutes to allow sufficient mixing of the electrolyte.

2. Perform the hydrometer test of the battery-electrolyte.

IMPORTANT

Make sure the area around the battery caps is clean before opening the caps.

A. Use a hydrometer to measure the specific gravity of each cell. Pull the electrolyte in and out of the hydrometer barrel before taking a reading to warm-up the hydrometer. At the same time, take the temperature of the cell.

B. The temperature is correct each cell reading. For each 6°C (10°F) above 27°C (80°F) add 0.004 to the specific gravity reading. For each 6°C (10°F) below 27°C (80°F) subtract 0.004 from the specific gravity reading; refer to Temperature Correcting Specific Gravity (page 6–84).

C. If the difference between the highest and lowest cell specific gravity is 0.050 or more or the lowest cell specific gravity is less than 1.225, charge the battery.

D. Charge at the rate and time given in Battery Charge Rate (page 6–86) or until all cells specific gravity is 1.225 or greater with the difference in specific gravity between the highest and lowest cell being less than 0.050. If you cannot meet these charging conditions, replace the battery.

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

⚠ CAUTION ⚠

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

A. Check the voltage across the battery terminals before testing the battery. If the voltage is less than 12.0 VDC, charge the battery before continuing the test.

B. If you charge the battery, apply a 150 A load for 15 seconds to remove the surface charge. Use a battery load tester following the manufacturer's instructions.

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

D. Measure the electrolyte temperature of the center cell.

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

F. Apply a test load of 1/2 the cold cranking amperage rating of the battery; refer to Battery Specifications (page 6–82).

G. Take a test voltage reading while still under load after 15 seconds, then immediately remove the load.

H. Use Minimum Voltage (page 6–84) to determine the minimum voltage for the center cell electrolyte temperature reading.

I. If the test voltage is below the minimum, replace the battery. If the test voltage is at or above the minimum, return the battery to service.

Charging the Battery

Battery Charge Level

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

Battery Charge Rate

Battery Reserve Capacity (Minutes)	Battery Charge Level (Percent of Fully Charged)			
	75%	50%	25%	0%
80 or less	3.8 hrs @ 3 A	7.5 hrs @ 3 A	11.3 hrs @ 3 A	15 hrs @ 3 A
81 to 125	5.3 hrs @ 4 A	10.5 hrs @ 4 A	15.8 hrs @ 4 A	21 hrs @ 4 A
126 to 170	5.5 hrs @ 5 A	11 hrs @ 5 A	16.5 hrs @ 5 A	22 hrs @ 5 A
171 to 250	5.8 hrs @ 6 A	11.5 hrs @ 6 A	17.3 hrs @ 6 A	23 hrs @ 6 A
above 250	6 hrs @ 10 A	12 hrs @ 10 A	18 hrs @ 10 A	24 hrs @ 10 A

Charging the Battery (continued)

To minimize damage to the battery and allow the battery to charge fully, use the following slow charging procedure. You can accomplish this charging procedure with a constant current battery charger that is available locally.

IMPORTANT

Follow the manufacturer's instructions when using a battery charger.

Note: Using the specific gravity of the battery cells is the most accurate procedure of determining the battery condition.

1. Use Battery Charge Level (page 6–86) to determine the battery charge level from the specific gravity of the battery cells or open circuit voltage.
2. Use the manufacturer's battery charger instructions or Battery Charge Rate (page 6–86) to determine the charging time and rate.

CAUTION

Charging a frozen battery can cause explosion and can cause personal injury. Let the battery warm to 15°C (60°F) before connecting to a charger.

- **Charge the battery in a well-ventilated place to dissipate the gases produced from the charging.**
- **These gases are explosive; keep open flame and electrical spark away from the battery. Do not smoke.**
- **Inhaling the battery gases can cause nausea.**
- **Unplug the charger from the electrical outlet before connecting or disconnecting the charger leads from the battery terminals.**

3. Follow the battery charger manufacturer's instructions, connect the charger cables to the battery terminals. Ensure that you make a good connection.
4. Charge the battery following the manufacturer's instructions.
5. Occasionally check the temperature of the battery-electrolyte. If the temperature is more than 52°C (125°F) or the electrolyte is violently gassing or spewing, lower the charge rate or temporarily stop charging the battery.
6. Beginning three hours before the end of the scheduled charge, measure the specific gravity of a battery cell once per hour.

   Note: The battery is fully charged when the cells are gassing freely at a low charging rate and there is less than a 0.003 change in specific gravity for 3 consecutive readings.

Traction and PTO Drive

Table of Contents

Additional Reference Materials

Carraro DriveTech Model 26.09M Axle Repair Manual

General Information

Traction Unit Operator’s Manual and Accessory Installation Instructions

The traction unit *Operator’s Manual* and accessory *Installation Instructions* provide information regarding the operation, general maintenance and maintenance intervals for the machine and its accessories. Refer to the traction unit *Operator’s Manual* and accessory *Installation Instructions* for additional information.

Adjustments

Adjusting the Tie Rod Length

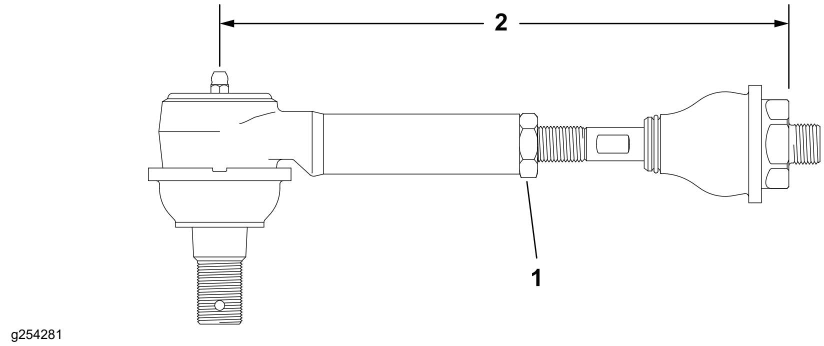


Figure 177

1. Jam nut
2. Tie rod length

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1. Loosen the jam nut and turn the inner tie rod shaft to adjust the tie rod length:
   - Front Tie Rod Length = (10.22 ± 0.03 inch).
   - Rear Tie Rod Length = (10.45 ± 0.03 inch).
2. Tighten the jam nut.

Adjusting Axle Stop Bolts

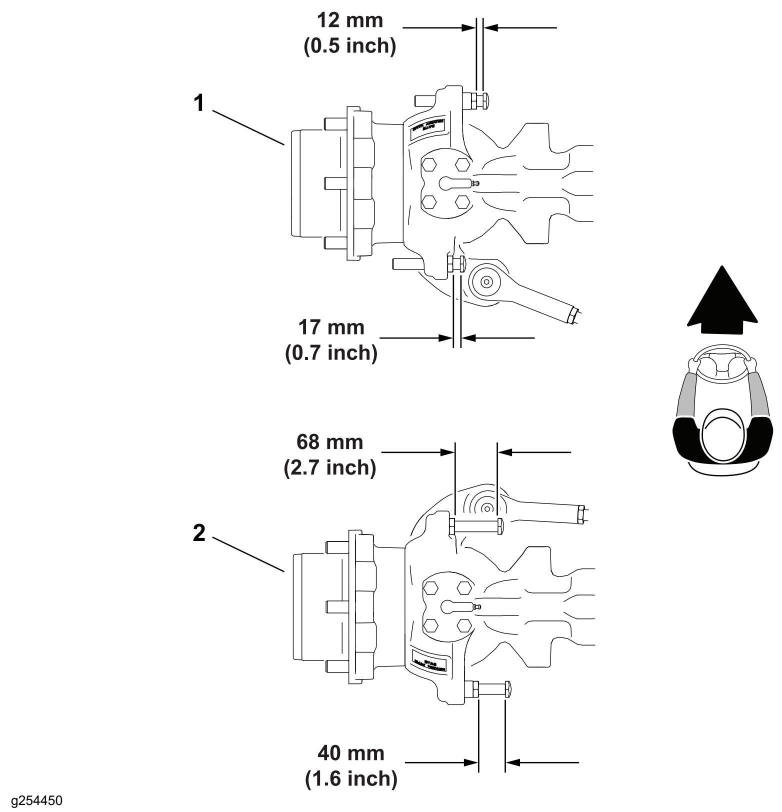


Figure 178

1. Front axle
2. Rear axle

Adjusting Axle Stop Bolts (continued)

Adjust the axle stop bolts after the axle has been installed on the machine and the tie rods have been installed.

Service and Repairs

Tie Rods

Removing the Tie Rods

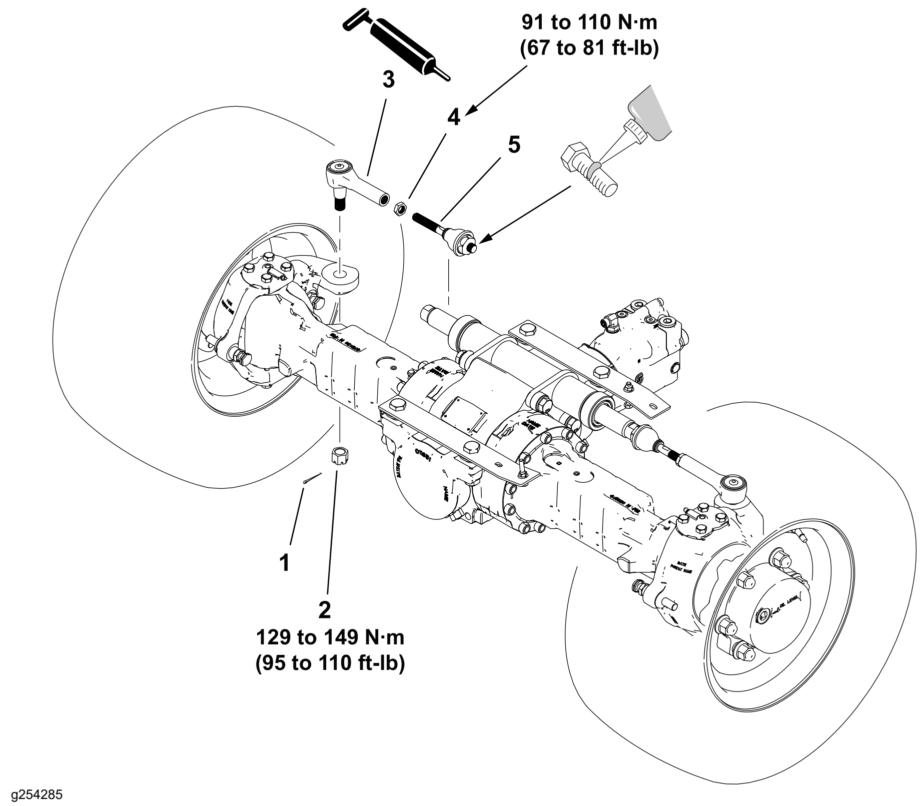


Figure 179

1. Cotter pin
2. Slotted nut
3. Outer tie rod
4. Jam nut
5. Inner tie rod

---

1. Remove and discard the cotter pin.

   Note: Move or remove the axle stop bolts to access the slotted nuts.

2. Remove the slotted nut.
3. Use a suitable tool (pickle fork) to separate the outer tie rod from the axle assembly.
4. Use the flats on the steering cylinder rod nearest the tie rod being removed to hold the cylinder rod and remove the inner tie rod.

Installing the Tie Rods

1. Check and adjust the tie rod length if necessary; refer to Adjusting the Tie Rod Length (page 7–3).

   Note: New inner tie rods have a thread locking compound pre-applied on the steering cylinder end. Clean the threads and apply a high strength thread locking compound if installing a used inner tie rod.

2. Use the flats on the steering cylinder rod nearest the tie rod being installed to hold the cylinder rod and install the inner tie rod. Tighten the inner tie rod to **91 to 110 N·m (67 to 81 ft-lb)**.

Installing the Tie Rods (continued)

3. Secure the outer tie rod to the axle with the slotted nut. Tighten the nut from **129 to 149 N·m (95 to 110 ft-lb)**.
4. Check and adjust the axle stop bolts; refer to Adjusting Axle Stop Bolts (page 7–3).
5. Continue to tighten the slotted nut to align if necessary and install a new cotter pin.
6. Grease the outer tie rod with Mobil high-temperature XHP-222 grease or equivalent until the boot swells. Do not allow the grease to purge from boot.

Front Axle

Machines with an Axle-Drive Gearbox

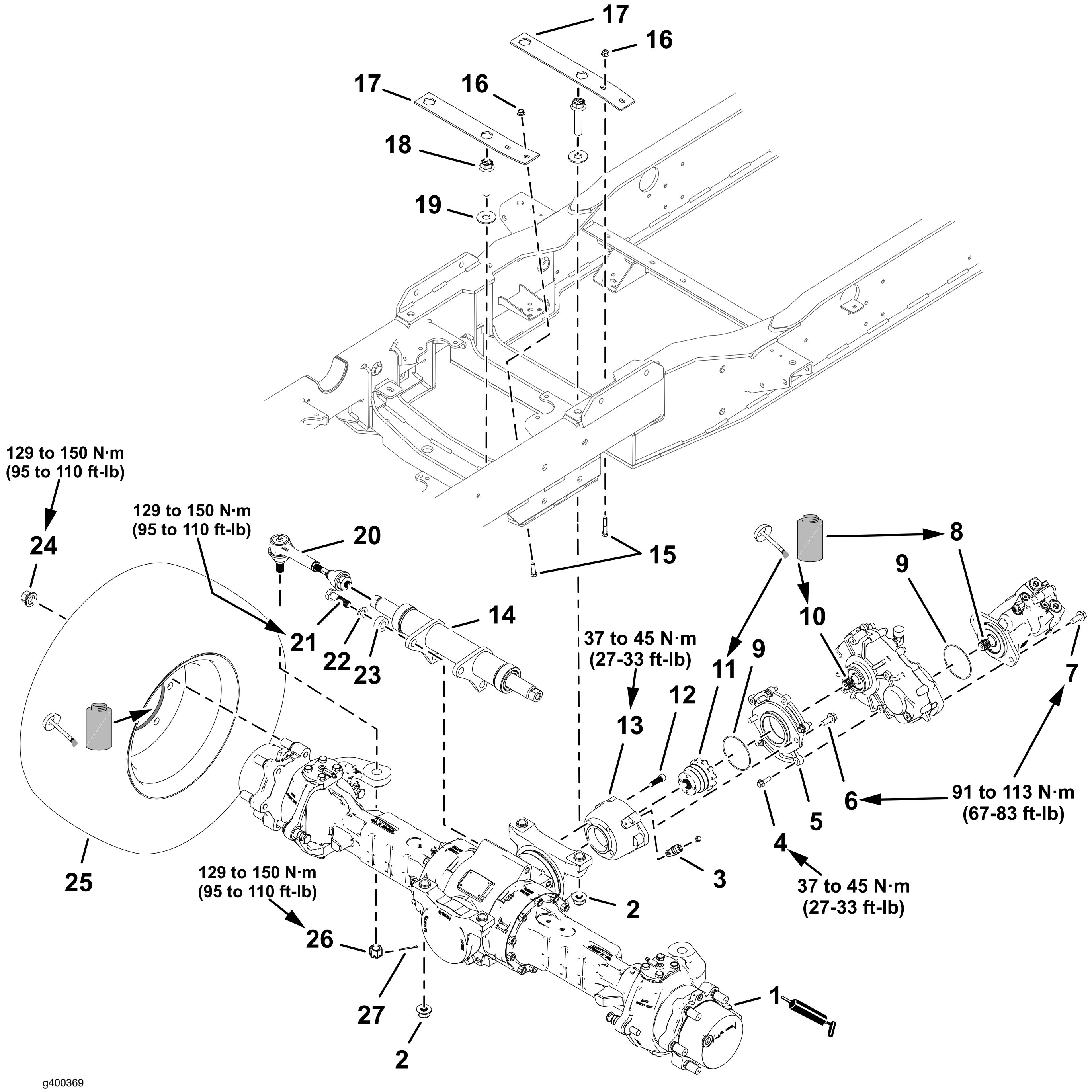


Figure 180

1. Front axle
2. Flange nut (4 each)
3. Speed sensor
4. Flange-head screw (4 each)
5. Gearbox adapter
6. Flange-head screw (2 each)
7. Flange-head screw (2 each)
8. Axle drive motor
9. O-ring
10. Axle-drive gearbox
11. Coupler assembly
12. Socket head screw (4 each)
13. Front hydraulic-motor mount
14. Steering cylinder
15. Capscrew (2 each)
16. Flange nut (2 each)
17. Retainer (2 each)
18. Flange-head screw (4 each)
19. Flat washer (4 each)
20. Tie rod assembly (2 each)
21. Capscrew (4 each)
22. Plain washer (4 each)
23. Spacer (4 each)
24. Lug nut (12 each)
25. Wheel assembly (2 each)
26. Slotted nut
27. Cotter pin

Removing the Front Axle

1. Raise and support the front of the machine; refer to Jacking Instructions (page 1–8).
2. Remove the front wheels.
3. Remove the front tie rods from the axle; refer to Removing the Tie Rods (page 7–5).

IMPORTANT

The axle drive motor weighs approximately 16 kg (34 lbs).

4. Remove the front axle drive motor from the axle-drive gearbox, and support the drive motor, refer to Removing the Axle Drive Motor (Machines with an Axle-Drive Gearbox) (page 5–92).
5. Disconnect the machine wire harness from the front axle speed sensor (item 3).
6. Disconnect and plug the hose at the axle-differential lock (located below the right steering cylinder hose) and the 2 steering cylinder hoses. Cap the hydraulic fittings.

WARNING

The front axle assembly weighs approximately 254 kg (560 lbs).

7. Use a trolley jack to support the center of the front axle.
8. Remove the 4 flange locknuts securing the front axle to the frame.

   Note: The front axle mounting bolts are held in position (captured) to the machine frame.
9. Lower and remove the front axle from the machine.
10. If necessary, remove the axle-drive gearbox, gearbox adapter, speed sensor, coupler assembly, front hydraulic-motor mount, dowel pin, and the steering cylinder assembly, refer to Removing the Axle-Drive Gearbox (page 7–22).

IMPORTANT

Remove the speed sensor before removing the drive coupling to prevent damaging the sensor.

Installing the Front Axle

1. If previously removed, install the dowel pin and front hydraulic-motor mount.
   A. Insert the dowel pin into the hole in the mounting flange of the axle.
   B. Assemble the hydraulic-motor mount to the axle with 4 capscrews, and torque the screws from **111 to 138 N·m (82 to 102 ft-lb)**.
2. If previously removed, install the steering cylinder assembly.
   A. Assemble the steering cylinder to the axle with 4 capscrews, plain washers, and spacers. Tighten the screws from **359 to 386 N·m (265 to 285 ft-lb)**.

Installing the Front Axle (continued)

B. If removed, install the tie rod assemblies to the steering cylinder; refer to Installing the Tie Rods (page 7–5).

3. Raise the axle to machine and align the tie rod assemblies through openings in the frame. Secure the axle to machine with 4 flange locknuts.
4. Install the tie rod assemblies to the axle with the slotted nuts. Torque the slotted nuts to **129 to 150 N·m (95 to 110 ft-lb)**, and secure the nuts to the tie rods with cotter pins.
5. Install the hydraulic hoses to the steering cylinder and the axle-differential lock (located below the right steering cylinder hose).
6. If the coupler assembly was previously removed, apply anti-seize lubricant to the splines of the front axle-input shaft and the coupler assembly, and assemble the coupler to the shaft.
7. If removed, install the front axle speed sensor to the hydraulic-motor mount.
8. Connect the machine wire harness to the speed sensor.
9. If previously removed, install the axle-drive gearbox; refer to Installing the Axle-Drive Gearbox (page 7–22).
10. Install the front axle drive motor to the axle-drive gearbox, refer to Installing the Axle Drive Motor (Machines with an Axle-Drive Gearbox) (page 5–93).
11. Check and adjust all 4 axle stop bolts as necessary; refer to Adjusting Axle Stop Bolts (page 7–3).
12. Check the oil level in each wheel hub and the front axle, and adjust the oil level as necessary; refer to the traction unit *Operator's Manual*.
13. Grease the front axle with Mobil high-temperature XHP-222 grease or equivalent; refer to the traction unit *Operator's Manual*.
14. Apply anti-seize lubricant to the inner edge of the wheel and install the wheel. Tighten the lug nuts in a crossing pattern from **380 to 434 N·m (280 to 320 ft-lb)**.
15. Check and adjust front tire air pressure as necessary.

Front Axle

Machines without an Axle-Drive Gearbox

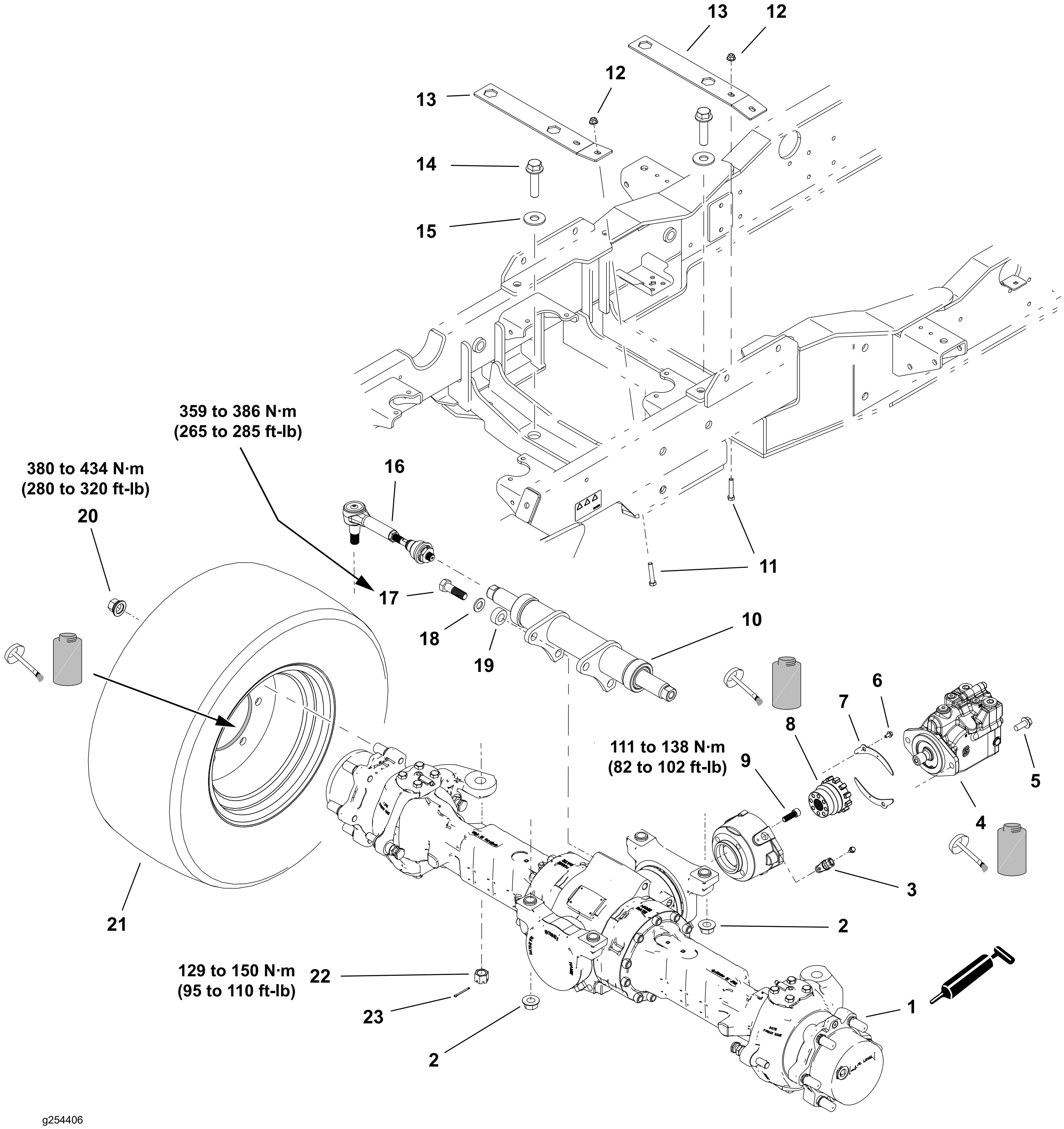


Figure 181

1. Front axle
2. Flange nut (4 each)
3. Speed sensor
4. Axle drive motor
5. Flange-head screw (2 each)
6. Flange-head screw (2 each)
7. Cover (2 each)
8. Coupler assembly
9. Socket head screw (4 each)
10. Steering cylinder
11. Capscrew (2 each)
12. Flange nut (2 each)
13. Retainer (2 each)
14. Flange-head screw (4 each)
15. Flat washer (4 each)
16. Tie rod assembly (2 each)
17. Capscrew (4 each)
18. Plain washer (4 each)
19. Spacer (4 each)
20. Lug nut (12 each)
21. Wheel assembly (2 each)
22. Slotted nut
23. Cotter pin

Removing the Front Axle

1. Raise and support the front of the machine; refer to Jacking Instructions (page 1–8).
2. Remove the front wheels.
3. Remove the front tie rods from the axle; refer to Removing the Tie Rods (page 7–5).

IMPORTANT

The axle drive motor weighs approximately 16 kg (34 lbs).

4. Remove the front axle drive motor from the hydraulic-motor mount, and support the motor; refer to Removing the Axle Drive Motor (Machines without an Axle-Drive Gearbox) (page 5–94).
5. Disconnect the machine wire harness from the front axle speed sensor (item 3).
6. Remove the front axle speed sensor from the hydraulic-motor mount.

IMPORTANT

Remove the speed sensor to prevent damaging it when removing the drive coupling.

7. Remove the coupler assembly (item 8) from the input shaft of the front axle.
8. Disconnect and plug the hose at the axle-differential lock (located below the right steering cylinder hose) and the 2 steering cylinder hoses. Cap the hydraulic fittings.

WARNING

The front axle assembly weighs approximately 231 kg (510 lbs).

9. Use a trolley jack to support the center of the front axle.
10. Remove the 4 flange locknuts securing the front axle to the frame.

    Note: The front axle mounting bolts are held in position (captured) to the machine frame.
11. Lower and remove the front axle from the machine.
12. If necessary, remove the front hydraulic-motor mount with covers, dowel pin, and the steering cylinder assembly.

Installing the Front Axle

1. If previously removed, install the dowel pin and front hydraulic-motor mount.
   A. Insert the dowel pin into the hole in the mounting flange of the axle.
   B. Assemble the hydraulic-motor mount to the axle with 4 capscrews. Torque the screws from **111 to 138 N·m (82 to 102 ft-lb)**.
   C. Install the covers.
2. If previously removed, install the steering cylinder assembly.

Installing the Front Axle (continued)

A. Assemble the steering cylinder to the axle with 4 capscrews, plain washers, and spacers. Tighten the screws from **359 to 386 N·m (265 to 285 ft-lb)**.

B. If removed, install the tie rod assemblies to the steering cylinder; refer to Installing the Tie Rods (page 7–5).

3. Raise the axle to machine and align the tie rod assemblies through openings in the frame. Secure the axle to machine with 4 flange locknuts.

4. Install the tie rod assemblies to the axle with the slotted nuts. Torque the slotted nuts to **129 to 150 N·m (95 to 110 ft-lb)**, and secure the nuts to the tie rods with cotter pins.

5. Install the hydraulic hoses to the steering cylinder and the axle-differential lock (located below the right steering cylinder hose).

6. Apply anti-seize lubricant to the splines of the front axle-input shaft and the coupler assembly, and install the coupler to the shaft.

7. Install the front axle speed sensor to the hydraulic-motor mount.

8. Connect the machine wire harness to the front axle speed sensor.

9. Ensure that the O-ring is assembled onto the housing of the axle drive motor.

10. Install the front axle drive motor to the hydraulic-motor mount; refer to Installing the Axle Drive Motor (Machines without an Axle-Drive Gearbox) (page 5–95).

11. Check and adjust all 4 axle stop bolts as necessary; refer to Adjusting Axle Stop Bolts (page 7–3).

12. Check the oil level in each wheel hub and the front axle, and adjust the oil level as necessary; refer to the traction unit *Operator's Manual*.

13. Grease the front axle with Mobil high-temperature XHP-222 grease or equivalent; refer to the traction unit *Operator's Manual*.

14. Apply anti-seize lubricant to the inner edge of the wheel and install the wheel. Tighten the lug nuts in a crossing pattern from **380 to 434 N·m (280 to 320 ft-lb)**.

15. Check and adjust front tire air pressure as necessary.

Machines with an Axle-Drive Gearbox

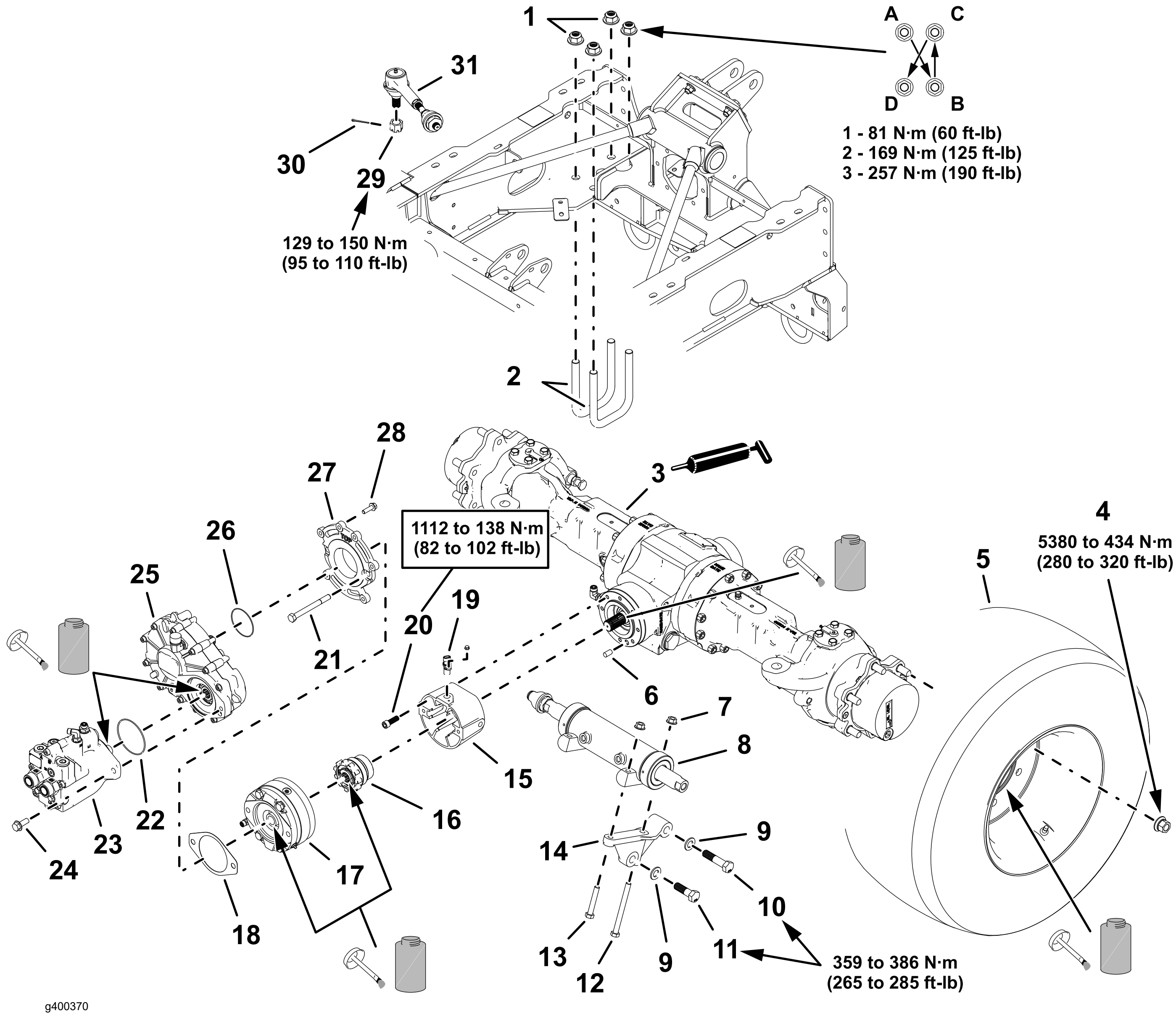


Figure 182

1. Flange nut (8 each)
2. U-bolt (4 each)
3. Rear axle
4. Lug nut (12 each)
5. Wheel assembly (2 each)
6. Dowel pin
7. Flange nut (4 each)
8. Steering cylinder
9. Plain washer (4 each)
10. Capscrew (2 each)
11. Capscrew (2 each)
12. Capscrew (2 each)
13. Capscrew (2 each)
14. Cylinder support (2 each)
15. Rear hydraulic-motor mount
16. Coupler assembly
17. Brake assembly
18. Gasket
19. Speed sensor
20. Socket head screw (4 each)
21. Capscrew (2 each)
22. O-ring
23. Axle drive motor
24. Capscrew (2 each)
25. Axle-drive gearbox
26. O-ring
27. Gearbox adapter
28. Flange-head screw (4 each)
29. Slotted nut
30. Cotter pin
31. Tie rod assembly (2 each)

Removing the Rear Axle

1. Raise and support the rear of the machine; refer to Jacking Instructions (page 1–8).
2. Remove the rear wheels.
3. Remove the rear tie rods from the axle; refer to Removing the Tie Rods (page 7–5).

IMPORTANT

The axle drive motor weighs approximately 16 kg (34 lbs).

4. Remove the rear axle drive motor from the axle-drive gearbox, and support the drive motor.

IMPORTANT

The gearbox assembly weighs approximately 20 kg (44 lbs).

5. Remove the axle-drive gearbox from the gearbox adapter; refer to Removing the Axle-Drive Gearbox (page 7–22).

IMPORTANT

The brake assembly weighs approximately 11 kg (24 lbs).

6. Remove the gearbox adapter and the brake assembly from the rear hydraulic-motor mount, and support the brake assembly; refer to Removing the Brake Assembly (page 5–99).
7. Disconnect the machine wire harness from the rear axle speed sensor (item 19).
8. Remove the front axle speed sensor from the hydraulic-motor mount.

IMPORTANT

Remove the speed sensor to prevent damaging it when removing the drive coupling.

9. Remove the coupler assembly (16) from the input shaft of the rear axle.
10. Disconnect and plug the hose at the axle-differential lock (located below the right steering cylinder hose) and the 2 steering cylinder hoses. Cap the hydraulic fittings.
11. Fully extend the drawbar.

IMPORTANT

The rear axle assembly weighs approximately 208 kg (460 lbs).

12. Use a trolley jack to support the center of the rear axle.
13. Remove the 4 flange locknuts and 4 U-bolts securing the rear axle to the frame.
14. Lower and remove the rear axle from the machine.

Removing the Rear Axle (continued)

15. If necessary, remove the rear hydraulic-motor mount, dowel pin, and steering cylinder assembly.

Installing the Rear Axle

1. If previously removed, install the dowel pin and rear hydraulic-motor mount.
   A. Insert the dowel pin into the hole in the mounting flange of the axle.
   B. Assemble the hydraulic-motor mount to the axle with 4 capscrews, and torque the screws from **111 to 138 N·m (82 to 102 ft-lb)**.
2. If previously removed, install the steering cylinder assembly.
   A. Assemble the steering cylinder to the axle with 4 capscrews, plain washers, and spacers. Tighten the screws from **359 to 386 N·m (265 to 285 ft-lb)**.
   B. If removed, install the tie rod assemblies to the steering cylinder; refer to Installing the Tie Rods (page 7–5).
3. Raise the axle to machine and align the tie rod assemblies through openings in the frame. Assemble the axle to the machine with 4 U-bolts and flange nuts. Ensure the axle is against the frame and each U-bolt is flush against the bottom of the axle before torquing flange nuts.
4. Refer to Figure 182 and torque the flange nuts as follows:
   A. Tighten each pair of flange nuts in a crossing pattern to **81 N·m (60 ft-lb)**.
   B. Tighten each pair of flange nuts in a crossing pattern to **169 N·m (125 ft-lb)**.
   C. Tighten each pair of flange nuts in a crossing pattern to **257 N·m (190 ft-lb)**.
5. Install the tie rod assemblies to the axle with the slotted nuts. Torque the slotted nuts to **129 to 150 N·m (95 to 110 ft-lb)**, and secure the nuts to the tie rods with cotter pins.
6. If the coupler assembly was previously removed, apply anti-seize lubricant to the splines of the front axle-input shaft and the coupler assembly, and assemble the coupler to the shaft.
7. Apply anti-seize lubricant to the splines of the brake assembly, and assemble the brake to the coupler assembly.
8. Align a new gasket between the gearbox adapter and the brake assembly, and install the adapter and brake to the hydraulic-motor mount; refer to Installing the Brake Assembly (page 5–100).
9. Install the rear axle speed sensor to the hydraulic-motor mount.
10. Connect the machine wire harness to the speed sensor.
11. Install the axle-drive gearbox to the brake assemble gearbox adapter; refer to Installing the Axle-Drive Gearbox (page 7–22).
12. Install the rear axle drive motor to the axle-drive gearbox, refer to Installing the Axle Drive Motor (Machines with an Axle-Drive Gearbox) (page 5–93).
13. Check and adjust all 4 axle stop bolts as necessary; refer to Adjusting Axle Stop Bolts (page 7–3).

Installing the Rear Axle (continued)

14. Check the oil level in each wheel hub and the front axle, and adjust the oil level as necessary; refer to the traction unit *Operator's Manual*.

15. Grease the rear axle with Mobil high-temperature XHP-222 grease or equivalent; refer to the traction unit *Operator's Manual*.

16. Apply anti-seize lubricant to the inner edge of the wheel and install the wheel. Tighten the lug nuts in a crossing pattern from **380 to 434 N·m (280 to 320 ft-lb)**.

17. Check and adjust rear tire air pressure as necessary.

Rear Axle

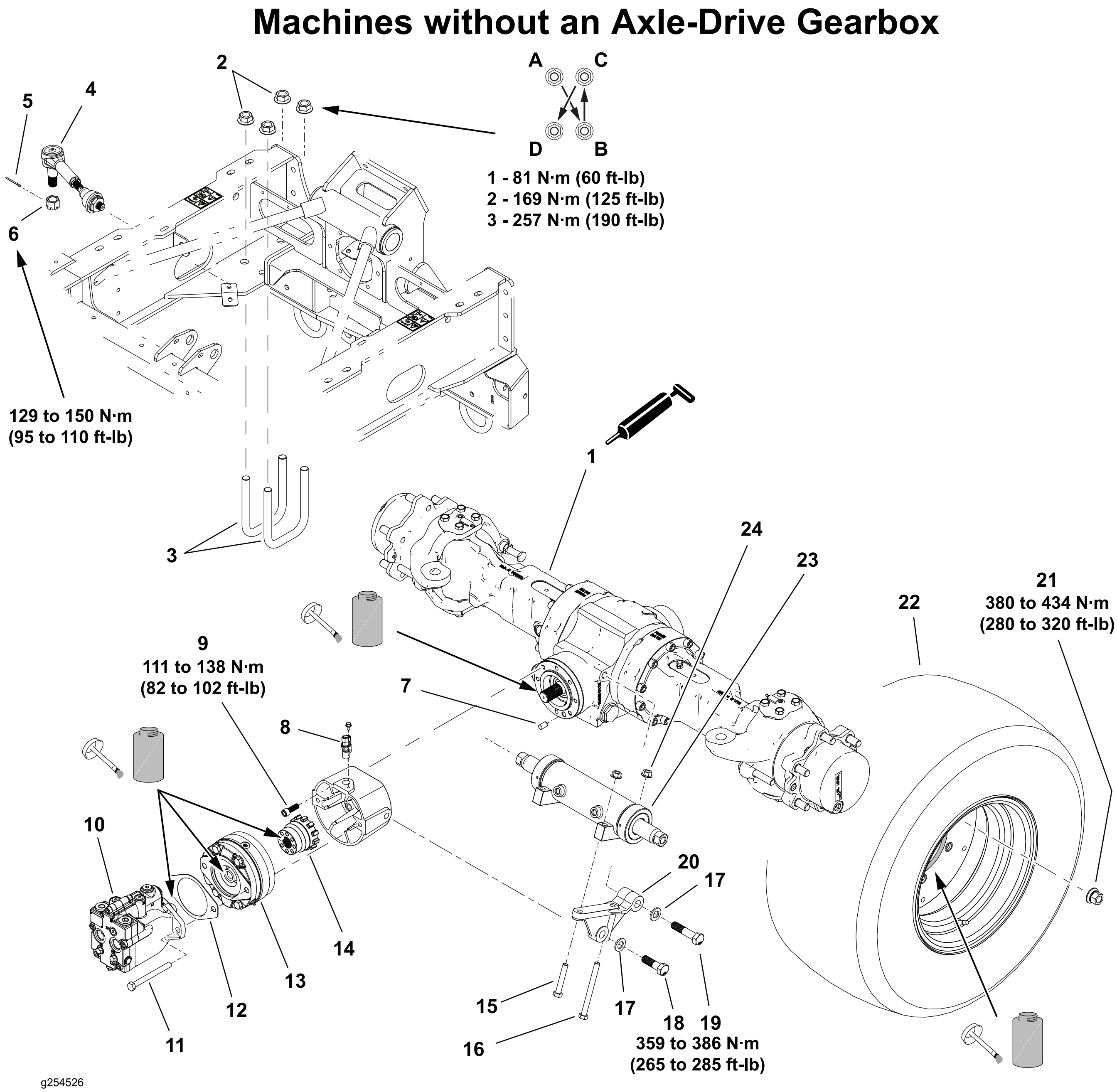


Figure 183

1. Rear axle
2. Flange nut (8 each)
3. U-bolt (4 each)
4. Tie rod assembly (2 each)
5. Cotter pin (2 each)
6. Slotted nut (2 each)
7. Dowel pin
8. Rear speed sensor
9. Socket head screw (4 each)
10. Axle drive motor
11. Capscrew (2 each)
12. Gasket
13. Brake assembly
14. Coupler assembly
15. Capscrew (2 each)
16. Capscrew (2 each)
17. Plain washer (4 each)
18. Capscrew (2 each)
19. Capscrew (2 each)
20. Cylinder support (2 each)
21. Lug nut (12 each)
22. Wheel assembly (2 each)
23. Steering cylinder
24. Flange nut (4 each)

Removing the Rear Axle

1. Raise and support the rear of the machine; refer to Jacking Instructions (page 1–8).
2. Remove the rear wheels.
3. Remove the rear tie rods from the axle; refer to Removing the Tie Rods (page 7–5).

IMPORTANT

The axle drive motor weighs approximately 16 kg (34 lbs) and the brake assembly weighs approximately 11 kg (24 lbs).

4. Remove the rear axle drive motor and brake assembly from the rear hydraulic-motor mount, and support the motor and brake; refer to Removing the Axle Drive Motor (Machines without an Axle-Drive Gearbox) (page 5–94) and Removing the Brake Assembly (page 5–101).
5. Disconnect the machine wire harness from the rear axle speed sensor (item 8).
6. Remove the front axle speed sensor from the hydraulic-motor mount.

IMPORTANT

Remove the speed sensor to prevent damaging it when removing the drive coupling.

7. Remove the coupler assembly (item 14) from the input shaft of the rear axle.
8. Disconnect and plug the hose at the axle-differential lock (located below the right steering cylinder hose) and the 2 steering cylinder hoses. Cap the hydraulic fittings.
9. Fully extend the drawbar.

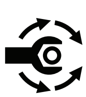
WARNING

The rear axle assembly weighs approximately 208 kg (460 lbs).

10. Use a trolley jack to support the center of the rear axle.
11. Remove the 4 flange locknuts and 4 U-bolts securing the rear axle to the frame.
12. Lower and remove the rear axle from the machine.
13. If necessary, remove the rear hydraulic-motor mount, dowel pin, and steering cylinder assembly with rear tie rods.

Installing the Rear Axle

1. If previously removed, install the dowel pin and rear hydraulic-motor mount.
   A. Insert the dowel pin into the hole in the mounting flange of the axle.



   B. Assemble the hydraulic-motor mount to the axle with 4 capscrews, and torque the screws from **111 to 138 N·m (82 to 102 ft-lb)**.
2. If previously removed, install the steering cylinder assembly.

Installing the Rear Axle (continued)

A. Assemble the steering cylinder to the axle with 4 capscrews, plain washers, and spacers. Tighten the screws from **359 to 386 N·m (265 to 285 ft-lb)**.

B. If removed, install the tie rod assemblies to the steering cylinder; refer to Installing the Tie Rods (page 7–5).

3. Raise the axle to machine and align the tie rod assemblies through openings in the frame. Assemble the axle to the machine with 4 U-bolts and flange nuts. Ensure the axle is against the frame and each U-bolt is flush against the bottom of the axle before torquing flange nuts.

4. Refer to Figure 183 and torque the flange nuts as follows:

   A. Tighten each pair of flange nuts in a crossing pattern to **81 N·m (60 ft-lb)**.

   B. Tighten each pair of flange nuts in a crossing pattern to **169 N·m (125 ft-lb)**.

   C. Tighten each pair of flange nuts in a crossing pattern to **257 N·m (190 ft-lb)**.

5. Install the tie rod assemblies to the axle with the slotted nuts. Torque the slotted nuts to **129 to 150 N·m (95 to 110 ft-lb)**, and secure the nuts to the tie rods with cotter pins.

6. Install the hydraulic hoses to the steering cylinder and the axle-differential lock (located below the right steering cylinder hose).

7. Apply anti-seize lubricant to the splines of the rear axle-input shaft and the coupler assembly, and install the coupler to the shaft.

8. Install the front axle speed sensor to the hydraulic-motor mount.

9. Connect the machine wire harness to the rear axle speed sensor.

10. Install the brake assembly and the axle drive motor to the hydraulic-motor mount with a new gasket, refer to Installing the Brake Assembly (page 5–102) and Installing the Axle Drive Motor (Machines without an Axle-Drive Gearbox) (page 5–95)

11. Check and adjust all 4 axle stop bolts as necessary; refer to Adjusting Axle Stop Bolts (page 7–3).

12. Check the oil level in the brake assembly and adjust the oil level as necessary; refer to traction unit *Operator's Manual*.

13. Check the oil level in each wheel hub and the rear axle and adjust the oil level as necessary; refer to traction unit *Operator's Manual*.

14. Grease the rear axle with Mobil high-temperature XHP-222 grease or equivalent ; refer to the traction unit *Operator's Manual*.

15. Apply anti-seize lubricant to the inner edge of the wheel and install the wheel. Tighten the lug nuts in a crossing pattern from **380 to 434 N·m (280 to 320 ft-lb)**.

16. Check and adjust rear tire air pressure as necessary.

Front and Rear Axle Service

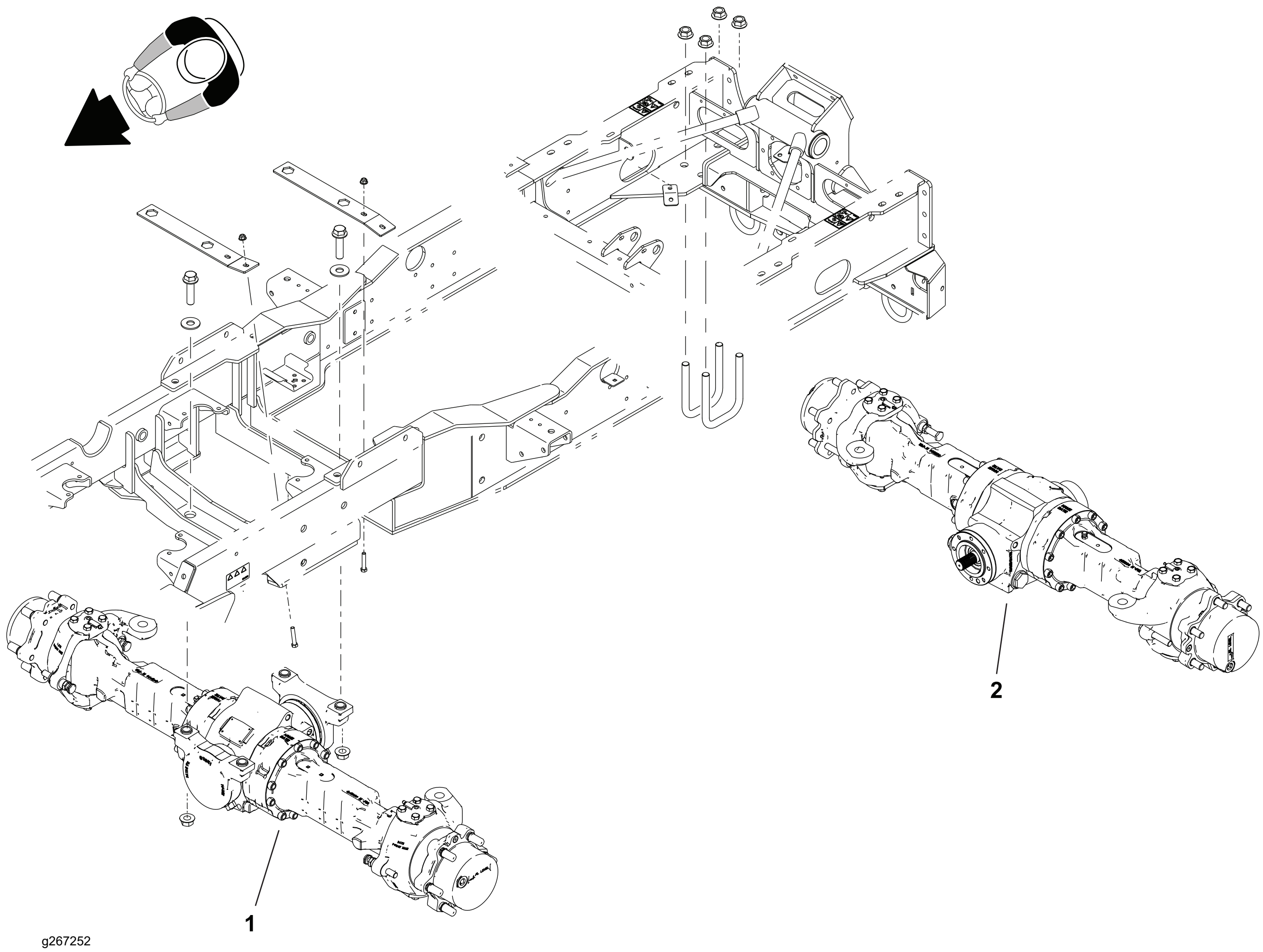


Figure 184

1. Front axle assembly
2. Rear axle assembly

Refer to the traction unit *Operator's Manual* for axle fluid change procedures. Additional axle service information can be found in the Carraro Drivetech Repair Manual for Model 26.09M.

Axle-Drive Gearbox

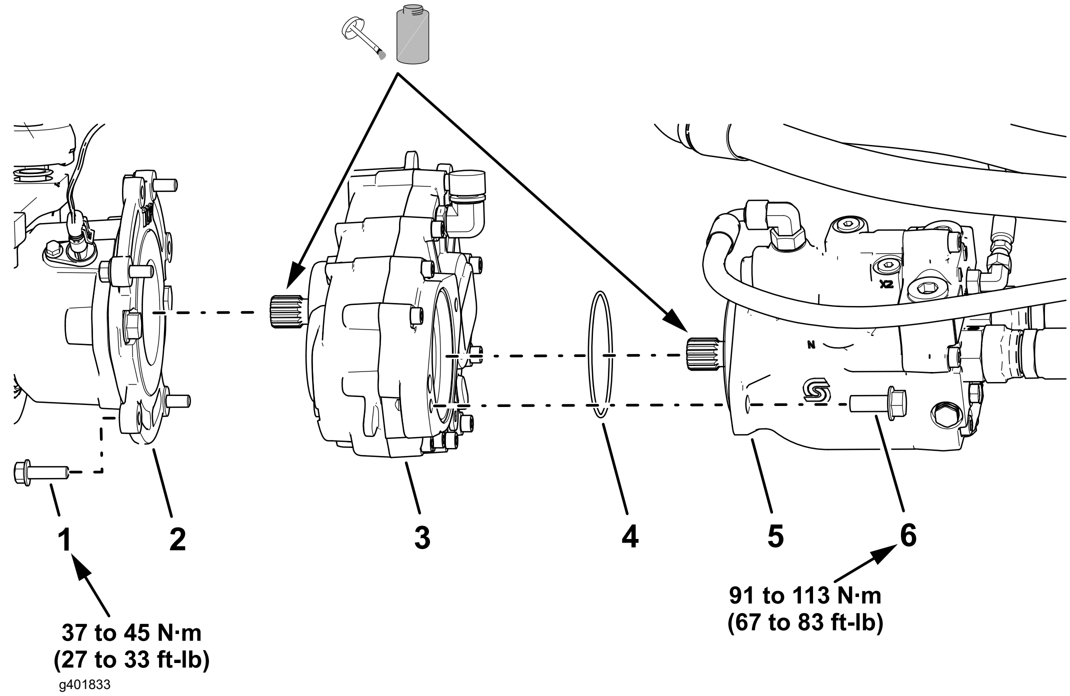


Figure 185

Front Axle-Drive Gearbox

1.	Flange-head screw	3.	O-ring	5.	Gearbox adapter
2.	Axle drive motor	4.	Axle-drive gearbox	6.	Flange-head screw

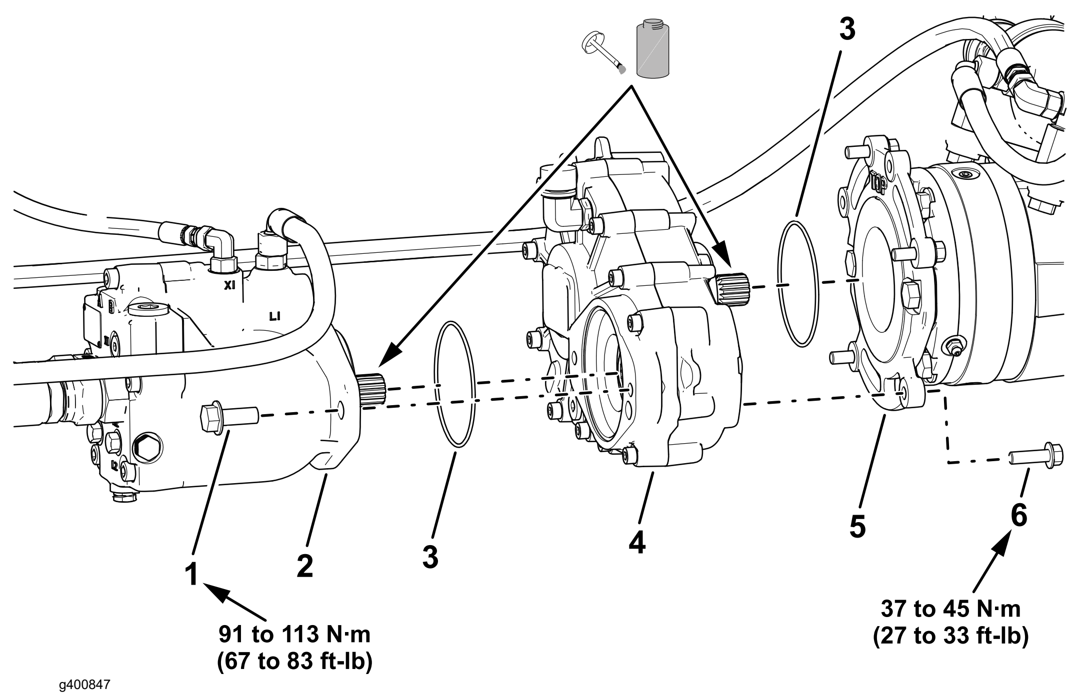


Figure 186

Rear Axle-Drive Gearbox

1.	Flange-head screw	3.	O-ring	5.	Gearbox adapter
2.	Axle drive motor	4.	Axle-drive gearbox	6.	Flange-head screw

Axle-Drive Gearbox (continued)

Removing the Axle-Drive Gearbox

1. Raise and support the machine; refer to Jacking Instructions (page 1–8).

IMPORTANT

The axle drive motor weighs approximately 16 kg (34 lbs).

2. Remove the front axle drive motor; refer to Removing the Axle Drive Motor (Machines with an Axle-Drive Gearbox) (page 5–92).
3. If you are removing the axle-drive gearbox to replacing the seals, drain the gearbox lubricant; refer to the *Operator's Manual* for the machine.

IMPORTANT

The gearbox assembly weighs approximately 20 kg (44 lbs).

4. Remove the axle-drive gearbox from the gearbox adapter.
5. Rear Axle-Drive Gearbox—remove the O-ring from the case of the axle-drive gearbox, and inspect the O-ring for wear or damage (Figure 186).

   Note: Replace the O-ring if it is worn or damaged.

Installing the Axle-Drive Gearbox

1. Rear Axle-Drive Gearbox—ensure that the O-ring is assembled onto the case of the axle-drive gearbox (Figure 186).
2. Apply anti-seize lubricant to the splines of the gearbox shaft (Figure 222).
3. Align the shaft with the splines of the coupler assemble (front axle) or brake assembly (rear axle), and assemble the shaft into the coupler or brake. Assemble the gearbox to the gearbox adapter with the 4 flange-head screws, and torque the screws to **37 to 45 N·m (27 to 33 ft-lb)**.
4. Install the front axle drive motor; refer to Installing the Axle Drive Motor (Machines with an Axle-Drive Gearbox) (page 5–93).
5. Service the axle-drive gearbox lubricant lubricate as follows:
   - If you drained the axle-drive gearbox lubricant or you are installing a new drive gearbox, add lubricate to the gearbox; refer to the *Operator's Manual* for the machine.
   - If you are installing an in-service gearbox, check the lubricate level; refer to the *Operator's Manual* for the machine.

Replacing Axle-Drive Gearbox Seals

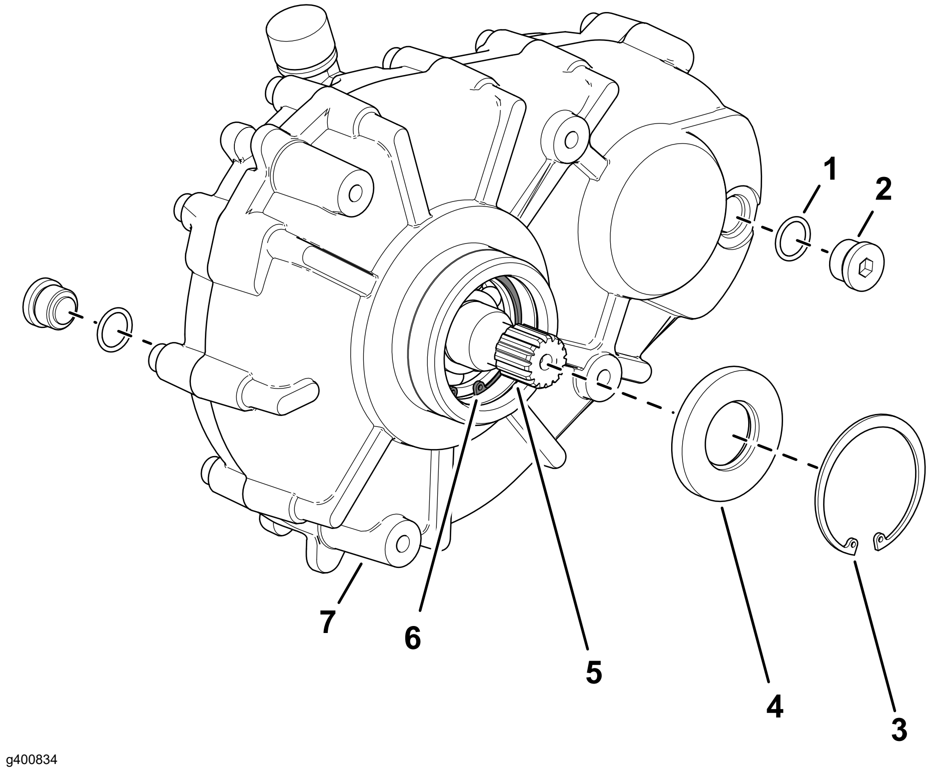


Figure 187

1. O-ring
2. Drain/fill plug
3. Retaining ring (outer)
4. Shaft seal
5. Shaft splines
6. Retaining ring (inner)
7. Gearbox case

---

1. Drain the axle-drive gearbox lubricant.
2. Remove the outer retaining ring (Figure 187) from the groove of the gearbox case.
3. Carefully remove the shaft seal from the gearbox case, and discard the seal.
4. Clean the gearbox housing bore, and cover the shaft splines with tape to protect the shaft seal during installation.
5. Install the new shaft seal, and remove the tape from the shaft splines.

   Note: Ensure that the seal is seated against the inner retaining ring.
6. Install the outer retaining ring into the groove in the gearbox case.
7. Replace the O-rings for the drain/fill plugs as needed,

Note: The axle drive motor and axle-drive gearbox must be assembled to the axle before checking or changing the gearbox oil; refer to the *Operator's Manual* for .

Front PTO Gearbox

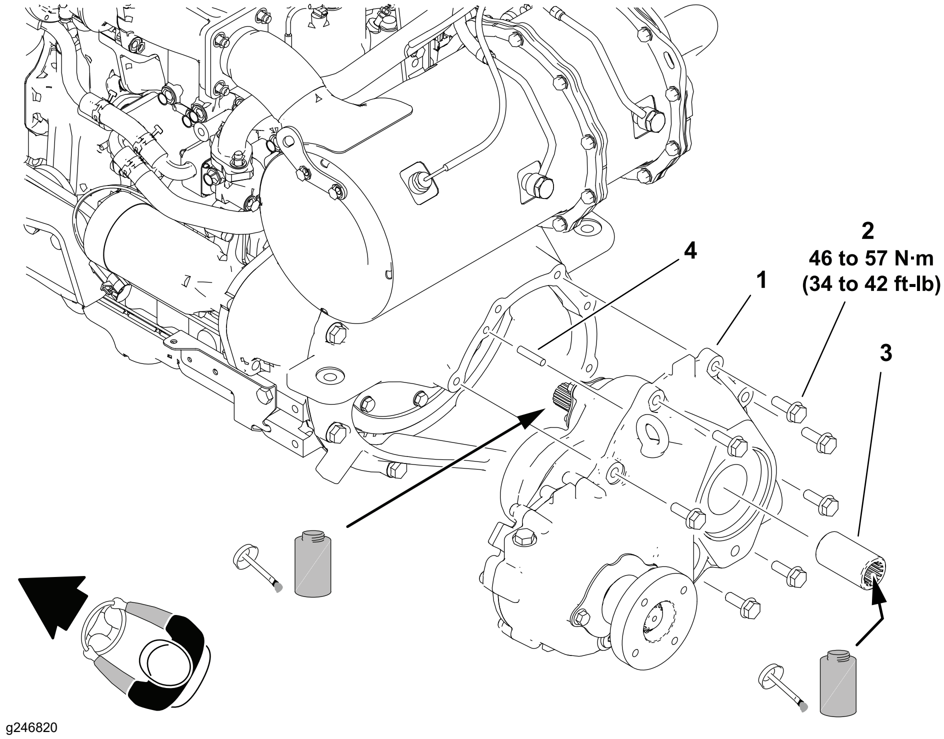


Figure 188

1. Front PTO gearbox
2. Flange-head screw (7 each
3. Coupler
4. Dowel pin (2 each)

⚠ CAUTION ⚠

The front PTO gearbox weighs approximately 42 kg (93 lbs). Use an appropriate lift to remove and install the gearbox.

Note: The front PTO gearbox output shaft seal can be replaced in the machine. The PTO driveshaft must be disconnected but the gearbox does not have to be removed.

Removing the Front PTO Gearbox

1. Remove the engine, PTO gearbox, and traction pump; refer to Removing the Engine, PTO Gearbox, and Tandem Piston (Traction) Pump. (page 4–17)

   Note: To remove the front PTO gearbox, it is removed with the engine—in the procedures the following components are disconnected, separated, or removed:

Fuel hoses	Driveshaft	Axle drive motor
Cables and engine harness	Dual gear pump	Hydraulic hoses
Operator’s platform or cab	Axle drive motor hoses	Main harness electrical connectors
Traction pump		

2. Remove the tandem piston (traction) pump from the PTO gearbox; Removing the Tandem Piston (Traction) Pump (P1) and (P2) (page 5–81).
3. Remove the front PTO gearbox from the flywheel housing and retrieve the coupler and dowel pins.

Replacing Front Gearbox Seals

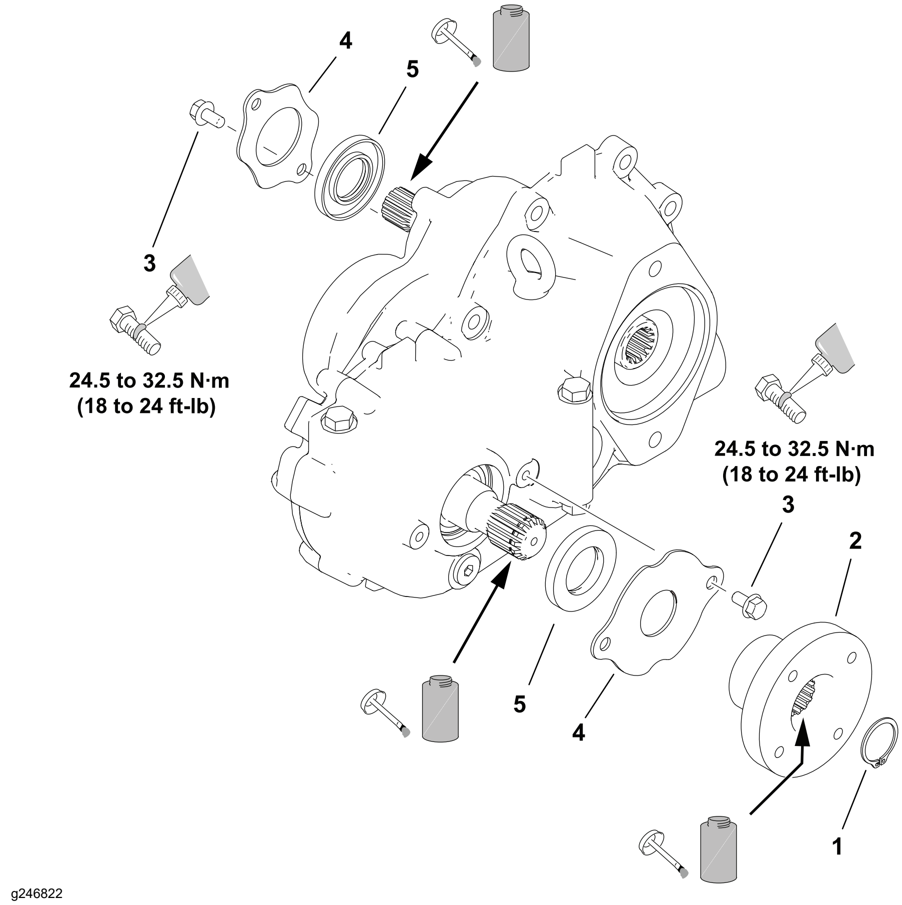


Figure 189

1. Retaining ring
2. Hub
3. Flange-head screw (4 each)
4. Plate (2 each)
5. Shaft seal (2 each)

---

1. Remove the retaining ring and the hub from the gearbox output shaft.
2. Remove the flange-head screws and plate to access either shaft seal.
3. Carefully remove and discard the shaft seal.
4. Clean the gearbox housing bore and cover the shaft splines with tape to protect the shaft seal during installation.
5. Install the shaft seal and remove the tape from the shaft splines.
6. Install the plate and tighten the flange-head screws from **24.5 to 32.5 N·m (18 to 24 ft-lb)**.
7. Apply anti-seize lubricant to the splines of the output shaft and hub, then install the hub and retaining ring.

Disassembling the Front PTO Gearbox

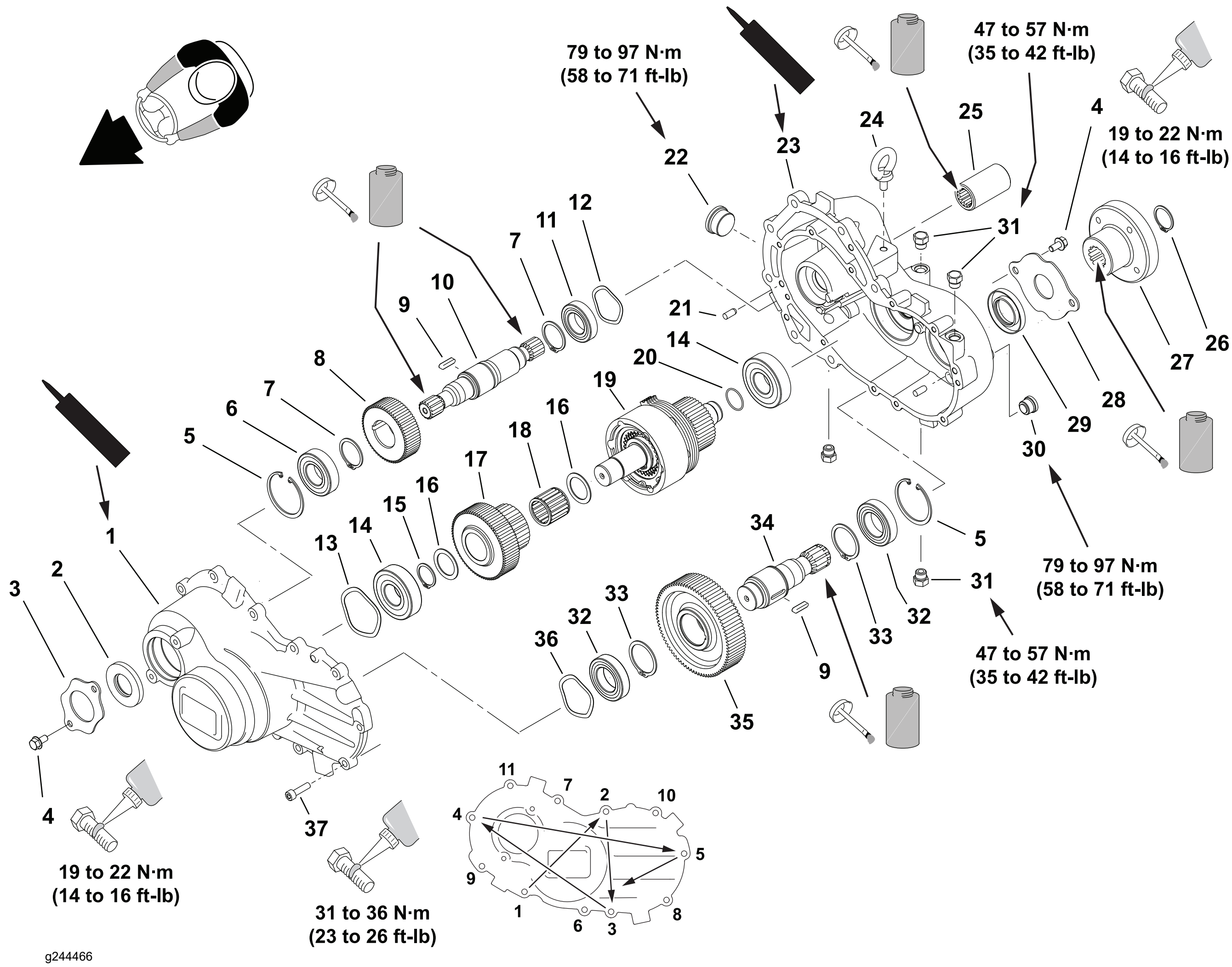


Figure 190

1. Cover
2. Shaft seal
3. Plate
4. Flange-head screw (4 each)
5. Retaining ring
6. Bearing
7. Retaining ring (2 each)
8. Gear – 64T
9. Key (2 each)
10. Input shaft
11. Bearing
12. Wave washer
13. Wave washer
14. Bearing
15. Retaining ring
16. Thrust washer (2 each)
17. Gear – 77T
18. Needle bearing
19. Clutch assembly
20. O-ring
21. Dowel pin (2 each)
22. Plug
23. Case
24. Eyebolt
25. Coupler
26. Retaining ring
27. Hub
28. Plate
29. Shaft seal
30. Plug
31. Plug (4 used)
32. Bearing (2 each)
33. retaining ring (2 each)
34. Output shaft
35. Gear – 84T
36. Wave washer
37. Capscrew (11 each)
38.

---

1. Remove the retaining ring and hub from the output shaft.
2. Remove the socket head capscrews and use the tabs provided to pry the cover from the gearbox.
3. Retrieve the dowel pins from the cover or case, and retrieve the wave washers from the clutch shaft and the output shaft assemblies.
4. Remove the input shaft assembly from the gearbox case.

Disassembling the Front PTO Gearbox (continued)

5. Remove the clutch shaft and the output shaft assemblies from the gearbox case together.
6. Remove the plates and shaft seals.
7. Clean the gearbox cover and case, removing any old sealant.

Assembling the Front PTO Gearbox

1. If previously removed, fit the dowel pins into the gearbox case or cover.

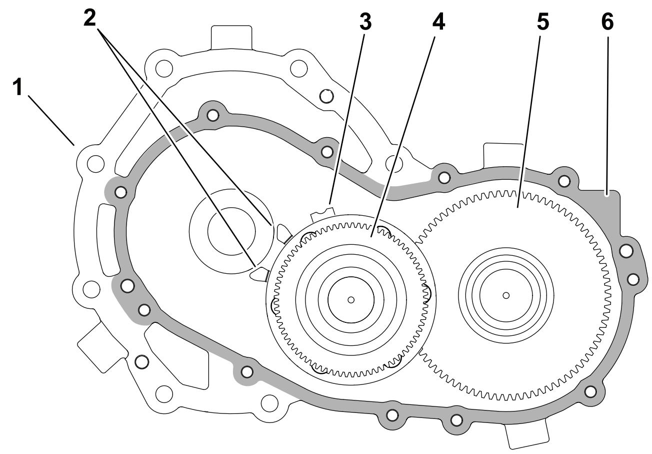


Figure 191

1. Gearbox case
2. Stops
3. Brake disc pack tabs
4. Clutch shaft assembly
5. Output shaft assembly
6. Mating surface

---

2. Engage the clutch shaft and the output shaft assemblies together. Position the tabs on the brake disc pack outside of the stops in the gearbox case and install the shafts into the gearbox case together.
3. Install the output shaft assembly into the gearbox case.
4. Clean any residue from the gearbox and cover mating surfaces with solvent and apply silicone sealant to only the mating surfaces.
5. Place the wave washers over the clutch shaft and output shaft bearings.
6. Fit the cover over the shaft bearings, wave washers and dowel pins.
7. Apply medium strength thread locking compound and install the socket head capscrews. Tighten the capscrews in a crossing pattern from **31 to 36 N·m (23 to 26 ft-lb)**.
8. Rotate the input shaft by hand to confirm proper gearbox assembly.
9. Replace the gearbox seals; refer to Replacing Front Gearbox Seals (page 7–25).

Installing the Front PTO Gearbox

1. Apply a thin layer of anti-seize lubricant to the splines of the input shaft and the flywheel adapter.

   Note: Long dowel pins are provided to enable shaft spline alignment during gearbox installation.

2. Fit the gearbox to the flywheel housing and install the 7 flange-head screws. Tighten screws in an alternating pattern from **46 to 57 N·m (34 to 42 ft-lb)**.

Installing the Front PTO Gearbox (continued)

3. Apply a thin layer of anti-seize lubricant to the splines of the output shaft and the coupler, then install the coupler.

PTO Clutch Service

The PTO clutch is a hydraulically actuated mechanism located in the front PTO gearbox. If the PTO clutch is worn or damaged, replace the PTO gearbox assembly; refer to Removing the Front PTO Gearbox (page 7–24) and Installing the Front PTO Gearbox (page 7–27).

Rear PTO Gearbox

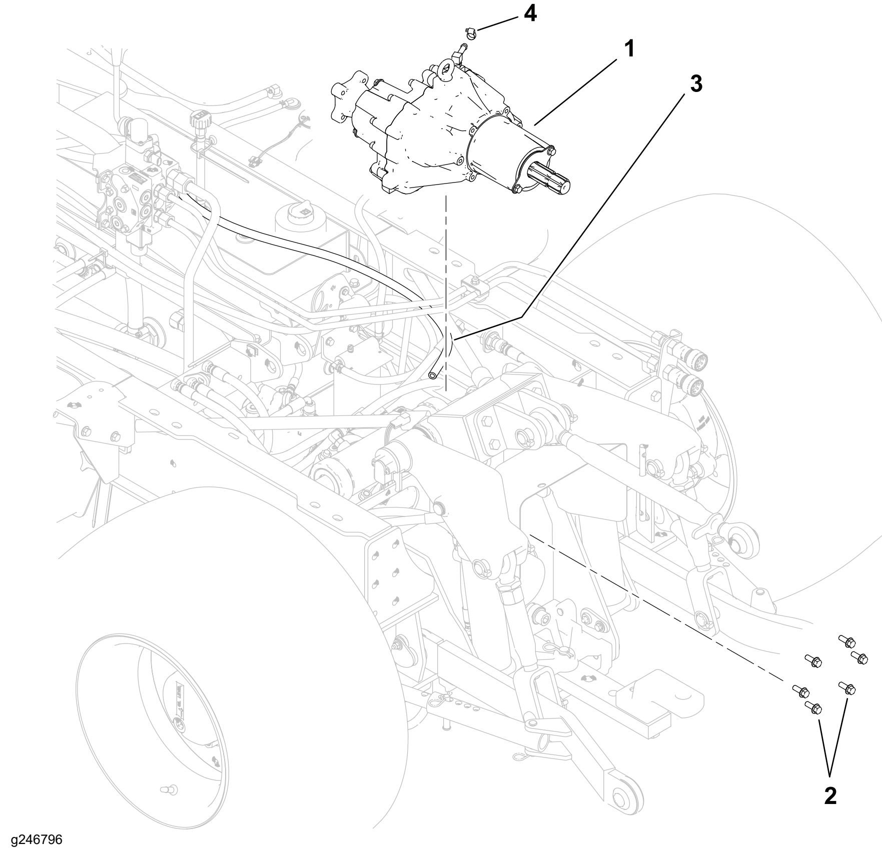


Figure 192

1. Rear PTO gearbox
2. Flange-head screw (6 each)
3. Breather hose
4. Hose clamp

CAUTION

The rear PTO gearbox weighs approximately 38 kg (84 lbs). Use an appropriate lift to remove and install the gearbox.

Note: The rear PTO gearbox shaft seals can be replaced in the machine. The PTO driveshaft must be disconnected but the gearbox does not have to be removed.

Removing the rear PTO Gearbox

1. Disconnect the breather hose from the top of the gearbox.
2. Remove the PTO driveshaft; refer to Removing the PTO Driveshaft (page 7–33).
3. Support the rear PTO gearbox from overhead.
4. Remove the 6 capscrews securing the rear of the gearbox housing to the frame and lift the gearbox from the machine.

Replacing Rear Gearbox Seals

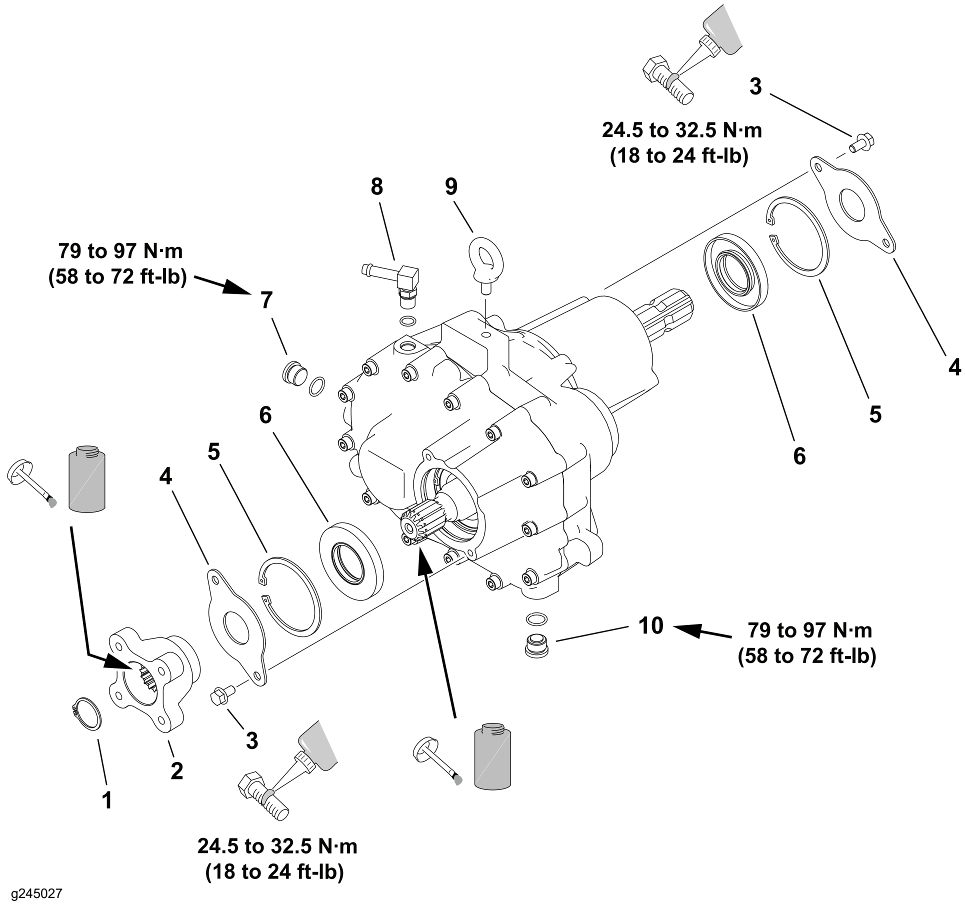


Figure 193

1.	Retaining ring	5.	Retaining ring (2 each)	9.	Eyebolt
2.	Hub	6.	Shaft seal (2 each)*	10.	Magnetic plug
3.	Flange-head screw (4 each)	7.	Plug		
4.	Plate (2 each)	8.	Barb elbow		

*Service Part

1. Remove the retaining ring and the hub from the gearbox input shaft.
2. Remove the flange-head screws, plate and retaining ring to access either shaft seal.
3. Carefully remove and discard the shaft seal.
4. Clean the gearbox housing bore and cover the shaft splines with tape to protect the shaft seal during installation.
5. Install the shaft seal and remove the tape from the shaft splines.
6. Install the retaining ring and the plate. Tighten the flange-head screws from **24.5 to 32.5 N·m (18 to 24 ft-lb)**.
7. Apply a thin layer of anti-seize lubricant to the splines of the input shaft and hub, then install the hub and retaining ring.

Installing the Rear PTO Gearbox

1. Support the rear PTO gearbox from overhead.

Installing the Rear PTO Gearbox (continued)

2. Lift the gearbox into the machine and install the 6 capscrews securing the rear of the gearbox housing to the frame.
3. Connect the breather hose to the top of the gearbox.
4. Check and adjust the rear PTO gearbox fluid level; refer to the traction unit *Operator's Manual*.
5. Install the PTO driveshaft; refer to Installing the PTO Driveshaft (page 7–34).

PTO Driveshaft

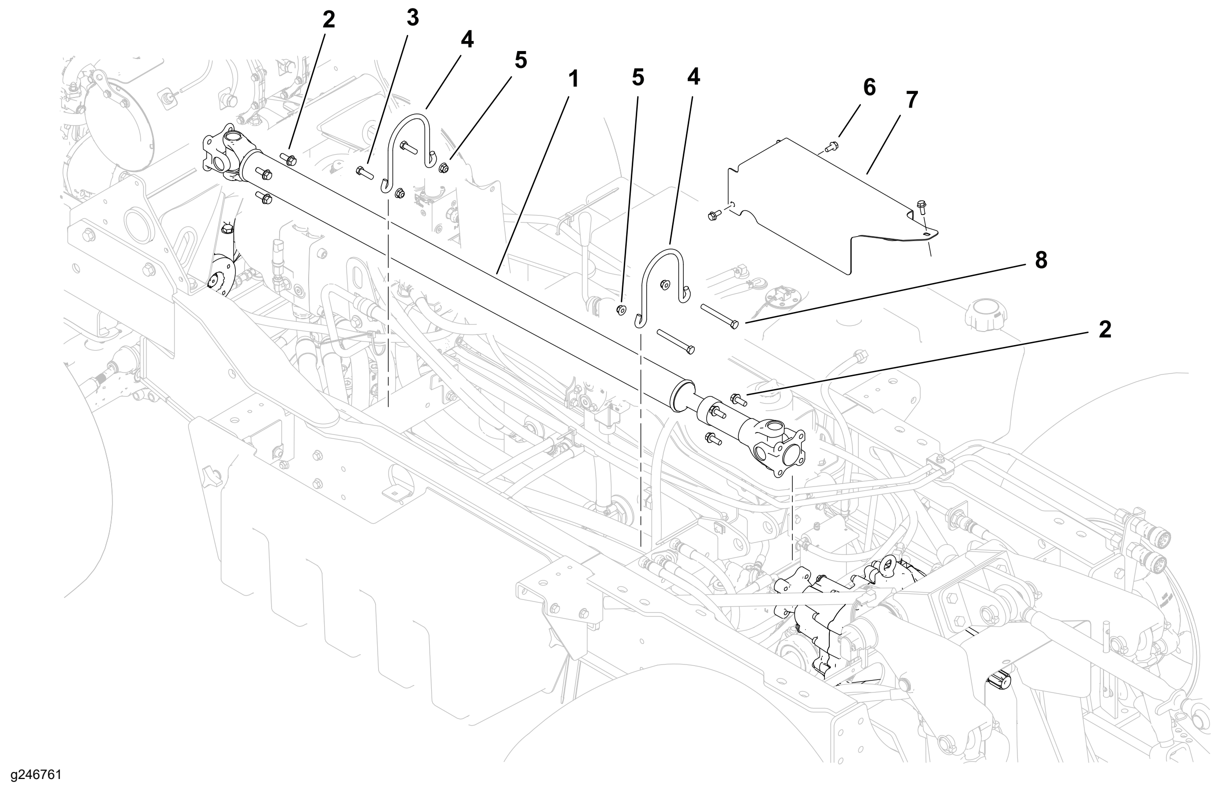


Figure 194

1. PTO driveshaft
2. Flange-head screw (8 each)
3. Capscrew (2 each)
4. Shaft guard (2 each)
5. Flange nut (4 each)
6. Flange-head screw (3 each)
7. Shaft cover
8. Capscrew (2 each)

Removing the PTO Driveshaft

CAUTION

It may be necessary to raise the operator platform to remove the PTO driveshaft. If so, block the operator platform to prevent it from lowering accidently.

1. Remove the bed.
2. Remove the PTO shaft cover.
3. Remove the 2 shaft guards.
4. Remove the screws securing the flange yokes to the gearbox hubs and remove the PTO shaft.
5. Slide the slip yoke off the tube yoke.

Servicing the PTO Driveshaft

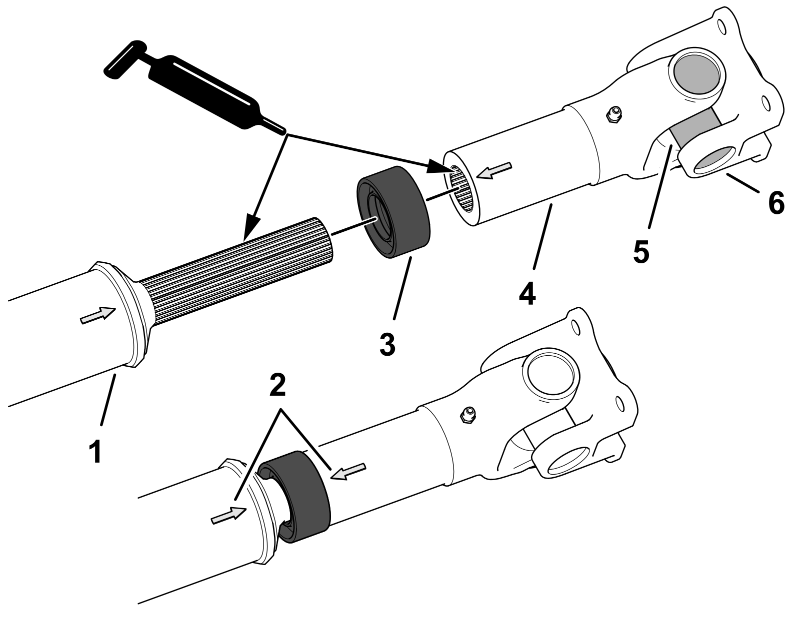


Figure 195

1. Tube yoke
2. Boot
3. Slip yoke
4. Phasing arrows
5. Cross bearing
6. Flange yoke

---

1. At each end of the driveshaft, inspect the cross bearings and flange yokes for wear and damage.
2. Separate the slip yoke from the tube yoke.
3. Remove the boot from the slip yoke.
4. Thoroughly clean and inspect the splines of the slip yoke from the tube yoke.
5. Apply a coat of Mobil high-temperature XHP–222 grease or equivalent to the slip yoke from the tube yoke splines.
6. Install the boot onto the slip yoke.
7. While aligning the phasing arrows, engaged the splines of the slip yoke with the splines of the tube yoke, and slide the yokes together.

IMPORTANT

Incorrect alignment of the phasing arrows prior to installing the PTO driveshaft will result in driveshaft vibration that may damage input and output drive components, and the cross bearings.

Installing the PTO Driveshaft

1. Ensure that the splines of the slip yoke and tube yoke have a coating of grease.
2. Position the PTO shaft in the machine and secure the flange yokes to the gearbox hubs.
3. Apply Mobil high-temperature XHP–222 grease or equivalent to the grease fitting on the slip yoke.

Installing the PTO Driveshaft (continued)

4. Install the 2 shaft guards.

5. Install the PTO shaft cover.

6. Install the bed.

Chapter 8

Chassis

Table of Contents

General Information

Traction Unit Operator’s Manual and Accessory Installation Instructions

The traction unit *Operator’s Manual* and accessory *Installation Instructions* provide information regarding the operation, general maintenance and maintenance intervals for the machine and its accessories. Refer to the traction unit *Operator’s Manual* and accessory *Installation Instructions* for additional information.

Service and Repairs

Front Screen

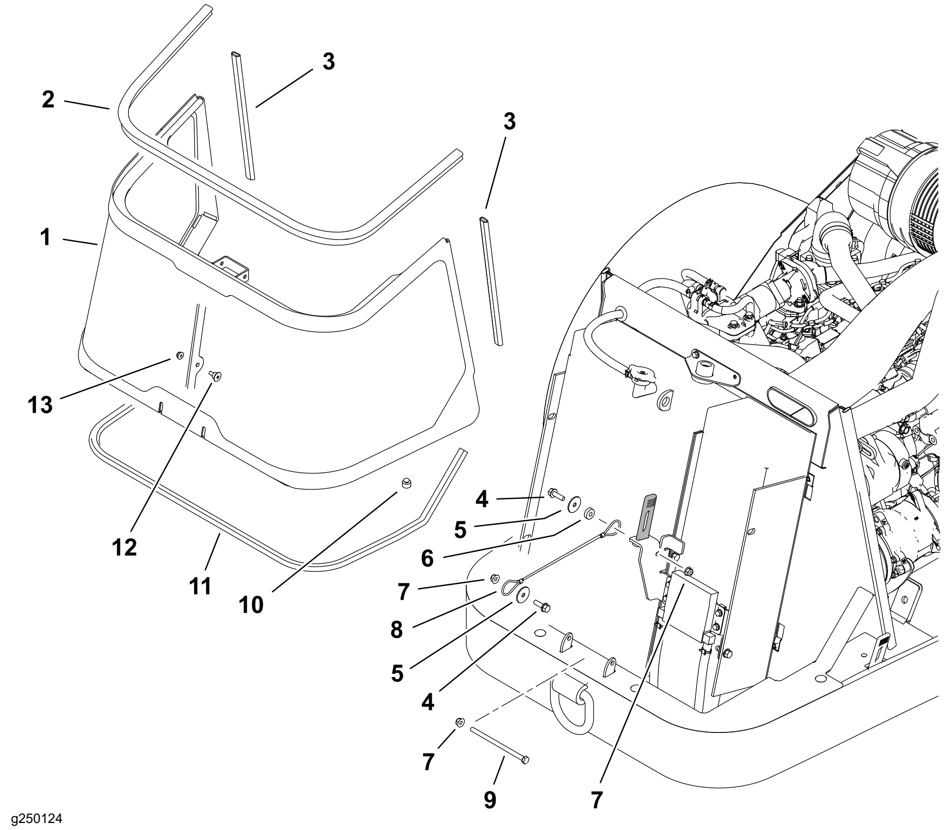


Figure 196

1. Front screen
2. Bulb seal
3. Bulb seal (2 each)
4. Flange-head screw (2 each)
5. Flat washer (2 each)
6. Spacer
7. Flange nut (3 each)
8. Tether
9. Capscrew
10. Bumper (2 each)
11. Bulb seal
12. Shoulder screw
13. Lock nut

Removing and Installing the Front Screen

1. Park the machine on a level surface, lower any attachments, shut off the engine and remove the key from the key switch.
2. Release the hood latches and raise the hood.
3. Release the front screen latch and tilt the screen forward.
4. Remove the fasteners at either end of the screen tether.
5. Remove the bolt and nut from the screen hinge and remove the screen.
6. Inspect the screen for worn or damaged bumpers or seals and replace them as necessary.
7. To install the screen, follow this procedure in reverse order.

Hood

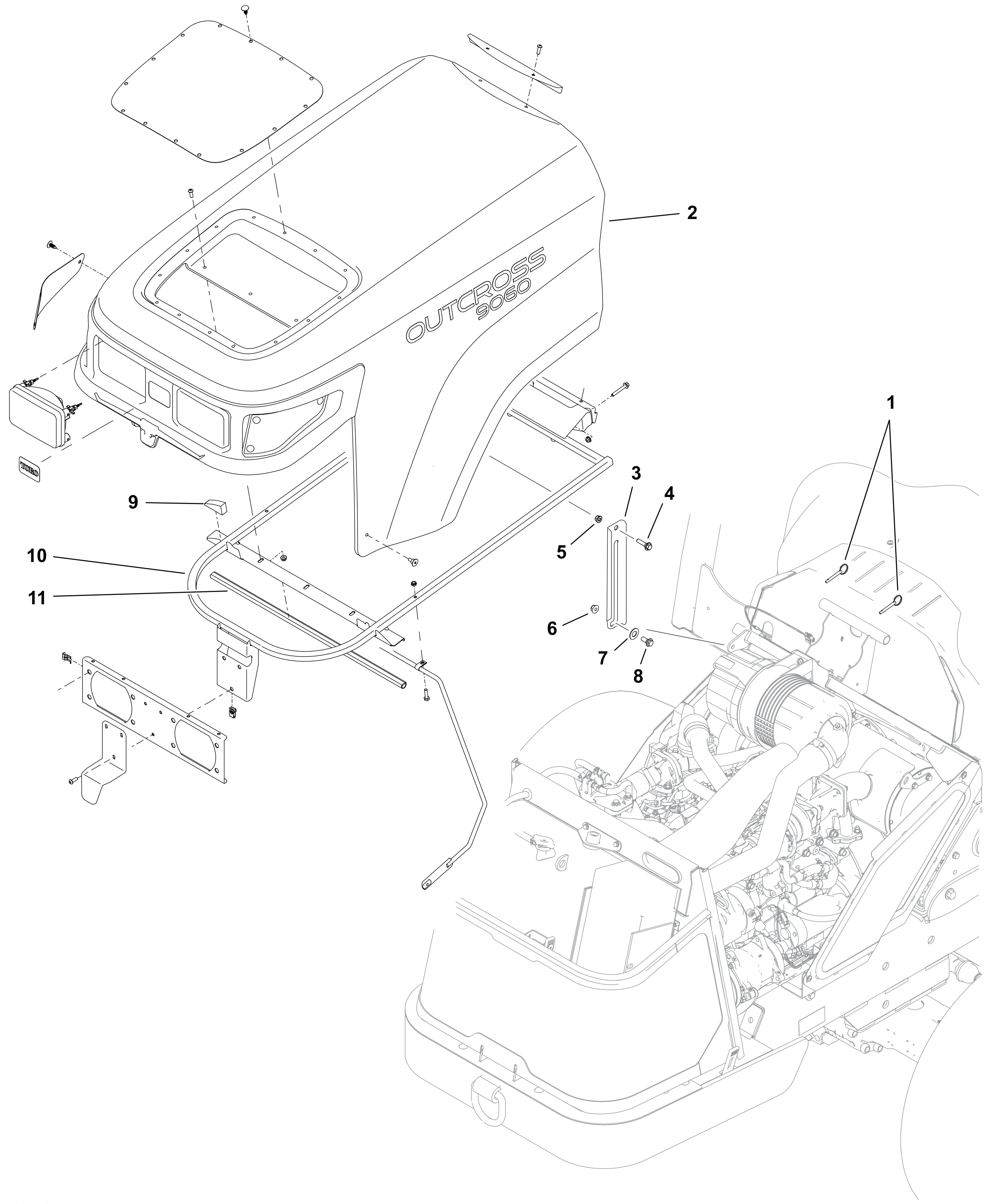


Figure 197

1.	Lynch pin (2 each)	5.	Lock nut	9.	Foam block (2 each)
2.	Hood skin	6.	Lock nut	10.	Hood frame
3.	Hood prop	7.	Washer	11.	Bulb seal
4.	Shoulder screw	8.	Shoulder screw		

Removing and Installing the Hood

1. Park the machine on a level surface, lower any attachments, shut off the engine and remove the key from the key switch.
2. Release the hood latches and raise the hood.
3. Disconnect the headlight harness of the hood from the platform wire harness.
4. Support the hood and remove the fasteners at either end of the hood prop.

CAUTION

The hood assembly is bulky. Two technicians can safely remove the hood assembly, one on each side of the machine.

5. Remove the lynch pins from the hood hinge and remove the hood.
6. Inspect the hood for worn or damaged seals (radiator area) and replace them as necessary.
7. To install the hood, follow this procedure in reverse order.

Operator Platform or Cab

Removing the Operator's Platform or Cab

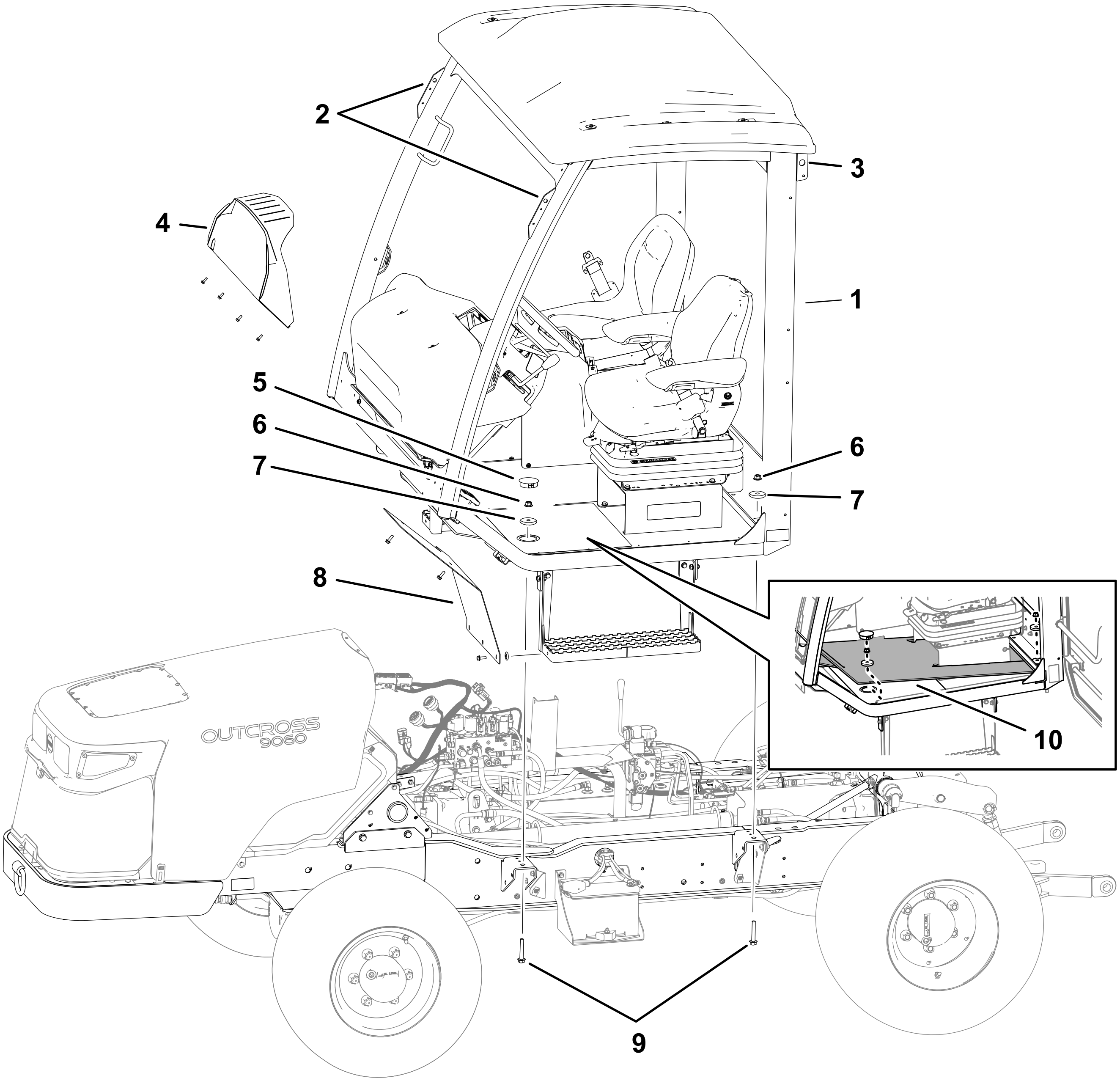


Figure 198

1. Operator platform
2. Front lift point (2 each)
3. Rear lift point (2 each)
4. Front cowl
5. Plug (2 each)
6. Flange nut (4 each)
7. Snubbing washer (4 each)
8. Front fender (2 each)
9. Capscrew (4 each)
10. Floor tread (machines with a cab)

IMPORTANT

To prevent damage to the electrical wire harnesses, coolant hoses, and refrigerant hoses, numerous cable ties and clamps are used to secure these items to the machine. Record the location of all cable ties and clamps that are removed from the machine during operator platform removal so that they can be properly replaced during installation.

Removing the Operator's Platform or Cab (continued)

Preparing the Machine

1. Park the machine on a level surface.
2. If installed, remove the front loader, and lower rear counterweight to the ground.
3. If installed, remove the rear attachment from the 3-point hitch or the draw bar.
4. Remove the standard utility box; refer to Standard Utility Box (page 8–35), or the optional cargo bed; refer to the *Installation Instructions*.
5. Disconnect the battery; refer to Removing the Battery (page 6–83).

Disconnecting the Hydraulic Manifold Hoses

1. Remove the access panel from the right side of the control console.

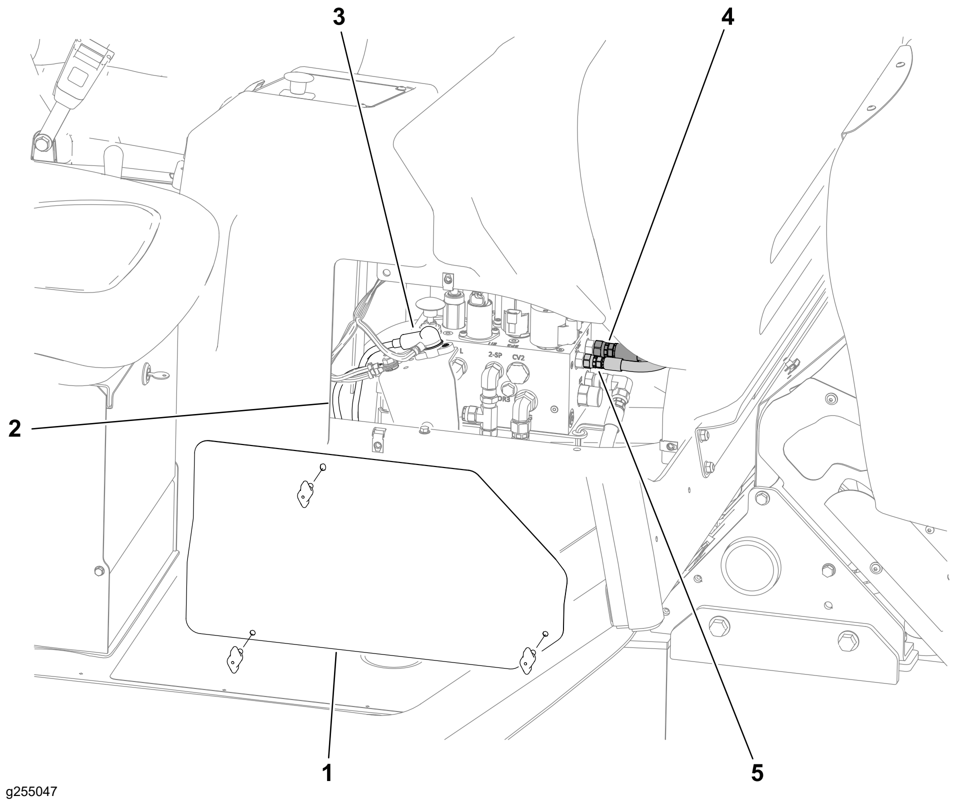


Figure 199

1. Access panel
2. Battery negative (-) cable
3. Battery negative (+) cable
4. Hydraulic manifold ST port
5. Hydraulic manifold LS/OR1 port

---

2. Disconnect the hose from the ST port of the hydraulic manifold. Cap the port fitting and plug the hose to prevent contamination from entering the hydraulic system.
3. Disconnect the hose from the LS/OR1 port of the hydraulic manifold. Cap the port fitting and plug the hose to prevent contamination from entering the hydraulic system.

Disconnecting the Electrical Harnesses

1. Disconnect the battery positive (+) and negative (-) cables from the terminal bracket posts (Figure 199).
2. Unplug the 2 engine wire harness connectors from the engine ECU.

Removing the Operator’s Platform or Cab (continued)

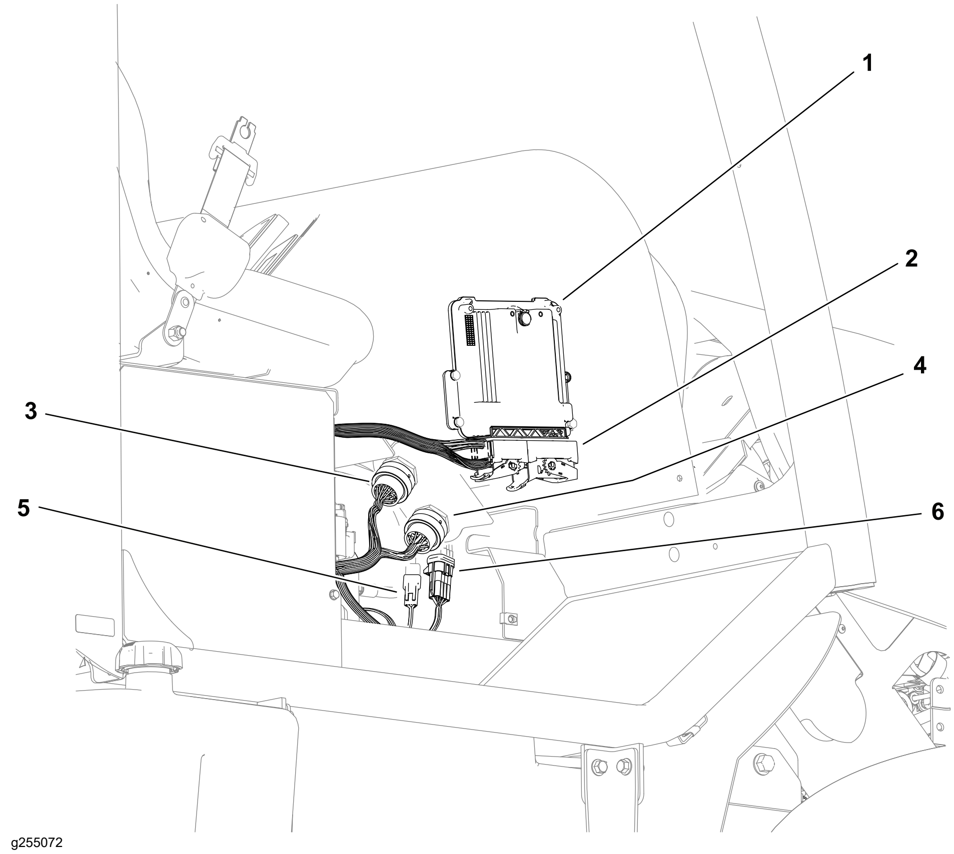


Figure 200

1. Engine ECU
2. Engine wire harness connector
3. Frame wire harness connector (blue ring)
4. Frame wire harness connector (green ring)
5. 3-pin engine harness connector P63
6. 7-pin engine harness connector P18

3. Unplug the frame wire harness at the 2 connectors from the operator platform wire harness connectors (behind the forward side of the dash cover).
4. Unplug the engine wire harness connector P63 (3 pins) from the main harness.
5. Unplug the engine wire harness connector P18 (7 pins) from the main harness.
6. Remove 3 socket-head screws that secure the control panel to the dash panel, and lift the control panel to access the glow, start and EGR relays.

Removing the Operator's Platform or Cab (continued)

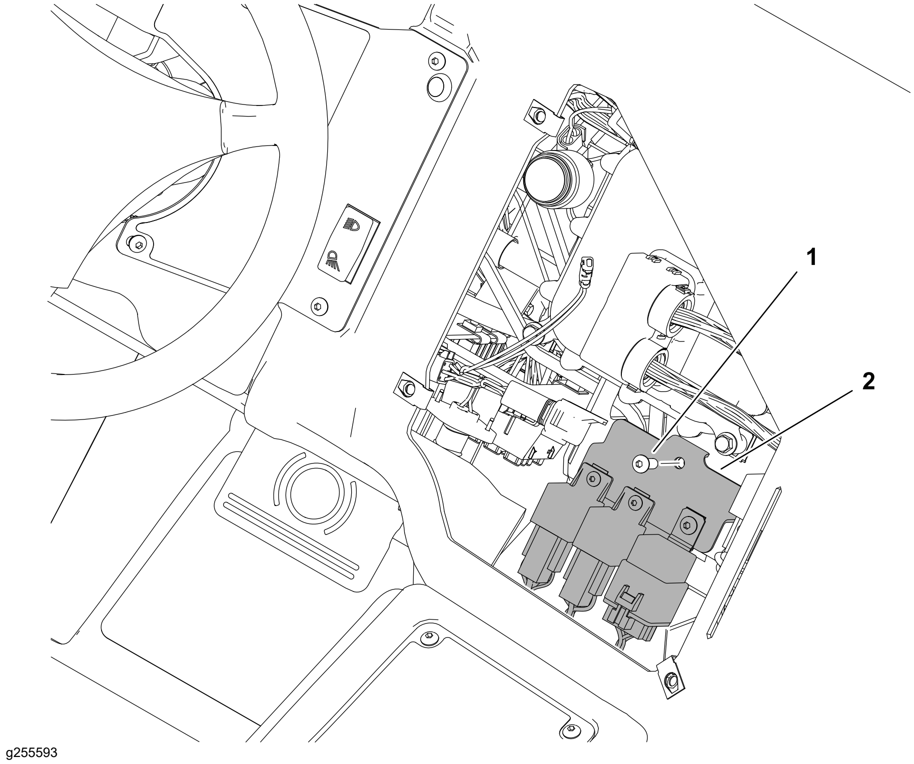


Figure 201

1. Capscrew
2. Relay panel and relays

7. Remove the socket-head screw that secures the relay panel (supporting the glow-plug relay, start relay, and EGR relay) to the dash plate, and route the panel and relays out of the operator platform.
8. Route the engine harness (2 ECU connectors, connector P18, connector P63, and the relay panel and relays) down through the opening in the floor tunnel.

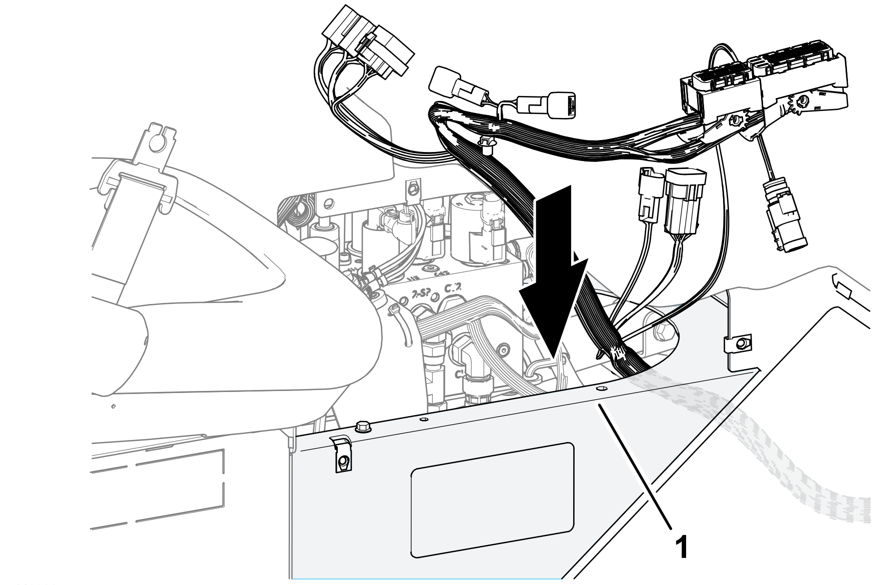


Figure 202

1. Floor tunnel

Removing the Operator's Platform or Cab (continued)

Preparing the Console Controls

1. Remove the rubber boot from the auxiliary load valve.

   Note: Do not remove the knob on the rod for the auxiliary load valve.

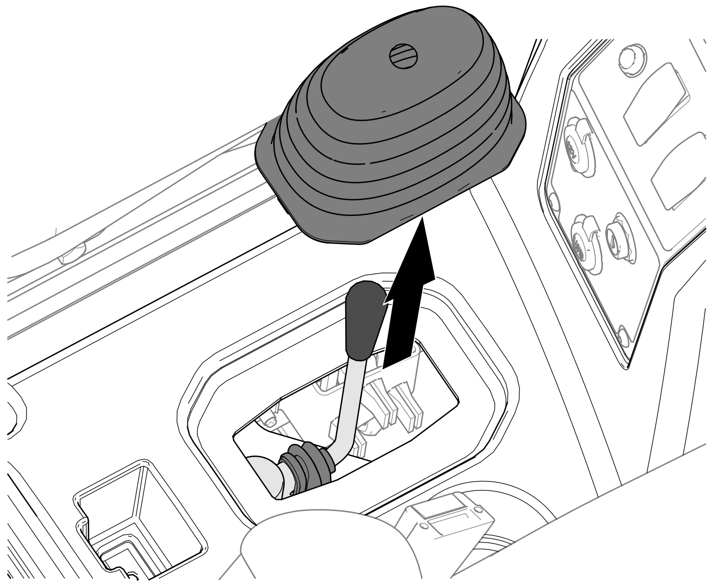


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Figure 203

2. For machines equipped with a front loader, remove the knob and rubber boot from the loader valve.

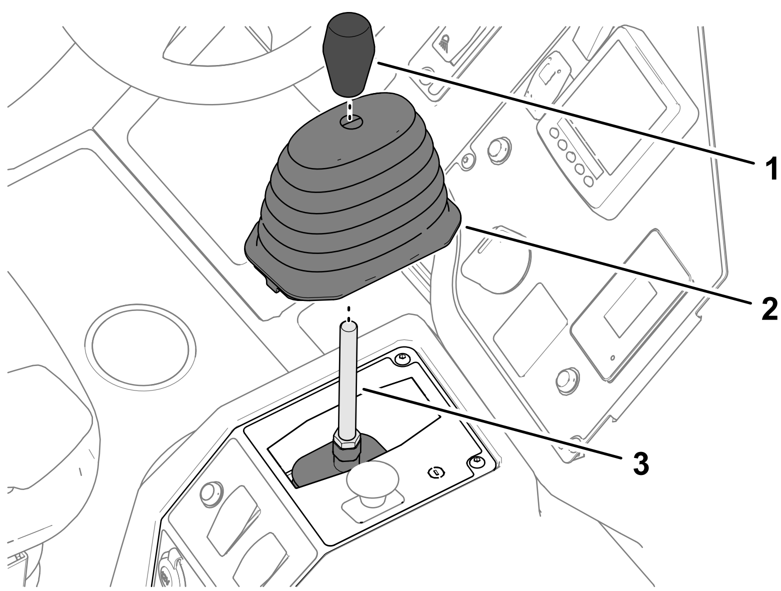

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Figure 204

Machine with a loader.

1. Knob
2. Rubber boot
3. Rod (loader control valve)

Removing the Operator’s Platform or Cab (continued)

Disconnecting the Steering Hoses

1. At the back of the operator’s platform or the cab, label and disconnect the 3 hoses from the fittings at the bulkhead support.

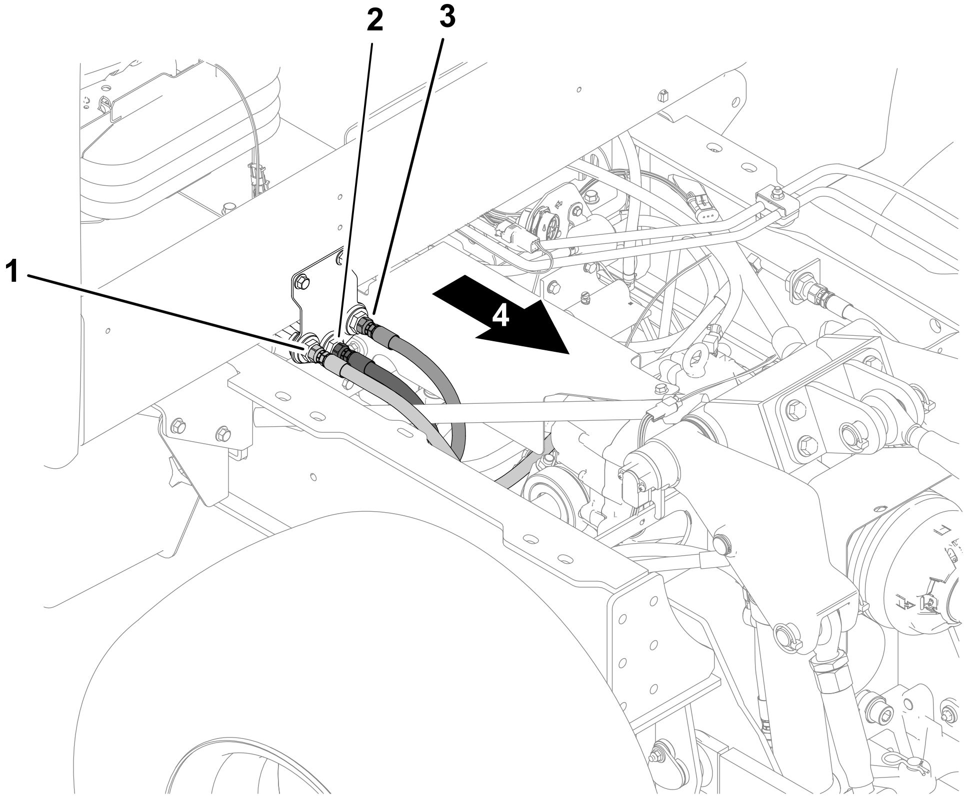

Figure 205

1.	Hydraulic hose (rear steering cylinder, right fitting)	3.	Hydraulic hose (hydraulic tube)
2.	Hydraulic hose (front steering cylinder, left fitting)	4.	Back of the machine

2. Cap the fittings and plug the hoses to prevent contamination from entering the hydraulic system.

Disconnecting the Heating and Air Conditioning Hoses—Machines with a Cab

1. At the front of the engine, label and disconnect the coolant hoses for the heater core and heat valve of the cab. Cap the fittings and plug the hoses to prevent contamination from entering the engine or coolant lines.

Removing the Operator's Platform or Cab (continued)

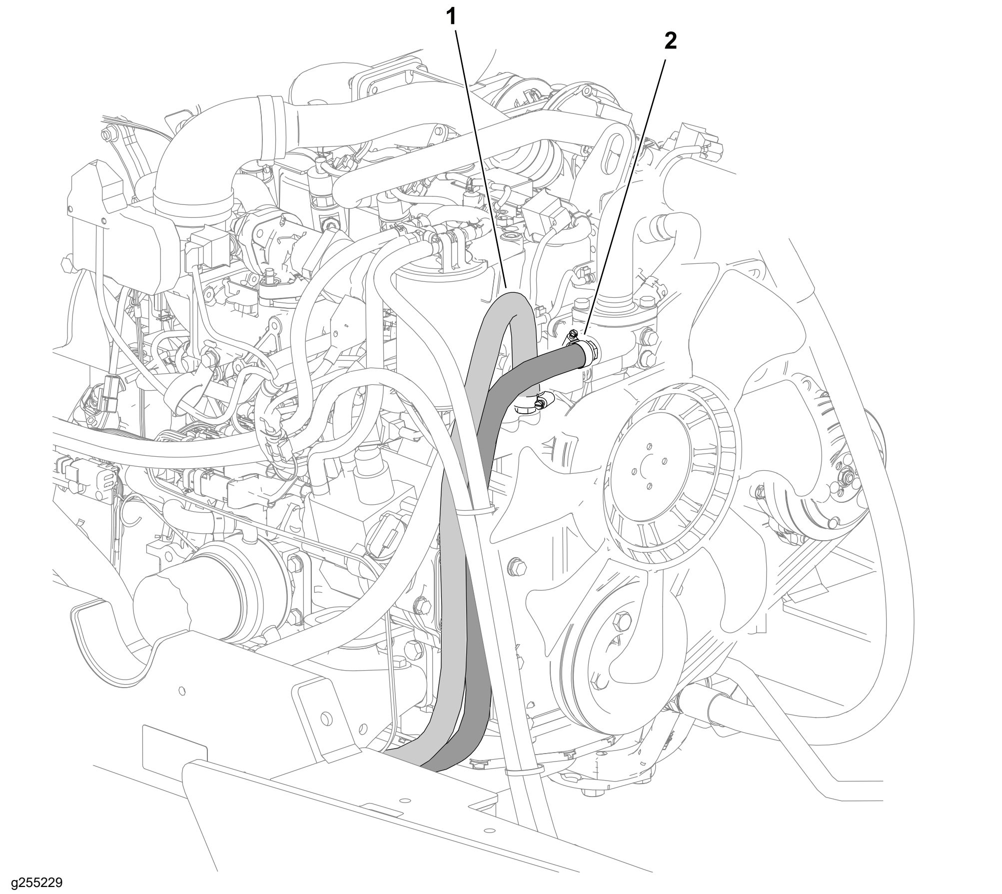

Figure 206

1. Coolant hose (from heater core)
2. Coolant hose (to heat valve)

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2. Recover the refrigerant in accordance with local regulations.

IMPORTANT

Important: Do not allow refrigerant to discharge into the atmosphere. Before opening or disconnecting parts from the refrigerant circuit, reclaim the refrigerant into a specified recovery cylinder, and dispose of it correctly.

Removing the Operator's Platform or Cab (continued)

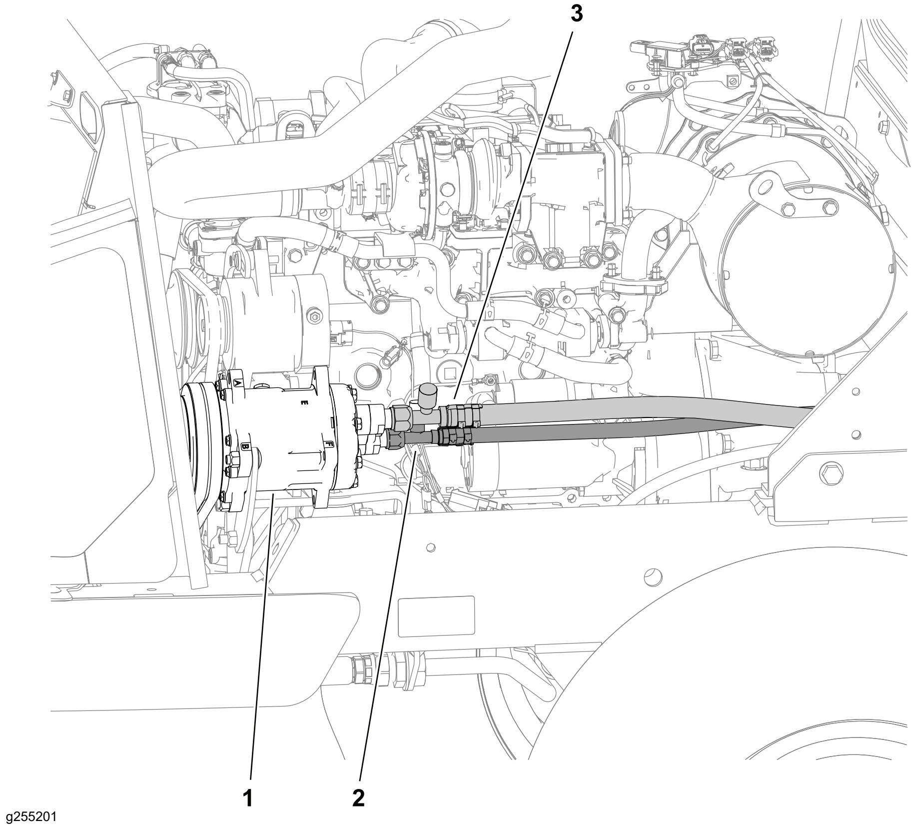

Figure 207

1. Compressor
2. Refrigerant hose (high side)
3. Refrigerant hose (low side)

3. Disconnect the hoses from the air-conditioning compressor fittings.

IMPORTANT

Cap the compressor fittings and plug the hoses immediately to prevent moisture and contamination from entering the component s of the air conditioning system.

Note: Leave the refrigerant hoses connected at the cab.

Separating the Operator's Platform or Cab from the Frame of the Machine

1. Remove the front cowl (Figure 198).
2. Remove the front fenders (Figure 198).
3. Machines with a cab—lift the forward edge of the floor treads to access the front floor plugs, nuts, and washers (Figure 198).
4. Remove the 2 floor plugs, 4 flange nuts, snubbing washers, and capscrews securing the operator platform to the frame (Figure 198).

Removing the Operator’s Platform or Cab (continued)

⚠ CAUTION ⚠

Use an appropriate hoist to raise and lower the operator platform assembly:

- **The standard operator platform assembly weighs approximately 748 kg (1,650 lb).**
- **The operator platform and cab assembly weighs approximately 952 kg (2,100 lb).**

---

5. Using the 4 lift points provided, raise the operator platform a few inches. Place blocks between the operator platform mounts and the chassis, then ensure all the required hoses and wire harnesses are disconnected and free to separate from the chassis.

IMPORTANT

The operator’s platform assembly can rest on the right and left steps. Support the front and rear of the platform assembly with blocks or jack stands to prevent it from tipping.

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6. Raise the operator platform or the cab until it clears of the machine, then lower the platform or cab to the floor.

Installing the Operator's Platform or Cab

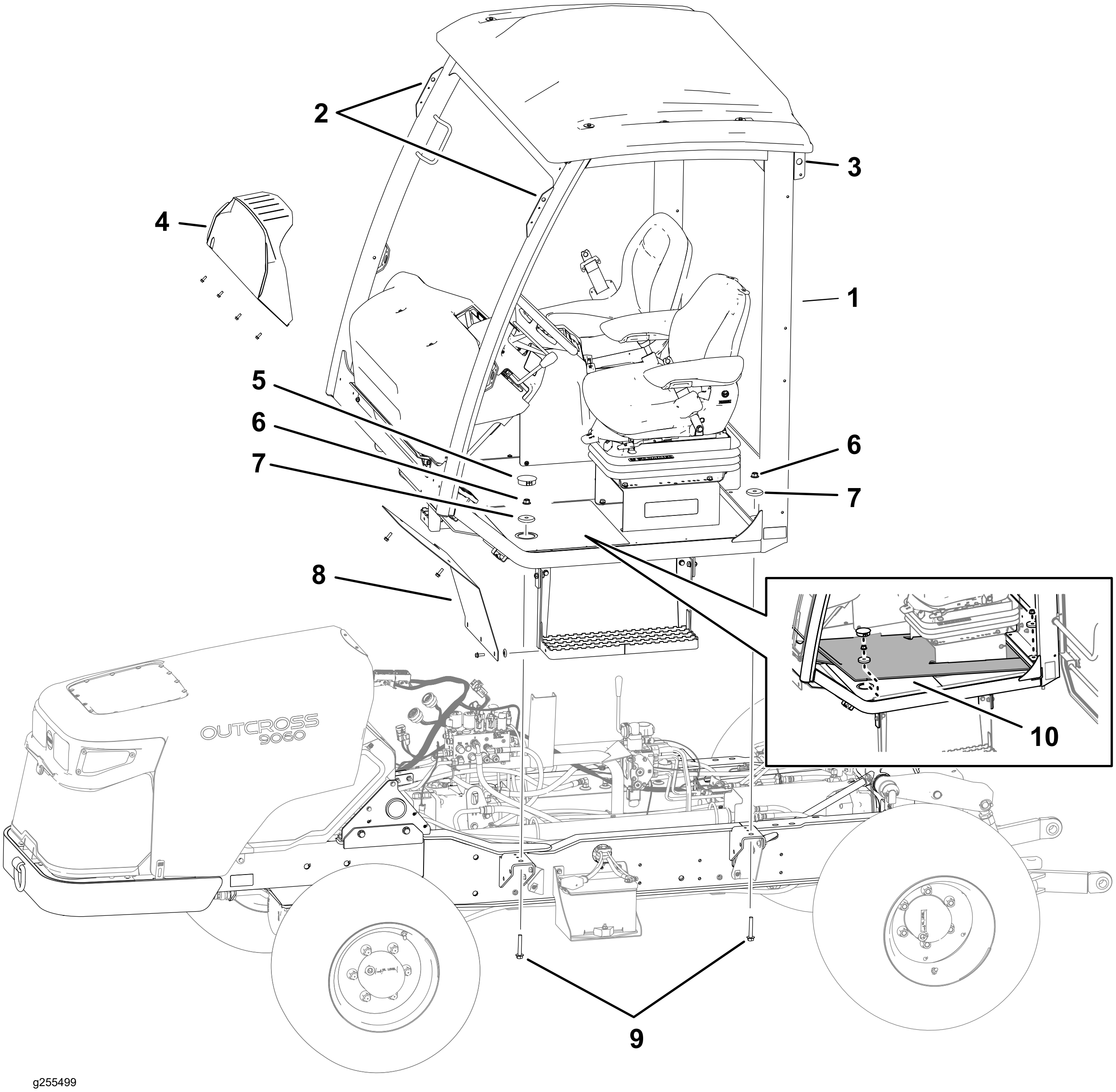

Figure 208

1. Operator platform
2. Front lift point (2 each)
3. Rear lift point (2 each)
4. Front cowl
5. Plug (2 each)
6. Flange nut (4 each)
7. Snubbing washer (4 each)
8. Front fender (2 each)
9. Capscrew (4 each)
10. Floor tread (machines with a cab)

IMPORTANT

To prevent damage to the electrical wire harnesses, coolant hoses, and refrigerant hoses, numerous cable ties and clamps are used to secure these items to the machine. Replace all cable ties and clamps that were removed from the machine during operator platform removal.

Assembling the Operator’s Platform or Cab to the Frame of the Machine

1. Use the 4 lift points provided, and lower the operator platform or cab over the machine chassis. Place blocks between the platform mounts and the chassis, then ensure all the required hoses and wire harnesses are safely routed to the chassis (Figure 208).
2. Align the operator’s platform or cab to the chassis and install the 4 capscrews, snubbing washers, and flange nuts (Figure 208).
3. Install the plugs in the platform at the 2 front mounting points (Figure 208).
4. Machines with a cab—align left and right floor treads to the floor plate of the cab (Figure 208).
5. Install the front fenders (Figure 208).
6. Install the front cowl (Figure 208).

Connecting the Heating and Air Conditioning Hoses—Machines with a Cab

1. Assemble the fitting for the high side refrigerant hose (smaller) to the inboard air-conditioning compressor fitting.

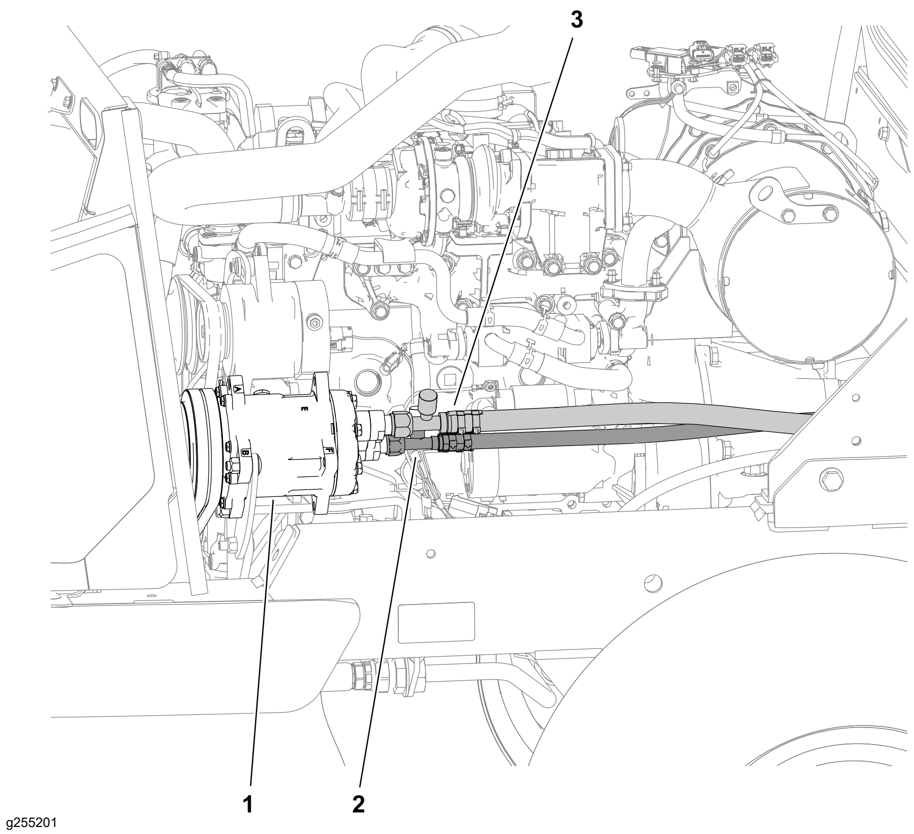

Figure 209

1. Compressor
2. Refrigerant hose (high side)
3. Refrigerant hose (low side)

---

2. Torque the high side refrigerant hose fitting to 33 to 39 N·m (24 to 29 ft-lb)
3. Assemble the fitting for the low side refrigerant hose (larger) to the outboard air-conditioning compressor fitting.
4. Torque the low side refrigerant hose fitting to 32 to 42 N·m (23 to 31 ft-lb)

5. At the front of the engine, connect the coolant hoses for the heater core and heat valve of the cab. Cap the fittings and plug the hoses to prevent contamination from entering the engine or coolant lines.

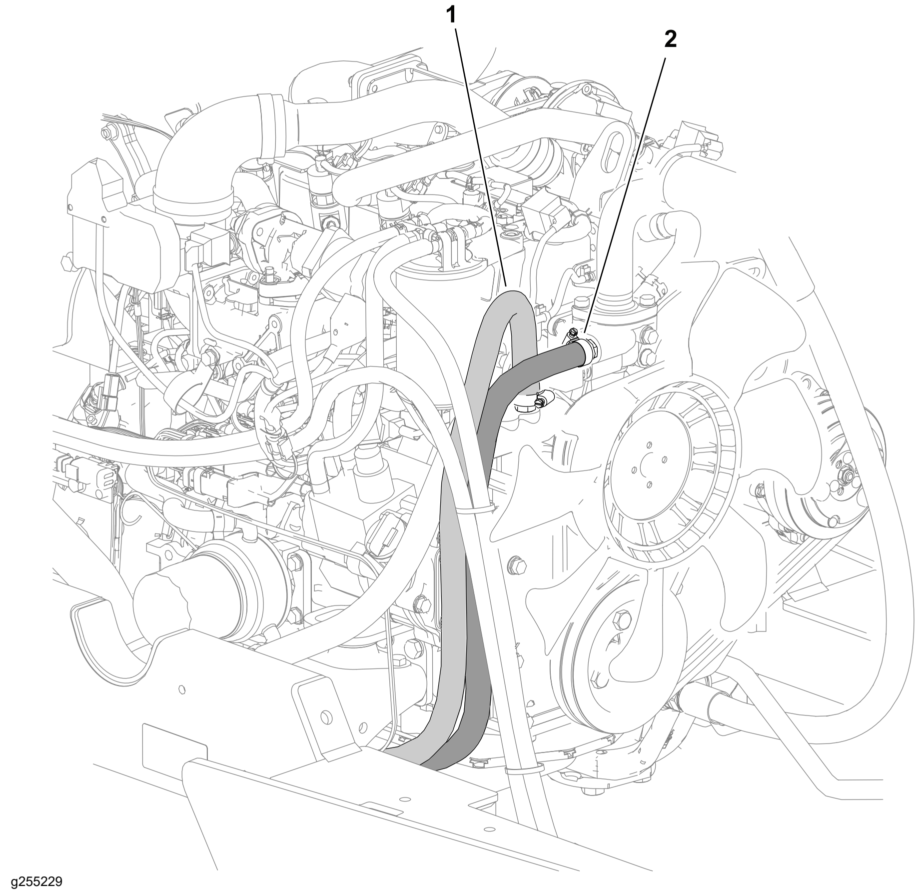

Figure 210

1. Coolant hose (from heater core)
2. Coolant hose (to heat valve)

Connecting the Hydraulic Manifold Hoses

1. At the back of the operator’s platform or the cab, route the 3 hoses to the fittings of the bulkhead support.

Installing the Operator's Platform or Cab (continued)

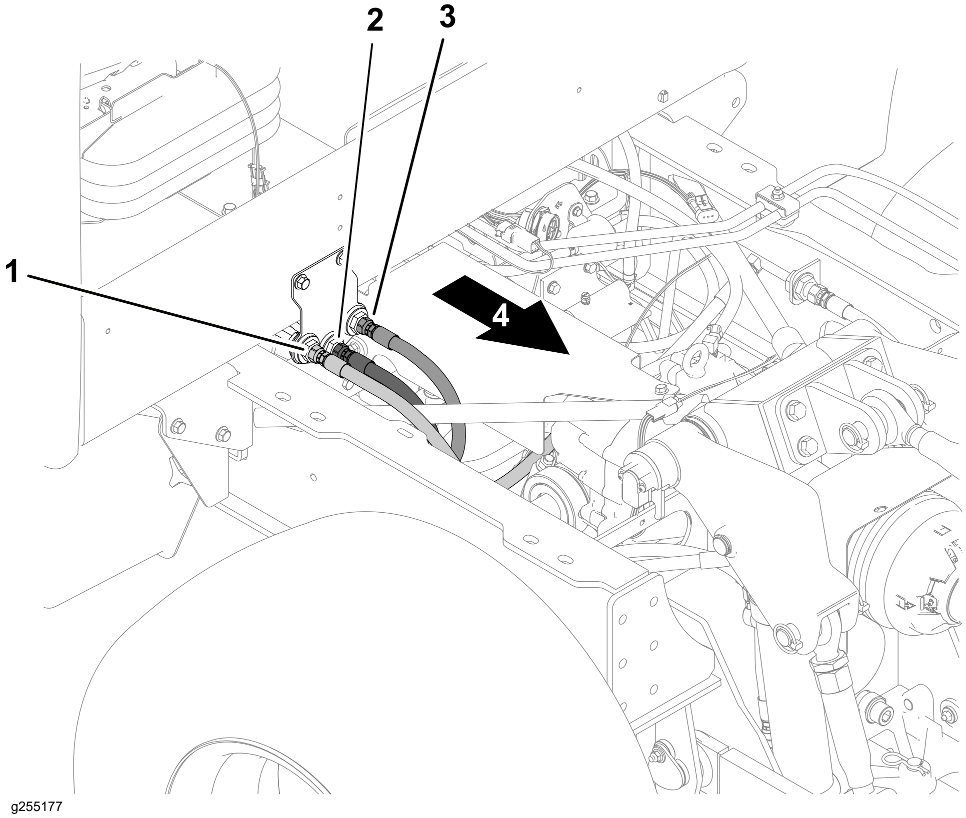

Figure 211

1. Hydraulic hose (rear steering cylinder, right fitting)
2. Hydraulic hose (front steering cylinder, left fitting)
3. Hydraulic hose (hydraulic tube)
4. Back of the machine

---

2. Assemble the hoses to the bulkhead fittings.

Assembling the Console Controls

1. Assemble the rubber boot over the knob and rod for the auxiliary load valve.

Installing the Operator’s Platform or Cab (continued)

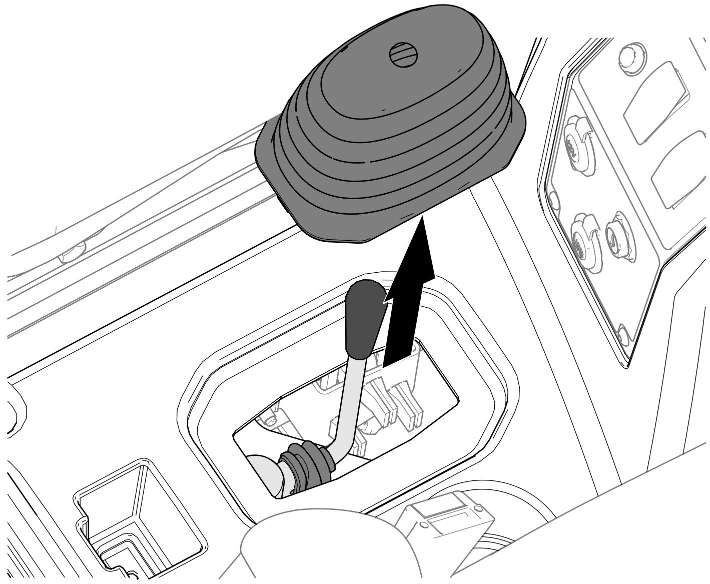

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Figure 212

2. Align the flange at bottom of the boot over the opening of the console.
3. For machines equipped with a front loader, rubber boot over the rod for the loader valve.

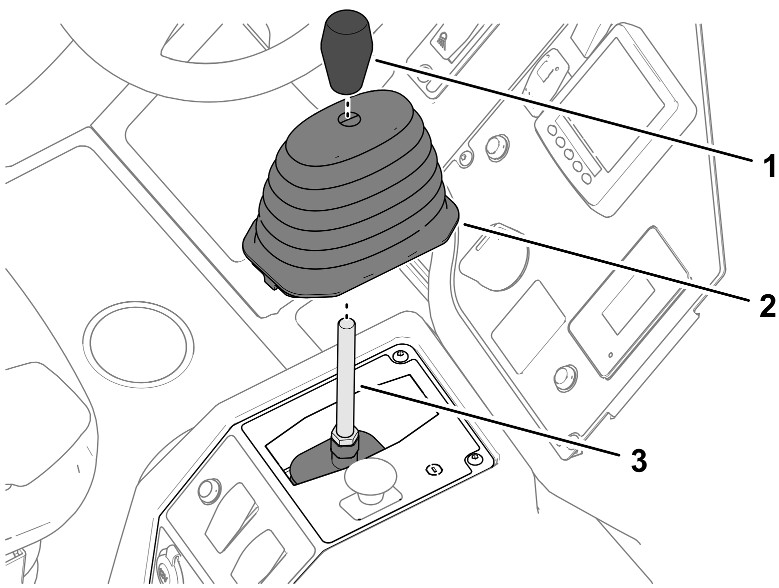

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Figure 213

Machine with a loader.

1. Knob
2. Rubber boot
3. Rod (loader control valve)

4. Align the flange at bottom of the boot over the opening of the console.
5. Assemble the knob to the rod for the loader valve.

Connecting the Electrical Harnesses

1. Route the engine harness (2 ECU connectors, connector P18, connector P63, and the relay panel and relays) up through the opening in the floor tunnel.

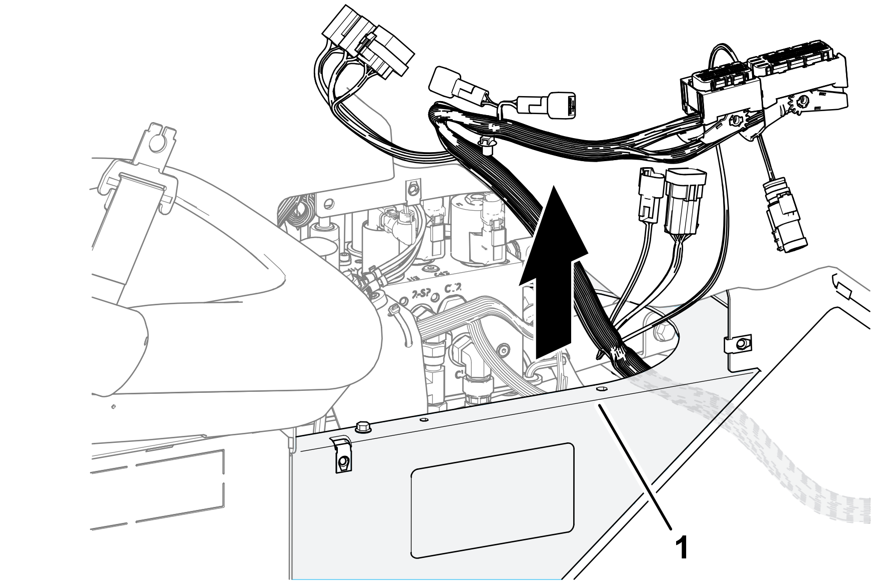

Figure 214

2. Align the tab of the relay panel (supporting the glow-plug relay, start relay, and EGR relay) to the slot in the dash plate.

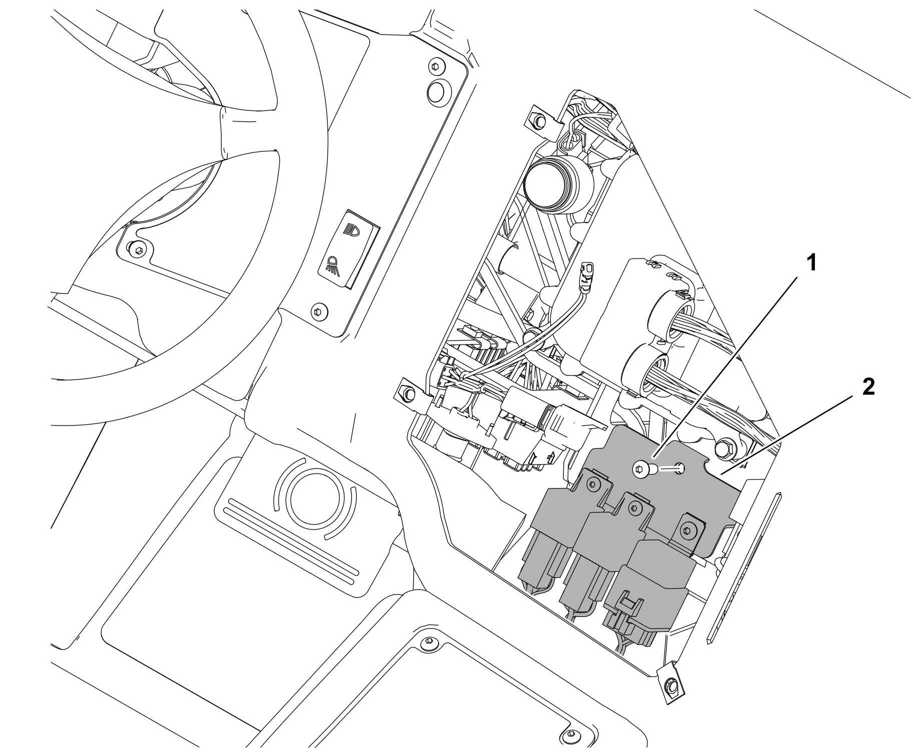

Figure 215

1. Capscrew
2. Relay assembly

3. Secure the relay panel to the dash plate with the socket-head screw.
4. Align the control panel to the dash panel, and secure the control panel to the dash with the 3 socket-head screws.
5. Plug the engine wire harness connector P18 (7 pins) into the main harness.

Installing the Operator’s Platform or Cab (continued)

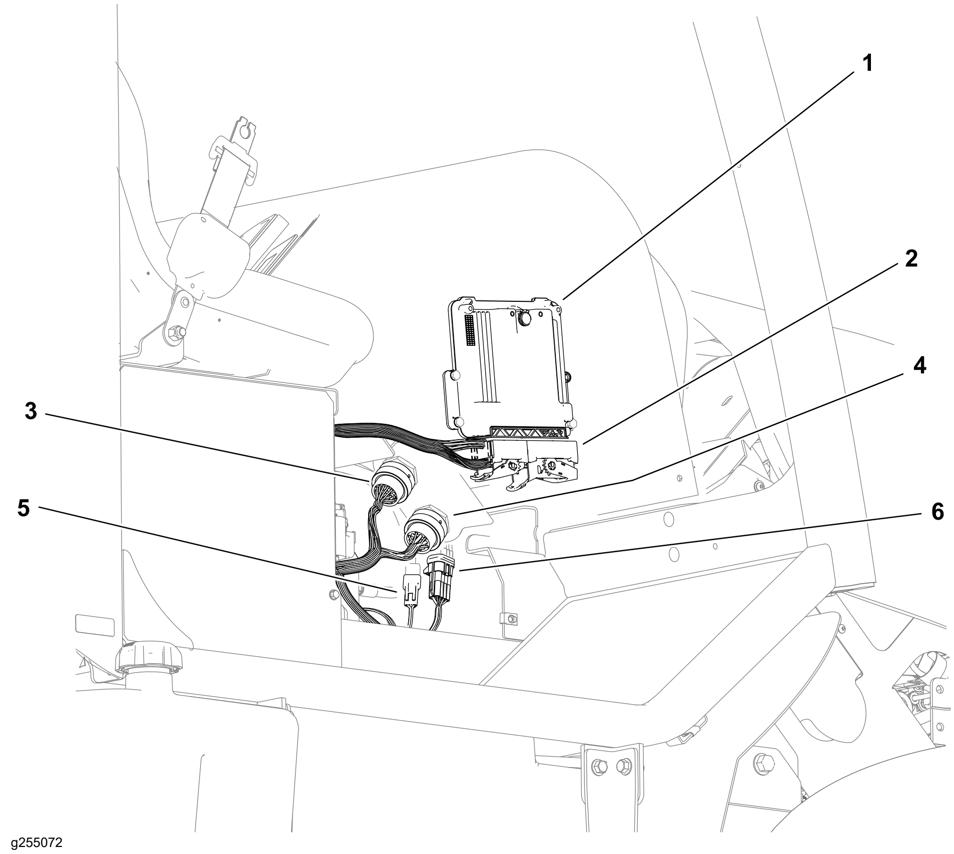

Figure 216

1. Engine ECU
2. Engine wire harness connector
3. Frame wire harness connector (blue ring)
4. Frame wire harness connector (green ring)
5. 3-pin engine harness connector P63
6. 7-pin engine harness connector P18

---

6. Plug the engine wire harness connector P63 (3 pins) into the main harness.
7. Plug the frame wire harness at the 2 connectors into the operator platform wire harness connectors (behind the forward side of the dash cover).
8. Plug the 2 engine wire harness connectors into the engine ECU, and latch the connectors.
9. Connect the battery positive (+) and negative (-) cables to the terminal bracket posts.

Installing the Operator’s Platform or Cab (continued)

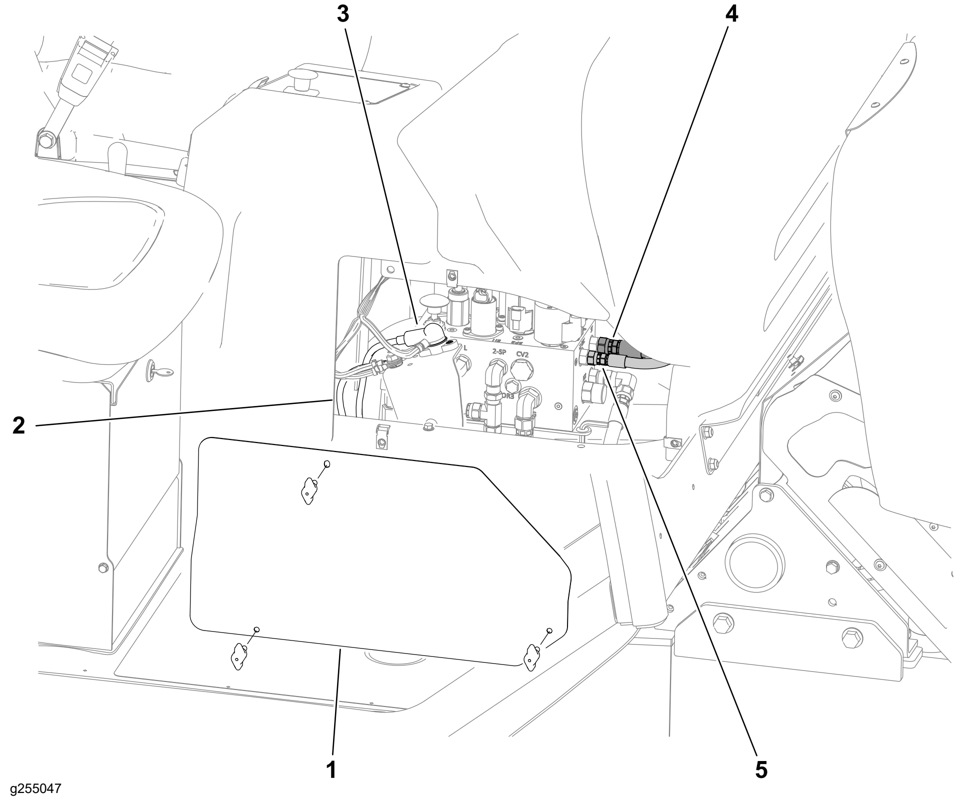

Figure 217

1. Access panel
2. Battery negative (-) cable
3. Battery negative (+) cable
4. Hydraulic manifold ST port
5. Hydraulic manifold LS/OR1 port

Connecting the Steering Hoses

1. Install the hose to the LS/OR1 port of the hydraulic manifold (Figure 217).
2. Install the hose to the ST port of the hydraulic manifold.
3. Install the access panel to the right side of the control console.

Finishing the Operator’s Platform or Cab Installation

1. Connect the battery; refer to Installing the Battery (page 6–83).
2. Install the standard utility box; refer to Standard Utility Box (page 8–35), or the optional cargo bed; refer to the *Installation Instructions*.
3. If removed, raise rear counterweight from the ground and installed the front loader.
4. If removed, installed the rear attachment to the 3-point hitch or the draw bar.
5. Operate the machine carefully at first to allow the hydraulic system to refill with fluid. Check for and correct any hydraulic leaks. Check and adjust the hydraulic fluid level as required; refer to the traction unit *Operator’s Manual*.
6. Machines equipped with a cab heater—operate the heater and adjust the coolant level as required; refer to the traction unit *Operator’s Manual*.
7. Machines equipped with air conditioning—have a certified refrigeration technician fill/recharge and test the air conditioning system.

Steering Wheel, Instrument Panels and Dash Cover

Removing the Steering Wheel, Instrument Panels and Dash Cover

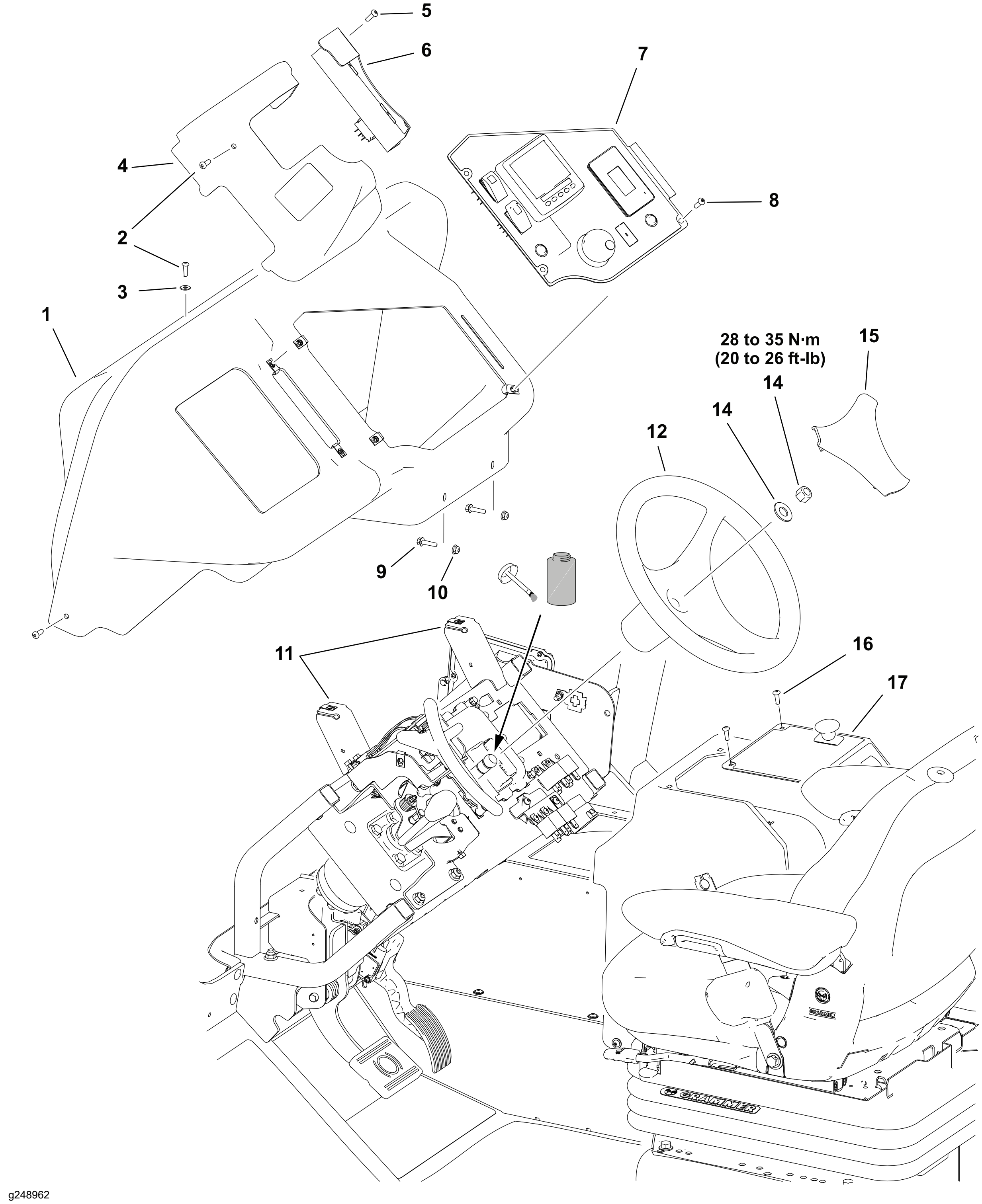

Figure 218

1. Dash cover
2. Button head screw (5 each)
3. Washer (2 each)
4. Steering column cover (outboard)
5. Button head screw (4 each)
6. Instrument panel – steering
7. Instrument panel – main
8. Button head screw (3 each)
9. Flange-head screw (2 each)
10. Flange nut (2 each)
11. Dash-plate brackets
12. Steering wheel
13. Washer
14. Lock nut
15. Steering wheel cover
16. Button head screw (4 each)
17. Instrument panel – console

Removing the Steering Wheel, Instrument Panels and Dash Cover (continued)

Preparing the Machine

1. Park the machine on a level surface, align the front wheels straight ahead, and lower any attachments.
2. Shut off the engine and remove the key from the key switch.
3. Disconnect the battery; refer to Removing the Battery (page 6–83).

Removing the Windshield—Machines with a Cab

Remove the windshield; refer to Removing the Windshield (page 9–16)

Removing the Steering Wheel

1. Remove the cover from the spokes of the steering wheel.
2. Remove the locknut and washer that secure the steering wheel to the steering column.
3. Use a suitable puller to remove the steering wheel from the steering column.

Removing the Main Instrument Panel

Note: The main instrument panel can be passed through the dash cover opening without disconnecting all the controls from the wire harness.

1. Remove the 3 screws that secure the main instrument panel to the dash (Figure 218).
2. Label all the wire harness connectors to the switches and displays.
3. Unplug the wire harness connectors from the instrument panel switches and displays.

Removing the Steering Instrument Panel

1. Remove the 4 screws that secure the steering instrument panel to the dash (Figure 218).
2. Label all the wire harness connectors to the switches.
3. Disconnect the wire harness connectors from the steering instrument panel switches.

Removing the Dash Cover

1. Remove the screw that secures the outboard steering column cover to the shifter assembly (Figure 218).
2. Remove the access panel from the right side of the control console.

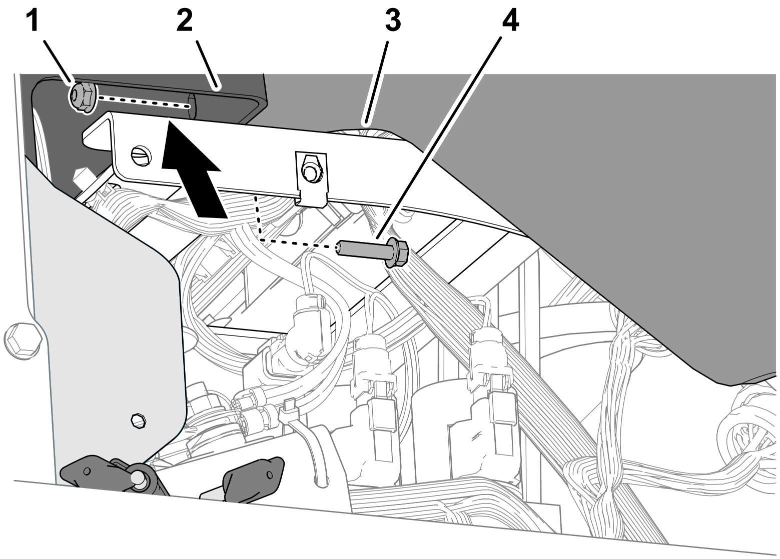

Figure 219

1. Locknut
2. Control console
3. Dash cover
4. Flange head screw

---

3. Remove the 2 flange head screws and locknuts that secure the dash cover to the control console.
4. Machines with an operator's platform—remove the 2 screws and washers that secure the dash cover to the dash-plate brackets, and remove the dash cover from the machine (Figure 218).

   Note: Machines with a cab: the flange-head capscrews secure the lower windshield mount and the dash cover to the dash-plate brackets; refer to Removing the Windshield (page 9–16).

Installing the Steering Wheel, Instrument Panels and Dash Cover

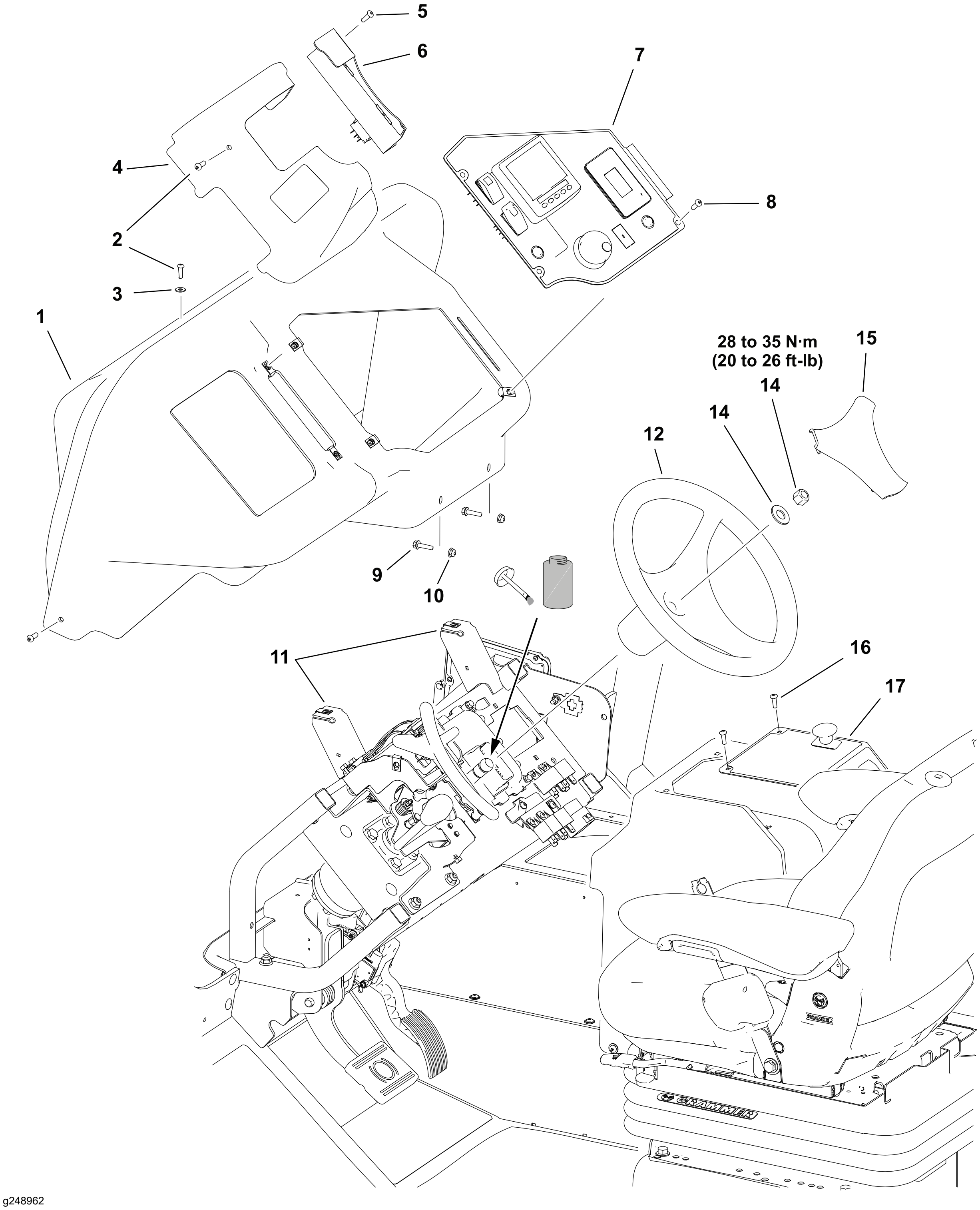

Figure 220

1. Dash cover
2. Button head screw (5 each)
3. Washer (2 each)
4. Steering column cover (outboard)
5. Button head screw (4 each)
6. Instrument panel – steering
7. Instrument panel – main
8. Button head screw (3 each)
9. Flange-head screw (2 each)
10. Flange nut (2 each)
11. Dash-plate brackets
12. Steering wheel
13. Washer
14. Lock nut
15. Steering wheel cover
16. Button head screw (4 each)
17. Instrument panel – console

Installing the Dash Cover

1. Align the dash cover with the dash frame, and align the holes in the cover with the holes in the dash-plate brackets and the front of the control console (Figure 220).
2. Assemble the dash cover to the dash-plate brackets with the 2 screws and washers (Figure 220).
3. Assemble the dash cover to the control console with the 2 flange head screws and locknuts.

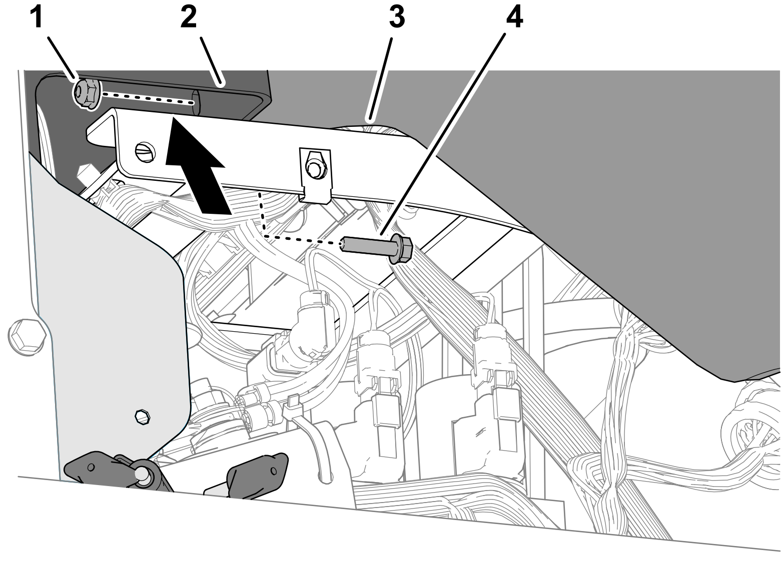

Figure 221

1. Locknut
2. Control console
3. Dash cover
4. Flange head screw

4. Assemble the access panel to the right side of the control console (Figure 220).
5. Align the outboard steering column cover to the dash cover, and assemble the column cover to the shifter assemble with the screw (Figure 220).

Installing the Steering Instrument Panel

1. If disconnected, plug the wire harness connectors into the steering instrument panel switches.
2. Align the holes in the steering instrument panel to the holes in the dash (Figure 220).
3. Assemble the instrument panel to the dash with the 4 screws.

Installing the Main Instrument Panel

1. If disconnected, plug the wire harness connectors into the main instrument panel switches and displays.
2. Insert the tab of the main instrument panel into the slot in the dash cover (Figure 220).
3. Assemble the instrument panel to the dash with the 3 screws.

Installing the Steering Wheel

1. Apply a thin coat of anti-seize lubricant to the splines of the steering column (Figure 220).

Installing the Steering Wheel, Instrument Panels and Dash Cover (continued)

2. Align the splines of the steering wheel to the splines of the steering column.
3. Center the bottom spoke of the steering wheel, and assemble the wheel to the column with the washer and locknut.
4. Torque the lock nut to **28 to 35 N·m (20 to 26 ft-lb)**.
5. Assemble the cover to the spokes of the steering wheel.

Installing the Windshield—Machines with a Cab

Install the windshield; refer to Installing the Windshield (page 9–18).

Finishing the Steering Wheel, Instrument Panels and Dash Cover Installation

1. Connect the battery; refer to Installing the Battery (page 6–83).
2. Verify instrument panel controls function before returning the machine to service.

Operator's Console

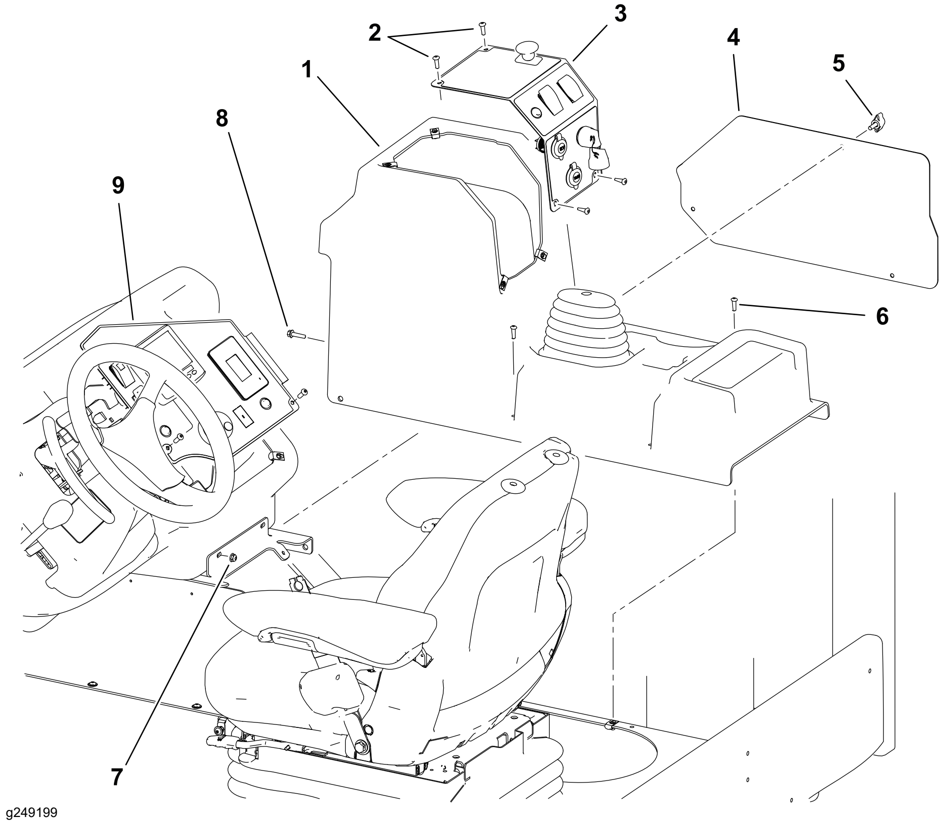

Figure 222

1. Console
2. Button head screw (4 each)
3. Instrument panel – console
4. Access panel
5. Knob (3 each)
6. Button head screw (4 each)
7. Flange nut (2 each)
8. Flange-head screw (2 each)
9. Instrument panel – main

Removing and Installing the Operator's Console

1. Park the machine on a level surface, lower any attachments, shut off the engine and remove the key from the key switch.
2. Disconnect the battery; refer to Removing the Battery (page 6–83).
3. Remove the access panel from the left side of the console.
4. Remove the console instrument panel. Label all the wire harness connections for assembly purposes and disconnect the wire harness from the panel controls.
5. Remove the main instrument panel fasteners and move the panel to allow access to the 2 fasteners securing the dash cover to the console.
6. Remove the console.
7. To install the console, follow this procedure in reverse order.

Seats

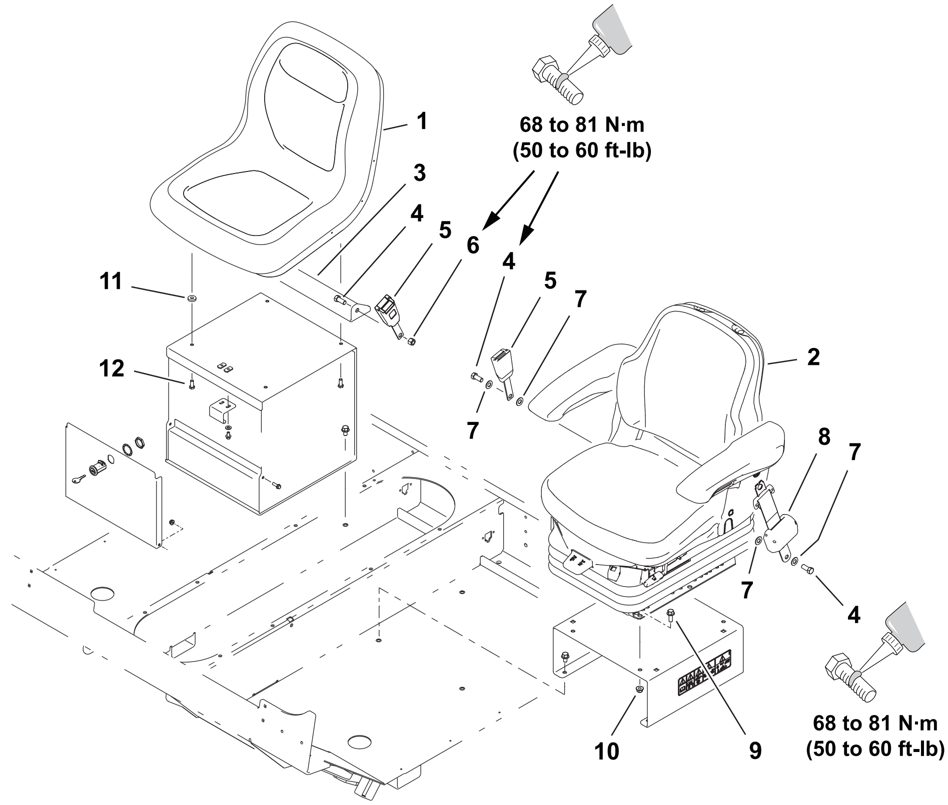

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Figure 223

1. Passenger seat
2. Operator seat
3. Seat belt bracket
4. Capscrew (4 each)
5. Seat belt buckle (2 each)
6. Lock nut (2 each)
7. Flat washer (4 each)
8. Retractable seat belt (2 each)
9. Flange-head screw (4 each)
10. Flange nut (4 each)
11. Spacer (2 each)
12. Capscrew (4 each)

Removing the Seat Belt

1. Remove the capscrews and washers that secures the seat-belt halves to the base of the seat.
2. Inspect the seat belt and retract mechanism for wear and damage.

   Note: Replace a worn or damaged seat belt.

Installing the Seat Belt

1. Clean the thread-locking compound from the threads of the capscrews and seat base.
2. Apply medium strength thread locking compound to the capscrews.
3. Assemble the seat belt halves to the seat base with the capscrews and washers.

Installing the Seat Belt (continued)

4. Torque the capscrews to **68 to 81 N·m (50 to 60 ft-lb)**.

Servicing the Operator Seat

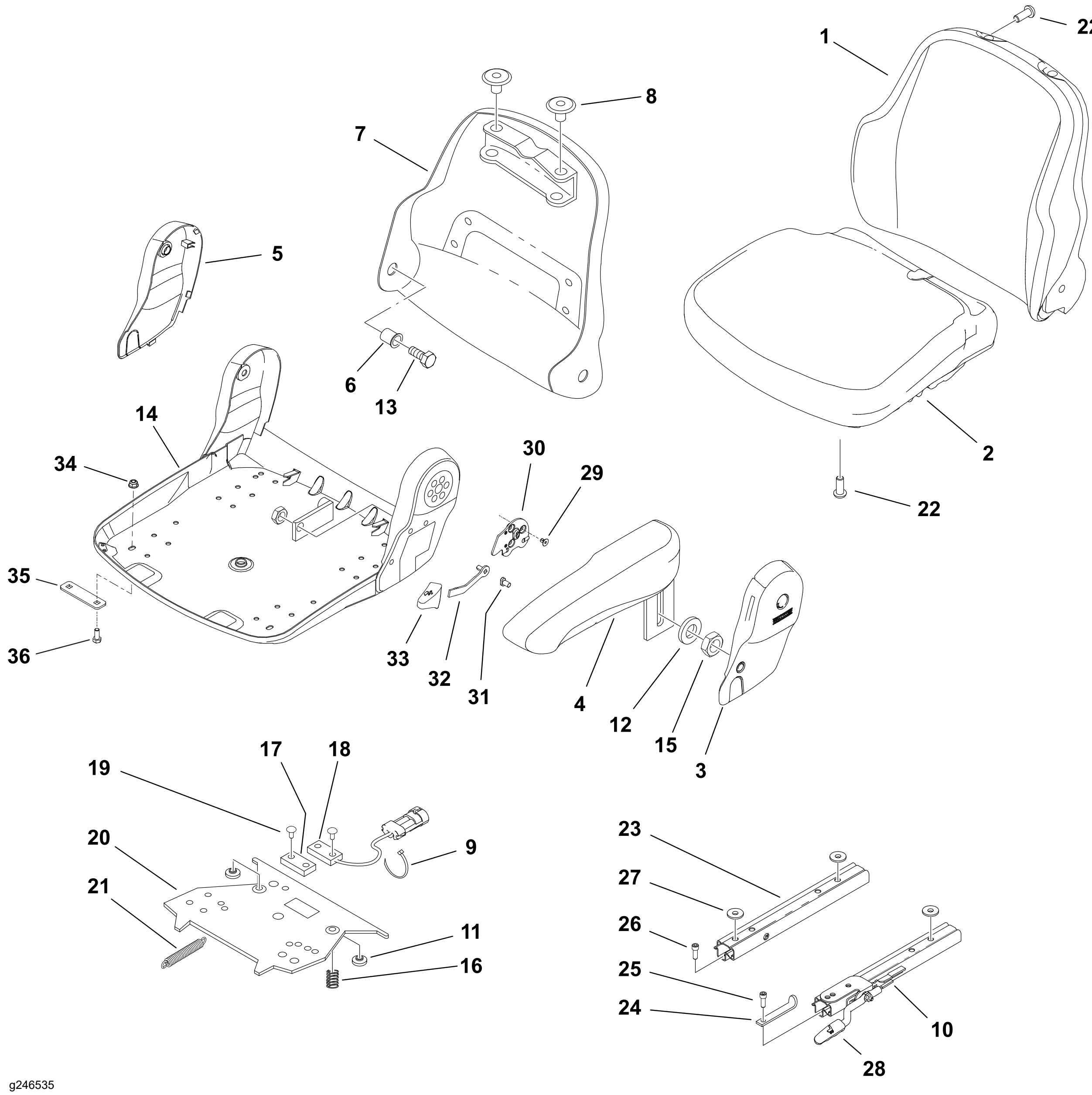


Figure 224

1. Backrest cushion
2. Seat cushion
3. RH support cover
4. LH armrest
5. RH support cover
6. Bushing (2 each)
7. Backrest
8. Plug (2 each)
9. Cable tie (3 each)
10. LH adjustment rail
11. Bumper (2 each)
12. Washer
13. Capscrew (2 each)
14. Seat frame
15. Nut
16. Spring (2 each)
17. Magnet
18. Seat switch
19. Rivet (4 each)
20. Mounting plate
21. Return spring
22. Torx screw (5 each)
23. RH adjustment rail
24. Rail stop
25. Torx screw
26. Torx screw (3 each)
27. Washer (3 each)
28. Handle
29. Flat head screw (3 each)
30. Adaptor plate
31. Screw
32. Lever
33. Handle
34. Nut
35. Support bracket
36. Capscrew

Servicing the Operator Seat Suspension

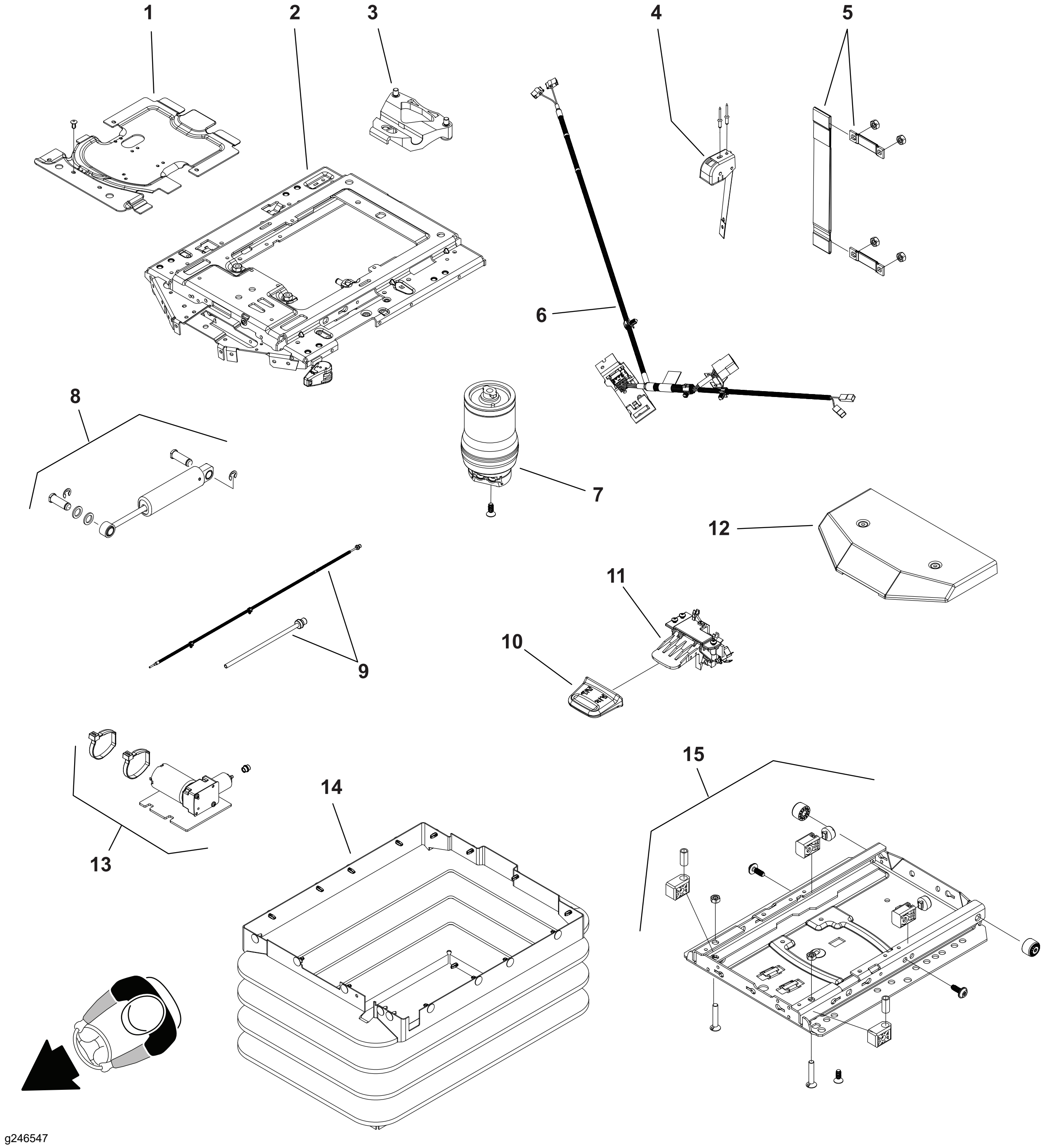


Figure 225

1. Cover assembly	6. Wire harness	11. Air control valve
2. Upper suspension	7. Air spring	12. Cover
3. Thrust limiter	8. Shock absorber	13. Compressor
4. Control lever	9. Air tube assembly	14. Bellows
5. Tether	10. Handle	15. Lower suspension

Remove the operator seat to gain access the seat suspension assembly. Most of the operator seat suspension components can be serviced with the lower seat suspension mounted to the frame platform. If the air spring assembly requires removal, the lower seat suspension must be removed from the seat platform.

Standard Utility Box

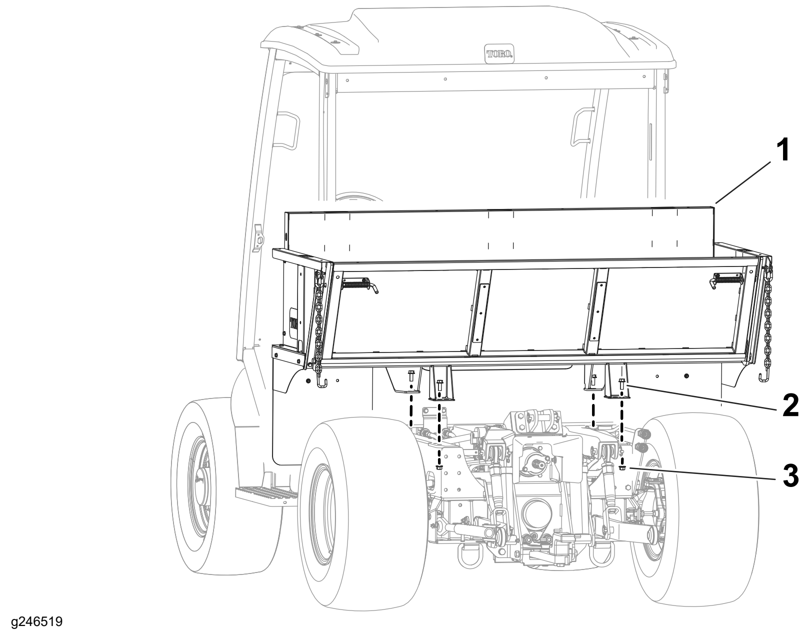


Figure 226

1. Standard utility box
2. Flange-head screw (4 each)
3. Flange nut (4 each)

CAUTION

The standard utility box weighs approximately 107 kg (235 lbs). Make sure the hoist, lift, or stands used to remove the utility box can properly support the weight.

Front Loader Attachment

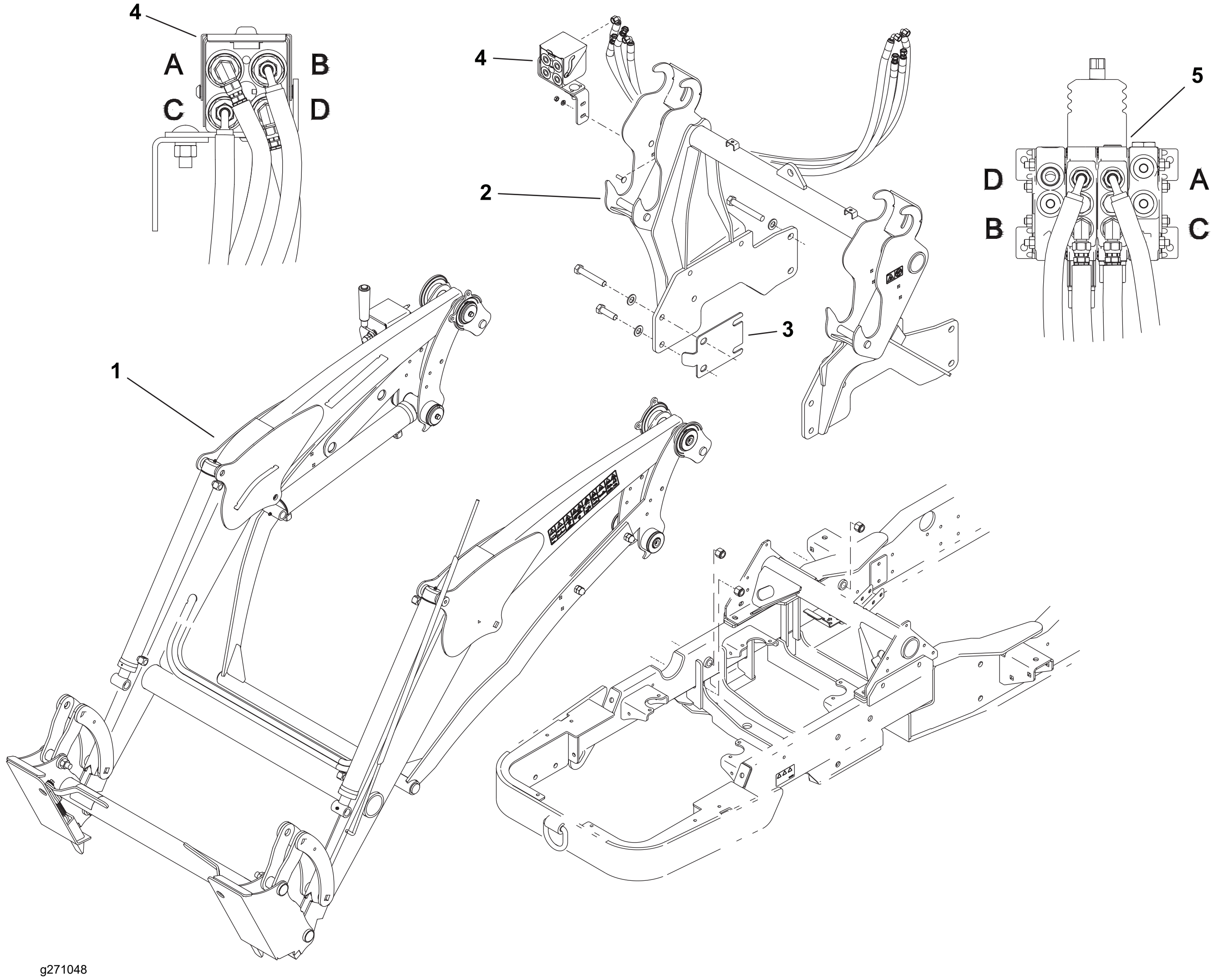


Figure 227

1. Front loader arm assembly
2. Support assembly
3. Shim
4. Female coupler assembly
5. Front loader control valve

Refer to General Precautions for Removing and Installing the Hydraulic System Components (page 5–65) prior to removing hydraulic system components.

CAUTION

The front loader arm assembly weighs approximately 218 kg (480 lbs).

Operator Cab

Table of Contents

Additional Reference Materials

Sanden SD Compressor Service Guide

General Information

Traction Unit Operator's Manual and Accessory Installation Instructions

The traction unit *Operator's Manual* and accessory *Installation Instructions* provide information regarding the operation, general maintenance and maintenance intervals for the machine and its accessories. Refer to the traction unit *Operator's Manual* and accessory *Installation Instructions* for additional information.

Electrical Components, Schematics and Wire Harness Drawings

For information regarding machine electrical cab components (switches and relays); refer to 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

Air Conditioning Components

The air conditioning system used in the machine operator cab consists of the following components:

- The compressor is mounted at the left side of the engine driven by 2 poly V−belts.
- The condenser assembly with two (2) condenser fans are located outside the rear of the cab roof assembly.
- The evaporator, drier-receiver, and expansion valve are mounted above the headliner of the cab.
- The refrigerant pressure switch
- The thermostat
- The evaporator freeze switch
- 3 relays (condenser fans, air conditioning switch signal, compressor clutch)
- The necessary hoses and tubes that connect the air conditioning system components.
- The 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.
- The operator controls to turn the air conditioning on, to adjust the fan speed and to control the cab air temperature.

Air Conditioning Performance

There are several factors that can affect the performance of the machine air conditioning system. To ensure the best system operation, inspect the following components.

- Make sure that the heater control fully closes the heater valve in the cab headliner.
- Make sure that the condenser and evaporator fins are not obstructed and clean.
- Verify that refrigerant charge quantity and system operating pressures are correct.
- Make sure that exposed metal surfaces inside cab are insulated.
- If the ambient temperature exceeds 43C (110F) apply additional window tinting to lower the solar heat load to the cab.

Cab Heater System

The cab heater system used in the machine operator cab consists of the following components:

- A heater core in the mixing box mounted in the headliner of the cab.
- Hoses to allow a circuit for engine coolant to circulate through the heater core.
- 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.
- Operator controls to adjust the fan speed and to control the amount of coolant passing through the heater core (air temperature).

Adjustments

Adjusting the Compressor Belt Tension

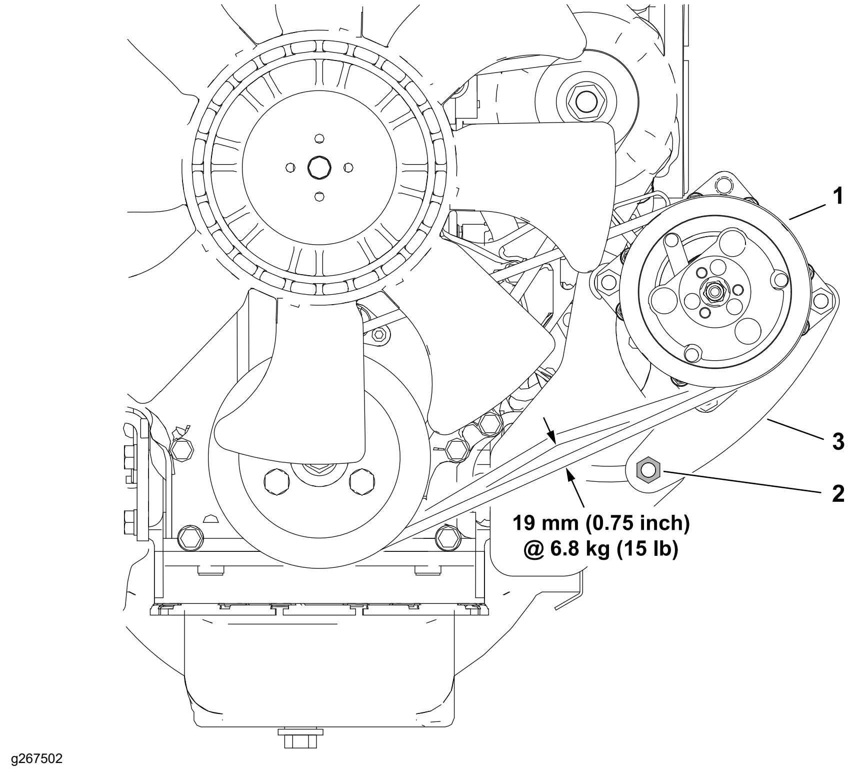


Figure 228

1. Compressor
2. Nut
3. Tensioner plate

Compressor belt(s) tension = **19 mm (0.75 inch) deflection when 6.8 kg (15 lb) is applied** halfway between the engine and compressor pulleys.

1. Loosen nut at bottom of tensioner plate and lift or gently pry compressor upward to decrease belt(s) deflection.
2. Tighten nut and recheck belt tension.

Adjusting the Doors

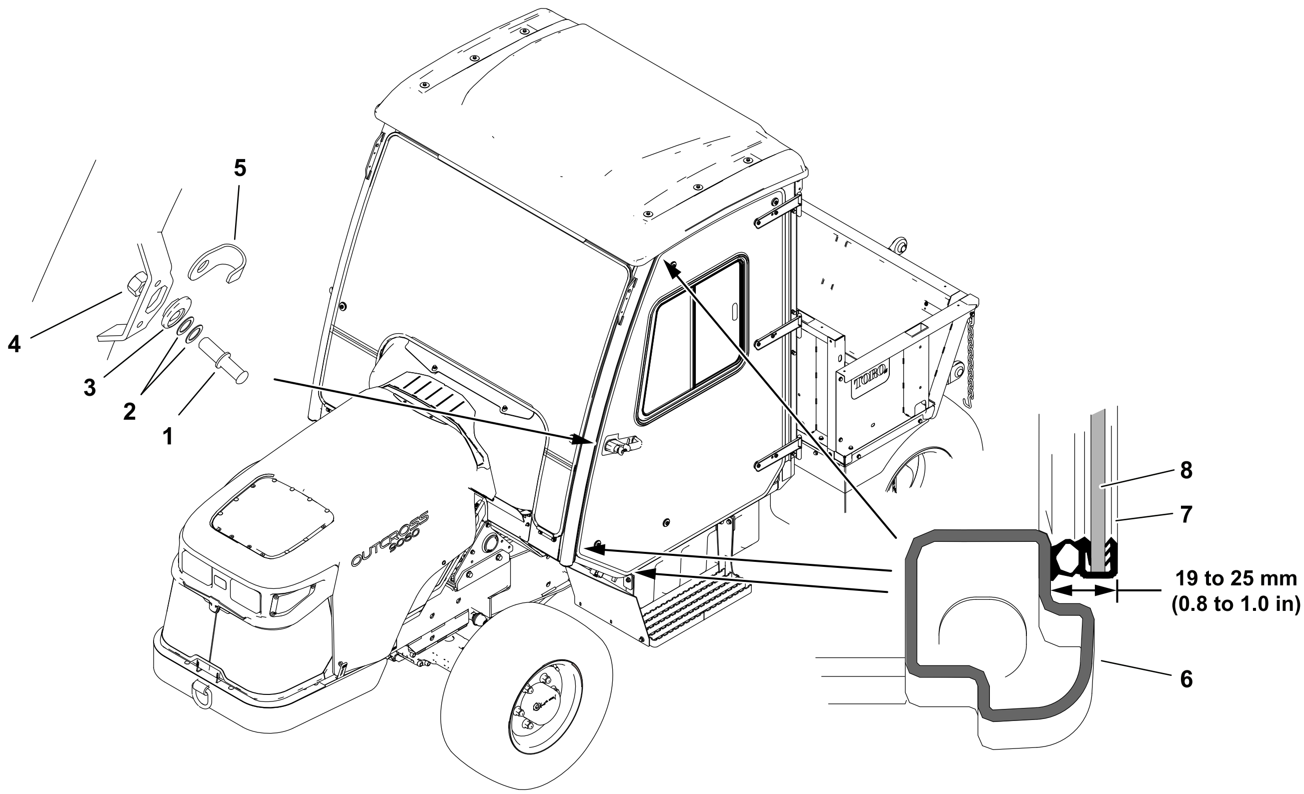


Figure 229

1.	Striker stud	4.	Lock nut	7.	Door seal
2.	Shim (as required)	5.	Striker guard	8.	Door panel
3.	Adjuster	6.	Frame		

1. Use shims under the striker stud if necessary for proper door latch engagement.

2. Check the door adjustment to ensure proper sealing at the 3 points indicated. The distance between the sealing surface of the frame and the outer edge of the door trim when the door is fully latched should be from **19 to 25 mm (0.8 to 1.0 inch)**.

3. Loosen the striker stud lock nut to move the striker stud and adjust the door fit. Disassemble the striker stud and rotate the adjuster to increase stud movement if necessary.

Service and Repairs

Heating and Air Conditioning Components

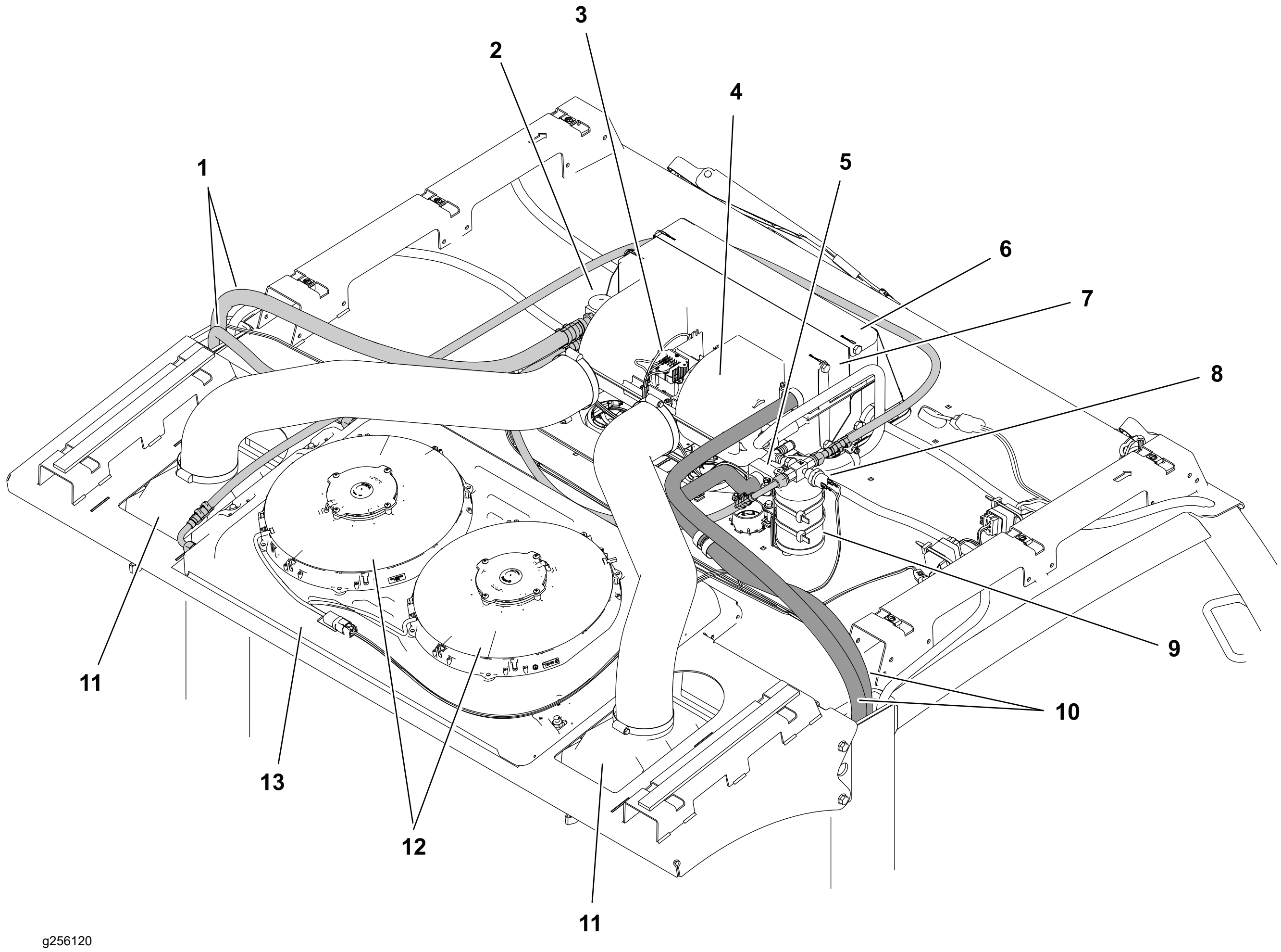


Figure 230

Shown with roof removed.

1. Refrigerant hoses
2. Expansion valve
3. Thermostat – resistor
4. Blower
5. Heat valve
6. Evaporator
7. Heater core
8. Pressure switch
9. Drier – receiver
10. Heater (engine coolant) hoses
11. Fresh air intake (2 each)
12. Condenser fans
13. Condenser

Remove the roof to access the heating and air conditioning components. Inspect and repair damaged roof seals as necessary before installing the roof.

Air Conditioning Components

The 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 expansion valve is replaced, replacement of the drier-receiver is also recommended.

General Precautions for Removing and Installing Air Conditioning System Components

WARNING

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 air conditioning service technician.

CAUTION

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.

- 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.
- 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.
- Put labels on disconnected lines and hoses for proper installation after repairs are completed.
- 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.
- 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.
- Always use a DOT approved tank for storing used and recycled refrigerants.
- 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.
- Be sure the work area is properly ventilated to prevent any accumulation of refrigerant or other fumes.

Air Conditioning Compressor

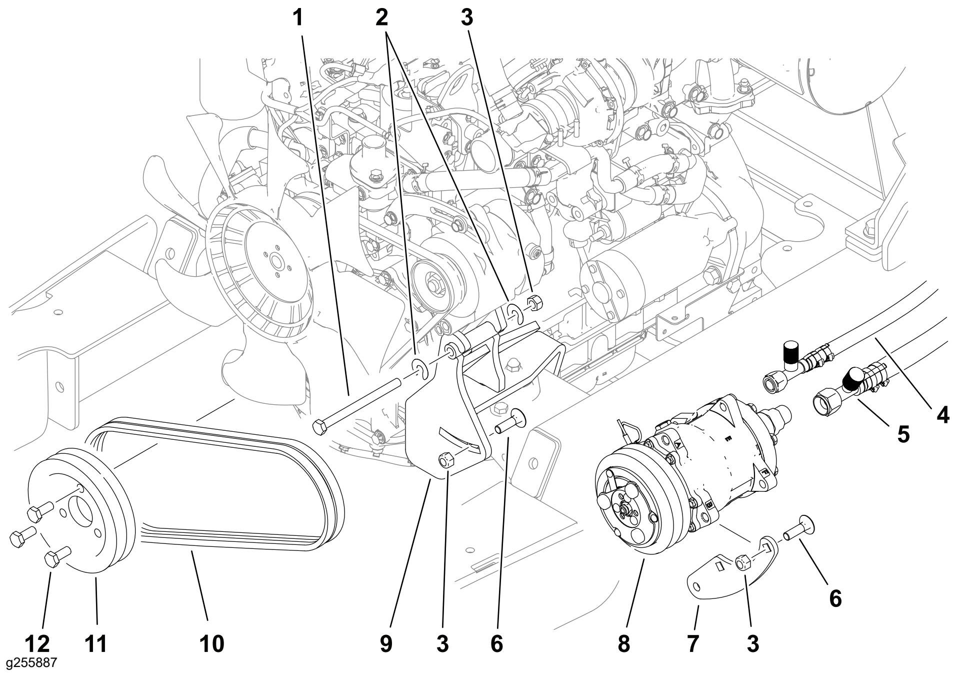


Figure 231

1.	Capscrew	7.	Tensioner plate
2.	Shim (as required)	8.	Compressor
3.	Locknut (4 each)	9.	Compressor mount
4.	Refrigerant hose (high side)	10.	V-belt (2 each)
5.	Refrigerant hose (low side)	11.	Drive pulley
6.	Carriage bolt (3 each)	12.	Capscrew (3 each)

The air conditioning compressor used on the Outcross 9060 is a Sanden model SD7H15. For air conditioning compressor repair procedures; refer to the Sanden SD Compressor Service Guide.

Preparing for Air Conditioning Service

1. 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.

Removing the Compressor

WARNING

The air conditioning system is under high pressure. Do not loosen any system fitting or component until the refrigerant has been completely recovered by a certified air conditioning service technician.

1. Have a certified air conditioning service technician recover the refrigerant from air conditioning system.

Removing the Compressor (continued)

2. Disconnect the machine wire harness connector labeled CLUTCH from the electrical connector for the compressor clutch.

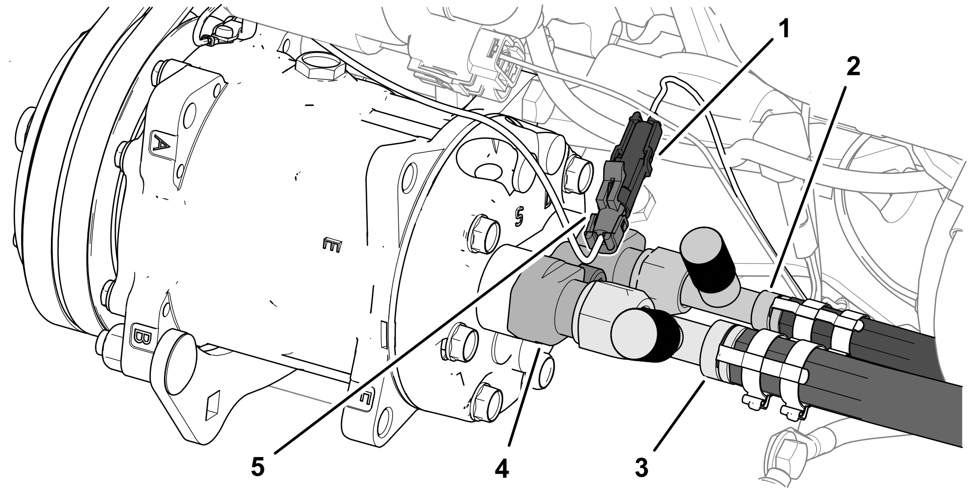


Figure 232

1. Machine wire harness connector P64 (CLUTCH)
2. Refrigerant hose (high side)
3. Refrigerant hose (low side)
4. Compressor manifold
5. Electrical connector (compressor clutch)

---

3. Disconnect the high-side and low-side hoses at the compressor fittings, and immediately cap the fittings and plug the hoses to prevent contamination from entering the air conditioning system.
4. Loosen the capscrew, carriage bolt, and locknuts, and relieve belt tension.
5. Remove and inspect the V-belts for wear or damage.

IMPORTANT

When replacing worn or damaged belts, replace them in pairs.

IMPORTANT

To prevent compressor oil from filling the compressor cylinders, keep compressor in the same orientation as the installed position.

6. Remove the carriage bolt, capscrew, and locknuts securing the compressor to the compressor mount, and remove the compressor.

IMPORTANT

Locate and retrieve any shims, refer to item 2 in Figure 231.

7. If necessary, remove the tensioner plate from the compressor.

Servicing the Air Conditioning System after a Catastrophic Compressor Failure

IMPORTANT

If the air conditioning compressor has a catastrophic failure, debris from the pump spreads to all components throughout the refrigerant circuit. To ensure that the new air conditioning compressor is not damaged perform the following steps:

1. Flush the refrigerant hoses and expansion valve clean with air-conditioning system flushing solvent; refer to Air Conditioning Components (page 9–3).
2. Replace the drier-receiver, condenser, and evaporator.

Installing the Compressor

IMPORTANT

If the air conditioning compressor is removed for service or replaced for wear, it is recommended to replace the drier-receiver.

1. If removed, install the tensioner plate to the compressor with the 2 carriage bolts and locknuts.
2. Align the head of the capscrew toward the back of the engine, and loosely assemble the compressor to the compressor mount with the capscrew and locknut.
3. Loosely assemble the tensioner plate to the compressor mount with the carriage bolt and locknut.
4. Rotate the pulley of the compressor 10 revolutions to distribute the oil in the compressor.
5. Assemble the 2 belts to the engine pulley and compressor pulley, and lightly tension the belts.
6. Look at the alignment of the compressor pulley, belts, and drive pulley to determine which side of the compressor mount tube you need to add shim(s) to align the pulleys.

IMPORTANT

Regardless of shim location, the gap between the compressor flanges and the compressor mount tube must be less than 0.102 mm (.004 inches).

7. Remove the capscrew, and assemble the compressor to the compressor mount with the capscrew, shims, and locknut.
8. Adjust the compressor belt tension, and tighten the locknuts; refer to Adjusting the Compressor Belt Tension (page 9–5).
9. Connect the machine wire harness connector P64 labeled CLUTCH to the electrical connector for the compressor clutch.

Installing the Compressor (continued)

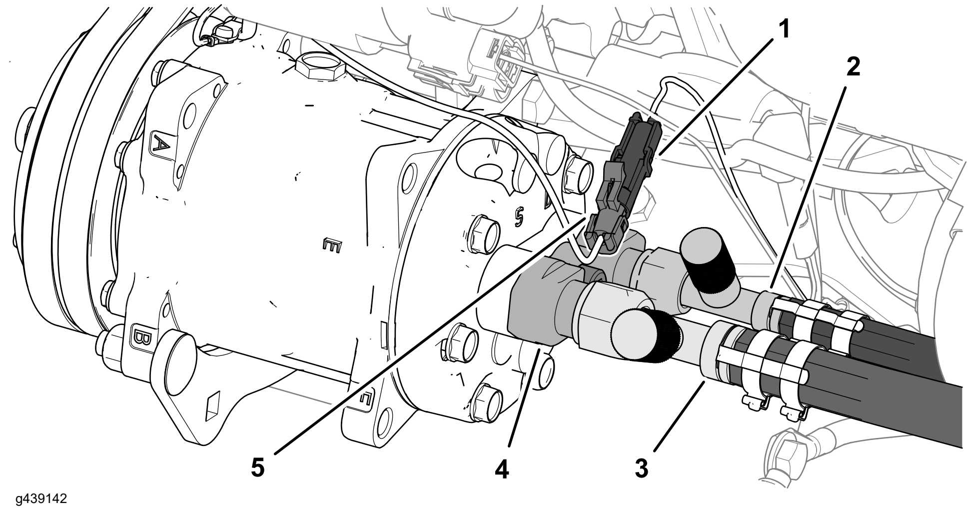


Figure 233

1. Machine wire harness connector P64 (CLUTCH)
2. Refrigerant hose (high side)
3. Refrigerant hose (low side)
4. Compressor manifold
5. Electrical connector (compressor clutch)

10. Remove the cap from the inboard fitting of the compressor manifold and the plug from the high-side hose, and install the hose to the manifold.

    Note: The high-side hose inside diameter = 10.3 mm (0.406 in)

11. Remove the plug from the low-side hose, and pour 236.6 cc(8 oz) of the specified compressor oil into the hose.

    Note: The low-side hose inside diameter = 15.9 mm (0.625 in).

    Compressor oil specification: Toro PN. 139-1895

IMPORTANT

Do not use other compressor oils.

12. Remove the cap from the outboard fitting of the compressor manifold, and install the low-side hose to the manifold.

13. Have a certified air conditioning service technician evacuate the air conditioning system completely, leak test the system, and properly recharge the system with R134a.

Refrigerant specification:	R134a
Approximate refrigerant quantity:	1.13 kg (40 oz or 2.53 lbs)

IMPORTANT

Do not use other refrigerants. Do not use refrigerants with sealants use stop refrigerant leaks.

Control Panel and Windshield Wiper Assembly

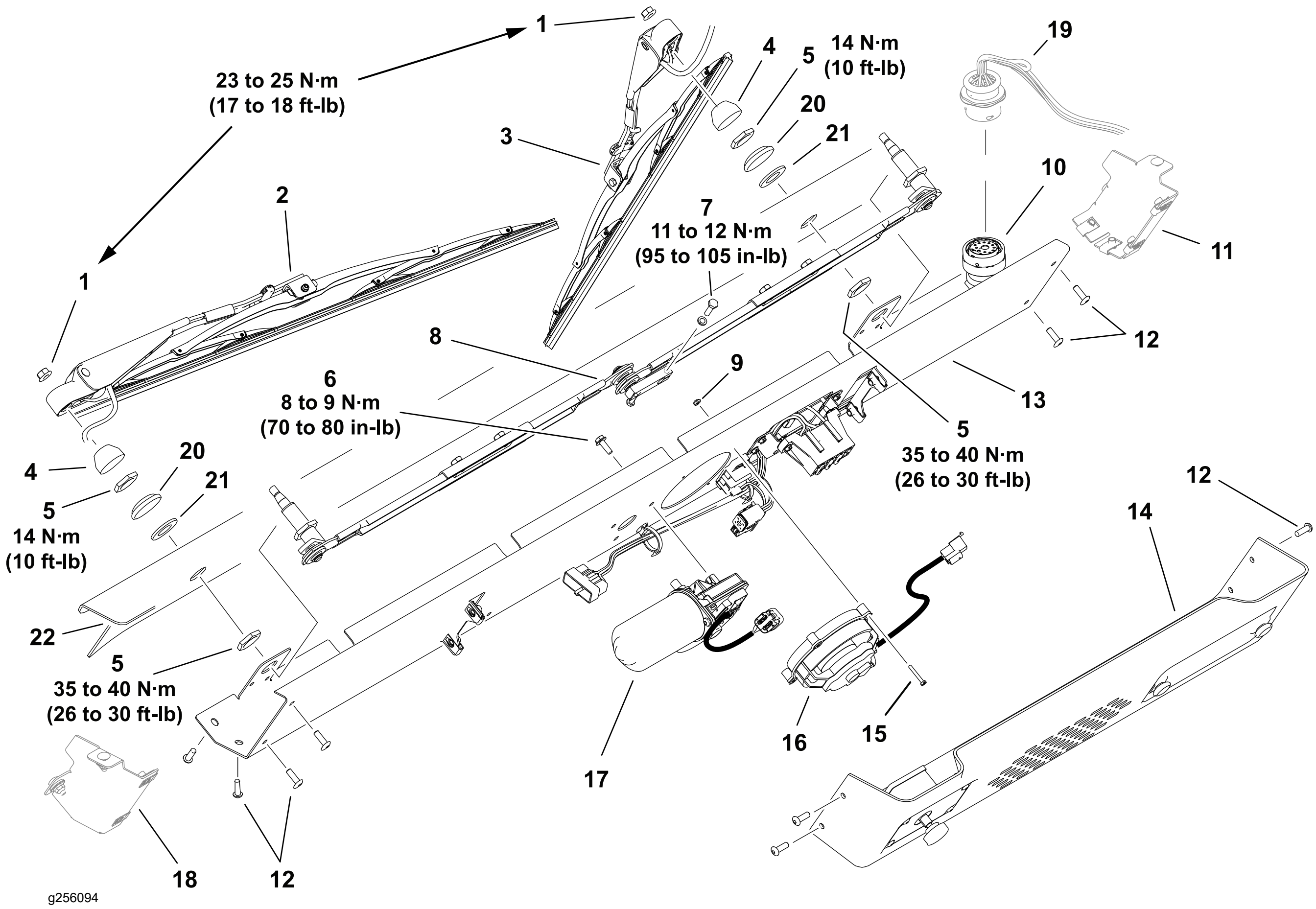


Figure 234

1. Flange nut (2 each)
2. Wiper arm – LH
3. Wiper arm – RH
4. Boot (2 each)
5. Lock nut (4 each)
6. Capscrew (3 each)
7. Capscrew
8. Wiper linkage assembly
9. Lock nut (4 each)
10. Control panel wire harness
11. Bracket – RH
12. Capscrew (12 each)
13. Control panel assembly
14. Control panel cover assembly
15. Capscrew (4 each)
16. Defroster fan
17. Wiper motor
18. Bracket – LH
19. Roof wire harness
20. Cup (2 each)
21. Rubber washer (2 each)
22. Roof panel

Removing the Control Panel and Windshield Wiper Assembly

Note: If possible, operate the windshield wipers to ensure the wiper motor shaft is in its home position prior to disassembly.

1. Mark the wipers left and right. Disconnect the washer supply hoses at the bulkhead fittings and remove windshield wipers.
2. Remove the windshield wiper boots, lock nuts, cups, and rubber washers from the roof panel.
3. Remove the 4 capscrews securing the control panel cover. Disconnect the windshield wiper/washer switch from the wire harness and remove the cover assembly.
4. Remove the 8 capscrew securing the control panel assembly to the left and right brackets, then lower the control panel enough to disconnect the

Removing the Control Panel and Windshield Wiper Assembly (continued)

control panel wire harness from the roof harness. Remove the control panel assembly.

5. Continue to disassemble the control panel as necessary.

Installing the Control Panel and Windshield Wiper Assembly

1. Install all components previously removed from the control panel.
2. If the wiper motor or wiper linkage assembly was removed:

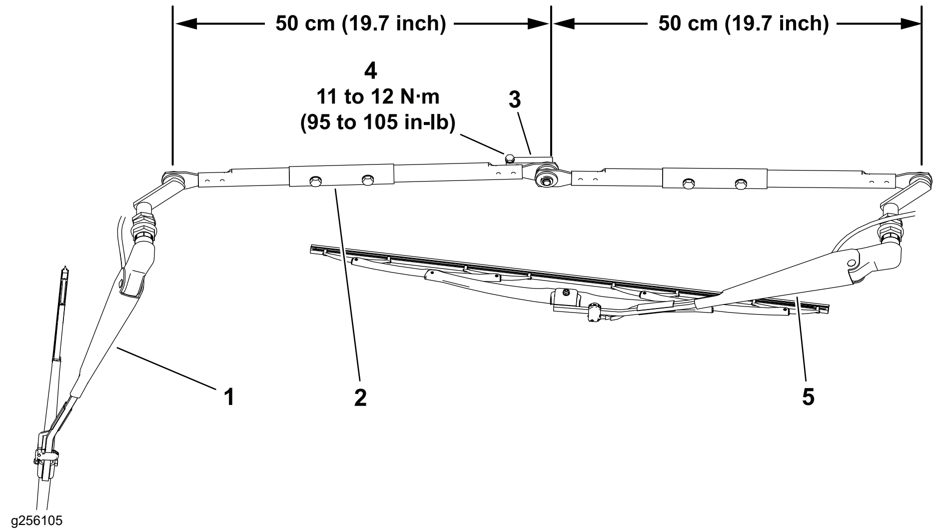


Figure 235

Viewed from outside cab.

1. Wiper arm – RH (passenger side)
2. Linkage assembly
3. Wiper motor shaft
4. Center arm capscrew
5. Wiper arm – LH (driver side)

A. Verify linkage arm lengths and adjust as necessary.

B. Fit the wiper linkage shafts to the control panel, install the lock nuts, and tighten the nuts to **35 to 40 N·m (26 to 30 ft-lb)**.

Note: The wiper motor shaft must be in its home position prior to installing the linkage. Replacement wiper motors are shipped with the shaft in the home position. You may also energize and operate the wiper motor for at least one cycle to set the motor to its home position.

C. Align the linkage drive arms as shown (center arm capscrew head upward) and fit the center arm over the wiper motor shaft. Tighten the center arm capscrew from **11 to 12 N·m (95 to 105 ft-lb)**.

3. Connect the control panel wire harness to the roof harness and install the control panel assembly.
4. Install the windshield wiper rubber washers, cups, and lock nuts against the roof panel. Tighten the lock nuts so the rubber washers deform enough to assure tightness, approximately **14 N·m (10 ft-lb) or less**.
5. With the wiper motor in its home position, install the wiper arms as shown (RH driver side wiper parallel to roof and LH passenger side wiper parallel to cab post). Install the flange nuts and tighten from **23 to 25 N·m (17 to 18 ft-lb)**.
6. Connect the washer hoses at the bulkhead fittings.
7. Test wiper and washer operation before returning the machine to service.

Windshield

Removing the Windshield

1. Remove the 8 screws that secure the cab control cover to the mounting brackets.

   Note: You need access to the horizontal row of 4 locknuts that secure the upper windshield retainer to the cab roof.

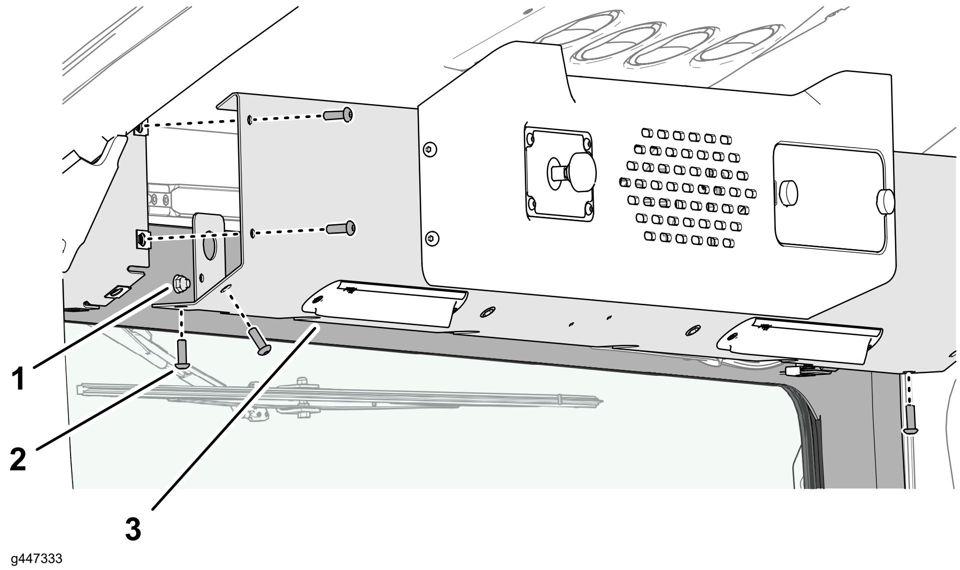


Figure 236

1. Locknut
2. Screw
3. Cab control cover

2. Loosen the flange-head capscrews and locknuts that secure the upper windshield retainer to the cab roof.

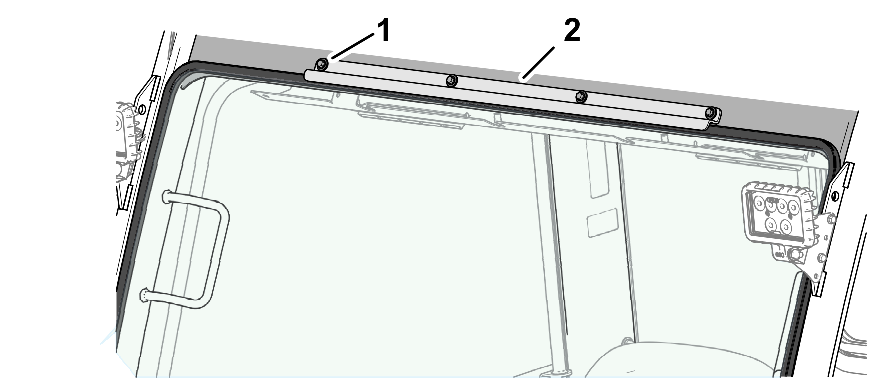


Figure 237

1. Flange-head capscrew
2. Upper windshield retainer

3. Remove the flange-head capscrews, sealing washers, and locknuts that secure the lower left and lower right windshield retainers from the floor bracket.

Removing the Windshield (continued)

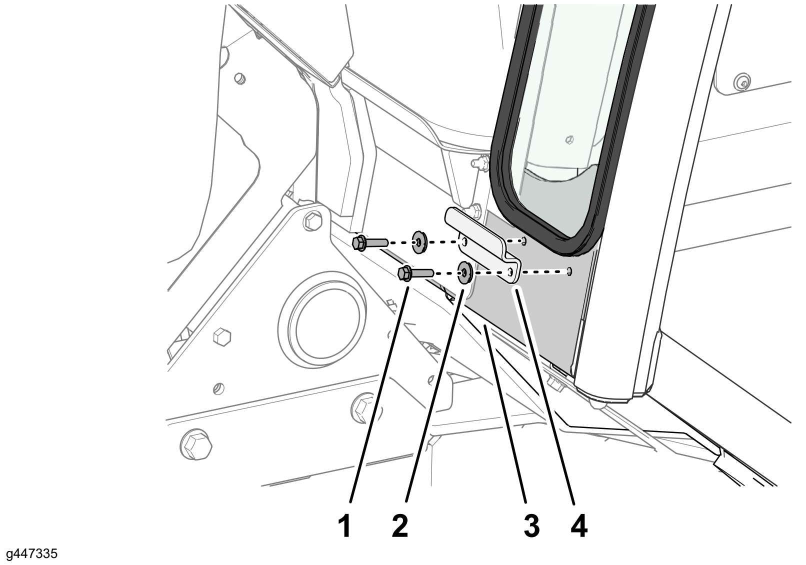


Figure 238

1. Flange-head capscrew
2. Sealing washer
3. Lower windshield retainer

4. Remove the 2 shoulder screws, thick washers, thin flange bushings, thick flange bushings, and locknuts that secure the windshield to the front pillar brackets of the cab.

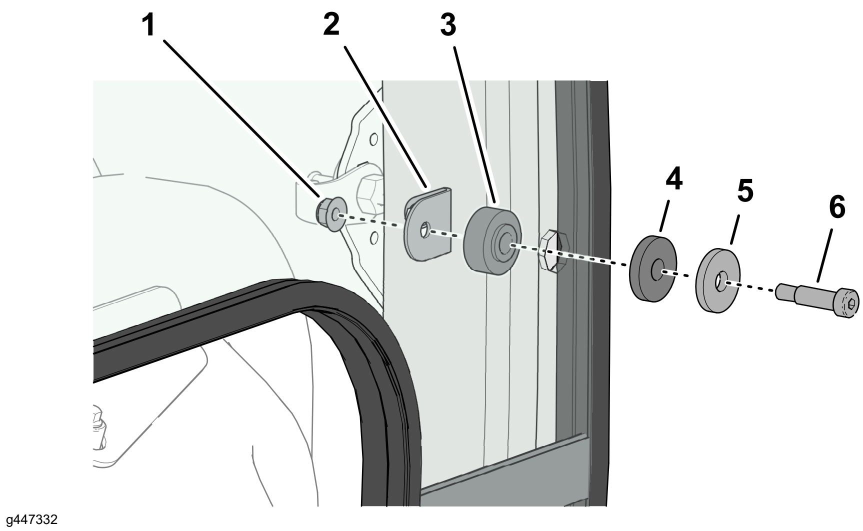


Figure 239

1. Locknut
2. Front pillar bracket
3. Thick flange bushing
4. Thin flange bushing
5. Thick washer
6. Shoulder screw

5. Remove the 2 flange-head capscrews that secure the cowl windshield retainer and dash cover to the dash-plate brackets.

Removing the Windshield (continued)

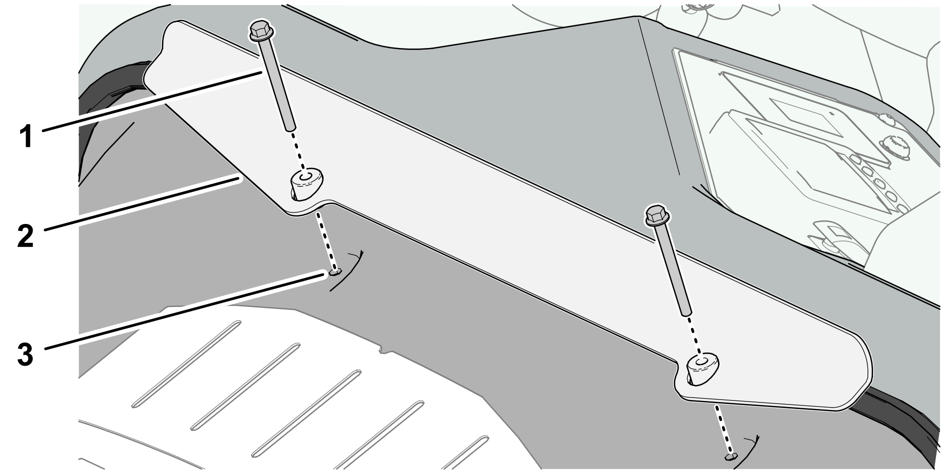


Figure 240

1. Flange-head capscrew
2. Cowl windshield retainer
3. Dash cover

6. Slip the windshield and seal from the upper windshield retainer, and remove the windshield from the machine.

Installing the Windshield

1. Align the top of the windshield and seal with the upper windshield retainer, and slip the windshield between the retainer and cab roof. Hold the windshield and seal against the dash cover.

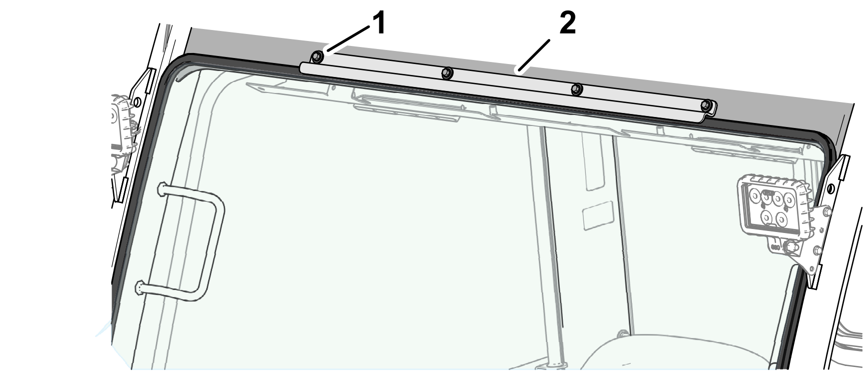


Figure 241

1. Flange-head capscrew
2. Upper windshield retainer

2. Align the cowl windshield retainer to the dash cover, and loosely secure the retainer and cover to the dash-plate brackets with the 2 flange-head capscrews.

Installing the Windshield (continued)

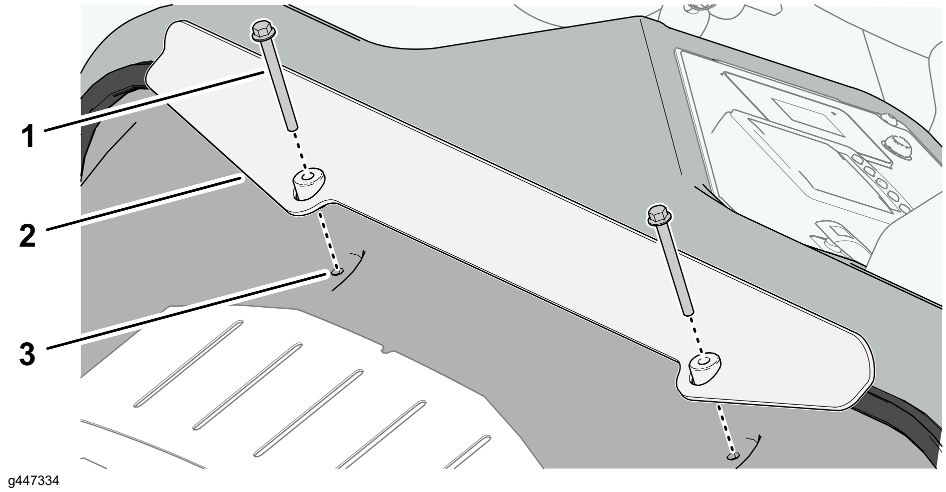


Figure 242

1. Flange-head capscrew
2. Cowl windshield retainer
3. Dash cover

---

3. Assemble the 2 thick flange bushings between the windshield and the front pillars of the cab, and align the holes.

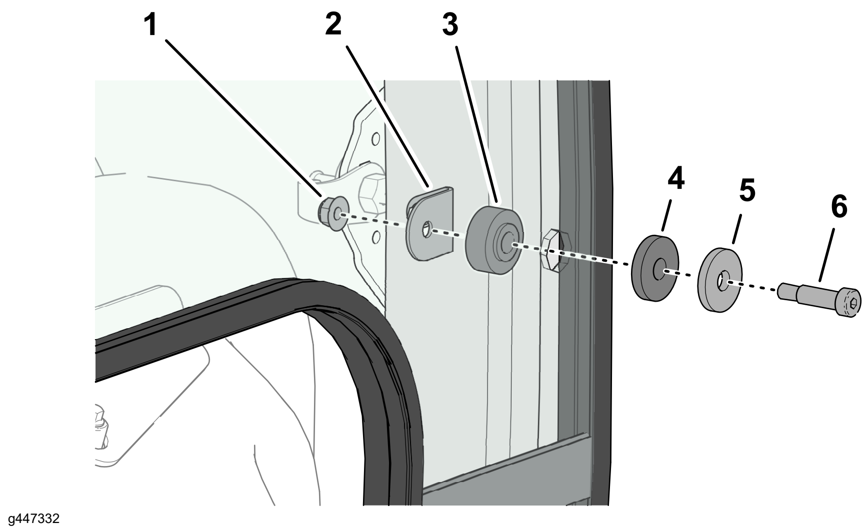


Figure 243

1. Locknut
2. Front pillar bracket
3. Thick flange bushing
4. Thin flange bushing
5. Thick washer
6. Shoulder screw

---

4. Loosely assemble the 2 shoulder screws, thick washers, thin flange bushings to the thick flange bushings, windshield, and front pillars of the cab with the locknuts
5. Loosely assemble the lower left and lower right windshield retainers to the floor bracket with the flange-head capscrews, sealing washers, and locknuts.

Installing the Windshield (continued)

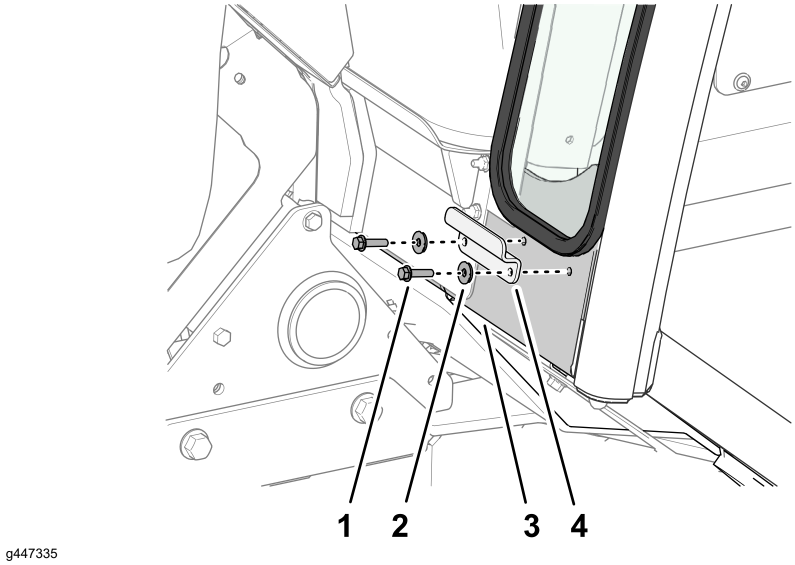


Figure 244

1. Flange-head capscrew
2. Sealing washer
3. Lower windshield retainer

6. Tighten the fasteners at the following locations:
   A. 2 flange-head capscrews at the windshield retainer at the dash cover (Figure 242)
   B. 2 shoulder screws and locknuts at the front pillars (Figure 243)
   C. 4 flange-head capscrews and locknuts at the floor bracket (Figure 244)
   D. 4 flange-head capscrews and locknuts at the cab roof (Figure 241)
7. Inside the cab, align the cab control cover and mounting bracket holes.

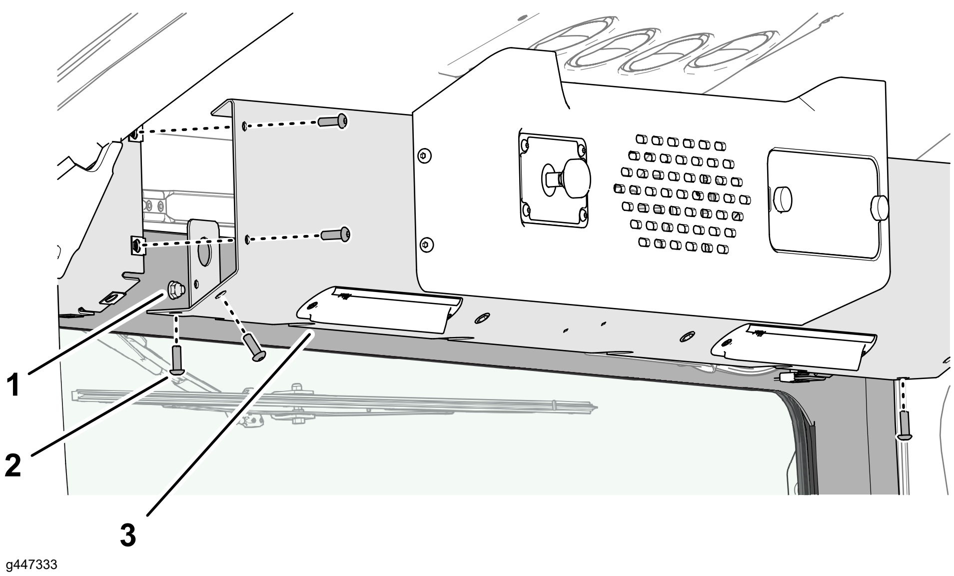


Figure 245

1. Locknut
2. Screw
3. Cab control cover

8. Assemble the control cover to the mounting brackets with the 8 screws.
9. Lower the windshield wiper arms.

Doors

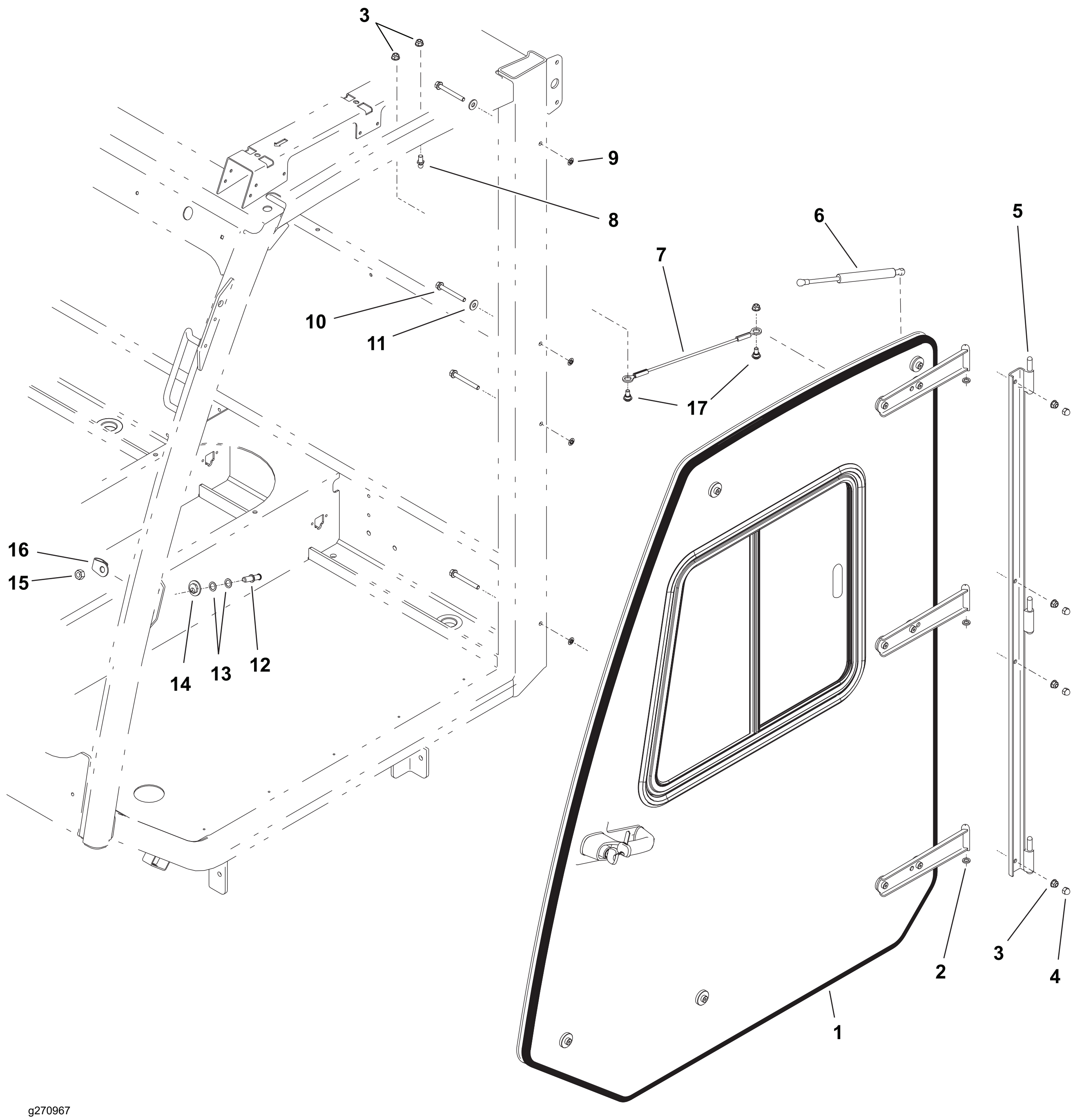


Figure 246

1. Door assembly (LH shown)
2. Washer (6 each)
3. Flange nut (14 each)
4. Acorn nut (8 each)
5. Door mount (LH shown)
6. Door spring (2 each)
7. Lanyard (2 each)
8. Ball stud (4 each)
9. Retainer (8 each)
10. Flange-head screw (8 each)
11. Washer (4 each)
12. Striker stud (2 each)
13. Shim (as required)
14. Adjuster (2 each)
15. Hex nut (2 each)
16. Striker guard (2 each)
17. Shoulder bolt (2 each)

CAUTION

Each cab door assembly weighs approximately 41 kg (90 lbs).

Install the gas spring (item 6) as shown, with the barrel end at the door and the rod end at the frame.

Adjust the door fit against the frame as necessary; refer to Adjusting the Doors (page 9–6).

Disassembling the Door

Removing the Door Latch

1. Remove the 2 flange-head screws and locknuts that secure the latch and support plate to the door frame.
2. Remove the latch from the door frame.

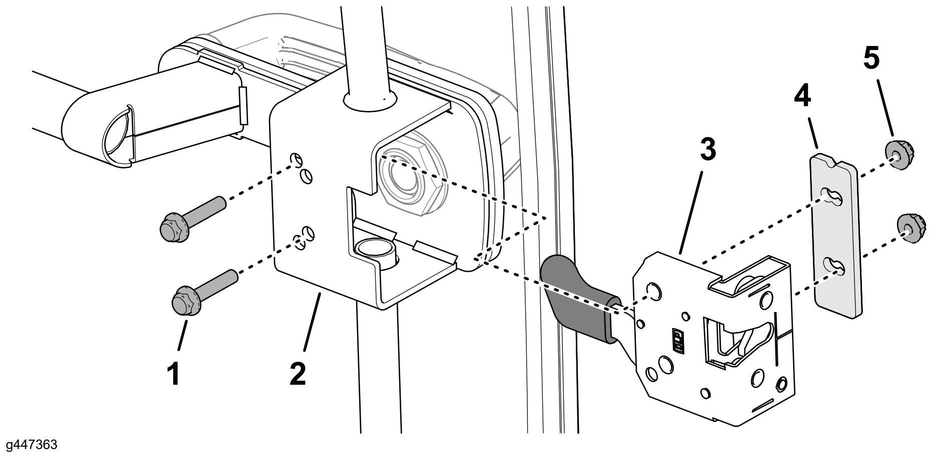


Figure 247

1. Flange-head screw
2. Door frame
3. Latch
4. Support plate
5. Locknut

Removing the Door Handle

1. Remove the nut and washer that secures the handle, bushing, grommet to the glass and door frame.

Disassembling the Door (continued)

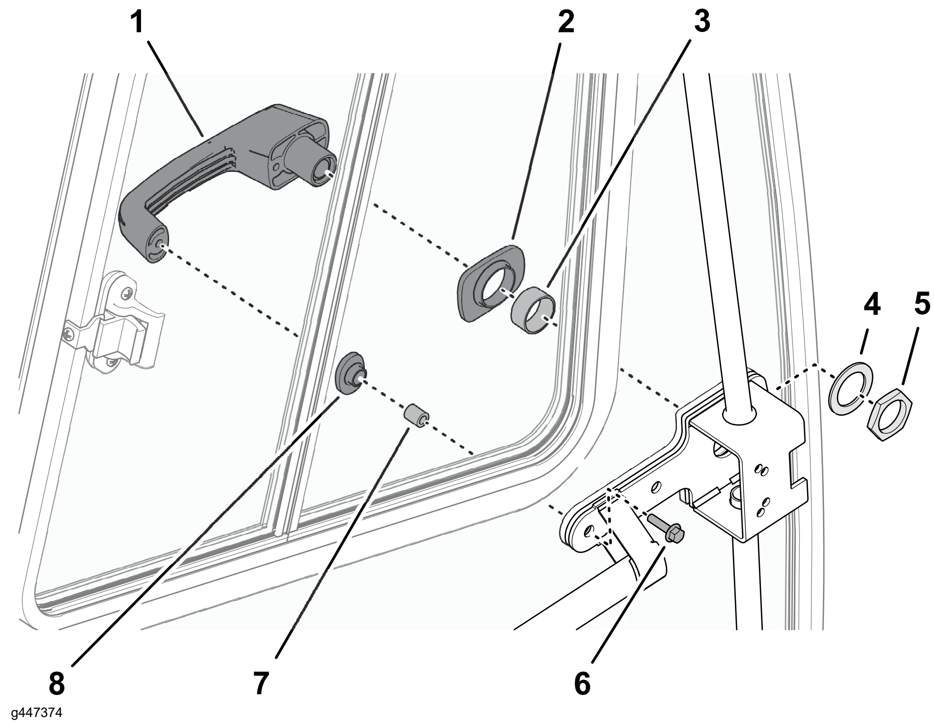


Figure 248

1. Handle
2. Grommet (large)
3. Bushing (large)
4. Washer
5. Nut
6. Flange-head capscrew
7. Bushing (small)
8. Grommet (small)

---

2. Remove the flange-head capscrew, that secure the bushing grommet and handle to the glass and door frame. Remove the handle.

Disassembling the Glass and Door Frame

Note: When possible, disassembling the glass and door frame on a flat work surface.

1. Remove the shoulder screws and locknuts that secure the 3 upper-hinge halves, flange bushings, and glass to the door frame.

Disassembling the Door (continued)

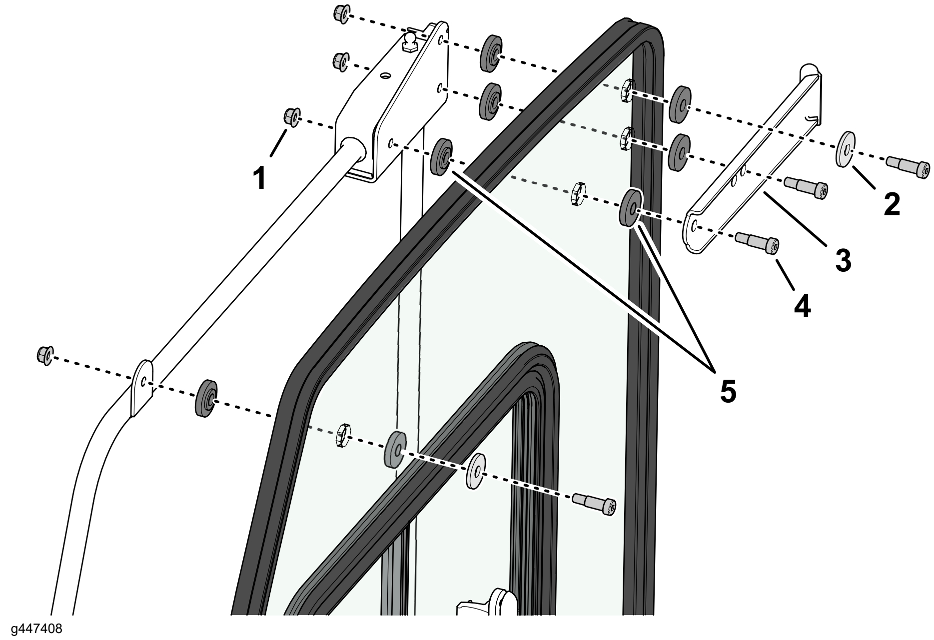


Figure 249

1. Locknut
2. Washer
3. Upper-hinge-half
4. Shoulder screws
5.

---

2. Remove the remaining shoulder screws, washers, flange bushings, and locknuts securing the glass to the door frame.
3. Remove the glass from the frame.

Assembling the Door

Assembling the Glass and Door Frame

Note: When possible, assembling the glass and door frame on a flat work surface.

1. Insert 10 flange bushings to the holes at the inner side of the glass.

   Note: Use a dab of clear silicone grease to adhere the bushings to the glass.

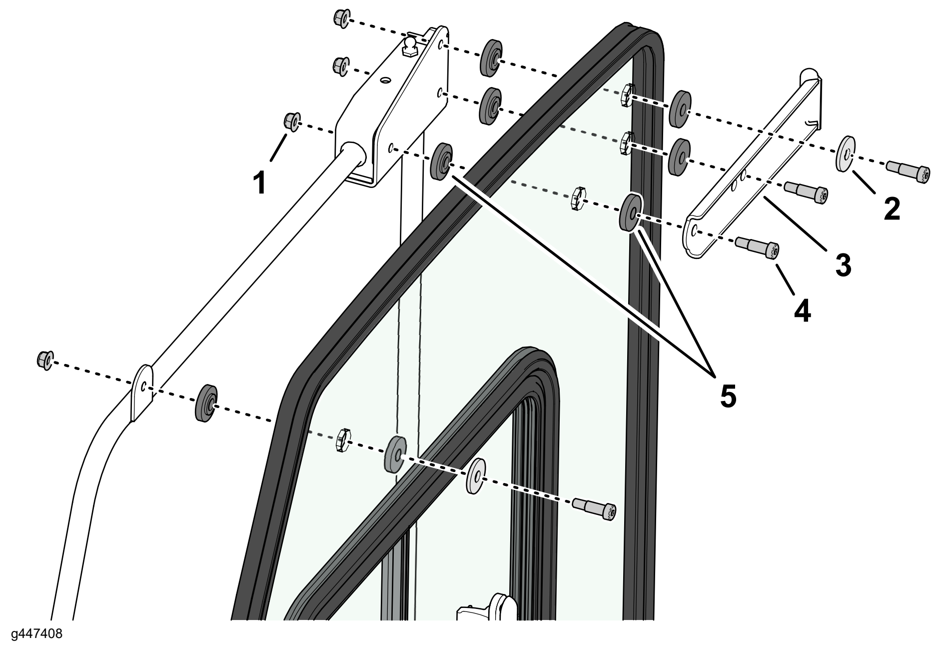


Figure 250

1. Locknut
2. Washer
3. Upper-hinge-half
4. Shoulder screws
5. Flange bushings

2. Align the holes in the flange bushings to the holes in the door frame.
3. Insert 10 flange bushings to the holes at the outer side of the glass.
4. Loosely assemble the bushings and glass to the door frame with the shoulder bolts and locknuts.
5. Loosely assemble the 3 upper-hinge halves, grommets, and glass to the door frame with the shoulder bolts and locknuts.
6. Tighten the shoulder bolts and locknuts.

Installing the Door Handle

1. Insert the small bushing into the small grommet, and the large bushing into the large grommet.
2. Remove the nut and washer that secures the handle, bushing, grommet to the glass and door frame.

Assembling the Door (continued)

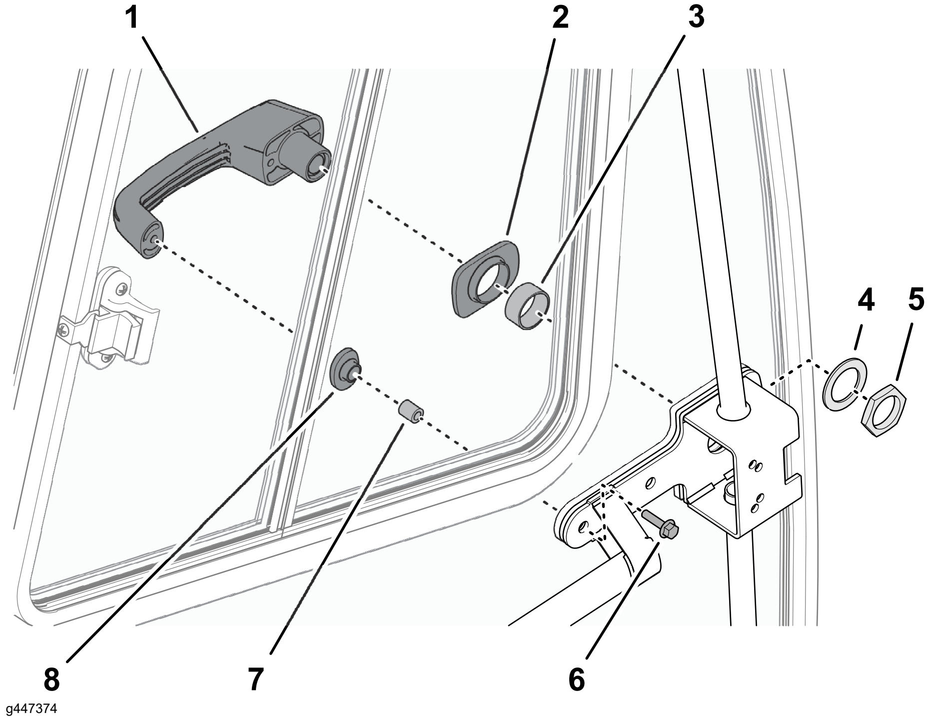


Figure 251

1. Handle
2. Grommet (large)
3. Bushing (large)
4. Washer
5. Nut
6. Flange-head capscrew
7. Bushing (small)
8. Grommet (small)

---

3. Assemble the door handle, grommets, and bushings to the glass and door frame.
4. Align the grommets to the handle.
5. Loosely assemble the door handle to the door frame with the washer and nut, and the flange-head capscrew.
6. Torque the nut to 20 to 27 N·m (15 to 20 ft-lb)

Installing the Latch

1. Insert the latch into the door frame.

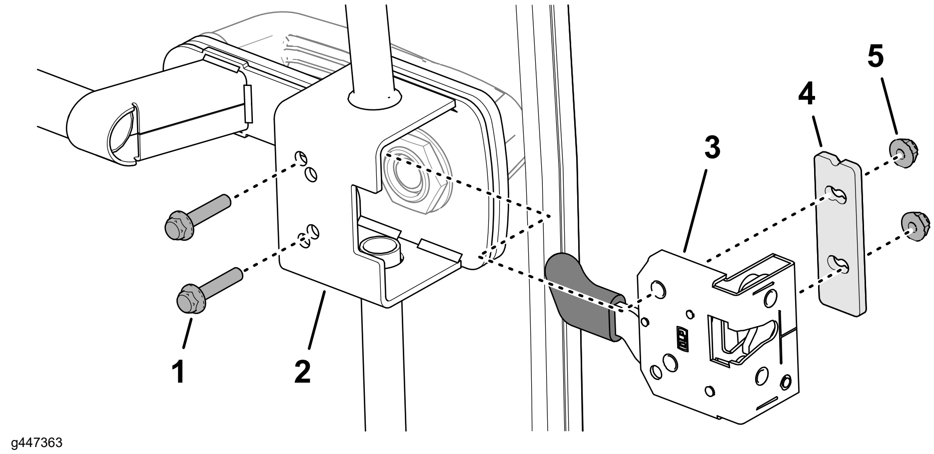


Figure 252

1. Flange-head screw
2. Door frame
3. Latch
4. Support plate
5. Locknut

2. Secure the latch to the door frame with the 2 flange-head , support plate, and locknuts.

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

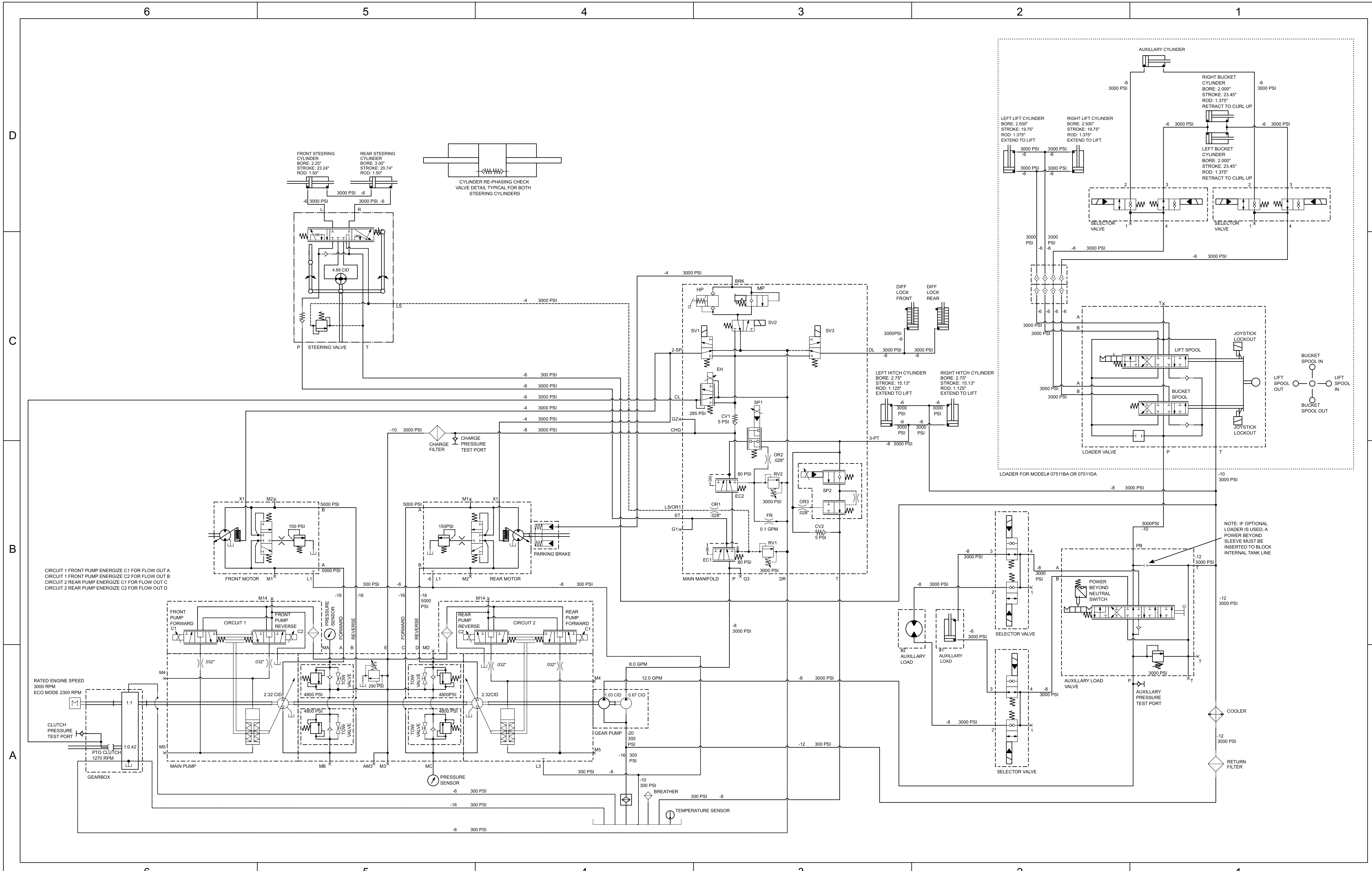
The individual wires of the electrical harness diagrams in this chapter identify both the wire color and the wire size.

Examples:

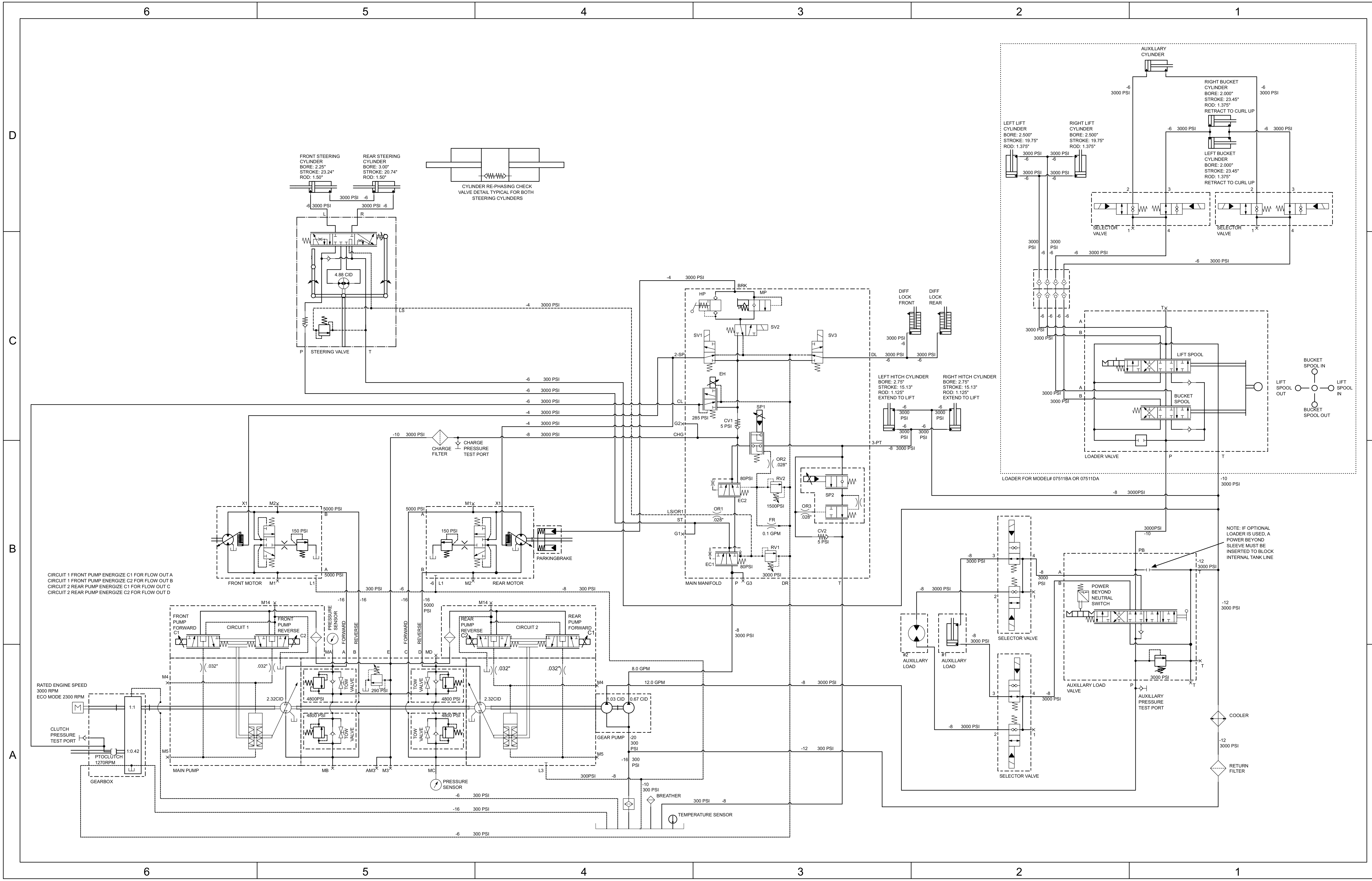
- 16 BK = 16 AWG (American Wire Gauge) wire that has a black insulator
- 050 R = 0.5 mm metric wire that has a red insulator (AWG equivalents for metric wire appear in the following table)

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

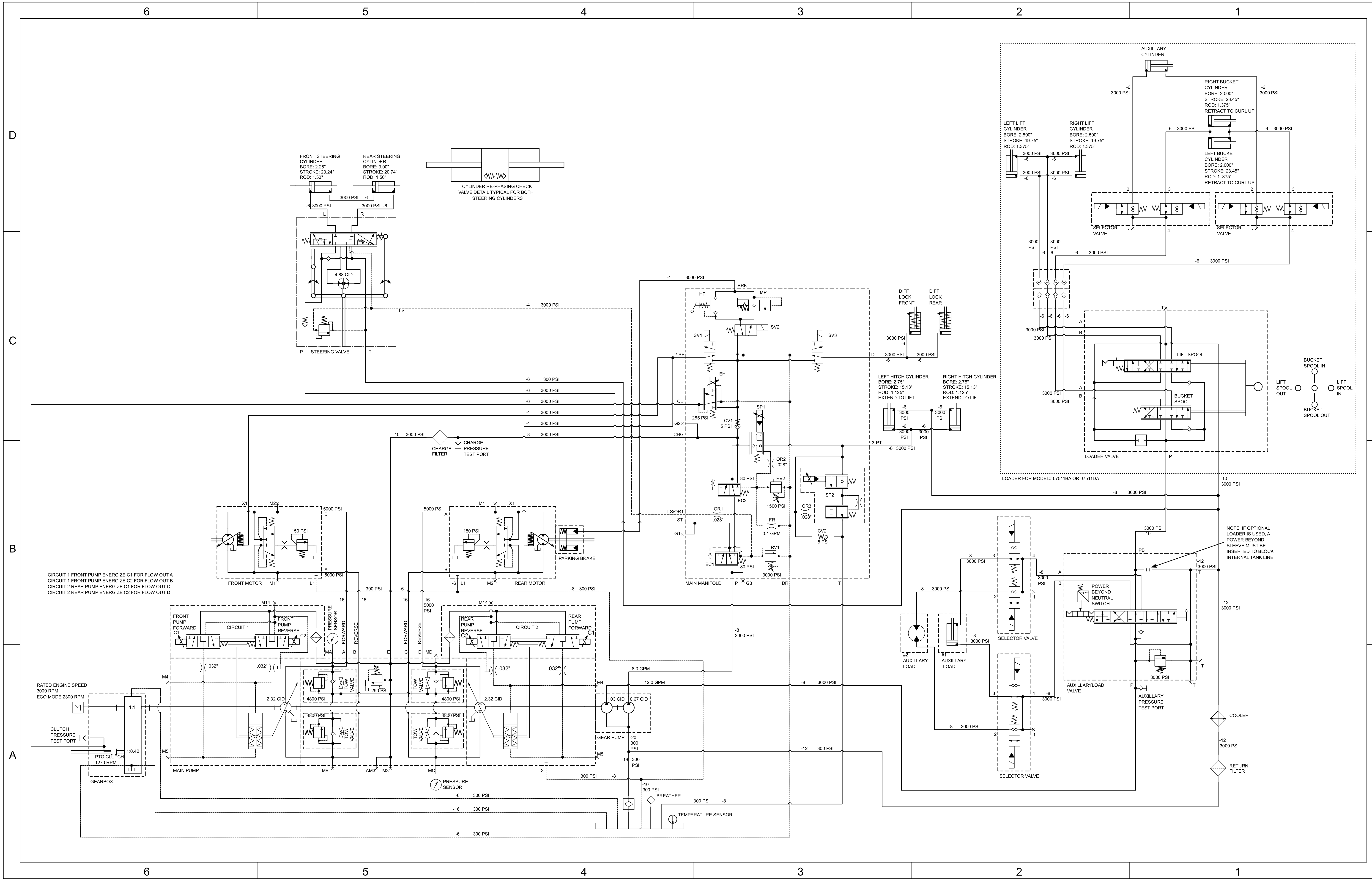


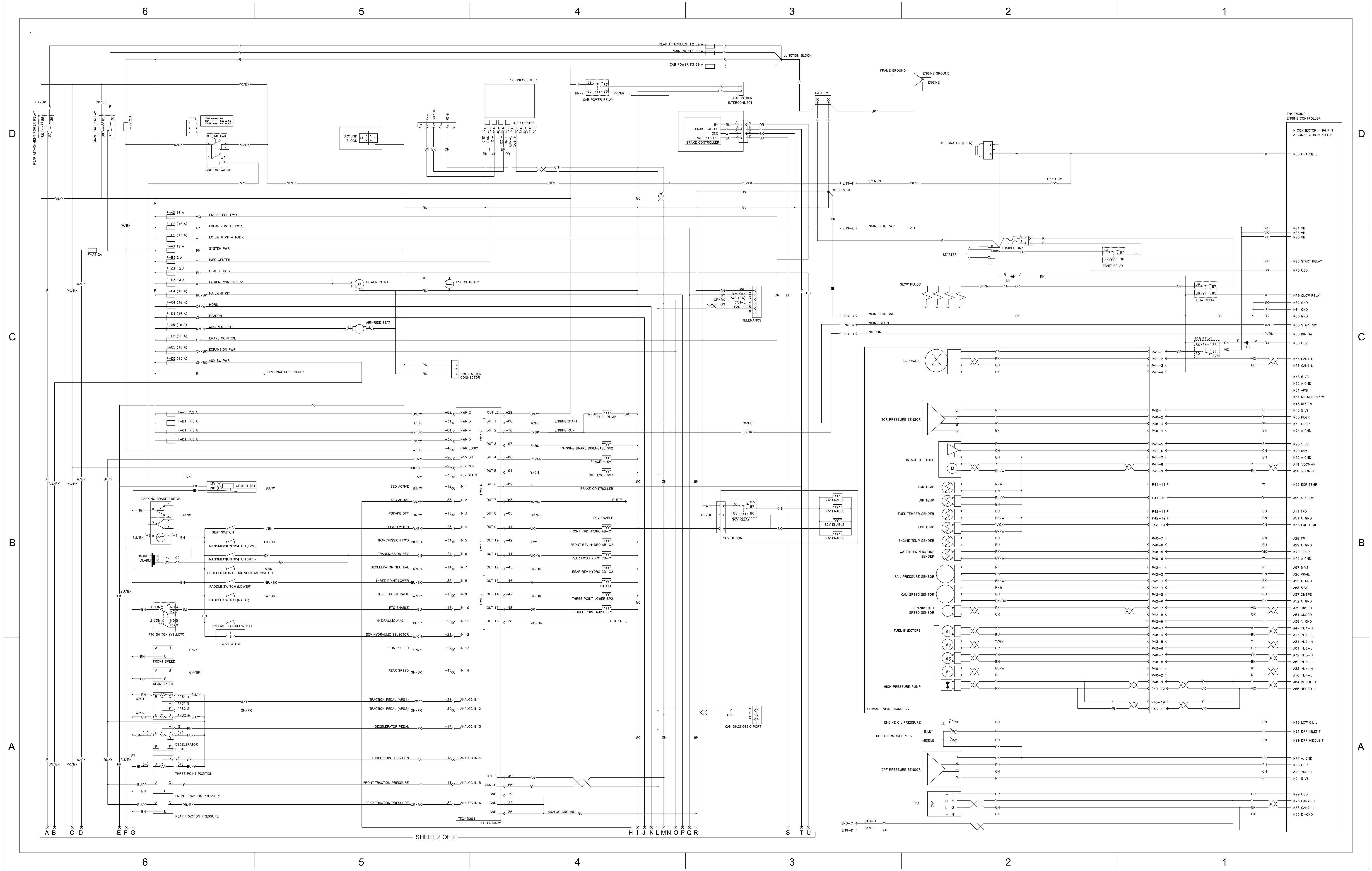
g436816


FRONT STEERING CYLINDER BORE: 2.25" STROKE: 23.24" ROD: 1.50"
REAR STEERING CYLINDER BORE: 3.00" STROKE: 20.74" ROD: 1.50"
CYLINDER RE-PHASING CHECK VALVE DETAIL TYPICAL FOR BOTH STEERING CYLINDERS
4.88 CID
STEERING VALVE
AUXILLARY CYLINDER
RIGHT BUCKET CYLINDER BORE: 2.000" STROKE: 23.45" ROD: 1.375" RETRACT TO CURL UP
LEFT LIFT CYLINDER BORE: 2.500" STROKE: 19.75" ROD: 1.375"
RIGHT LIFT CYLINDER BORE: 2.500" STROKE: 19.75" ROD: 1.375"
LEFT BUCKET CYLINDER BORE: 2.000" STROKE: 23.45" ROD: 1.375" RETRACT TO CURL UP
SELECTOR VALVE
LIFT SPOOL
BUCKET SPOOL
LOADER VALVE
BUCKET SPOOL IN
LIFT SPOOL OUT
LIFT SPOOL IN
BUCKET SPOOL OUT
LOADER FOR MODEL# 07511BA OR 07511DA
DIFF LOCK FRONT
DIFF LOCK REAR
LEFT HITCH CYLINDER BORE: 2.75" STROKE: 15.13" ROD: 1.125" EXTEND TO LIFT
RIGHT HITCH CYLINDER BORE: 2.75" STROKE: 15.13" ROD: 1.125" EXTEND TO LIFT
MAIN MANIFOLD
CHARGE FILTER
CHARGE PRESSURE TEST PORT
FRONT MOTOR
REAR MOTOR
PARKINGBRAKE
CIRCUIT 1 FRONT PUMP ENERGIZE C1 FOR FLOW OUT A
CIRCUIT 1 FRONT PUMP ENERGIZE C2 FOR FLOW OUT B
CIRCUIT 2 REAR PUMP ENERGIZE C1 FOR FLOW OUT C
CIRCUIT 2 REAR PUMP ENERGIZE C2 FOR FLOW OUT D
FRONT PUMP FORWARD
FRONT PUMP REVERSE
REAR PUMP REVERSE
REAR PUMP FORWARD
CIRCUIT 1
CIRCUIT 2
PRESSURE SENSOR
TOW VALVE
MAIN PUMP
GEAR PUMP
RATED ENGINE SPEED 3000 RPM ECO MODE 2300 RPM
CLUTCH PRESSURE TEST PORT
PTOCLUTCH 1270RPM
GEARBOX
BREATHER
TEMPERATURE SENSOR
#2 AUXILLARY LOAD
#1 AUXILLARY LOAD
POWER BEYOND NEUTRAL SWITCH
AUXILLARY LOAD VALVE
AUXILLARY PRESSURE TEST PORT
NOTE: IF OPTIONAL LOADER IS USED, A POWER BEYOND SLEEVE MUST BE INSERTED TO BLOCK INTERNAL TANK LINE
COOLER
RETURN FILTER

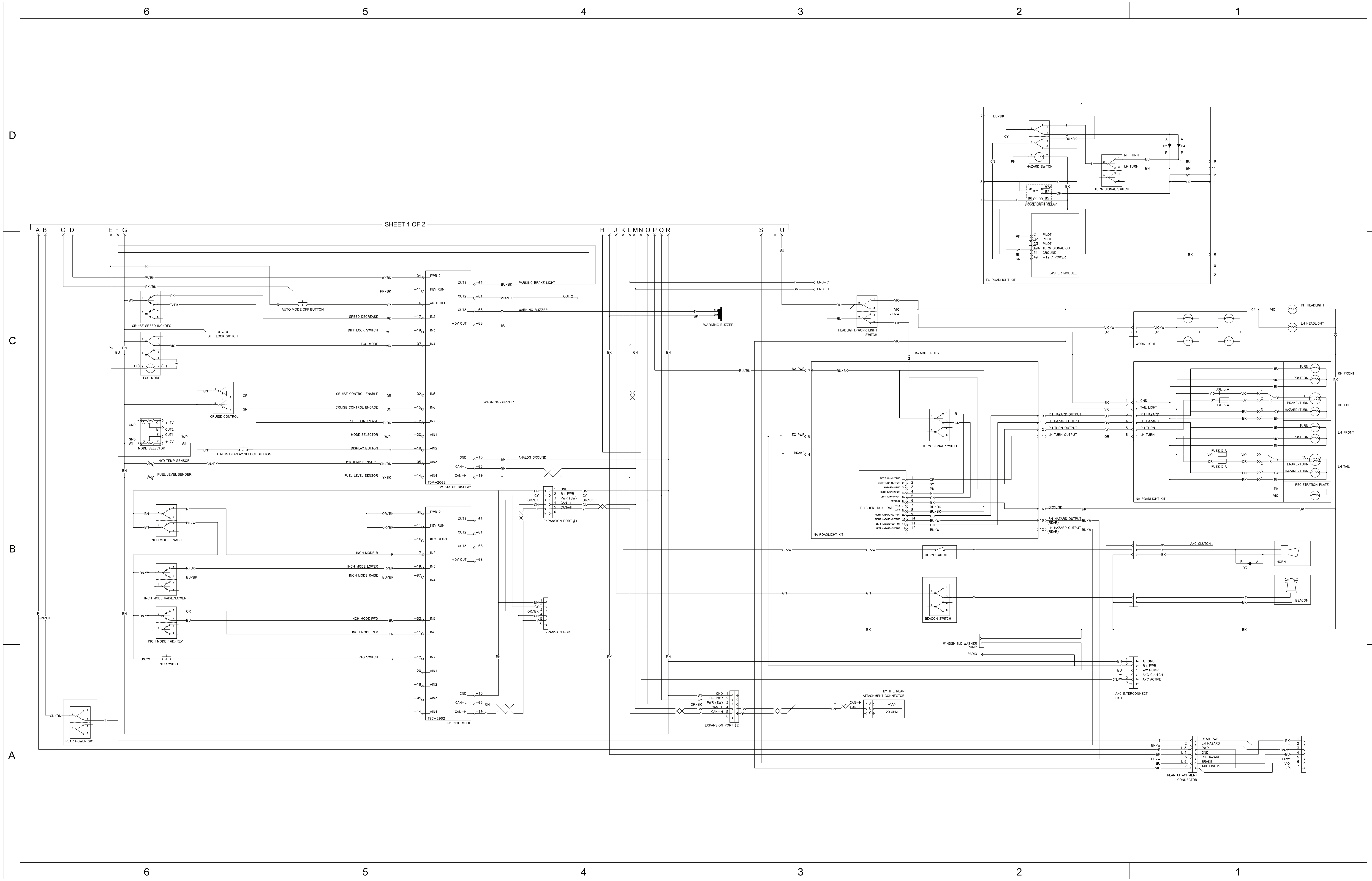
g436817

Hydraulic Schematic

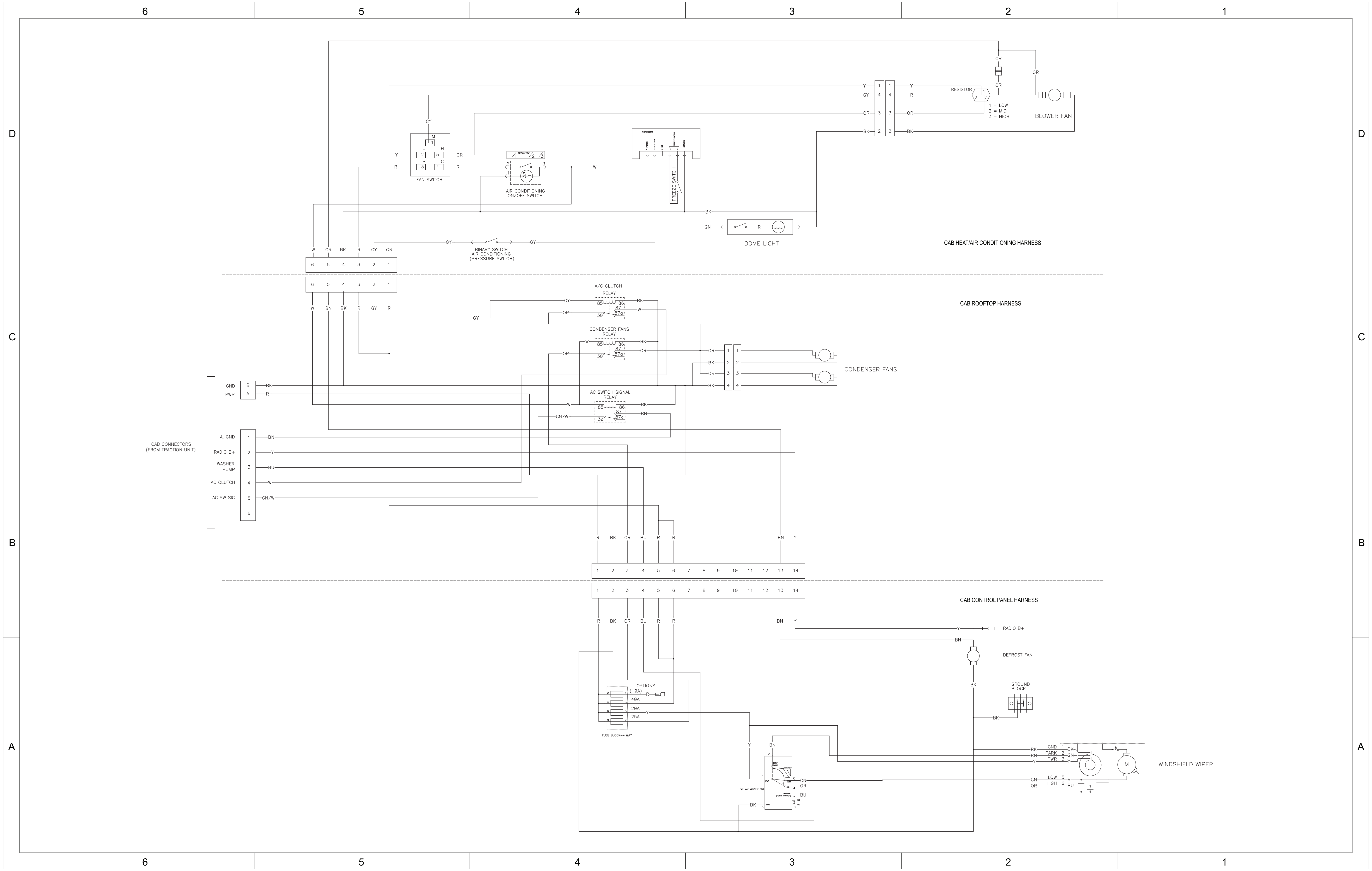



SHEET 2 OF 2
JUNCTION BLOCK
BATTERY
IGNITION SWITCH
CAB POWER RELAY
INFO CENTER
TELEMATICS
STARTER
GLOW PLUGS
GLOW RELAY
EGR RELAY
START RELAY
ALTERNATOR (80 A)
EN: ENGINE
ENGINE CONTROLLER
YANMAR ENGINE HARNESS
SCV OPTION
CAN DIAGNOSTIC PORT
PARKING BRAKE SWITCH
PTO SWITCH (YELLOW)
FRONT SPEED
REAR SPEED
DECELERATOR PEDAL
THREE POINT POSITION
FRONT TRACTION PRESSURE
REAR TRACTION PRESSURE
TEC-5004
T1: PRIMARY
g264053

Electrical Schematic (part 2 of 3)

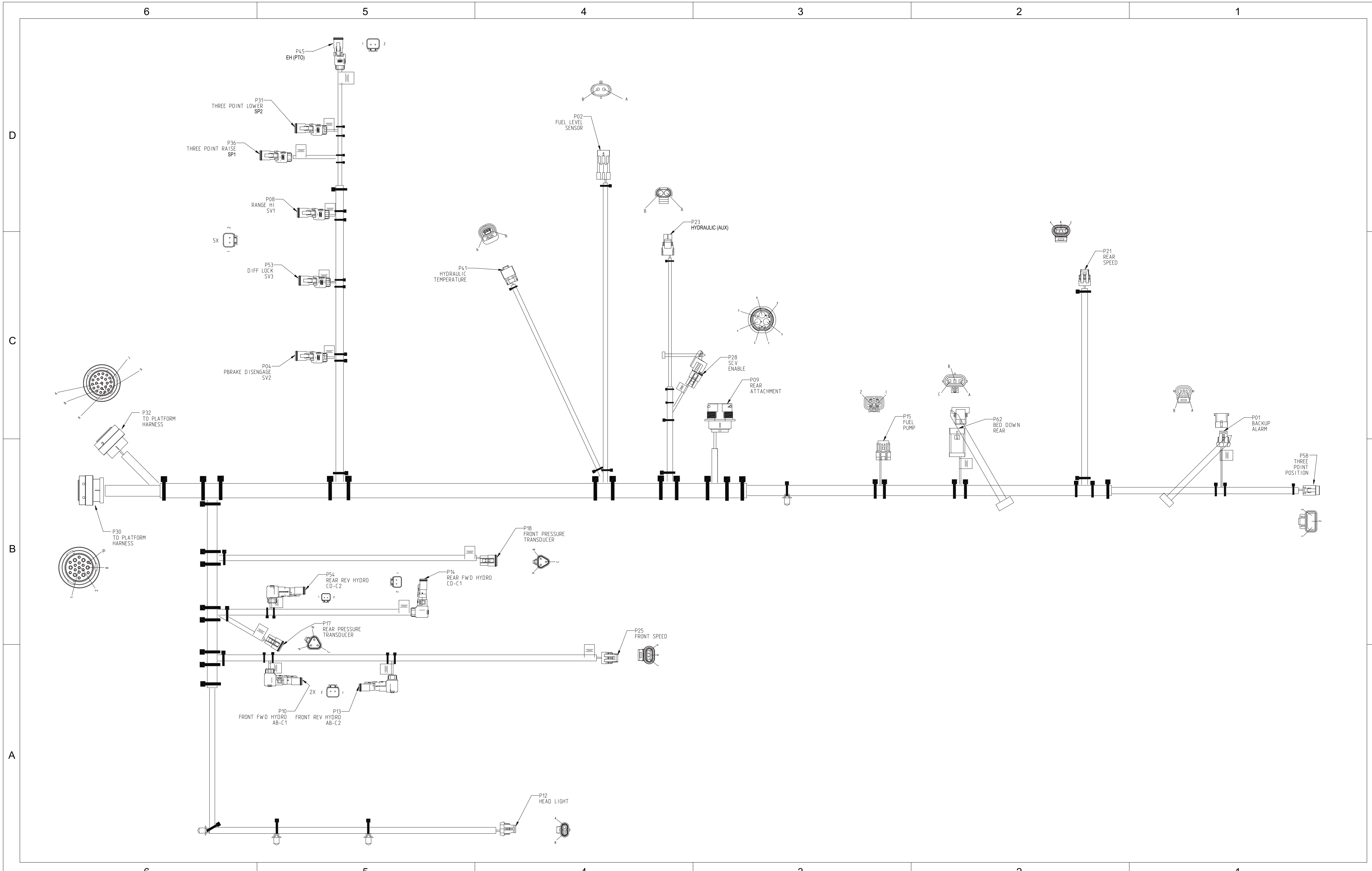


g264054

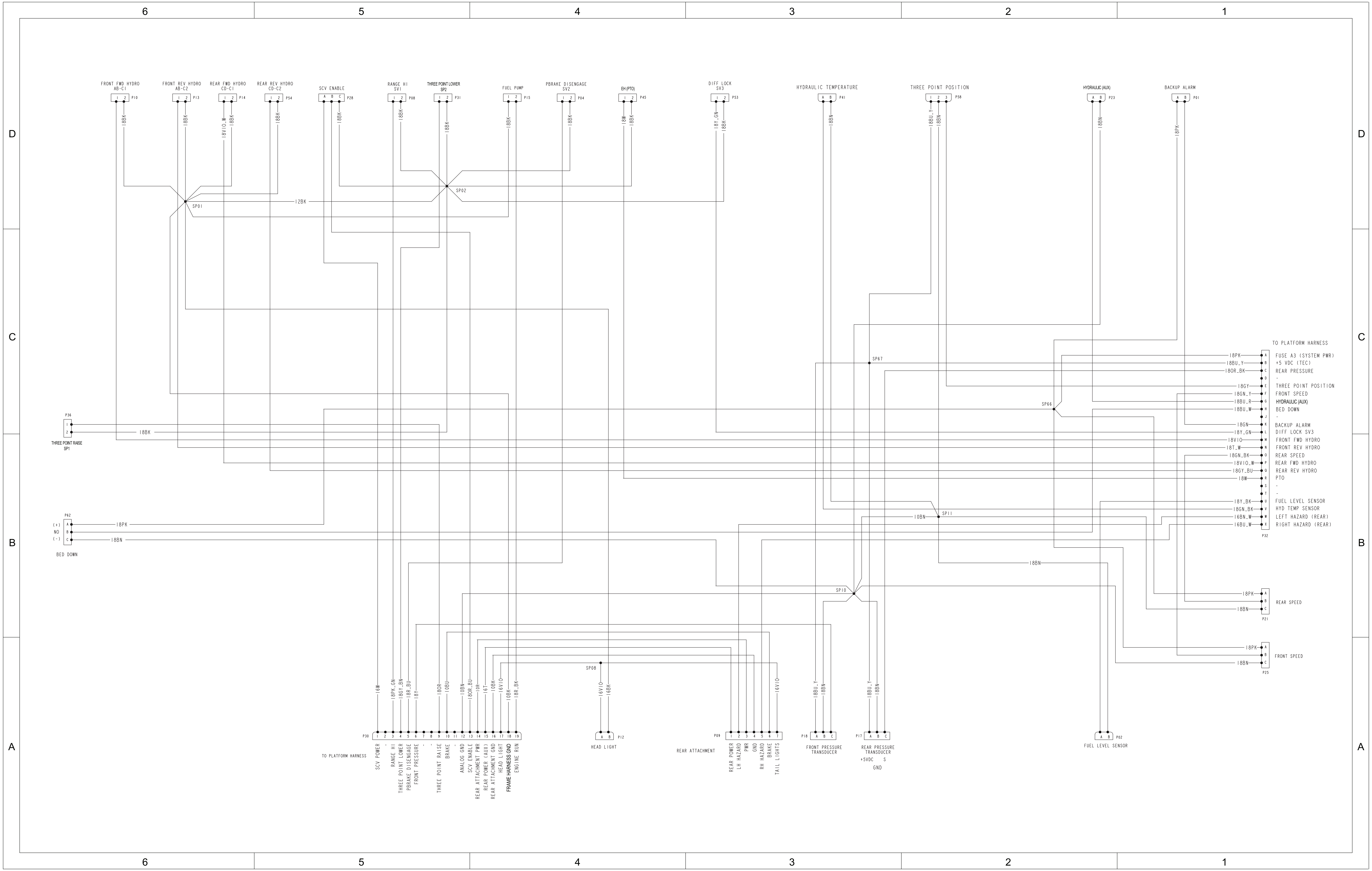

BLOWER FAN
RESISTOR
1 = LOW
2 = MID
3 = HIGH
FAN SWITCH
AIR CONDITIONING
ON/OFF SWITCH
THERMOSTAT
FREEZE SWITCH
DOME LIGHT
BINARY SWITCH
AIR CONDITIONING
(PRESSURE SWITCH)
CAB HEAT/AIR CONDITIONING HARNESS
A/C CLUTCH
RELAY
CONDENSER FANS
RELAY
AC SWITCH SIGNAL
RELAY
CAB ROOFTOP HARNESS
CONDENSER FANS
CAB CONNECTORS
(FROM TRACTION UNIT)
GND
PWR
A. GND
RADIO B+
WASHER
PUMP
AC CLUTCH
AC SW SIG
CAB CONTROL PANEL HARNESS
RADIO B+
DEFROST FAN
GROUND
BLOCK
OPTIONS
(10A)
40A
20A
25A
FUSE BLOCK—4 WAY
DELAY WIPER SW
WINDSHIELD WIPER
PARK
LOW
HIGH

g267771

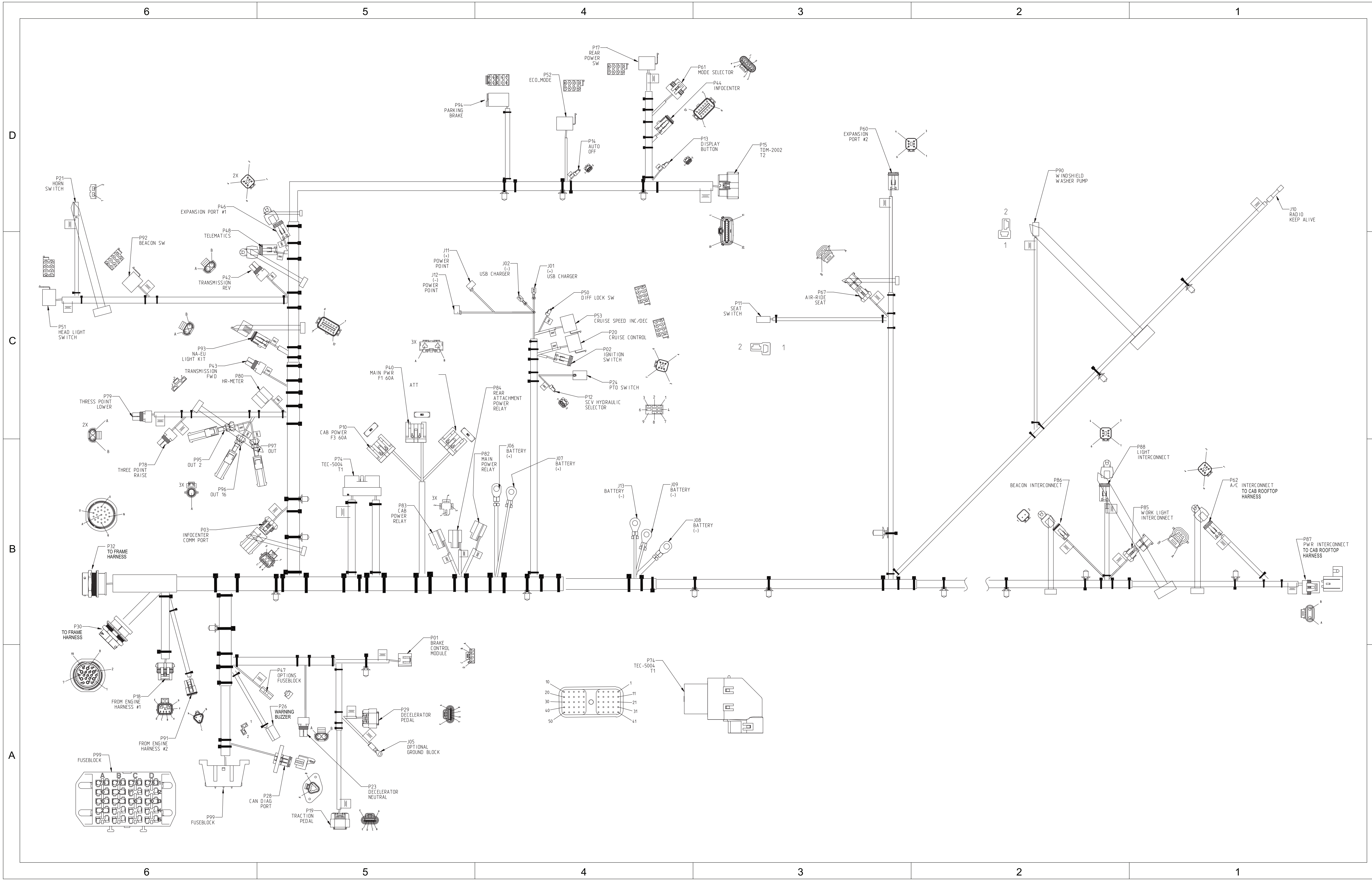
Wire Harness Drawing – Frame



g256296

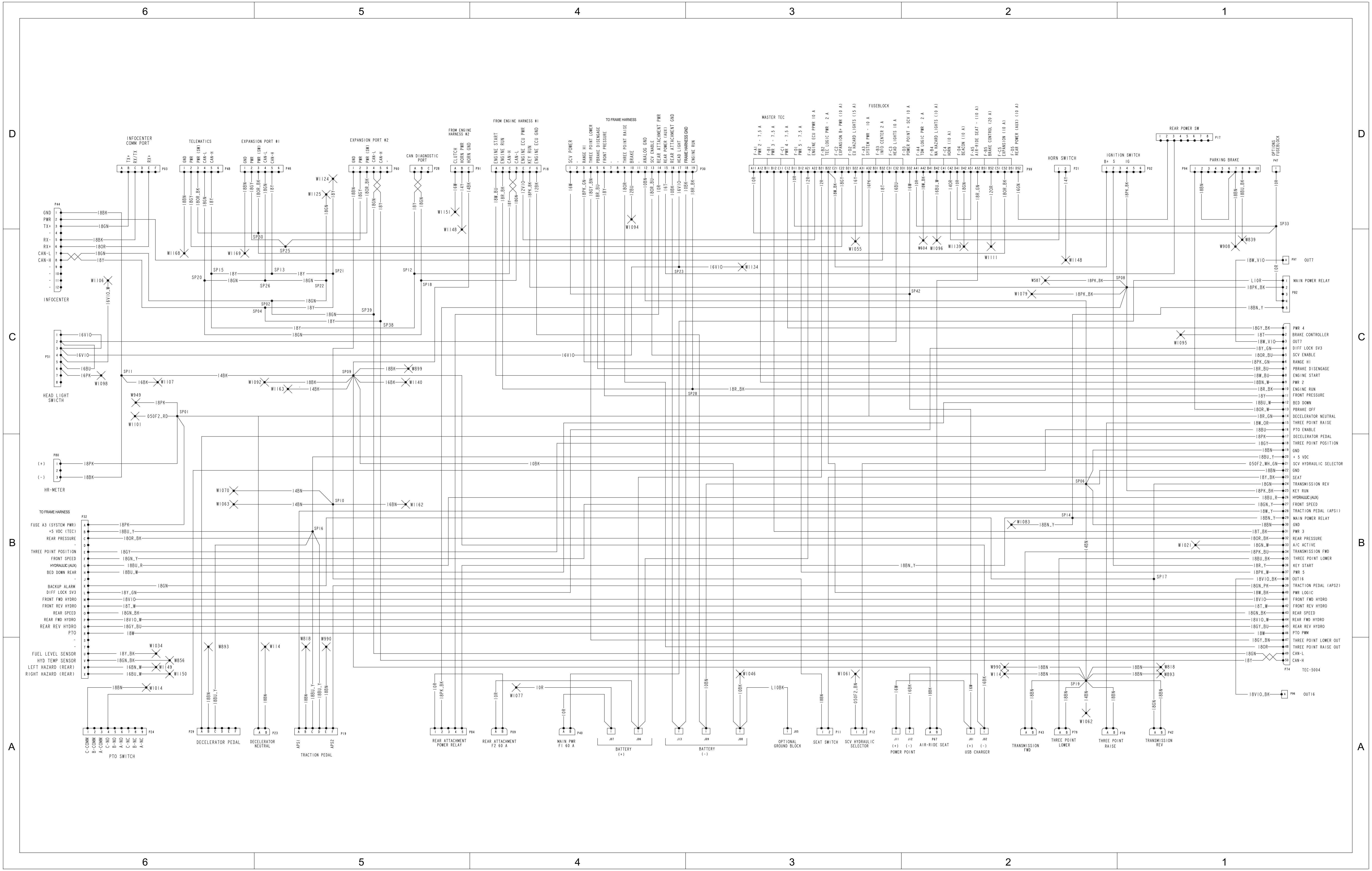


FRONT FWD HYDRO AB-C1 P10
FRONT REV HYDRO AB-C2 P13
REAR FWD HYDRO CD-C1 P14
REAR REV HYDRO CD-C2 P34
SCV ENABLE P28
RANGE HI SV1 P08
THREE POINT LOWER SP2 P31
FUEL PUMP P15
PBRAKE DISENGAGE SV2 P04
EH (PTO) P45
DIFF LOCK SV3 P53
HYDRAULIC TEMPERATURE P41
THREE POINT POSITION P58
HYDRAULIC (AUX) P23
BACKUP ALARM P61
SP01
SP02
SP66
SP67
SP10
SP11
SP08
THREE POINT RAISE SP1 P36
BED DOWN P62
TO PLATFORM HARNESS P32
FUSE A3 (SYSTEM PWR)
+5 VDC (TEC)
REAR PRESSURE
THREE POINT POSITION
FRONT SPEED
HYDRAULIC (AUX)
BED DOWN
BACKUP ALARM
DIFF LOCK SV3
FRONT FWD HYDRO
FRONT REV HYDRO
REAR SPEED
REAR FWD HYDRO
REAR REV HYDRO
PTO
FUEL LEVEL SENSOR
HYD TEMP SENSOR
LEFT HAZARD (REAR)
RIGHT HAZARD (REAR)
REAR SPEED P21
FRONT SPEED P25
TO PLATFORM HARNESS P30
SCV POWER
RANGE HI
THREE POINT LOWER
PBRAKE DISENGAGE
FRONT PRESSURE
THREE POINT RAISE
BRAKE
ANALOG GND
SCV ENABLE
REAR ATTACHMENT PWR
REAR POWER (AUX)
REAR ATTACHMENT GND
HEAD LIGHT
FRAME HARNESS GND
ENGINE RUN
HEAD LIGHT P12
REAR ATTACHMENT P09
REAR POWER
LH HAZARD
PWR
GND
RH HAZARD
BRAKE
TAIL LIGHTS
FRONT PRESSURE TRANSDUCER P18
REAR PRESSURE TRANSDUCER P17
+5VDC
S
GND
FUEL LEVEL SENSOR P02
g256295

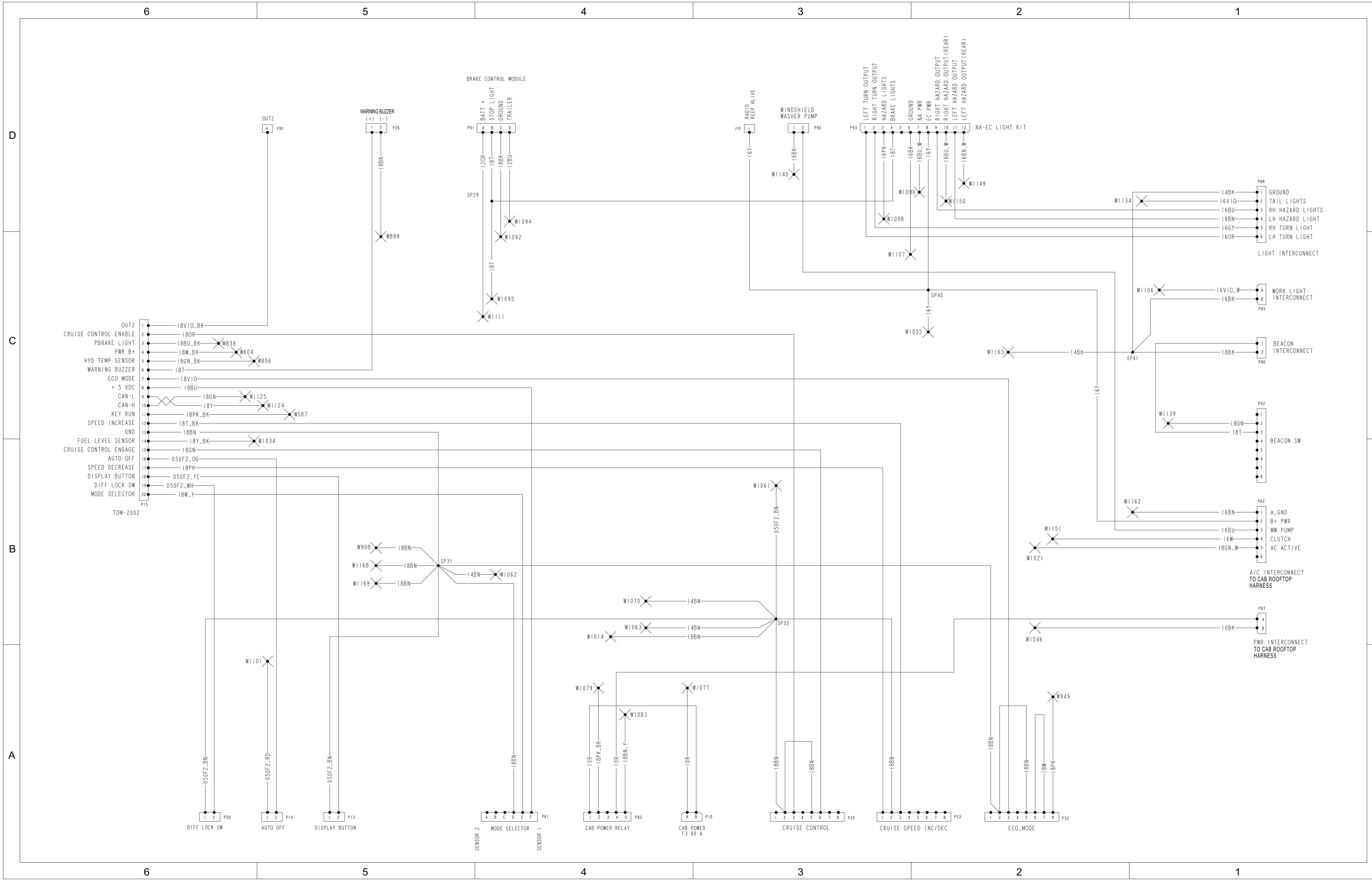


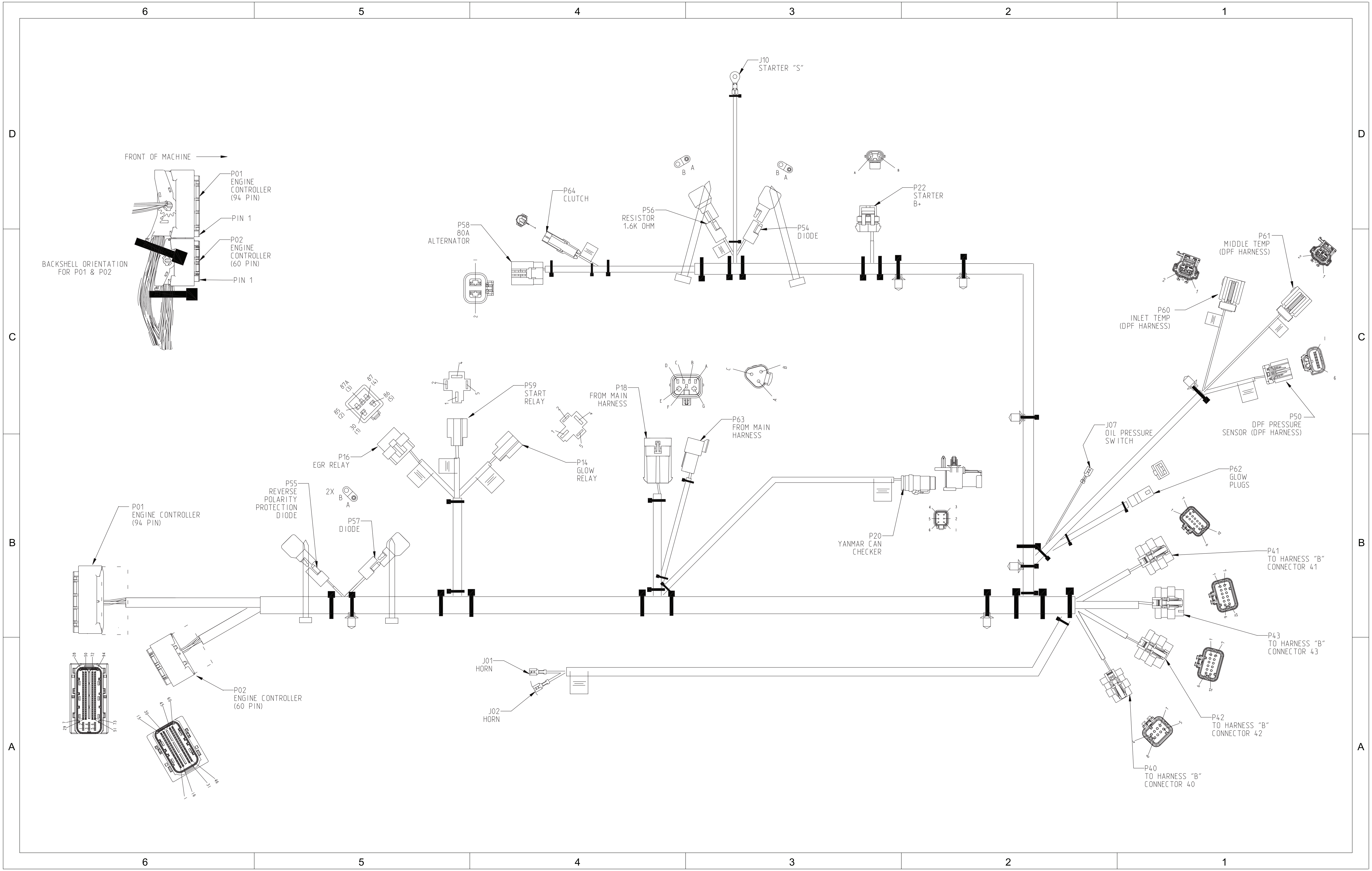
P17 REAR POWER SW
P52 ECO_MODE
P94 PARKING BRAKE
P61 MODE SELECTOR
P44 INFOCENTER
P14 AUTO OFF
P13 DISPLAY BUTTON
P15 TDM-2002 T2
P60 EXPANSION PORT #2
P21 HORN SWITCH
P46 EXPANSION PORT #1
P48 TELEMATICS
P92 BEACON SW
P42 TRANSMISSION REV
P51 HEAD LIGHT SWITCH
P93 NA-EU LIGHT KIT
P43 TRANSMISSION FWD
P80 HR-METER
P79 THRESS POINT LOWER
P78 THREE POINT RAISE
P95 OUT 2
P96 OUT 16
P97 OUT
P03 INFOCENTER COMM PORT
P32 TO FRAME HARNESS
P30 TO FRAME HARNESS
P18 FROM ENGINE HARNESS #1
P91 FROM ENGINE HARNESS #2
P99 FUSEBLOCK
J11 (+) POWER POINT
J12 (-) POWER POINT
J02 (-) USB CHARGER
J01 (+) USB CHARGER
P50 DIFF LOCK SW
P53 CRUISE SPEED INC/DEC
P20 CRUISE CONTROL
P02 IGNITION SWITCH
P24 PTO SWITCH
P12 SCV HYDRAULIC SELECTOR
P40 MAIN PWR F1 60A
ATT
P84 REAR ATTACHMENT POWER RELAY
P10 CAB POWER F3 60A
P74 TEC-5004 T1
P82 MAIN POWER RELAY
J06 BATTERY (+)
J07 BATTERY (+)
P83 CAB POWER RELAY
J13 BATTERY (-)
J09 BATTERY (-)
J08 BATTERY (-)
P11 SEAT SWITCH
P67 AIR-RIDE SEAT
P90 WINDSHIELD WASHER PUMP
J10 RADIO KEEP ALIVE
P88 LIGHT INTERCONNECT
P86 BEACON INTERCONNECT
P85 WORK LIGHT INTERCONNECT
P62 A/C INTERCONNECT TO CAB ROOFTOP HARNESS
P87 PWR INTERCONNECT TO CAB ROOFTOP HARNESS
P01 BRAKE CONTROL MODULE
P47 OPTIONS FUSEBLOCK
P26 WARNING BUZZER
P29 DECELERATOR PEDAL
J05 OPTIONAL GROUND BLOCK
P28 CAN DIAG PORT
P23 DECELERATOR NEUTRAL
P19 TRACTION PEDAL
P99 FUSEBLOCK
P74 TEC-5004 T1

g256443


INFOCENTER
TELEMATICS
EXPANSION PORT #1
EXPANSION PORT #2
CAN DIAGNOSTIC PORT
FROM ENGINE HARNESS #1
TO FRAME HARNESS
MASTER TEC
FUSEBLOCK
HORN SWITCH
IGNITION SWITCH
REAR POWER SW
PARKING BRAKE
HEAD LIGHT SWITCH
HR-METER
PTO SWITCH
DECELERATOR PEDAL
DECELERATOR NEUTRAL
TRACTION PEDAL
REAR ATTACHMENT POWER RELAY
MAIN PWR F1 60 A
BATTERY (+)
BATTERY (-)
OPTIONAL GROUND BLOCK
SEAT SWITCH
SCV HYDRAULIC SELECTOR
POWER POINT
AIR-RIDE SEAT
USB CHARGER
TRANSMISSION FWD
THREE POINT LOWER
THREE POINT RAISE
TRANSMISSION REV
MAIN POWER RELAY
TEC-5004

g256441

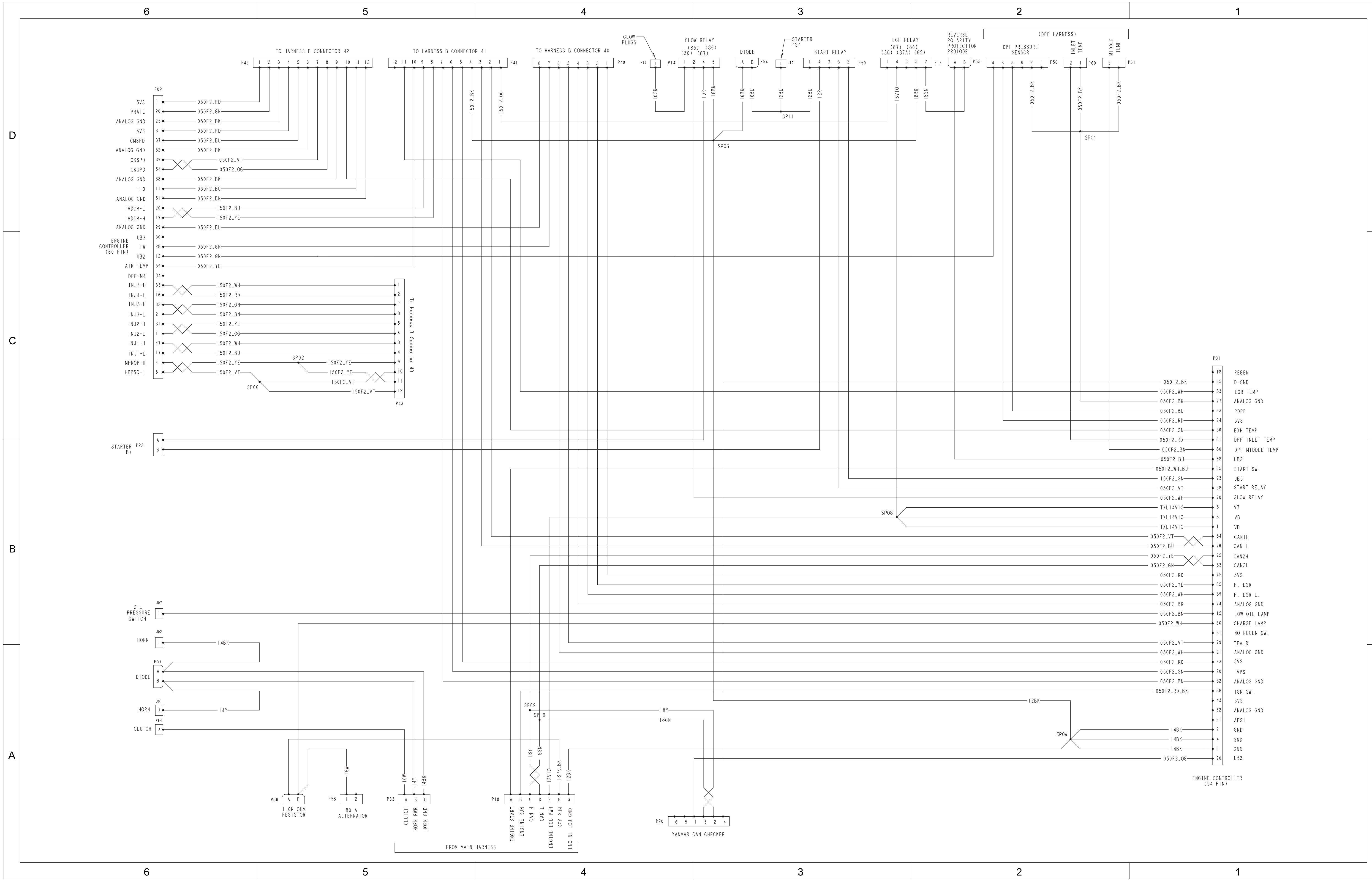

BRAKE CONTROL MODULE
BATT +
STOP LIGHT
GROUND
TRAILER
OUT2
WARNING BUZZER
RADIO KEEP ALIVE
WINDSHIELD WASHER PUMP
LEFT TURN OUTPUT
RIGHT TURN OUTPUT
HAZARD LIGHTS
BRAKE LIGHTS
GROUND
NA PWR
EC PWR
RIGHT HAZARD OUTPUT
RIGHT HAZARD OUTPUT(REAR)
LEFT HAZARD OUTPUT
LEFT HAZARD OUTPUT(REAR)
NA-EC LIGHT KIT
GROUND
TAIL LIGHTS
RH HAZARD LIGHTS
LH HAZARD LIGHT
RH TURN LIGHT
LH TURN LIGHT
LIGHT INTERCONNECT
WORK LIGHT INTERCONNECT
BEACON INTERCONNECT
BEACON SW
A_GND
B+ PWR
WW PUMP
CLUTCH
AC ACTIVE
A/C INTERCONNECT
TO CAB ROOFTOP HARNESS
PWR INTERCONNECT
TO CAB ROOFTOP HARNESS
OUT2
CRUISE CONTROL ENABLE
PBRAKE LIGHT
PWR B+
HYD TEMP SENSOR
WARNING BUZZER
ECO MODE
+ 5 VDC
CAN-L
CAN-H
KEY RUN
SPEED INCREASE
GND
FUEL LEVEL SENSOR
CRUISE CONTROL ENGAGE
AUTO OFF
SPEED DECREASE
DISPLAY BUTTON
DIFF LOCK SW
MODE SELECTOR
TDM-2002
DIFF LOCK SW
AUTO OFF
DISPLAY BUTTON
SENSOR 2
MODE SELECTOR
SENSOR 1
CAB POWER RELAY
CAB POWER F3 60 A
CRUISE CONTROL
CRUISE SPEED INC/DEC
ECO_MODE
g256442



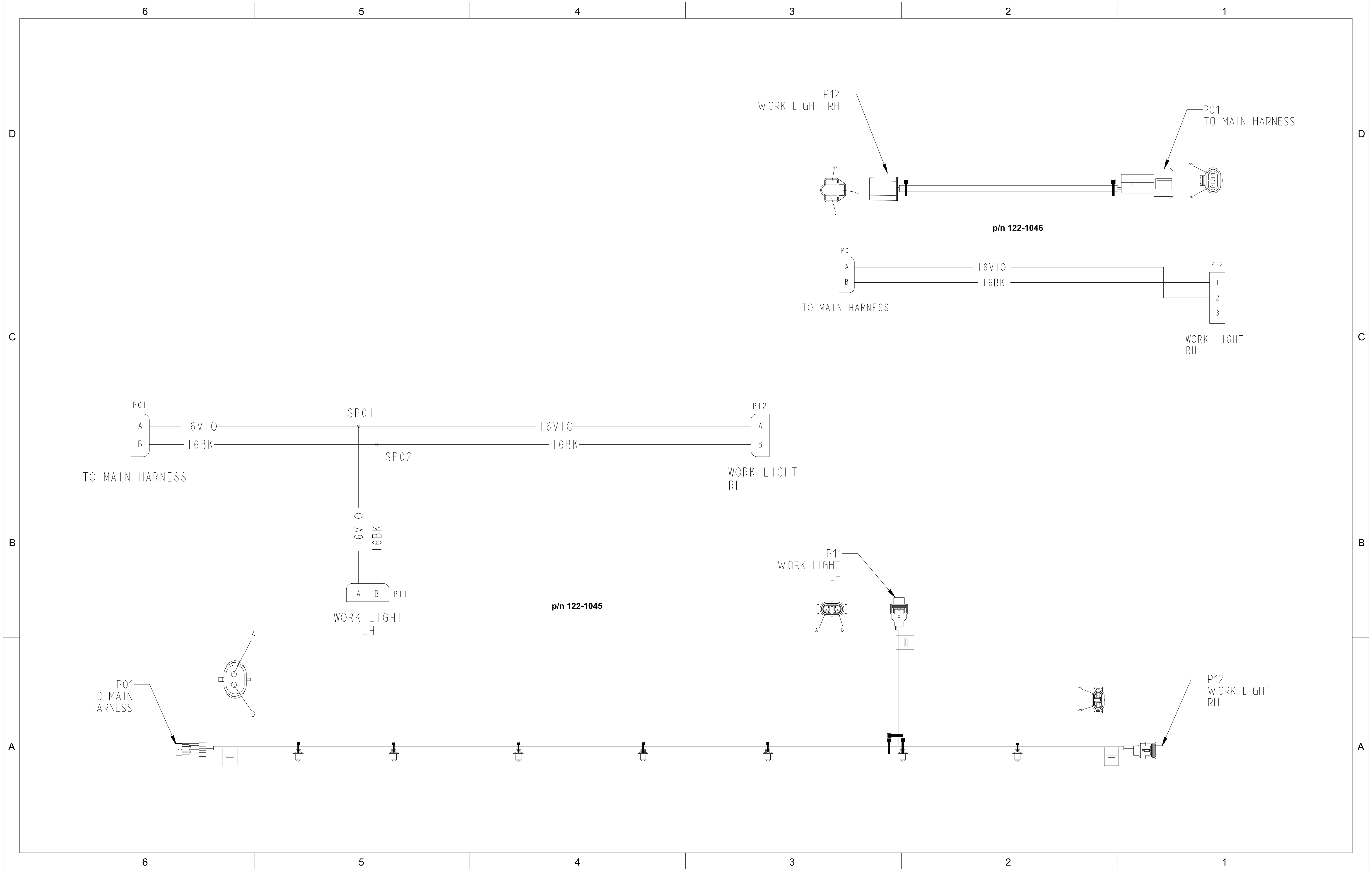
FRONT OF MACHINE
P01 ENGINE CONTROLLER (94 PIN)
PIN 1
P02 ENGINE CONTROLLER (60 PIN)
PIN 1
BACKSHELL ORIENTATION FOR P01 & P02
J10 STARTER "S"
P64 CLUTCH
P58 80A ALTERNATOR
P56 RESISTOR 1.6K OHM
P54 DIODE
P22 STARTER B+
P61 MIDDLE TEMP (DPF HARNESS)
P60 INLET TEMP (DPF HARNESS)
P50 DPF PRESSURE SENSOR (DPF HARNESS)
J07 OIL PRESSURE SWITCH
P62 GLOW PLUGS
P59 START RELAY
P18 FROM MAIN HARNESS
P63 FROM MAIN HARNESS
P16 EGR RELAY
P14 GLOW RELAY
P55 REVERSE POLARITY PROTECTION DIODE
2X
P57 DIODE
P20 YANMAR CAN CHECKER
P01 ENGINE CONTROLLER (94 PIN)
P02 ENGINE CONTROLLER (60 PIN)
J01 HORN
J02 HORN
P41 TO HARNESS "B" CONNECTOR 41
P43 TO HARNESS "B" CONNECTOR 43
P42 TO HARNESS "B" CONNECTOR 42
P40 TO HARNESS "B" CONNECTOR 40

g256294

Wire Harness Diagram – Engine

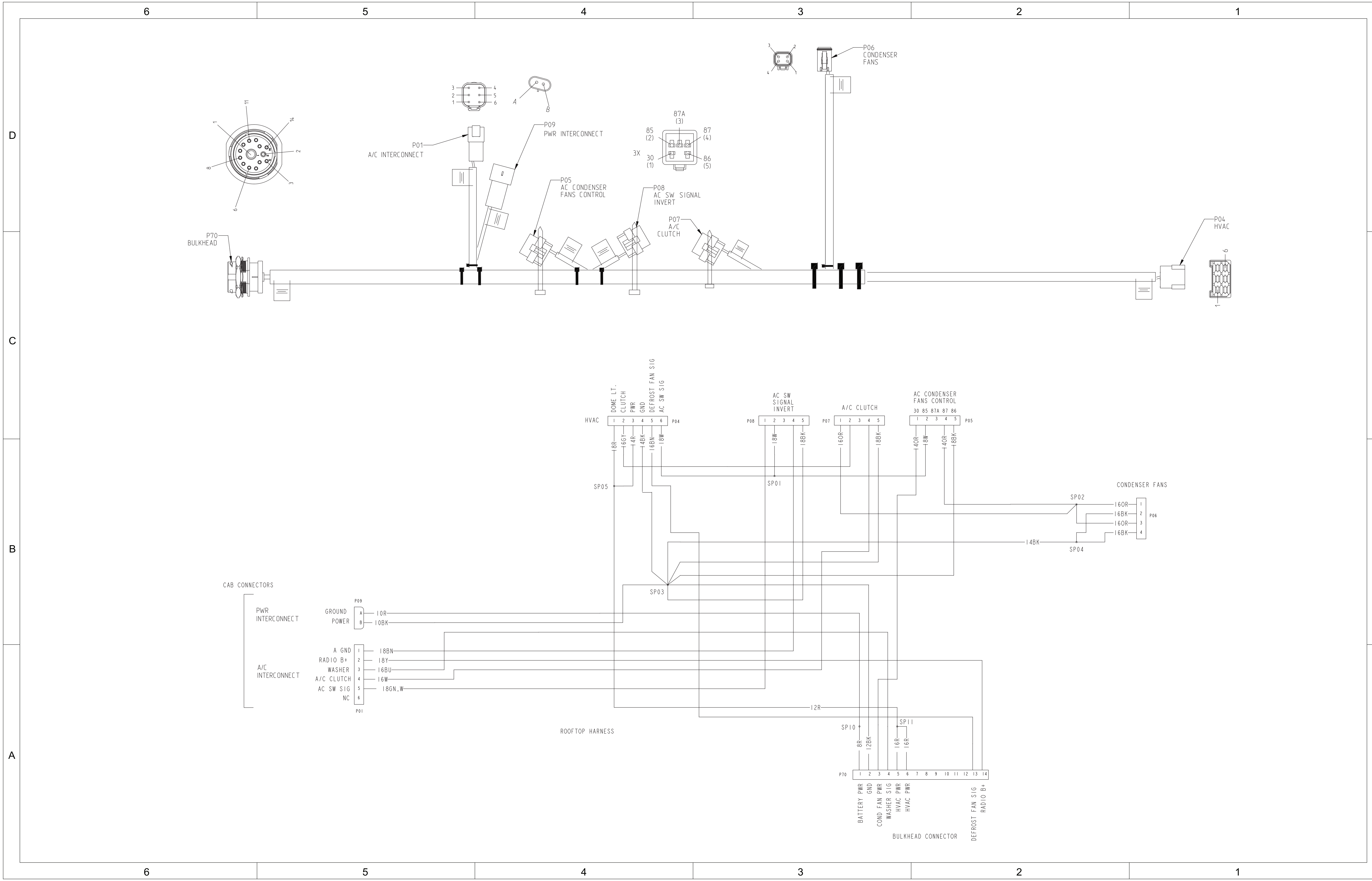


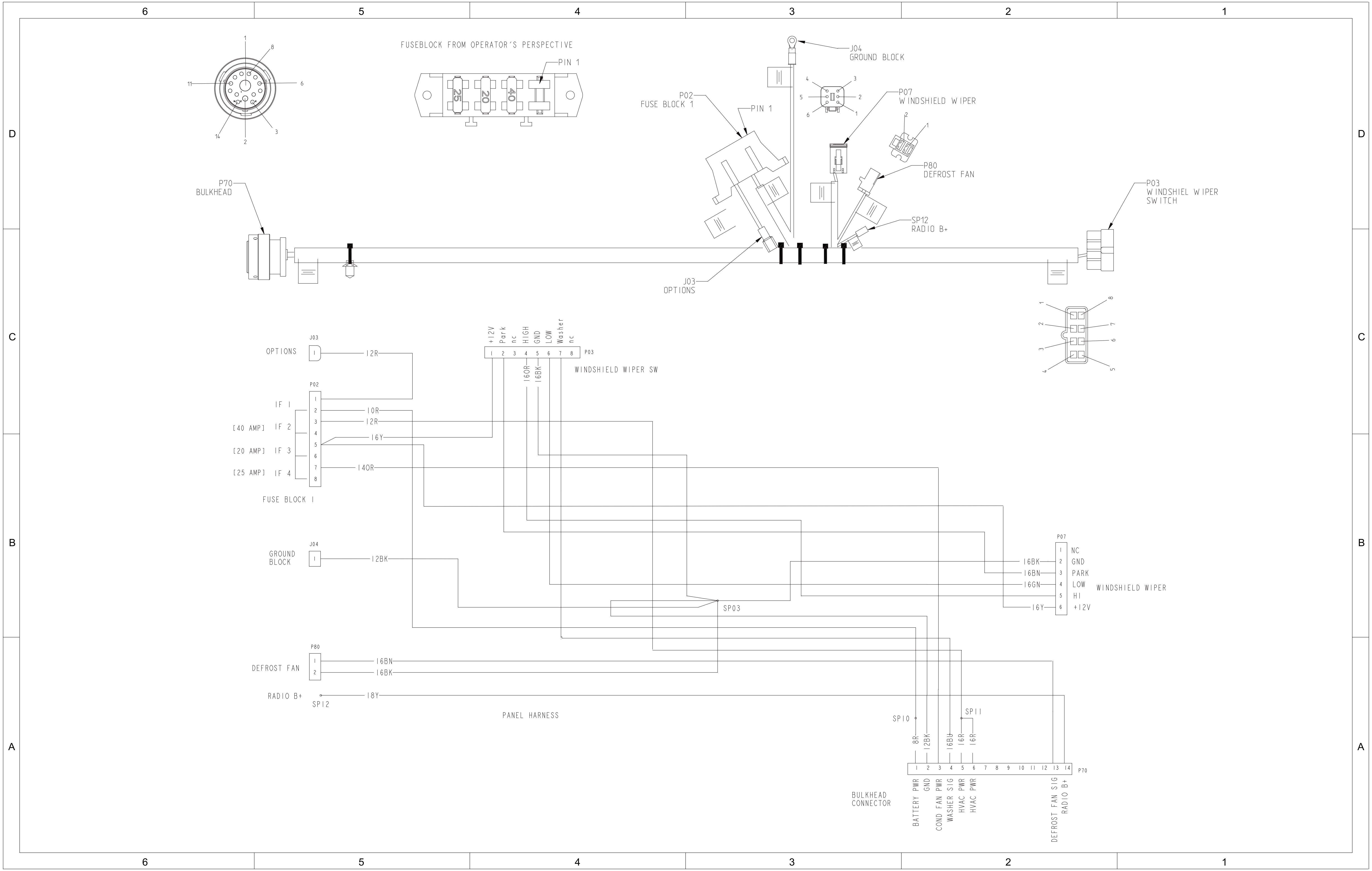
g256293


P12
WORK LIGHT RH
P01
TO MAIN HARNESS
p/n 122-1046
P01
A
B
16VIO
16BK
TO MAIN HARNESS
P12
1
2
3
WORK LIGHT
RH
P01
A
B
16VIO
16BK
SP01
SP02
16VIO
16BK
P12
A
B
TO MAIN HARNESS
WORK LIGHT
RH
16VIO
16BK
A B P11
WORK LIGHT
LH
p/n 122-1045
P11
WORK LIGHT
LH
A
B
P01
TO MAIN
HARNESS
P12
WORK LIGHT
RH

g259593

Wire Harness – Cab Rooftop

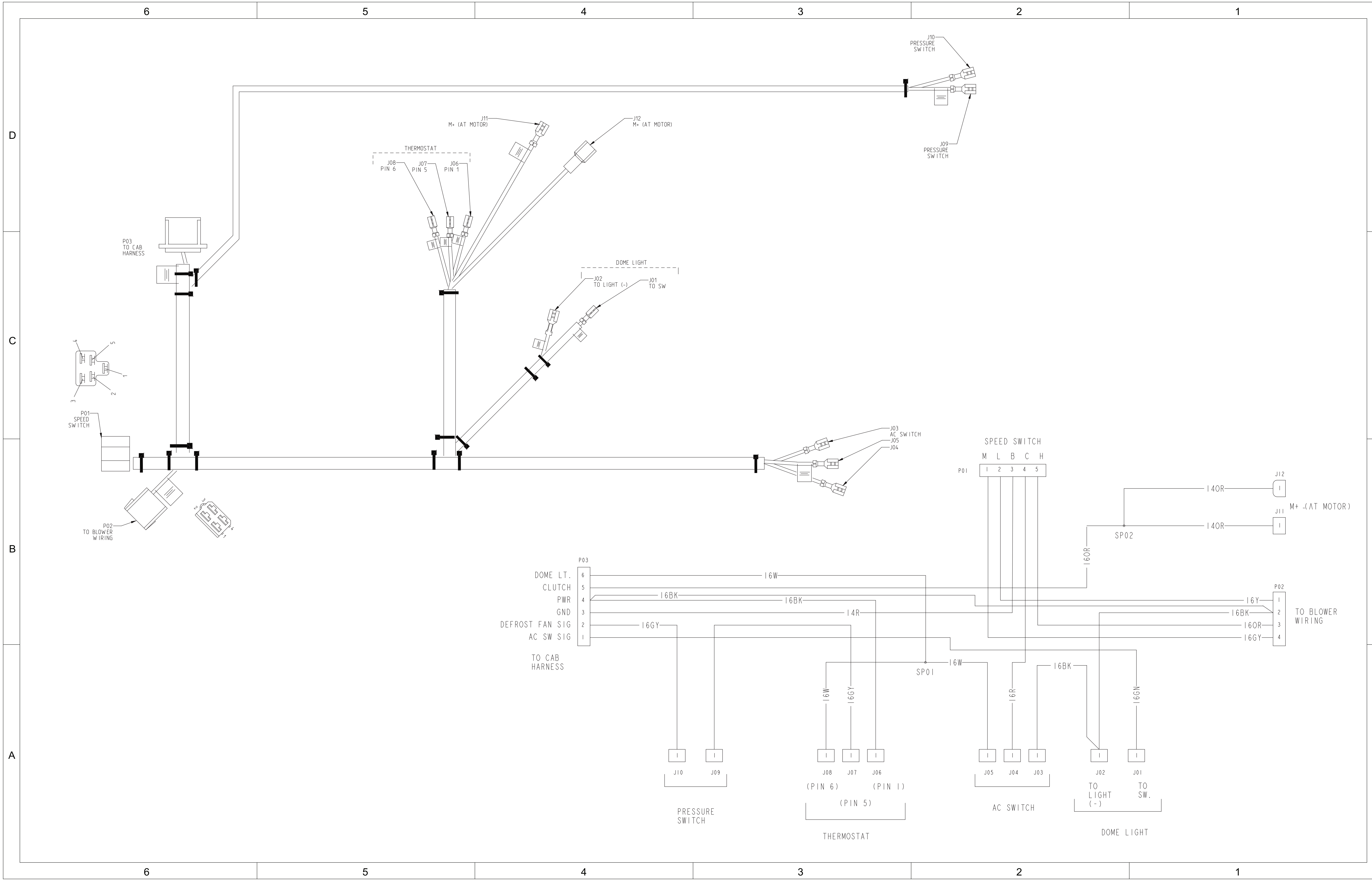


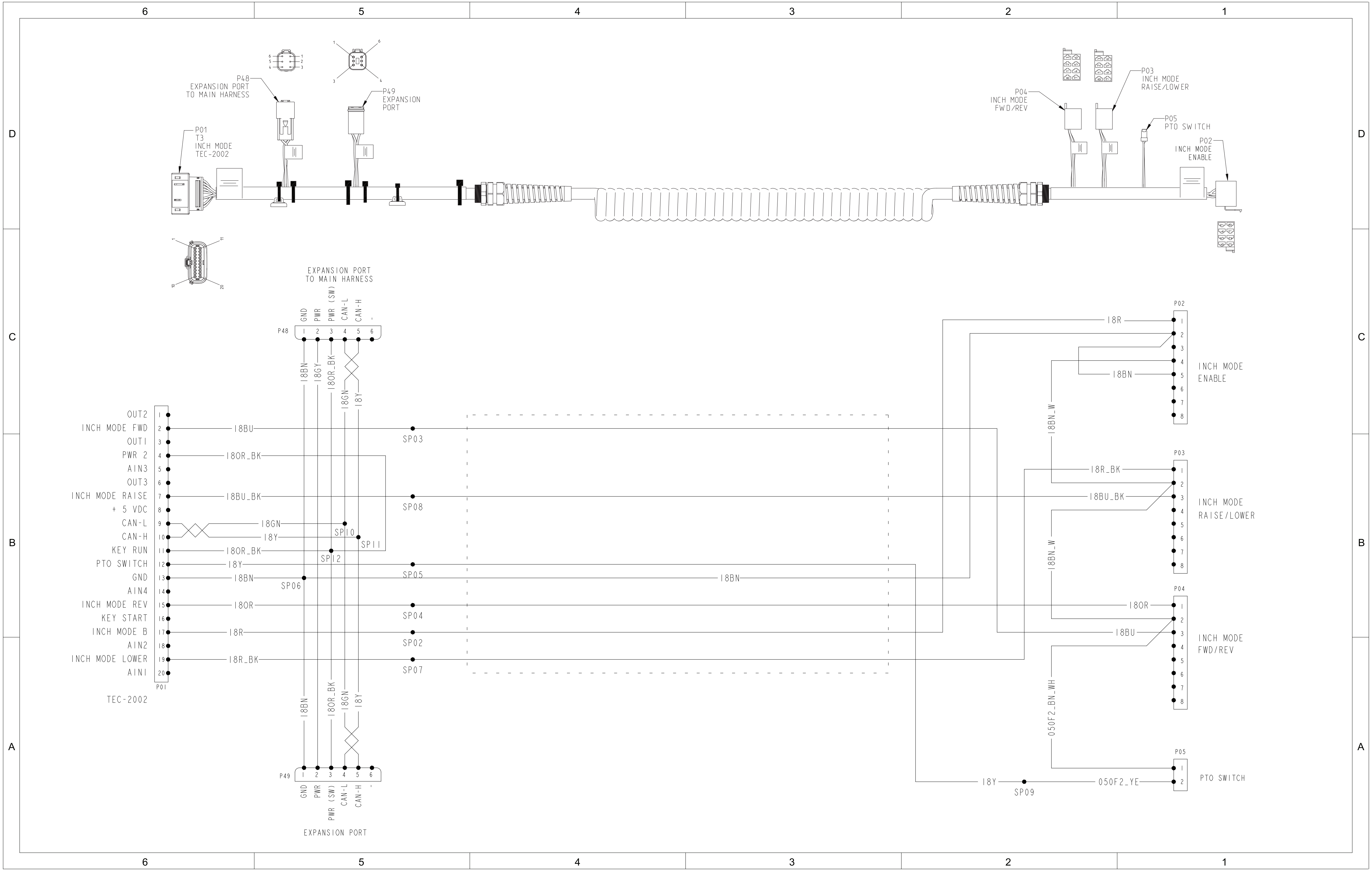


FUSEBLOCK FROM OPERATOR'S PERSPECTIVE
PIN 1
25
20
40
J04
GROUND BLOCK
P02
FUSE BLOCK 1
PIN 1
P07
WINDSHIELD WIPER
P80
DEFROST FAN
P70
BULKHEAD
P03
WINDSHIEL WIPER
SWITCH
SP12
RADIO B+
J03
OPTIONS
J03
OPTIONS
12R
+12V Park nc HIGH GND LOW Washer nc
P03
WINDSHIELD WIPER SW
16OR
16BK
P02
IF 1
[40 AMP] IF 2
[20 AMP] IF 3
[25 AMP] IF 4
10R
12R
16Y
14OR
FUSE BLOCK 1
J04
GROUND
BLOCK
12BK
P07
NC
GND
PARK
LOW
HI
+12V
16BK
16BN
16GN
16Y
WINDSHIELD WIPER
SP03
P80
DEFROST FAN
16BN
16BK
RADIO B+
SP12
18Y
PANEL HARNESS
SP10
SP11
8R
12BK
16BU
16R
16R
P70
BULKHEAD
CONNECTOR
BATTERY PWR
GND
COND FAN PWR
WASHER SIG
HVAC PWR
HVAC PWR
DEFROST FAN SIG
RADIO B+

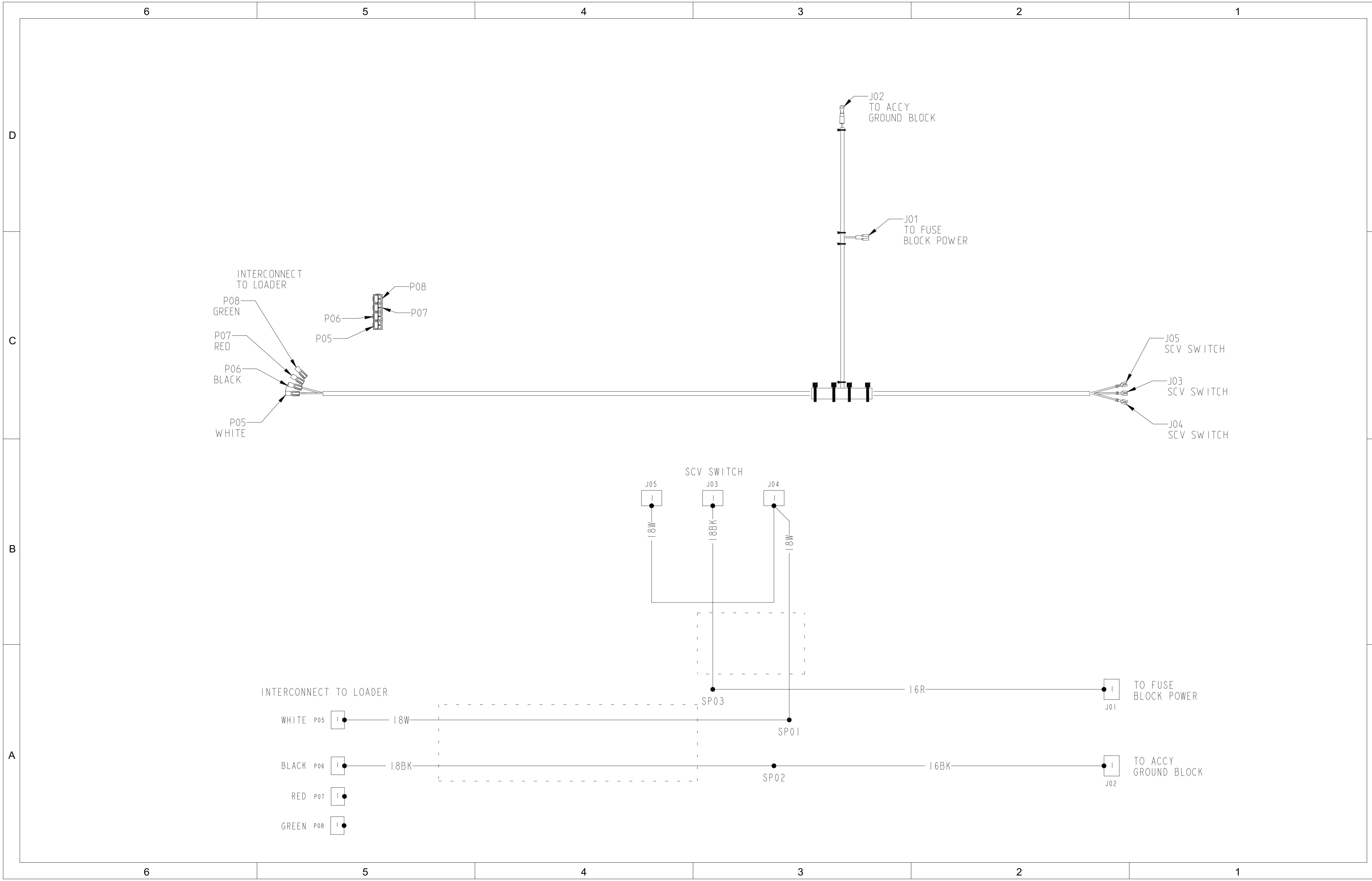
g256479

Wire Harness – Cab Heat/Air Conditioning

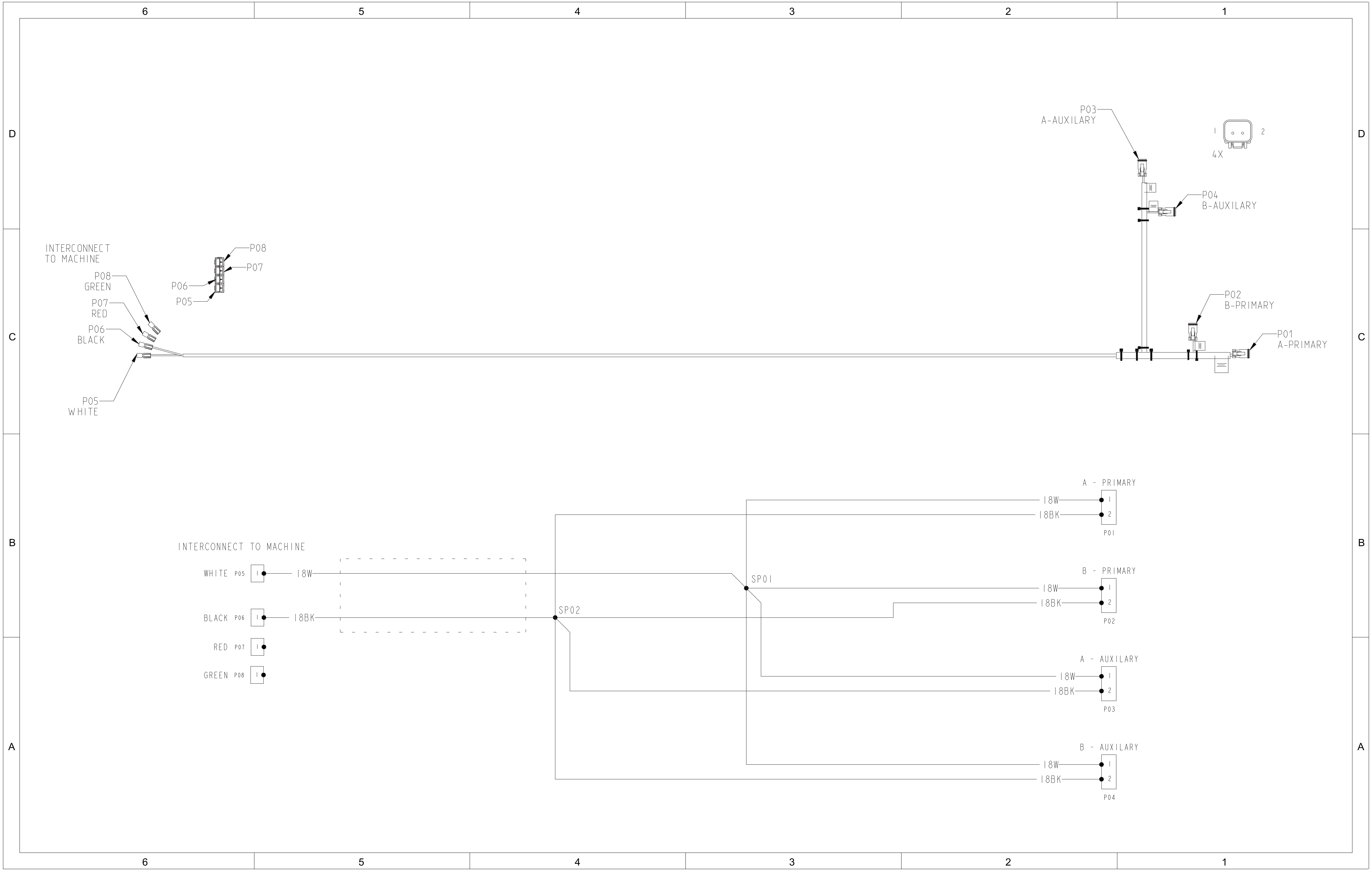



P48
EXPANSION PORT
TO MAIN HARNESS
P49
EXPANSION
PORT
P01
T3
INCH MODE
TEC-2002
P04
INCH MODE
FWD/REV
P03
INCH MODE
RAISE/LOWER
P05
PTO SWITCH
P02
INCH MODE
ENABLE
EXPANSION PORT
TO MAIN HARNESS
GND
PWR
PWR (SW)
CAN-L
CAN-H
OUT2
INCH MODE FWD
OUT1
PWR 2
AIN3
OUT3
INCH MODE RAISE
+ 5 VDC
CAN-L
CAN-H
KEY RUN
PTO SWITCH
GND
AIN4
INCH MODE REV
KEY START
INCH MODE B
AIN2
INCH MODE LOWER
AIN1
TEC-2002
18BU
18OR_BK
18BU_BK
18GN
18Y
18BN
18OR
18R
18R_BK
18GY
SP03
SP08
SP10
SP11
SP12
SP05
SP06
SP04
SP02
SP07
SP09
18BN_W
050F2_BN_WH
050F2_YE
INCH MODE
ENABLE
INCH MODE
RAISE/LOWER
INCH MODE
FWD/REV
PTO SWITCH
EXPANSION PORT
g259592

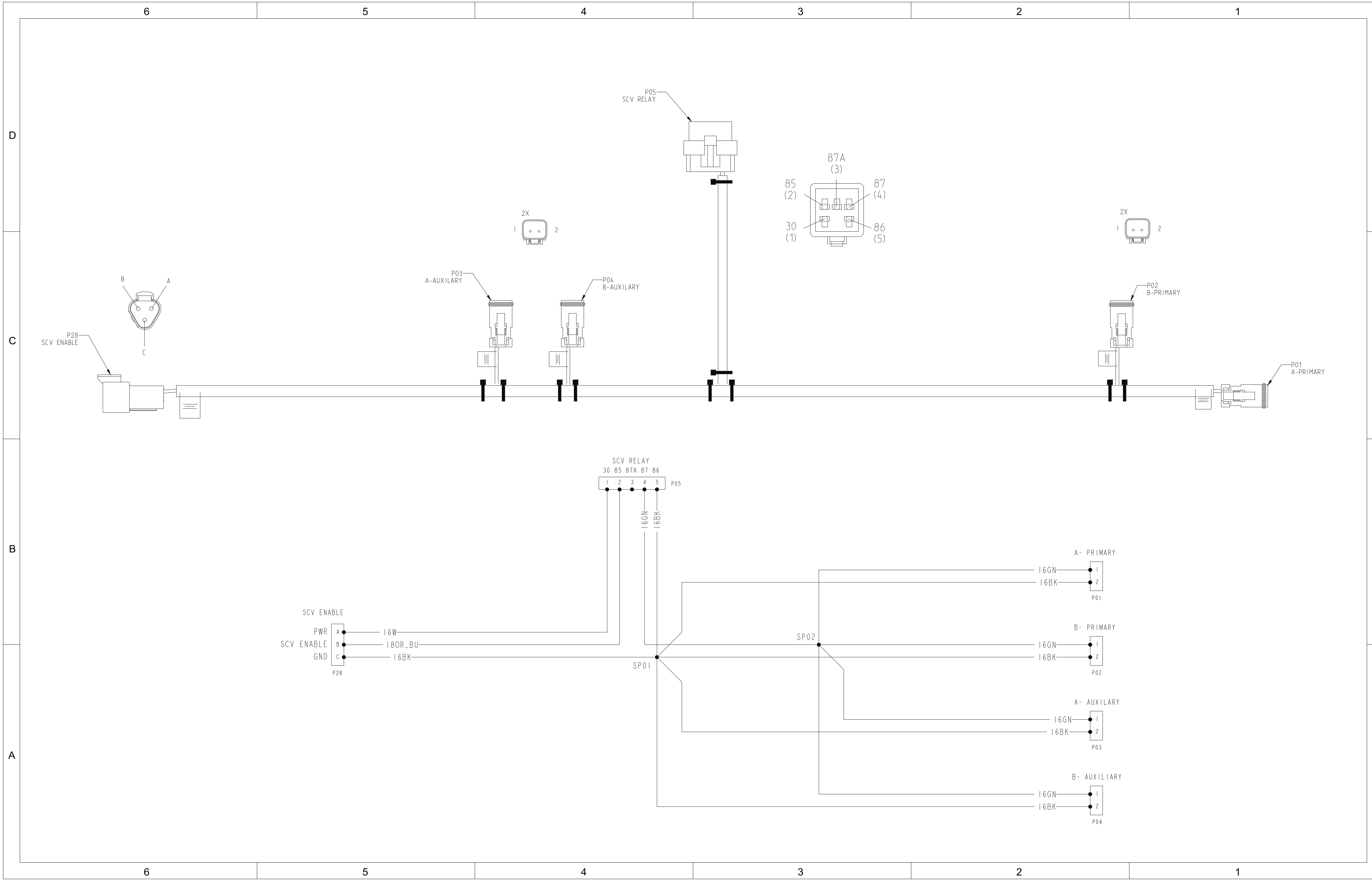
Wire Harness – Loader Selector Control Valve (SCV) Switch (optional)

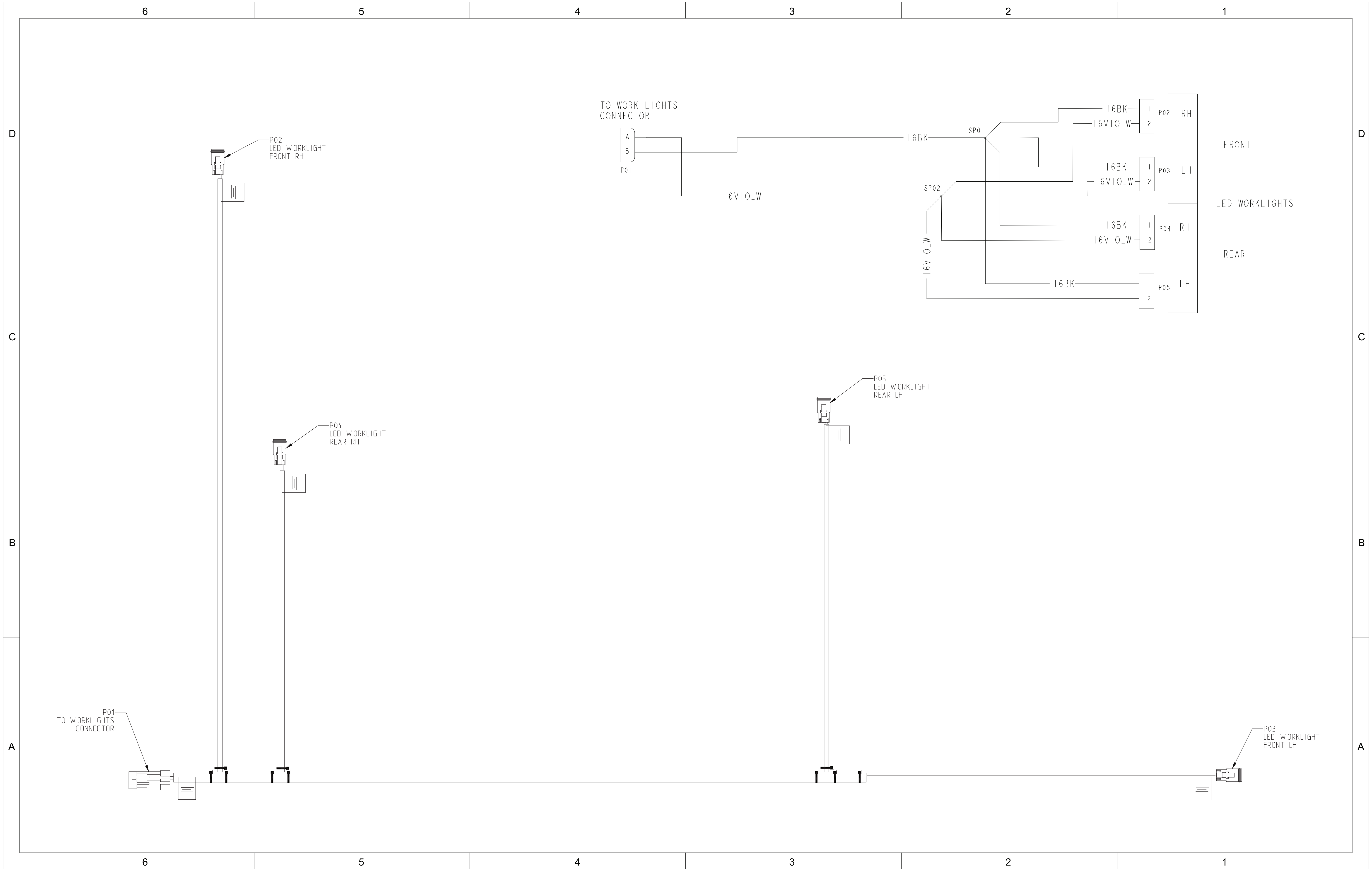


g260279


INTERCONNECT TO MACHINE
P08 GREEN
P07 RED
P06 BLACK
P05 WHITE
P08
P07
P06
P05
P03 A-AUXILARY
P04 B-AUXILARY
P02 B-PRIMARY
P01 A-PRIMARY
1
2
4X
INTERCONNECT TO MACHINE
WHITE P05
BLACK P06
RED P07
GREEN P08
18W
18BK
SP01
SP02
A - PRIMARY
P01
B - PRIMARY
P02
A - AUXILARY
P03
B - AUXILARY
P04
g260280

Wire Harness – Rear Selector Control Valve (SCV) Kit (optional)

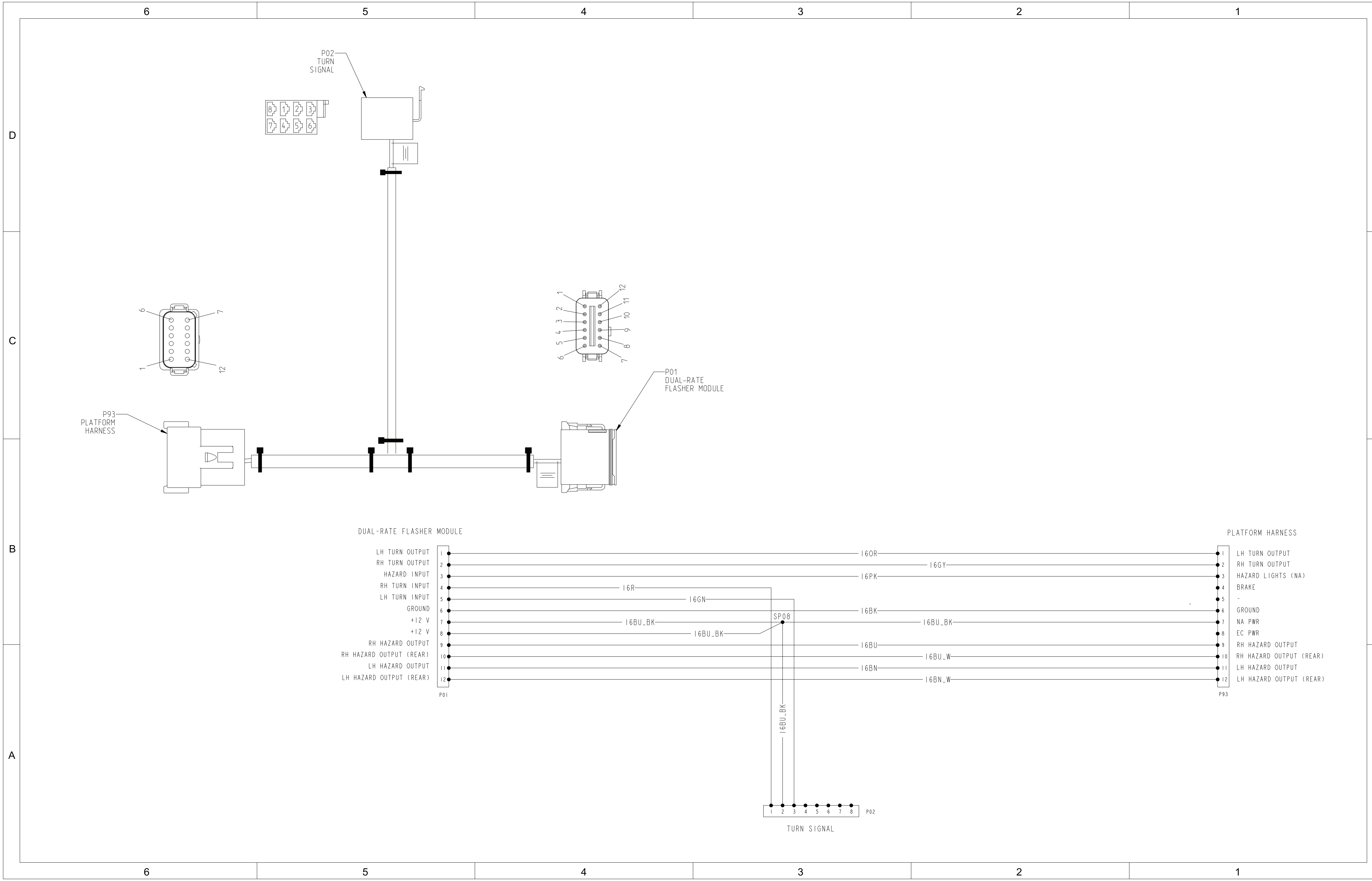




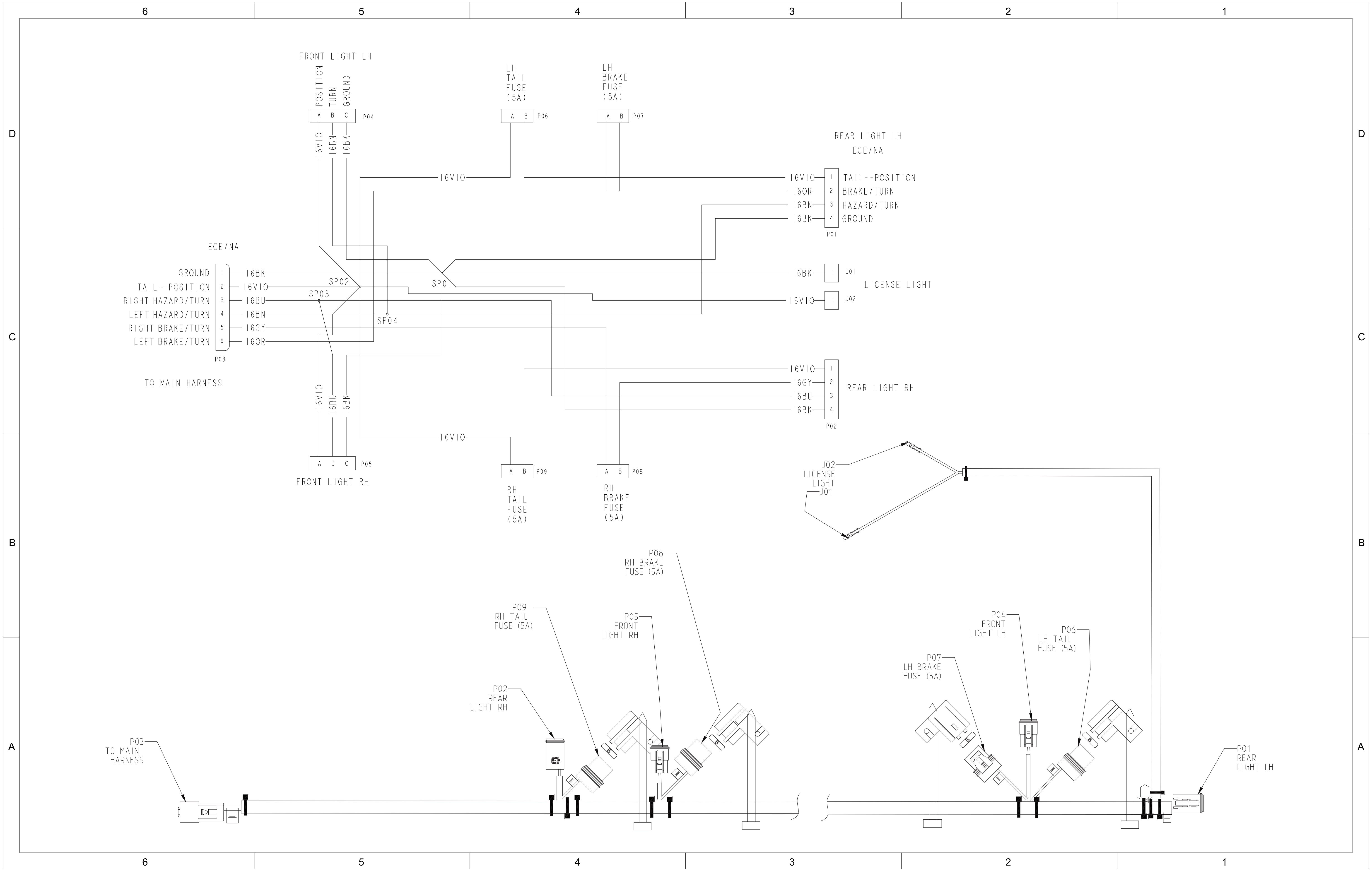
TO WORK LIGHTS CONNECTOR
P01
A
B
16BK
16VIO_W
SP01
SP02
P02 RH
P03 LH
P04 RH
P05 LH
FRONT
LED WORKLIGHTS
REAR
P02 LED WORKLIGHT FRONT RH
P04 LED WORKLIGHT REAR RH
P05 LED WORKLIGHT REAR LH
P01 TO WORKLIGHTS CONNECTOR
P03 LED WORKLIGHT FRONT LH

g260313

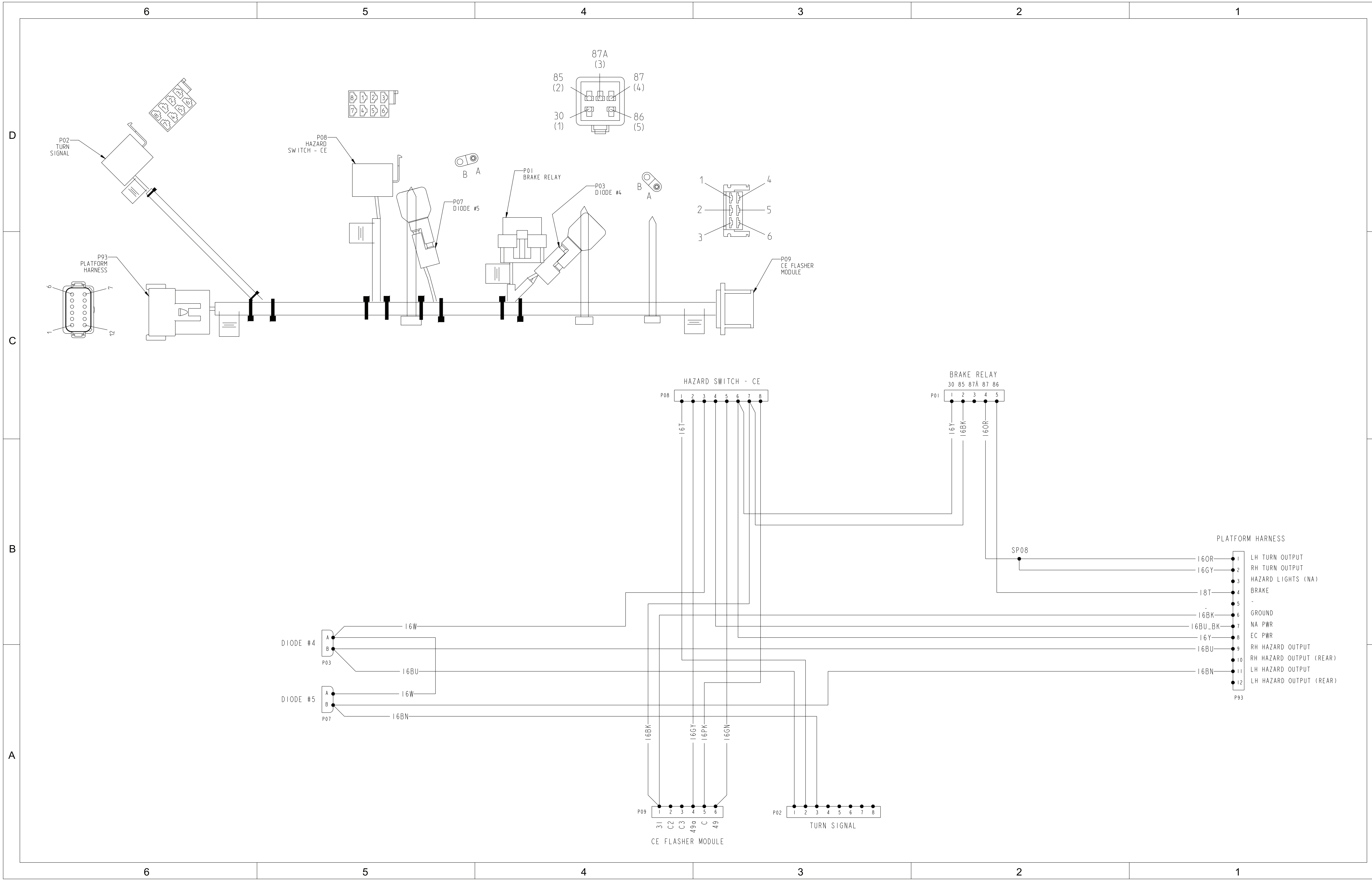
Wire Harness – Domestic Road Light Kit (optional)



g259650


FRONT LIGHT LH
POSITION
TURN
GROUND
P04
LH TAIL FUSE (5A)
P06
LH BRAKE FUSE (5A)
P07
REAR LIGHT LH
ECE/NA
16VIO 1 TAIL--POSITION
16OR 2 BRAKE/TURN
16BN 3 HAZARD/TURN
16BK 4 GROUND
P01
ECE/NA
GROUND 1 16BK
TAIL--POSITION 2 16VIO
RIGHT HAZARD/TURN 3 16BU
LEFT HAZARD/TURN 4 16BN
RIGHT BRAKE/TURN 5 16GY
LEFT BRAKE/TURN 6 16OR
P03
TO MAIN HARNESS
SP01
SP02
SP03
SP04
16BK 1 J01
LICENSE LIGHT
16VIO 1 J02
16VIO 1
16GY 2
16BU 3
16BK 4
REAR LIGHT RH
P02
P05
FRONT LIGHT RH
P09
RH TAIL FUSE (5A)
P08
RH BRAKE FUSE (5A)
J02 LICENSE LIGHT J01
P08 RH BRAKE FUSE (5A)
P09 RH TAIL FUSE (5A)
P05 FRONT LIGHT RH
P02 REAR LIGHT RH
P03 TO MAIN HARNESS
P04 FRONT LIGHT LH
P06 LH TAIL FUSE (5A)
P07 LH BRAKE FUSE (5A)
P01 REAR LIGHT LH
g260339

Wire Harness – International Road Light Kit (optional)



g259651

Count on it.