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TORO

Count on it.

Service Manual

Sand Pro® 3040 and 5040

(Models 08743 and 08745)

Revision History

Revision	Date	Description
A	04/2021	Initial release

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

This service manual was written expressly for service technicians. Basic shop safety knowledge and mechanical/electrical skills are assumed.

The purpose of this publication is to provide the service technician with information about troubleshooting, testing, and repairing major systems and components. This manual may also be specified for use on numerous products. Refer to the Table of Contents for a list of the systems and the related topics covered in this manual. The Toro Company has made every effort to make the information in this manual complete and correct.

Refer to the traction unit and cutting unit *Operator's Manual* for additional information about operating, maintaining, and adjusting the machine. Keep a copy of the *Operator's Manuals*, *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* and *Parts Catalogs* are available at www.toro.com.

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

Service Procedure Icons

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

Critical Process

This icon is used to highlight:

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

Critical Torque

This icon is used to highlight an assembly torque requirement that is different than what is recommended in the Standard Torque Tables; refer to Standard Torque for Dry, Zinc Plated, and Steel Fasteners (Inch) (page 2–8) and Standard Torque for Dry, Zinc Plated, and Steel Fasteners (Metric Fasteners) (page 2–10).

Fluid Specifications

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

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

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Additional Reference Materials

Briggs & Stratton V-Twin Engine Service Manual

Danfoss DDC20 Axial Piston Pump Service Manual
Parker Torqmotor™ Service Procedure (TF, TG, TH, and TL Series)
Danfoss OSPM Steering Unit Service Manual
Parker PGP/PGM 500 Series Service Manual

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Safety Instructions

DANGER

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

WARNING

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

CAUTION

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

IMPORTANT

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

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

Think Safety First

Toro Products are evaluated 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.

⚠ WARNING ⚠

To reduce the potential of injury or death, comply with the safety instructions in this manual, as well as information found in the *Operator's Manuals* and the Operator and Safety Training Materials found on www.toro.com.

- **Avoid unexpected starting of the engine…**

  Always turn off the engine and remove the key from the key switch before cleaning, adjusting, or making repairs.

- **Avoid lacerations and amputations…**

  Stay clear of all moving parts whenever the engine is running. Treat all normally moving parts as if they were moving whenever the engine is running or has the potential to start.

- **Avoid burns…**

  Do not touch the engine, muffler, or other components, which may be hot during operation, while the unit is running or shortly after it has been running. Allow the engine, muffler, and other components to cool before working near them.

- **Avoid fires and explosions…**

  Use extreme care in handling fuel. Fuel is flammable and its vapors are explosive.

  – Extinguish all cigarettes, cigars, pipes, and other sources of ignition.
  – Avoid spilling fuel and never smoke while working with any type of fuel or lubricant.
  – Wipe up any spilled fuel or oil immediately.
  – Never remove the fuel cap or add fuel when the engine is running.
  – Always use approved, labeled containers for storing or transporting fuel and lubricants.
  – Do not add or drain fuel in an enclosed space.
  – Do not store the machine or fuel container where there is an open flame, spark, or pilot light, such as on a water heater or other appliance.

- **Avoid asphyxiation…**

  Do not operate an engine in a confined area without proper ventilation.

- **Avoid injury from batteries…**

  – Battery acid is poisonous and can cause burns. Avoid contact with skin, eyes and clothing.
  – Battery gases can explode. Keep cigarettes, sparks and flames away from the battery.

- **Avoid injury due to inferior parts…**

Use only original equipment parts to ensure that important safety criteria are met.

- **Avoid injury to bystanders…**

  Always clear the area of bystanders before starting or testing powered equipment.

- **Avoid injury due to projectiles…**

  Always clear the area of any debris that could be picked up and thrown by the powered equipment.

- **Avoid modifications…**

  Do not alter or modify any part unless it is a factory approved procedure.

- **Avoid unsafe machine operation…**

  Always test the safety interlock system after making adjustments or repairs on the machine. Refer to the Electrical section in this manual for more information.

- **Avoid electrical shock…**
  - Never touch electrical wires or components while the engine is running. They can be sources of shock.
  - De-energize the system if you are having to do repairs.
  - If testing electrical components ensure that you are working in a dry environment.
  - Do not wear metal jewelry when working on or near electrical components or wiring.
- **Avoid contact with pressurized hydraulic fluid...**
  - Release all pressure in the hydraulic system before performing any work on the system.
  - Keep your body and hands away from pin-hole leaks or nozzles that eject hydraulic fluid under high pressure. Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and cause serious injury. Use cardboard or paper to find hydraulic leaks; never use your hands. **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.**
- **Use personal protective equipment…**
  - Tie back long hair, and do not wear loose clothing or jewelry.
  - Use appropriate personal protective equipment (PPE) for protecting yourself from potential hazards in the environment in which you will work.
  - Each process outlined in this manual may need different PPE to protect the service person. Use the proper PPE for the task at hand.
- **Using tools…**
  - All tools should be in proper working order. Do not use tools that are broken or in disrepair.
  - Use the proper tool for the proper application.
- **Using lifts, hoists, and jacks…**
  - All lifts, hoists, and jacks should be used in accordance with the manufacturer information.
  - Inspect lifts, hoists, and jacks prior to use.
  - Do not over load lifts, hoists, and jacks.
  - Do not work under a suspended load.

- Ensure that chock blocks are used on equipment that can move.
- Use lifts or jacks and jack stands that are rated to support the total weight of the machine and any attachments.
- Do not rely on jacks to support the machine.
- If you are unfamiliar with any lifts, hoists or jacks, do not use them until you know how to operate them correctly.

• **Using fire extinguishers…**

Use the proper class of fire extinguisher in case of fire.

Ensure that fire extinguishers are serviced regularly, and replace any fire extinguishers that are discharged or in use beyond their expiration dates.

- **Class A** fire extinguishers are for ordinary combustible materials such as paper, wood, cardboard, and most plastics. The numerical rating on these types of extinguishers indicates the amount of water it holds and the amount of fire it can extinguish. Geometric symbol (green triangle).
- **Class B** fire extinguishers are for fires that involve flammable or combustible liquids such as gasoline, kerosene, grease and oil. The numerical rating for class B extinguishers indicates the approximate number of square feet of fire it can extinguish. Geometric symbol (red square).
- **Class C** fire extinguishers are for fires that involve electrical equipment such as appliances, wiring, circuit breakers and outlets. Never use water to extinguish class C fires - the risk of electrical shock is far too great! Class C extinguishers do not have a numerical rating. The C classification means the extinguishing agent is non-conductive. Geometric symbol (blue circle).
- **Class ABC** fire extinguishers are a dry chemical type used for multiple purposes. See above descriptions for additional information.

Jacking Instructions

DANGER

Mechanical or hydraulic jacks may fail to support the machine and cause a serious injury.

- **Use jack stands to support the raised machine.**
- **Use only mechanical or hydraulic jacks to lift the machine.**
- **Do not use the attachment or implement as a jacking point.**

1. Park the machine on a level surface, lower or remove any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the key switch.
2. Position the jack securely under the desired jack point:
   - **Front**

     IMPORTANT

     To prevent damage to oil cooler, ensure that jack or jack stand is positioned directly under frame.

     Position the jack securely under the frame tube just behind the front wheel.
   - **Rear**

     Position the jack securely under the rear wheel motor.

   After raising the machine, use an appropriate jack stand under the machine frame to support the machine.

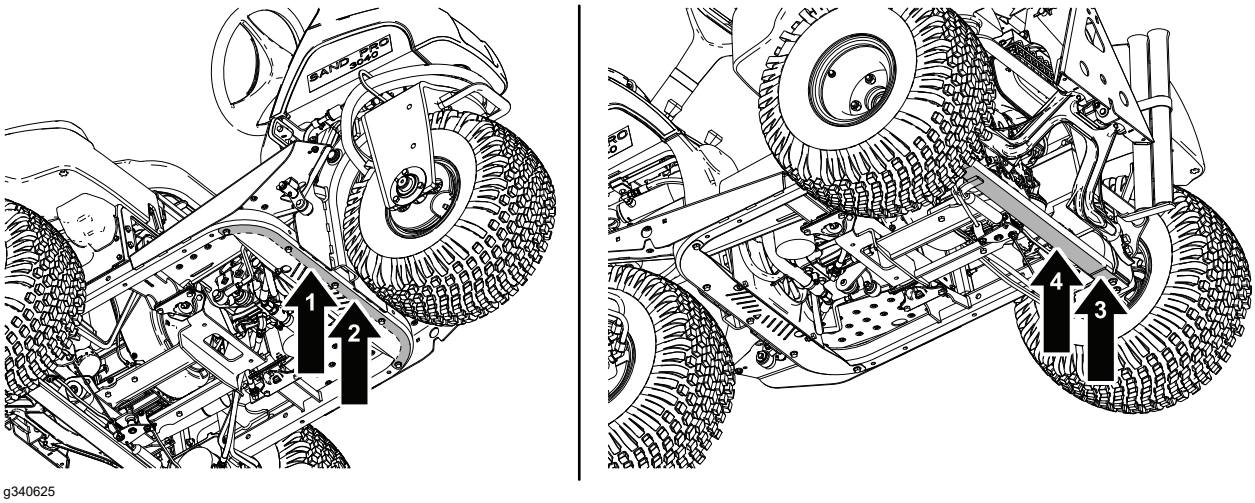

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Figure 1

1. Jack point – front
2. Jack stand point – front
3. Jack point – rear
4. Jack stand point – rear

Safety and Instructional Decals

Numerous safety and instruction decals are affixed to the traction unit and attachments of the Sand Pro 3040/5040. If any decal becomes illegible or damaged, replace it with a new decal. Part numbers are listed in the *Parts Catalogs*, *Operator's Manuals* and *Installation Instructions* for the traction unit or attachment. Order replacement decals from your Authorized Toro Distributor.

Specifications and Maintenance

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Specifications

Overall Dimensions

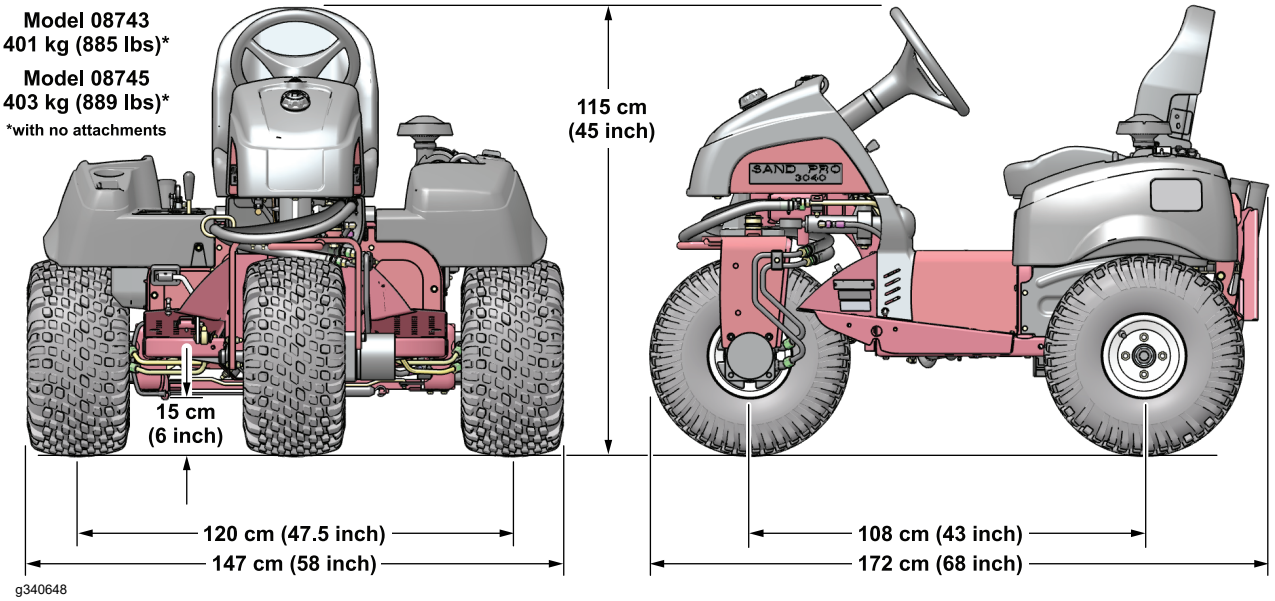

Figure 2

Engine Specifications (Model 08743)

Item	Description
Make/Designation	Briggs and Stratton Model 305447, 4–cycle, V–Twin Cylinder, OHV, Air Cooled, Gasoline Engine
Bore	68 mm (2.68 inch)
Stroke	66 mm (2.60 inch)
Total displacement	480 cm^3 (29.3 $inch^3$)
Fuel	Refer to the traction unit *Operator's Manual*
Fuel tank capacity	18.9L (5 US gallons)
Fuel pump	Pulsating Crankcase Vacuum
Carburetor	Float Feed, Single Barrel
Governor	Mechanical
Low idle (no load)	1,750 to 1,850 rpm
High idle (no load)	3,400 to 3,500 rpm
Engine oil	Refer to the traction unit *Operator's Manual*
Crankcase-oil capacity	1.66 L (1.75 US qt) with new oil filter
Oil pump	Gear driven geroter type
Spark Plugs	Champion RC14YC (or equivalent)
Spark Plug Gap	0.76 mm 0(.030 inch)
Starter	12 VDC
Alternator/Regulator	12 VDC, 15A
Engine weight (dry)	38 kg (84 lb)

Engine Specifications (Model 08745)

Item	Description
Make/Designation	Briggs and Stratton Model 356447, 4–cycle, V–Twin Cylinder, OHV, Air Cooled, Gasoline Engine
Bore	72 mm (2.83 inch)
Stroke	70 mm (2.76 inch)
Total displacement	570 cm^3 (34.8 $inch^3$)
Fuel	Refer to the traction unit *Operator's Manual*
Fuel tank capacity	18.9L (5 US gallons)
Fuel pump	Pulsating Crankcase Vacuum
Carburetor	Float Feed, Single Barrel
Governor	Mechanical
Low idle (no load)	1,750 to 1,850 rpm
High idle (no load)	3,400 to 3,500 rpm
Engine oil	Refer to the traction unit *Operator's Manual*
Crankcase-oil capacity	1.66 L (1.75 US qt) with new oil filter
Oil pump	Gear driven geroter type
Spark Plugs	Champion RC14YC (or equivalent)
Spark Plug Gap	0.76 mm 0(.030 inch)
Starter	12 VDC
Alternator/Regulator	12 VDC, 15A
Engine weight (dry)	38 kg (84 lb)

Hydraulic System Specifications

Item	Description
Piston (traction) pump	Danfoss DDC20 variable displacement axial piston pump with internal gerotor type implement/charge pump
Maximum piston (traction) pump displacement (per revolution)	14.7 cm^3 (0.9 in^3)
Traction circuit relief pressure (forward and reverse)	22,063 kPa (3200 psi)
Maximum implement/charge pump displacement (per revolution)	5.4 cm^3 (0.33 in^3)
Charge circuit relief	689 kPa (100 psi)
Front wheel motor	Parker Torqmotor TL series
Displacement (per revolution)	280 cm^3 (17.1 in^3)
Rear wheel motors	Parker Torqmotor TL series
Displacement (per revolution)	140 cm^3 (8.6 in^3
Steering valve (Model 08745)	Danfoss Steering Unit, Type OSPM with internal relief and shock valves
Displacement (per revolution)	80 cm^3 (4.9 in^3)
Steering circuit relief pressure (Model 08745)	5171 kPa (750 psi)

Hydraulic System Specifications (continued)

Item	Description
Lift circuit relief pressure	5171 kPa (750 psi)
Hydraulic filter	10 Micron spin-on cartridge type
Hydraulic fluid	Refer to the *Traction Unit Operator's Manual*
Hydraulic reservoir capacity	26.5 L (7 US gallons)

Chassis Specifications

Item	Description
Tires	
Standard – 22 x 11 – 8, 2 ply knobby	70 kPa (10 psi)
	Note: reduce tire pressure to 55 kPa (8 psi) If additional traction is required.
Optional – 22 x 11 – 8, 4 ply turf tread	70 kPa (10 psi)
	Note: reduce tire pressure to 55 kPa (8 psi) If additional traction is required.
Optional – 22 x 11 – 8, 2 ply smooth	55 to 70 kPa (8 to 10 psi)
Wheel fastener torque	95 to 122 N·m (70 to 90 ft-lb)
Steering wheel mounting nut	28 to 35 N·m (20 to 26 ft-lb)

Torque Specifications

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

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

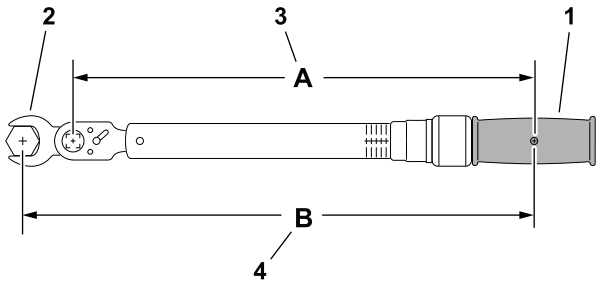

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Figure 3

Torque Conversion Factor = A / B

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

Using a drive-adapter wrench (e.g., crowfoot wrench) in any position other than 90° and 270° to the frame of the torque wrench will affect the torque value measured by the torque wrench because of the effective length (lever) of the torque wrench changes. When using a torque wrench with a drive-adapter wrench, multiply the listed torque recommendation by the calculated torque conversion factor (Figure 3) 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

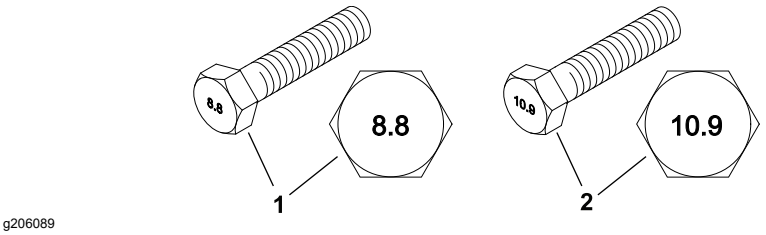


Figure 4
Metric Bolts and Screws

1. Class 8.8
2. Class 10.9

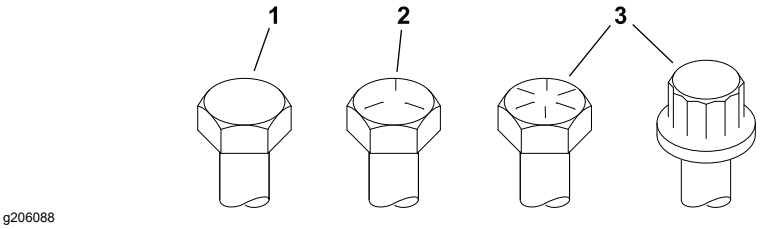


Figure 5
Inch Series Bolts and Screws

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 fastener threads and apply new thread locker to the fastener during installation.

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

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

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

Thread Size	Grade 1, 5 and 8 with Thin Height Nuts	SAE Grade 1 Bolts, Screws, Studs, and Sems with Regular Height Nuts(SAE J995 Grade 2 or Stronger Nuts)	SAE Grade 5 Bolts, Screws, Studs, and Sems with Regular Height Nuts(SAE J995 Grade 2 or Stronger Nuts)	SAE Grade 8 Bolts, Screws, Studs, and Sems with Regular Height Nuts(SAE J995 Grade 2 or Stronger Nuts)
#6 - 32 UNC	1 to 1.5 N·m (8 to 12 in-lb)	1 to 1.5 N·m (11 to 15 in-lb)	1.5 to 2 N·m (13 to 17 in-lb)	2 to 3 N·m (20 to 26 in-lb)
#6 - 40 UNF			1.5 to 2 N·m (15 to 19 in-lb)	2 to 3 N·m (22 to 28 in-lb)
8 - 32 UNC	1 to 1.5 N·m (11 to 15 in-lb)	2 to 3 N·m (20 to 30 in-lb)	3 to 4 N·m (26 to 33 in-lb)	4 to 5 N·m (36 to 46 in-lb)
#8 - 36 UNF			3 to 4 N·m (27 to 35 in-lb)	4 to 5 N·m (38 to 48 in-lb)
#10 - 24 UNC	2 to 2.5 N·m (16 to 20 in-lb)	3 to 4 N·m (25 to 35 in-lb)	4 to 5 N·m (37 to 47 in-lb)	6 to 7 N·m (54 to 66 in-lb)
#10 - 32 UNF			5 to 6 N·m (43 to 53 in-lb)	7 to 8 N·m (59 to 73 in-lb)
1/4 - 20 UNC	4 to 6 N·m (41 to 55 in-lb)	5 to 7 N·m (46 to 60 in-lb)	10 to 12 N·m (90 to 110 in-lb)	14 to 17 N·m (125 to 155 in-lb)
1/4 - 28 UNF	5 to 7 N·m (46 to 60 in-lb)	6 to 8 N·m (55 to 75 in-lb)	11 to 14 N·m (103 to 127 in-lb)	16 to 20 N·m (143 to 177 in-lb)
5/16 - 18 UNC	11 to 13 N·m (100 to 130 in-lb)	10 to 13 N·m (90 to 120 in-lb)	19 to 25 N·m (175 to– 225 in-lb)	30 to 37 N·m (270 to 330 in-lb)
5/16 - 24 UNF	13 to 17 N·m (121 to 155 in-lb)	13 to 16 N·m (111 to 145 in-lb)	23 to 28 N·m (200 to 250 in-lb)	33 to 40 N·m (292 to 358 in-lb)
3/8 - 16 UNC	19 to 24 N·m (14 to 18 ft-lb)	19 to 24 N·m (14 to 18 ft-lb)	37 to 45 N·m (27 to 33 ft-lb)	51 to 65 N·m (38 to 48 ft-lb)
3/8 - 24 UNF	20 to 26 N·m (15 to 19 ft-lb)	22 to 27 N·m (16 to 20 ft-lb)	42 to 53 N·m (31 to 39 ft-lb)	60 to 76 N·m (44 to 56 ft-lb)
7/16 - 14 UNC	33 to 40 N·m (24 to 30 ft-lb)	33 to 40 N·m (24 to 30 ft-lb)	61 to 74 N·m (45 to 55 ft-lb)	85 to 105 N·m (63 to 77 ft-lb)
7/16 - 20 UNF	35 to 43 N·m (26 to 32 ft-lb)	35 to 43 N·m (26 to 32 ft-lb)	66 to 83 N·m (49 to 61 ft-lb)	94 to 115 N·m (69 to 85 ft-lb)
1/2 - 13 UNC	37 to 45 N·m (27 to 33 ft-lb)	56 to 74 N·m (41 to 55 ft-lb)	90 to 112 N·m (67 to 83 ft-lb)	127 to 157 N·m (94 to 116 ft-lb)
1/2 - 20 UNF	38 to 46 N·m (28 to 34 ft-lb)	62 to 81 N·m (46 to 60 ft-lb)	100 to 125 N·m (74 to 92 ft-lb)	146 to 178 N·m (108 to 132 ft-lb)
5/8 - 11 UNC	75 to 102 N·m (55 to 75 ft-lb)	103 to 135 N·m (76 to 100 ft-lb)	185 to 225 N·m (135 to 165 ft-lb)	390 to 450 N·m (289 to 331 ft-lb)
5/8 - 18 UNF	90 to 115 N·m (65 to 85 ft-lb)	110 to 150 N·m (80 to 110 ft-lb)	205 to 255 N·m (152 to 188 ft-lb)	295 to 355 N·m (216 to 264 ft-lb)
3/4 - 10 UNC	110 to 142 N·m (81 to 105 ft-lb)	165 to 220 N·m (120 to 160 ft-lb)	325 to 395 N·m (238 to 292 ft-lb)	460 to 560 N·m (337 to 413 ft-lb)
3/4 - 16 UNF	135 to 175 N·m (100 to 130 ft-lb)	190 to 285 N·m (140 to 210 ft-lb)	365 to 450 N·m (270 to 330 ft-lb)	510 to 630 N·m (377 to 463 ft-lb)
7/8 - 9 UNC	165 to 215 N·m (120 to 160 ft-lb)	275 to 340 N·m (200 to 250 ft-lb)	525 to 645 N·m (385 to 475 ft-lb)	735 to 895 N·m (540 to 660 ft-lb)
7/8 - 14 UNF	175 to 245 N·m (130 to 180 ft-lb)	315 to 395 N·m (230 to 290 ft-lb)	580 to 710 N·m (427 to 523 ft-lb)	815 to 990 N·m (600 to 730 ft-lb)

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

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 locking compound such as Loctite. Fasteners with a factory applied “dry” thread locking compound are not considered lubricated and should be tightened to the standard torque value unless otherwise noted.

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	6 to 7 N·m (51 to 63 in-lb)	8 to 10 N·m (70 to 86 in-lb)
M6 X 1.0	10 to 12 N·m (86 to 106 in-lb)	13 to 16 N·m (119 to 147 in-lb)
M8 X 1.25	23 to 28 N·m (17 to 21 ft-lb)	34 to 42 N·m (25 to 31 ft-lb)
M10 X 1.5	46 to 57 N·m (34 to 42 ft-lb)	65 to 80 N·m (48 to 60 ft-lb)
M12 X 1.75	80 to 99 N·m (59 to 73 ft-lb)	112 to 140 N·m (83 to 103 ft-lb)
M16 X 2.0	202 to 248 N·m (149 to 183 ft-lb)	280 to 340 N·m (206 to 252 ft-lb)
M20 X 2.5	395 to 485 N·m (292 to 358 ft-lb)	550 to 670 N·m (404 to 496 ft-lb)

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. Fasteners with a factory applied “dry” thread locking compound are not considered lubricated and should be tightened to the standard torque value unless otherwise noted.

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	14 to 18 N·m (120 to 160 in-lb)	7 to 9 N·m (61 to 85 in-lb)
5/16 - 18 UNC	20 to 28 N·m (180 to 250 in-lb)	14 to 18 N·m (125 to 165 in-lb)
3/8 - 16 UNC	34 to 61 N·m (25 to 45 ft-lb)	20 to 28 N·m (15 to 21 ft-lb)
1/2 - 13 UNC	81 to 122 N·m (60 to 90 ft-lb)	54 to 81 N·m (40 to 60 ft-lb)

Thread Cutting Screws (Zinc Plated Steel)

Type 1, Type 23 or Type F	
Thread Size	Baseline Torque**
No. 6 - 32 UNC	2 to 3 N·m (15 to 25 in-lb)
No. 8 - 32 UNC	3 to 4 N·m (25 to 35 in-lb)
No. 10 - 24 UNC	4 to 5 N·m (31 to 45 in-lb)
1/4 - 20 UNC	8 to 11 N·m (70 to 100 in-lb)
5/16 - 18 UNC	10 to 14 (90 to 130 in-lb)
3/8 - 16 UNC	11 to 34 (100 to 300 in-lb)

Wheel Bolts and Lug Nuts

Thread Size	Recommended Torque*
7/16 - 20 UNF Grade 5	74 to 102 N·m (55 to 75 ft-lb)
1/2 - 20 UNF Grade 5	94 to 122 N·m (70 to 90 ft-lb)
M12 X 1.25 Class 8.8	94 to 122 N·m (70 to 90 ft-lb)
M12 X 1.5 Class 8.8	94 to 122 N·m (70 to 90 ft-lb)

*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	2 to 3 N·m (15 to 25 in-lb)
No. 8	15	18	3 to 4 N·m (25 to 35 in-lb)
No. 10	12	16	4 to 5 N·m (31 to 45 in-lb)
No. 12	11	14	8 to 11 N·m (70 to 100 in-lb)

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

Conversion Factors

in-lb X 11.2985 = N·cm

ft-lb X 1.3558 = N·m

N·cm X 0.08851 = in-lb

N·m X 0.7376 = ft-lb

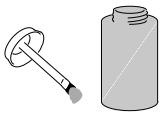
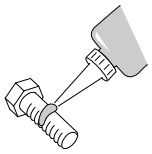
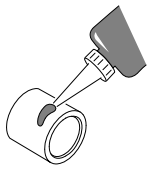
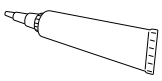
Shop Supplies

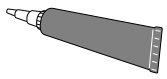
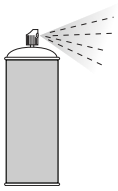
The procedures found in this *Service Manual* may recommend the use of commonly used shop supplies (lubricants, sealants, and adhesives). A symbol denoting the use of a shop supply may appear in figures that support a procedure. Always refer to the written procedure for specific information regarding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

IMPORTANT

Always follow manufacturers instructions when using or storing shop supplies.

Shop Supplies

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

GASKET COMPOUND Used to create a seal between mating parts. Gasket compounds may be used with or without the presence of a pre-formed gasket. Gasket compounds may be solvent or silicone based, and cure when exposed to air or designed to cure in an air-less environment (anaerobic). Most gasket compounds are designed to be applied to clean surfaces free of oil, chemical residue and previously used gaskets or gasket compounds.	
SILICONE SEALANT Designed for a broad variety of sealing and bonding requirements, silicone sealants are usually room temperature vulcanizing (RTV) which form a flexible silicone rubber that bonds to a wide variety of smooth or porous materials when cured. Standard silicone sealants are designed to perform in temperatures from -51°F to 232°C (-60°F to 400°F), while high temperature variants can preform in temperatures up to 343°C (650°F).	
AEROSOL PROTECTANT/LUBRICANT Most commonly used to coat battery terminals, ring terminals, and fork terminals to reduce corrosion problems. Apply an areosol protectant to the connection after you secure the terminal connection. Do Not use an areosol protectant on small multi-pin electrical connectors. An areosol lubricant may also be specified. Refer to the specific service procedure for details.	

Special Tools

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

Hydraulic Pressure Testing Kit

K–Line Part No. TOR47009

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

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57 LPM (15 GPM) Hydraulic Tester Kit

K–LinePart No. TOR214678

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

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

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

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

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

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

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

Hydraulic O-Ring Kit

Toro Part No. 117-2727

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

Hydraulic Hose Kit

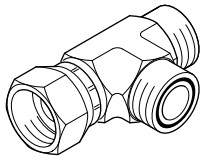
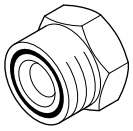
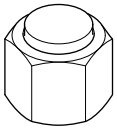
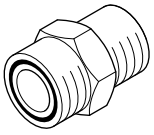
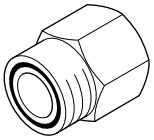
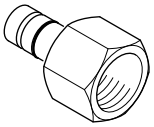
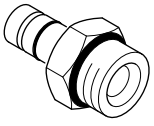
K–Line Part No. TOR6007

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

Hydraulic Test Fitting Kit

K–Line Part No. TOR4079

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

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

High Flow Hydraulic Filter Kit

K–Line Part Number: TOR6011

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

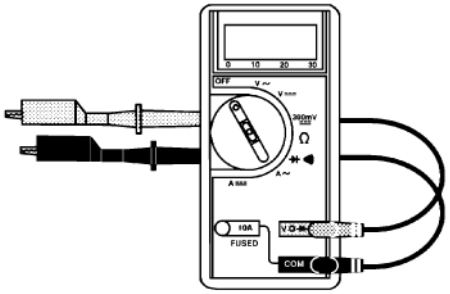
If a component failure occurs in the closed loop traction circuit, contamination from the damaged part will remain in the circuit until you remove it. Install a high flow hydraulic-fluid filter into the circuit when you connect the hydraulic test gauges in order to test the traction circuit components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

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

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



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

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

Battery Terminal Protector

Toro Part No. 107-0392

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

Dielectric Gel

Toro Part No. 107-0342

Use the dielectric gel to prevent corrosion of Unsealed Connection Terminals Only. Apply the gel to the component and wire harness connector liberally 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.

Wheel Hub Puller

K–Line Part Number: TOR4097

The wheel hub puller allows safe removal of the wheel hub from the shaft of wheel motors.

Chapter 3

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

1. **Gather Information**
   - Information reported by the customer
   - Information observed by you
   - Establish the what, where and when of the issue
2. **Evaluate Potential Causes**
   - Consider possible causes of the problem to develop a hypothesis
   - Narrow down the focus of the problem
3. **Assess Performance**
   - Ensure that you have all the necessary tools for testing
   - Test all potential causes of the failure
   - Reevaluate and create a new hypothesis if necessary
4. **Repair**
   - Return the unit to service by repairing, rebuilding or replacing
5. **Solution Confirmation**
   - Did the issue go away
   - Was the root cause of the issue correctly repaired
   - Are there any other new symptoms

Troubleshooting – Hydraulic

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

Review the hydraulic schematic found in Appendix A (page A–1) and information on the hydraulic system operation in the Hydraulic Flow Diagrams (page 5–13). This information will be useful during the hydraulic troubleshooting process.

Refer to Testing the Hydraulic System (page 5–23) for precautions and specific hydraulic test procedures.

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 suction filter or suction line is damaged, leaking, loose, or clogged.	Secure, clean or replace the suction filter or suction line.

General Hydraulic System Problems (continued)

Problem	Possible Cause	Corrective Action
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 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 is open or damaged.	Close or replace the traction pump bypass valve.
	The charge pressure is low (lift circuit performance, and steering circuit performance for model 07845 machines is also affected).	Verify charge pressure; refer to Testing the Traction Circuit – Charge Pressure in the Hydraulic System chapter of this manual.
	The traction pump is worn or damaged.	Verify traction pump operation; refer to Testing the Traction Circuit – Piston (traction) Pump (P1) Flow and Relief Pressure Test in the Hydraulic System chapter of this manual.
	The wheel motor(s) is worn or damaged.	Verify wheel motor operation; refer to Testing the Traction Circuit – Wheel Motor Efficiency in the Hydraulic System chapter of this manual.
	Note: If a traction circuit component has internal wear or damage, it is possible that the other traction components are also damaged.	
	The shuttle valve in the left rear wheel motor is stuck or damaged.	Remove, clean, and inspect the shuttle valve components; refer to Wheel Motor Service in the Hydraulic System chapter of this manual.

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 control linkage is incorrectly adjusted, binding, or damaged.	Inspect traction linkage operation and service or adjust if necessary.
	The traction pump bypass valve is open or damaged.	Close or replace the traction pump bypass valve.
	Engine speed is low.	Increase the engine speed.
	The charge pressure is low (lift circuit performance, and steering circuit performance for model 07845 machines is also affected).	Verify charge pressure; refer to Testing the Traction Circuit – Charge Pressure in the Hydraulic System chapter of this manual.
	The piston (traction) pump or pump relief valves are worn or damaged.	Verify traction pump operation; refer to Testing the Traction Circuit – Piston (traction) Pump (P1) Flow and Relief Pressure Test in the Hydraulic System chapter of this manual.
	The wheel motor(s) is worn or damaged.	Verify wheel motor operation; refer to Testing the Traction Circuit – Wheel Motor Efficiency in the Hydraulic System chapter of this manual.
	Note: If a traction circuit component has internal wear or damage, it is possible that the other traction components are also damaged.	
The machine travels too far before stopping when the traction pedal is released.	Traction pedal linkage out of adjustment, restricted, or damaged.	Inspect traction linkage operation and service or adjust if necessary.
Neutral is difficult to find or unit operates in one direction only (forward or reverse).	The traction control linkage is incorrectly adjusted, binding, or damaged.	Inspect traction linkage operation and service or adjust if necessary.
	The charge pressure is low (lift circuit performance, and steering circuit performance for model 07845 machines is also affected).	Verify charge pressure; refer to Testing the Traction Circuit – Charge Pressure in the Hydraulic System chapter of this manual.
	The piston (traction) pump or pump relief valves are worn or damaged.	Verify traction pump operation; refer to Testing the Traction Circuit – Piston (traction) Pump (P1) Flow and Relief Pressure Test in the Hydraulic System chapter of this manual.

Traction System Problems (continued)

Problem	Possible Cause	Corrective Action
No traction exists in either direction.	The parking brake is engaged.	Disengage the parking brake.
	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 control linkage is incorrectly adjusted, binding, or damaged.	Inspect traction linkage operation and service or adjust if necessary.
	The traction pump bypass valve is open or damaged.	Close or replace the traction pump bypass valve.
	The charge pressure is low (lift circuit performance, and steering circuit performance for model 07845 machines is also affected).	Verify charge pressure; refer to Testing the Traction Circuit – Charge Pressure in the Hydraulic System chapter of this manual.
	The piston (traction) pump or pump relief valves are worn or damaged.	Verify traction pump operation; refer to Testing the Traction Circuit – Piston (traction) Pump (P1) Flow and Relief Pressure Test in the Hydraulic System chapter of this manual.
	The wheel motor(s) is worn or damaged.	Verify wheel motor operation; refer to Testing the Traction Circuit – Wheel Motor Efficiency in the Hydraulic System chapter of this manual.
	Note: If a traction circuit component has internal wear or damage, it is possible that the other traction components are also damaged.	
The vehicle moves when stopped on a gentle slope (wheel motors will not hold load) in neutral.	The charge pressure is low (lift circuit performance, and steering circuit performance for model 07845 machines is also affected).	Verify charge pressure; refer to Testing the Traction Circuit – Charge Pressure in the Hydraulic System chapter of this manual.
	The piston (traction) pump or pump relief valves are worn or damaged.	Verify traction pump operation; refer to Testing the Traction Circuit – Piston (traction) Pump (P1) Flow and Relief Pressure Test in the Hydraulic System chapter of this manual.
The front wheel slips or spins (rear wheel traction is reduced).	Relief valve RV is stuck or damaged.	Disassemble, clean, inspect and repair or replace the relief valve.

Steering System Problems (Model 08745 Only)

Problem	Possible Cause	Corrective Action
Steering is sluggish, operates poorly or is inoperative.	Steering components (e.g. ball joint, steering cylinder) are worn or binding.	Inspect steering components and repair or replace if necessary.
	The charge pressure is low (traction charge and lift circuit performance is also affected).	Verify charge pressure; refer to Testing the Traction Circuit – Charge Pressure in the Hydraulic System chapter of this manual.
		Verify charge pump performance; refer to Testing the Steering and Lift Circuit – Charge Pump Flow and Circuit Relief Valve in the Hydraulic System chapter of this manual.
	The steering control relief valve in the steering control valve is faulty.	Verify the steering control relief valve operation; refer to Testing the Steering and Lift Circuit – Steering Cylinder and Steering Control Relief Valve in the Hydraulic System chapter of this manual.
	A steering cylinder shock relief valve in the steering control valve is faulty.	Repair or replace the steering control valve
	Steering control valve is worn or damaged.	Repair 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.
Charge pump is noisy from cavitation (steering, traction charge, and lift circuit performance is 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 Lift/Lower Problems

Problem	Possible Cause	Corrective Action
Lift cylinders will not raise or raise slowly.	Engine speed is too low.	Increase engine speed.
	Lift arms are binding, worn or damaged.	Inspect lift 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.
	The rear lift cylinder relief valve (model 08743 only) is faulty.	Verify the rear lift cylinder relief valve operation; refer to Testing the Steering and Lift Circuit – Rear Lift Cylinder Relief Valve in the Hydraulic System chapter of this manual.
	The steering relief valve (in the steering control valve – model 08745 only) is faulty.	Verify the steering relief valve operation; refer to Testing the Steering and Lift Circuit – Steering and Lift Circuit Relief Valve in the Hydraulic System chapter of this manual.
	Lift cylinder circuit pressure is low (traction charge is affected and steering circuit for model 08745 machines is affected also).	Verify charge pressure; refer to Testing the Traction Circuit – Charge Pressure in the Hydraulic System chapter of this manual.
		Verify charge pump performance; refer to Testing the Steering and Lift Circuit – Charge Pump Flow and Circuit Relief Valve in the Hydraulic System chapter of this manual.
	The lift cylinder is leaking internally.	Test and repair or replace the lift cylinder if necessary.
	The lift valve is worn or damaged.	Disassemble, clean, inspect and repair or replace the lift valve.
Lift cylinders raise but will not stay up. **NOTE:** Lift cylinders cannot provide an absolutely perfect seal. The lift arms will eventually lower if left supporting an attachment in the raised position during storage.	A lift cylinder is leaking internally.	Test and repair or replace the lift cylinder if necessary.
	The lift valve is worn or damaged.	Disassemble, clean, inspect and repair or replace the lift valve.

Attachment Hydraulic Problems

Problem	Possible Cause	Corrective Action
The front or rear attachment hydraulic motor will not engage.	The Operator is not in the seat when the traction pedal is depressed.	Sit in the seat before engaging the PTO switch.
	A mechanical problem exists with the attachment.	Inspect the attachment assembly for binding, wear or damage, and repair or replace if necessary.
	An electrical problem exists in the attachment circuit.	Refer to Troubleshooting – Electrical in this manual.
	Rear Remote Hydraulics Kit (model 08781): The remote hydraulics valve is stuck or damaged.	Remove, clean, inspect and repair or replace the valve if necessary.
	Hydraulic Switch Kit (model 08783) Front Attachment: The front attachment valve (SV2) or the tank valve (SV1) is stuck or damaged.	Remove, clean, inspect and repair or replace the valve if necessary.
	Hydraulic Switch Kit (model 08783) Rear Attachment: The front attachment valve (SV3) or the tank valve (SV1) is stuck or damaged.	Remove, clean, inspect and repair or replace the valve if necessary.
	The attachment gear pump or circuit relief valve is worn or damaged.	Verify attachment gear pump operation; refer to Testing the Attachment Circuit – Attachment Gear Pump (P3) Flow and Relief Pressure Test in the Hydraulic System chapter of this manual.
The front or rear attachment hydraulic motor operates when it shouldn't (engine running, PTO switch off, and no Operator in the seat).	Rear Remote Hydraulics Kit (model 08781): The remote hydraulics valve is stuck or damaged.	Remove, clean, inspect and repair or replace the valve if necessary.
	Hydraulic Switch Kit (model 08783) Front Attachment: The front attachment valve (SV2) or the tank valve (SV1) is stuck or damaged.	Remove, clean, inspect and repair or replace the valve if necessary.
	Hydraulic Switch Kit (model 08783) Rear Attachment: The front attachment valve (SV3) or the tank valve (SV1) is stuck or damaged.	Remove, clean, inspect and repair or replace the valve if necessary.
The front or rear attachment hydraulic motor performs poorly.	The attachment gear pump or circuit relief valve is worn or damaged.	Verify attachment gear pump operation; refer to Testing the Attachment Circuit – Attachment Gear Pump (P3) Flow and Relief Pressure Test in the Hydraulic System chapter of this manual.

Troubleshooting – Electrical

⚠ CAUTION ⚠

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

Starting Problems

Problem	Possible Cause	Corrective Action
Nothing happens when you attempt to start the engine.	The traction pedal is not in the NEUTRAL position, out of adjustment, or faulty.	Move the traction pedal to the neutral position.
		Check the neutral switch adjustment.
		Test the neutral switch.
	The battery is discharged.	Charge and test the battery or replace if necessary.
	The battery cables are loose, corroded, or damaged.	Clean the battery terminals (posts).
		Clean the terminals at the ends of the battery cables.
		Inspect the battery cables and repair or replace them if necessary.
	The fuse F1 (20 A) is damaged.	Test the fuse and replace if necessary.
	The fuse F3 (10 A) is damaged.	Test the fuse and replace if necessary.
	The wire harness fusible link at the engine starter solenoid is damaged.	Test the wire harness fusible link and repair or replace if necessary.
	The main relay or start relay is damaged.	Test the relays and replace if necessary.
	The key switch is damaged.	Test the key switch and replace if necessary.
	The starter solenoid is damaged.	Test the starter solenoid and replace if necessary.
The starter solenoid “Clicks”, but the engine does not crank.	The battery is discharged.	Charge and test the battery or replace if necessary.
	The battery cables are loose, corroded, or damaged.	Clean the battery terminals (posts).
		Clean the terminals at the ends of the battery cables.
		Inspect the battery cables and repair or replace them if necessary.
	The starter solenoid or starter motor is damaged.	Test the starter solenoid and starter motor and replace if necessary.
		Clean the terminals at the ends of the starter cable.
		Inspect the starter cable and repair or replace it if necessary.
	The starter mounting bolts are loose or corroded (insufficient ground).	Remove, clean, apply medium strength thread locking compound and install the mounting bolts. Tighten the bolts to the specified torque.

Starting Problems (continued)

Problem	Possible Cause	Corrective Action
The engine cranks, but does not start.	The fuel shut-off valve is closed.	Open the fuel shut-off valve.
	The fuel tank is empty.	Fill the fuel tank.
	The engine and/or fuel can be too cold.	Move the machine to a heated environment and allow the engine and fuel to warm.
	The fuel filter is plugged.	Check the fuel filter and replace if necessary.
	The impulse fuel pump is not functioning.	Inspect the impulse fuel pump hoses and replace if necessary.
		Test the impulse fuel pump and replace if necessary.
	The fuse F2 (10 A) is damaged.	Test the fuse and replace if necessary.
	The fuel solenoid is damaged.	Test the fuel solenoid and replace if necessary.
	An engine ignition system component (including the spark plugs) is faulty.	Test the engine ignition system components.
	Diode D2 is faulty.	Test the diode and replace if necessary.
	The interlock relay #1 is faulty.	Test the relay and replace if necessary.
	The key switch is faulty.	Test the key switch and replace if necessary.
The engine cranks slowly.	The battery is discharged.	Charge and test the battery or replace if necessary.
	The battery cables are loose, corroded, or damaged.	Clean the battery terminals (posts).
		Clean the terminals at the ends of the battery cables.
		Inspect the battery cables and repair or replace them if necessary.
	The engine and/or fuel can be too cold.	Move the machine to a heated environment and allow the engine and fuel to warm.

General Run Problems

Problem	Possible Cause	Corrective Action
The engine shuts off when the traction pedal is depressed.	The Operator is not in the seat or the seat switch is faulty.	Sit in the seat before depressing the traction pedal.
	The seat switch is faulty.	Test the seat switch and replace if necessary.
	Diode D1 is faulty.	Test the diode and replace if necessary.
The battery does not charge.	The battery is damaged.	Charge and test the battery or replace if necessary.
	A loose, corroded, or broken wire exists in the charging circuit.	Test the circuit wiring and repair or replace if necessary.
	The alternator or voltage regulator is damaged.	Test the alternator and voltage regulator output; refer to the Briggs & Stratton V-Twin Engine Service Manual.
	The wire harness fusible link at the voltage regulator is damaged.	Test the wire harness fusible link and repair or replace if necessary.

Attachment Electrical Problems

Problem	Possible Cause	Corrective Action
The front or rear attachment hydraulic motor will not engage.	The Operator is not in the seat when the traction pedal is depressed.	Sit in the seat before engaging the PTO switch.
	The fuse F4 (10 A) is damaged.	Test the fuse and replace if necessary.
	The seat switch is faulty.	Test the seat switch and replace if necessary.
	The seat switch relay is faulty.	Test the relay and replace if necessary.
	The PTO switch is faulty.	Test the PTO switch and replace if necessary.
	Rear Remote Hydraulics Kit (model 08781): The remote hydraulics solenoid valve coil is faulty.	Test the solenoid valve coil and replace if necessary.
	Hydraulic Switch Kit (model 08783) Front Attachment: The front attachment solenoid valve (SV2) coil or the tank solenoid valve (SV1) coil is faulty.	Test the solenoid valve coil and replace if necessary.
	Hydraulic Switch Kit (model 08783) Rear Attachment: The front attachment solenoid valve (SV3) coil or the tank solenoid valve (SV1) coil is faulty.	Test the solenoid valve coil and replace if necessary.
	A hydraulic problem exists in the attachment circuit.	Refer to Troubleshooting – Hydraulic in this manual.

Table of Contents

Additional Reference Materials

Briggs & Stratton V-Twin Engine Service Manual

General Information

This chapter gives information about specifications and repair of the Briggs & Stratton gasolinelengine used in the Sand Pro 3040/50400 machines. The general maintenance procedures are described in the Toro traction unit *Operator's Manual*. Detailed information on engine troubleshooting, testing, disassembly, and assembly is identified in the *Briggs & Stratton V-Twin Engine Service Manual*.

Additionally, some engine repair procedures are described in this manual. The described adjustments and repairs require tools which are commonly available in many service shops. Special tools are described in the *Briggs & Stratton V-Twin 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 Briggs & Stratton engines may be available through your Authorized Toro Distributor as many are also Authorized Briggs & Stratton Dealers. If the engine parts list is not included in the traction unit *Parts Catalog*, provide your distributor or Authorized Briggs & Stratton Dealer with the Toro model and serial number on the machine frame as well as the Briggs & Stratton model and serial number on the engine.

Traction Unit Operator's Manual

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

Briggs & Stratton Service Manual

The engine that powers the Sand Pro 3040 (model 08743) is a 16 horsepower Briggs & Stratton Model 305447 Type 0588. The engine that powers the Sand Pro 5040 (model 08745) is a an 18 horsepower Briggs & Stratton Model 356447 Type 0636. The *Briggs & Stratton V-Twin Engine Service Manual* is available for these engines.

Fuel Shut-Off Valve

The fuel shut-off valve is located under the fuel tank and should be closed if the machine is being transported on a trailer or when placing the machine in long term storage. Additionally, close the shut-off valve when servicing the fuel filter, fuel impulse pump, or fuel lines, and when removing the fuel tank or engine from the machine.

g339992

Figure 6

1. Fuel shut-off valve

Adjustments

Adjusting the Engine Controls

1. Park the machine on a level surface, lower any attachments, apply the parking brake, and set the key switch to the OFF position.
2. Pivot the seat upward.
3. Set the throttle control to full FAST (high idle).
4. The engine throttle linkage should be against the high speed stop.

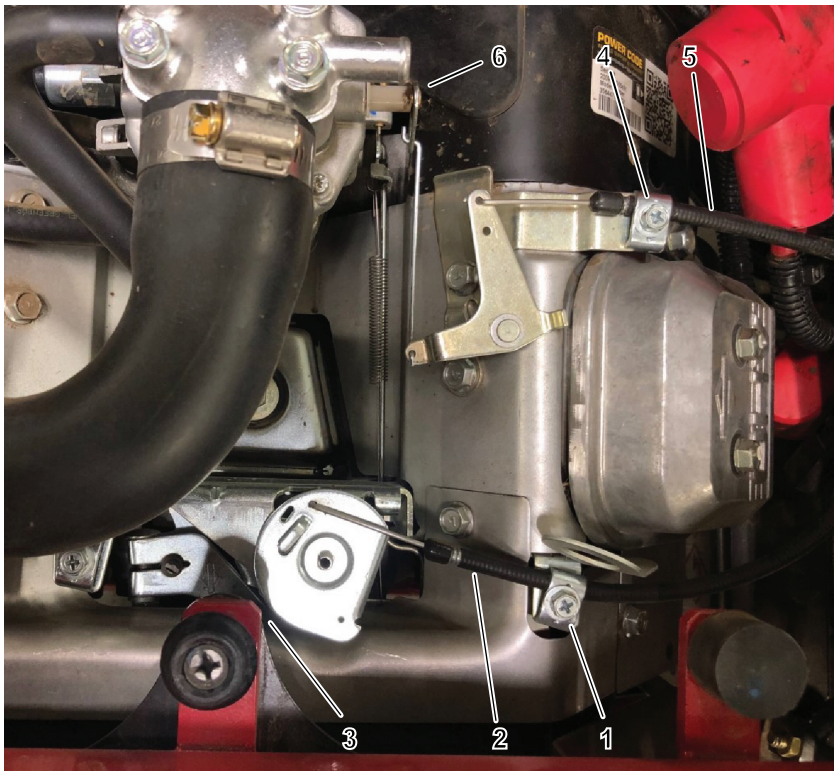


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Figure 7

1. Throttle cable clamp
2. Throttle cable
3. Stop
4. Choke cable clamp
5. Choke cable
6. Choke shaft

5. To adjust the throttle cable:
   A. Loosen the throttle cable clamp screw.
   B. Pull the throttle cable until the throttle linkage contacts the high speed stop.
   C. Tighten the throttle cable clamp screw.
6. Set the choke control to full ON (closed).
7. The choke shaft (butterfly) should be completely closed.
8. To adjust the choke cable:
   A. Loosen the choke cable clamp screw; refer to Figure 7.
   B. Pull the choke cable until the choke shaft is completely closed.
   C. Tighten the choke cable clamp screw.
9. Use a non-contact tachometer (phototach) to check the engine low idle and high idle speed; refer to Engine Specifications (Model 08743) (page 2–2) or Engine Specifications (Model 08745) (page 2–3).

10. Start the engine and let it run at half throttle for approximately 5 minutes to warm up.
11. Set the throttle control to the SLOW (low idle) position and verify the engine RPM.
12. Adjust the low idle setting if necessary:
    A. With the throttle control in the low idle position, adjust the idle stop screw counterclockwise until it no longer contacts the throttle lever.

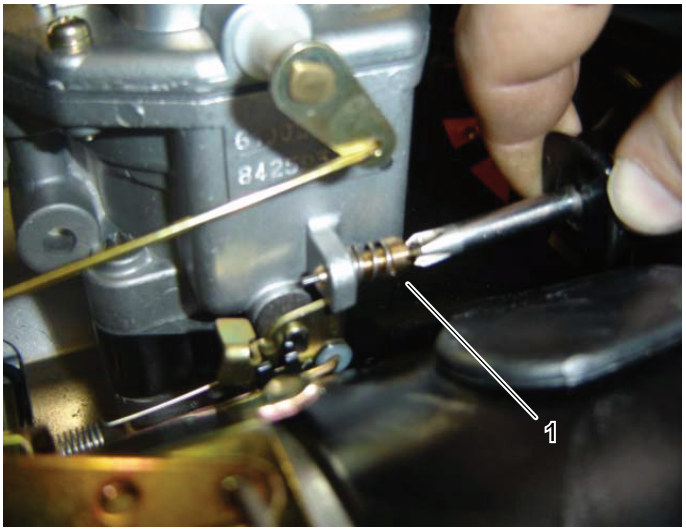

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Figure 8

1. Idle stop screw

    B. Bend the governed idle spring anchor tang to attain an idle speed of approximately 1,700 rpm.

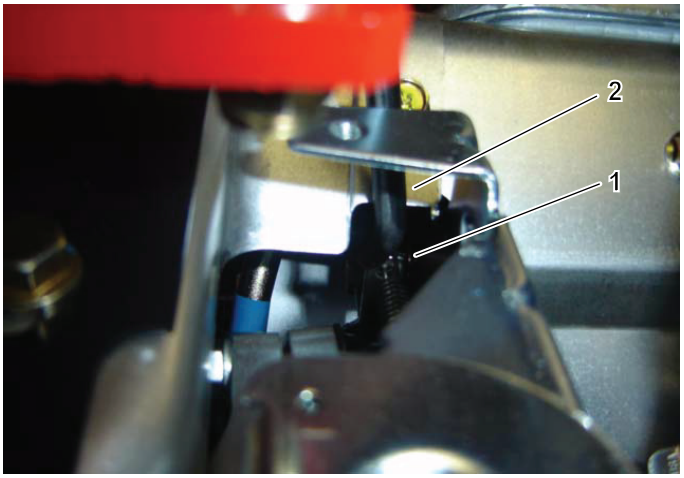

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Figure 9

1. Governed idle spring anchor tang
2. Adjustment tool (shown for reference)

    C. Adjust the idle stop screw to attain the specified low idle speed.
13. Set the throttle control to the FAST (high idle) position and verify the engine RPM.

14. Adjust the high idle setting if necessary by bending the high-speed spring anchor tang to attain the specified high idle speed.

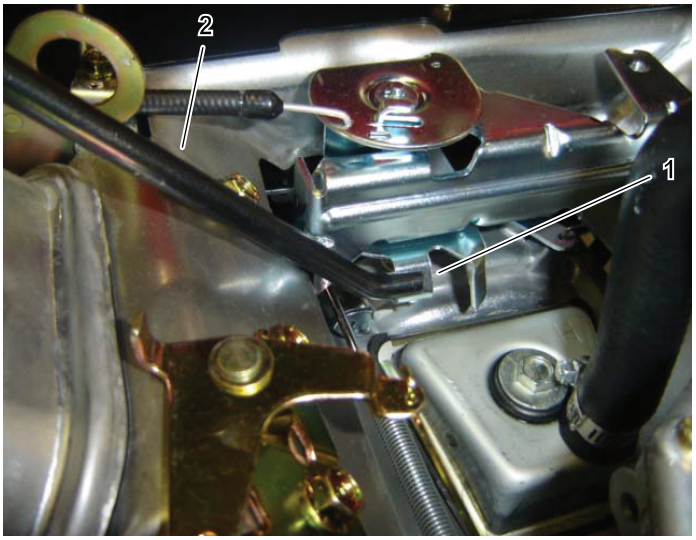

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Figure 10

1. High-speed spring anchor tang
2. Adjustment tool (shown for reference)

Service and Repairs

Cooling System

To ensure proper engine cooling, make sure the rotating screen, cooling fins and other external surfaces of the engine are kept clean at all times. Perform this maintenance procedure at the interval specified in the Operator's Manual.

IMPORTANT

The engine that powers Sand Pro machines is air–cooled. Operating the engine with dirty or plugged cooling fins, a blocked rotating screen or a plugged or dirty blower housing will result in engine overheating and engine damage.

1. Park the machine on a level surface, lower any attachments, apply the parking brake, set the key switch to the OFF position and remove the key from the switch.

⚠ CAUTION ⚠

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

IMPORTANT

Never clean engine with pressurized water. Water could enter and contaminate the fuel system.

2. Clean the cooling fins on both of the cylinder heads.

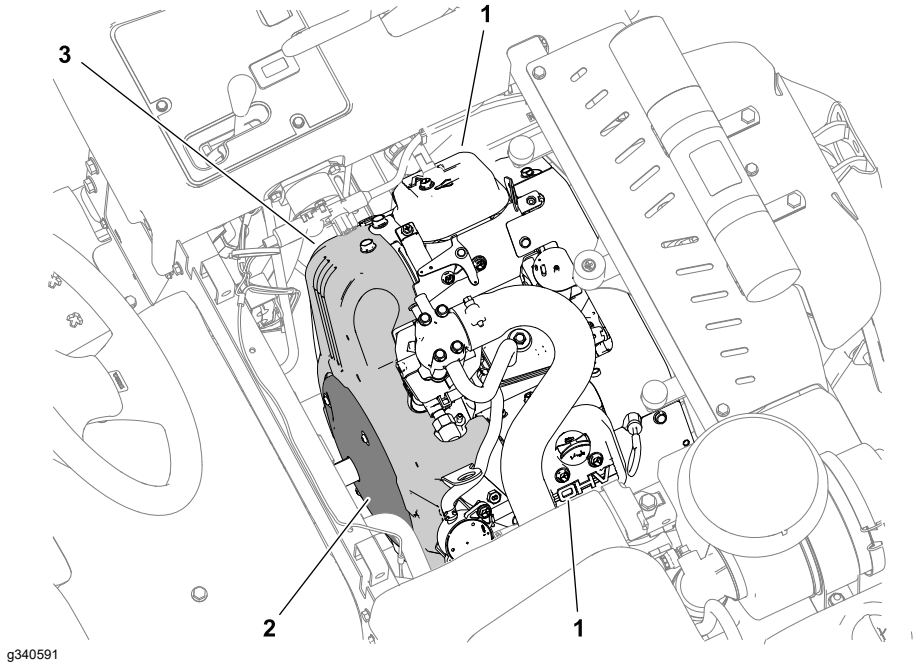

Figure 11

(shown with seat and seat base removed)

1. Cylinder head
2. Rotation screen
3. Blower housing

3. Clean the rotating screen and the blower housing of dirt and debris. If blower housing removal is necessary for cooling system cleaning, the engine needs to be removed from machine; refer to Removing the Engine (page 4–15).

IMPORTANT

Ensure that the rotating screen and the blower housing are installed to the engine. Never operate the engine without the blower housing installed or overheating and engine damage will result.

Air Cleaner Assembly

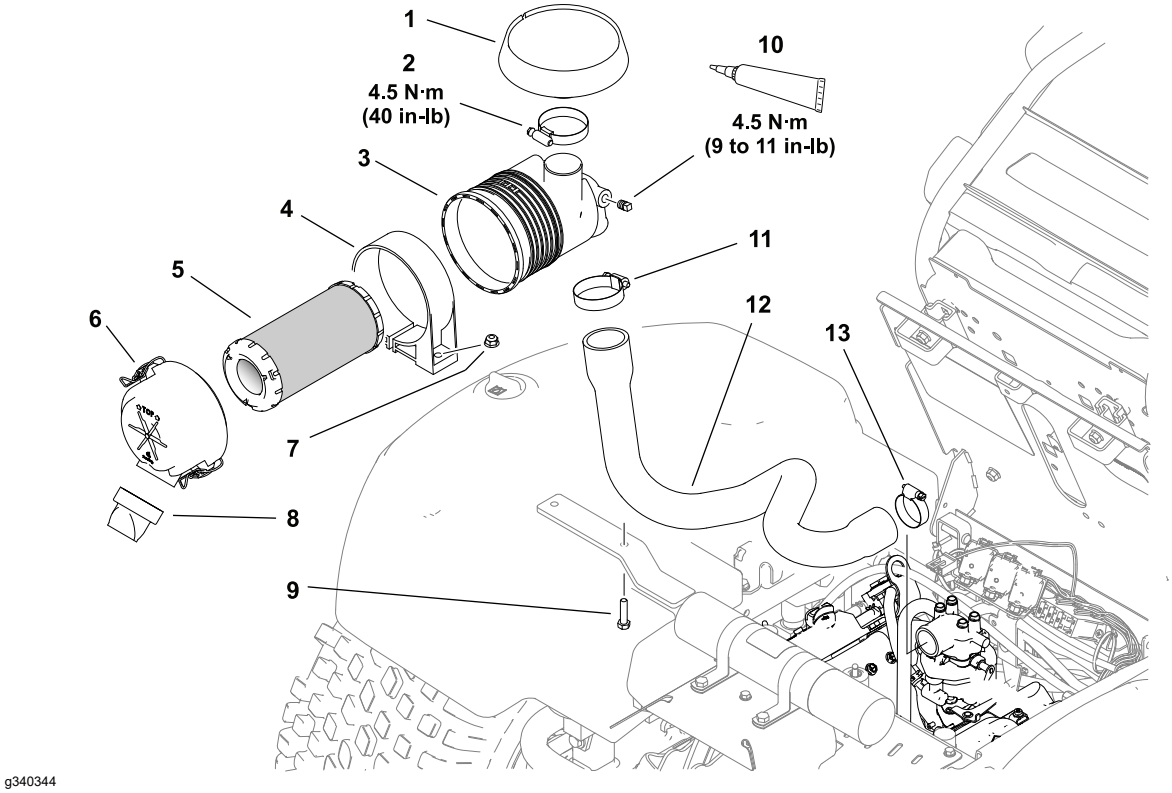

Figure 12

1. Cap
2. Hose clamp
3. Air cleaner housing
4. Mounting bracket
5. Filter element
6. Air cleaner cover
7. Lock nut (2 each)
8. Vacutator valve
9. Cap screw (2 each)
10. Plug
11. Hose clamp
12. Intake hose
13. Hose clamp

Removing and Installing the Air Cleaner Assembly

Refer to Figure 12 for this procedure.

1. Park the machine on a level surface, lower any attachment, apply the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Remove the air cleaner components as needed.
3. Refer to the traction unit *Operator's Manual* for air cleaner service and maintenance procedures.

IMPORTANT

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

4. Examine the air cleaner housing and cover for wear and damage that could cause possible air leaks. Replace components if necessary.
5. Examine the air intake hose for wear or damage and replace the hoses if necessary.

6. If the pipe plug was removed or replaced, apply sealant to the threads of the plug and install the plug in the air cleaner housing. Tighten the plug from **1.0 to 1.2 N·m (9 to 11 in-lb)**.
7. Install the air cleaner cover with the vacuator valve pointing downward.

Fuel System

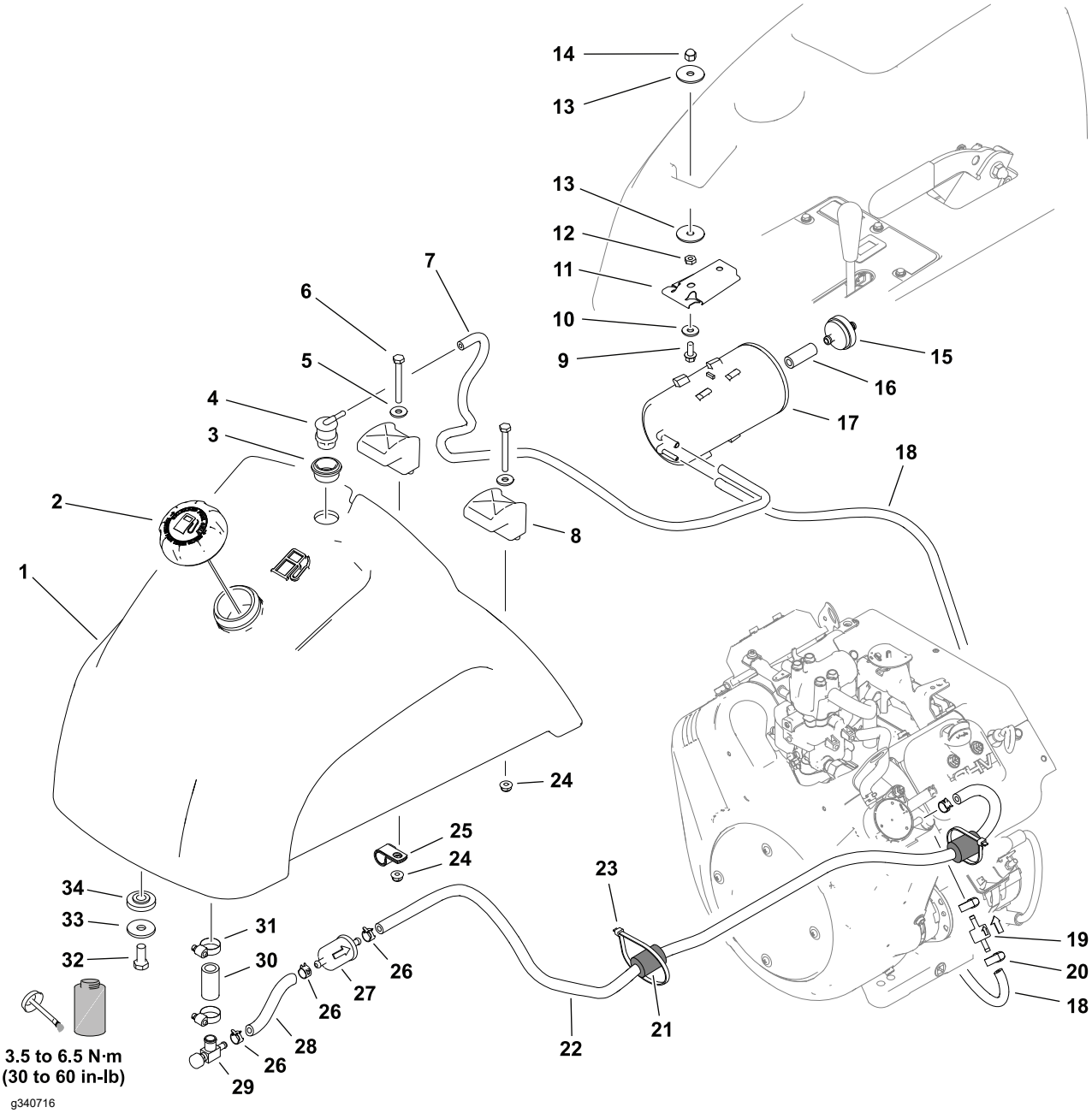

Figure 13

1. Fuel tank
2. Fuel cap
3. Grommet
4. Valve, rollover
5. Flat washer (2 used)
6. Cap screw (2 used)
7. Fuel hose, vent
8. Clamp, fuel tank (2 used)
9. Cap screw
10. Flat washer
11. Clamp, carbon canister
12. Hex nut
13. Flat washer (2 used)
14. Cap nut
15. Fresh air filter
16. Fuel hose, fresh air filter
17. Carbon canister
18. Fuel hose, check valve to carbon canister
19. Check valve
20. Hose clamp (2 used)
21. Rubber guard (2 used)
22. Fuel hose, filter to carburetor
23. Cable tie (2 used)
24. Flange nut (2 used)
25. R-clamp
26. Hose clamp (4 used)
27. Fuel filter
28. Fuel hose, filter
29. Shut-off valve
30. Fuel hose, shut-off valve
31. Hose clamp (2 used)
32. Cap screw
33. Flat washer
34. Rubber bushing

The fuel system includes a fuel tank with a mechanical fuel shut-off valve, an in-line fuel filter, and a vacuum pulse fuel pump mounted on the engine. The fuel system also includes a fuel evaporative control system designed to collect and store evaporative emissions from the fuel tank; refer to Evaporative Control System (page 4–13).

DANGER

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

CAUTION

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

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 if necessary; refer to Figure 13.

Removing and Installing the Fuel Tank

Refer to Figure 13 for this procedure.

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the key switch.

IMPORTANT

To prevent damage to the fuel hoses, cable ties and clamps may be 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.

2. Close the fuel shut-off valve and disconnect the fuel hose from the in-line fuel filter.
3. Place disconnected hose in appropriate container and open fuel shut-off valve to allow fuel tank to drain completely. Close the fuel shut-off valve.
4. Disconnect the fuel hose from the rollover valve at the top of the fuel tank.

5. Cover or plug the fuel hoses or fitting openings to prevent contamination from entering the fuel system.
6. Remove the cap screw (item 32) from under the front of the fuel tank.
7. Remove the three (3) screws that retain the dash panel to the machine, then carefully raise the dash panel to access the rear fuel tank clamps.

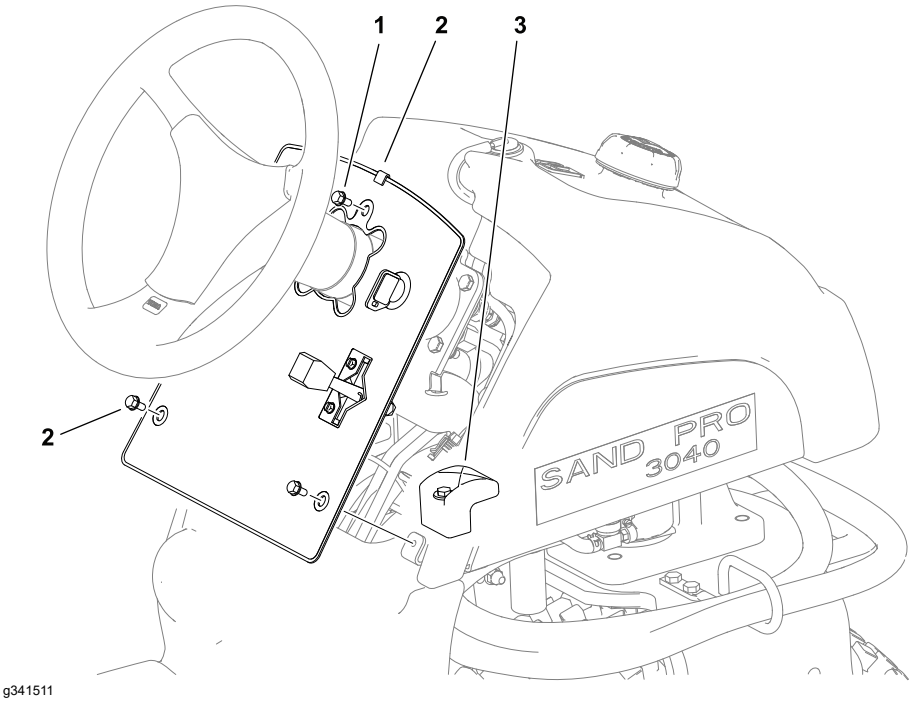

Figure 14

1. Mounting screws (3 used)
2. Dash panel
3. Fuel tank clamp (2 used)

8. Remove the cap screws and clamps from the rear of the fuel tank and remove the fuel tank from the machine.
9. Inspect the rubber bushing that supports the front of the fuel tank for damage or wear and replace it if necessary.
10. To install the fuel tank, follow this procedure in reverse order.
11. Apply anti-seize lubricant to the cap screw (item 32) that secures the front of the fuel tank to the machine. Install and tighten the screw from **3.4 to 6.8 N·m (30 to 60 in-lb)**.
12. Fill the fuel tank and open the fuel shut-off valve to check for leaks. Repair any leaks before starting the engine.

Evaporative Control System

The evaporate control system uses a carbon canister and a series of vent hoses to collect evaporative emissions from the fuel tank. The fuel tank uses a non-vented fuel cap. A rollover valve positioned at the top of the tank allows tank venting through a carbon canister mounted under the right side console. Fuel vapors from the fuel tank are vented to the canister and consumed by the engine when the engine is running.

A check valve located near the engine is used to control evaporative emission flow through the system. The carbon canister is connected to both the rollover valve (vent) and the check valve. When the engine is running, engine intake

vacuum unseats the check valve which then allows vapors from the canister to flow to the engine purge port. These vapors are then consumed by the engine. When the engine is not running, evaporative vapors remain in the fuel tank and carbon canister.

Note: If there is restriction in the carbon canister, the rollover valve or the vent hose, the fuel tank may distort due to venting issues. If the fuel tank returns to it's normal shape when the fuel cap is removed, restriction in the evaporative control system is likely.

Refer to Figure 13 for this procedure.

1. Inspect the carbon canister and attached hoses for damage or leaks. A damaged or leaking canister should be replaced.
2. Ensure the fresh air filter behind the carbon canister is not blocked.
3. Ensure all evaporative control system hoses are not kinked or pinched and are secured at each end with hose clamps.
4. Test the operation of the check valve. The valve should open (allow flow through the valve) when approximately **100 mm Aq (0.29 inch Hg)** vacuum is applied to port A. There should be no flow through the valve when the same amount of vacuum is applied to port B.
5. Repair or replace evaporative system components as necessary. Ensure the arrow on the check valve is pointed toward the engine purge port during installation.

Engine

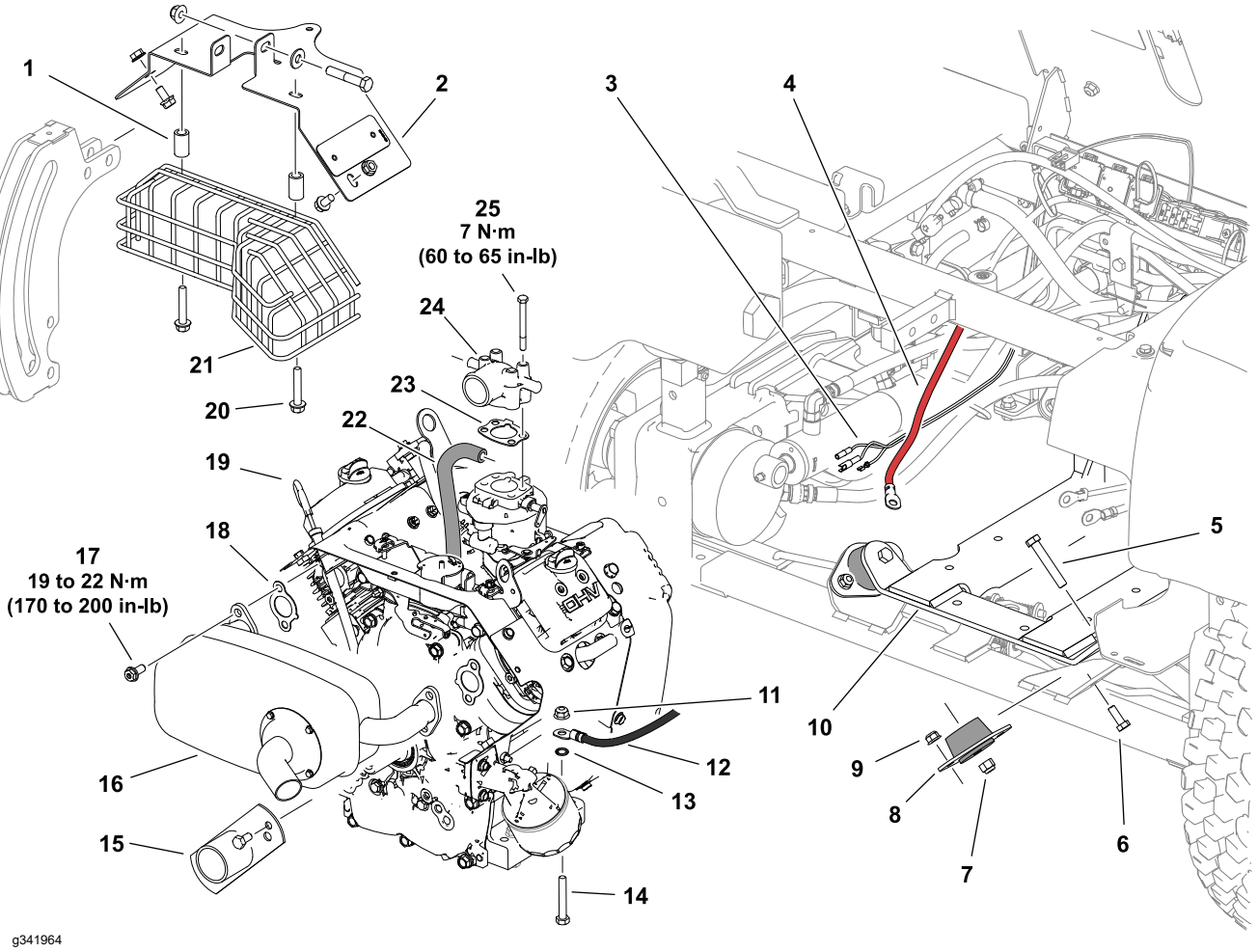

Figure 15

1. Spacer (2 used)
2. Exhaust shield
3. Wire harness connections
4. Starter motor power cable
5. Cap screw (4 used)
6. Cap screw (8 used)
7. Lock nut (4 used)
8. Engine mount (4 used)
9. Lock nut (8 used)
10. Engine Support
11. Lock nut (4 used)
12. Lock washer
13. Ground cable
14. Cap screw (4 used)
15. Cover
16. Muffler
17. Cap screw (4 used)
18. Exhaust gasket (2 used)
19. Engine assembly
20. Cap screw (2 used)
21. Muffler guard
22. Breather tube
23. Gasket
24. Intake elbow
25. Cap screw (4 used)

Removing the Engine

Refer to Figure 15 for this procedure.

1. Park the machine on a level surface, lower any attachments, apply the parking brake, set the key switch to the Off position and remove the key from the switch.
2. Remove any rear attachments from the machine.
3. Remove the battery from the machine; refer to Removing and Installing the Battery (page 6–31).

CAUTION

The engine and exhaust system may be hot. To avoid possible burns, allow the engine and exhaust system to cool before removing engine from machine.

4. Remove the hitch assembly from the rear of the machine; refer to Removing and Installing the Hitch Assembly (page 7–22).

   Note: The exhaust shield and muffler guard are attached to the hitch roller plate, and are removed during hitch removal.
5. Remove the air cleaner hose from the machine; refer to Air Cleaner Assembly (page 4–9).
6. Disconnect the breather tube from the intake elbow.
7. Remove the four (4) flange head screws that secure the intake elbow to the carburetor and remove the intake elbow and gasket. Discard the gasket. Ensure that all of the gasket material is removed from the carburetor and the intake elbow.
8. Disconnect the throttle control cable and choke control cable from the engine.

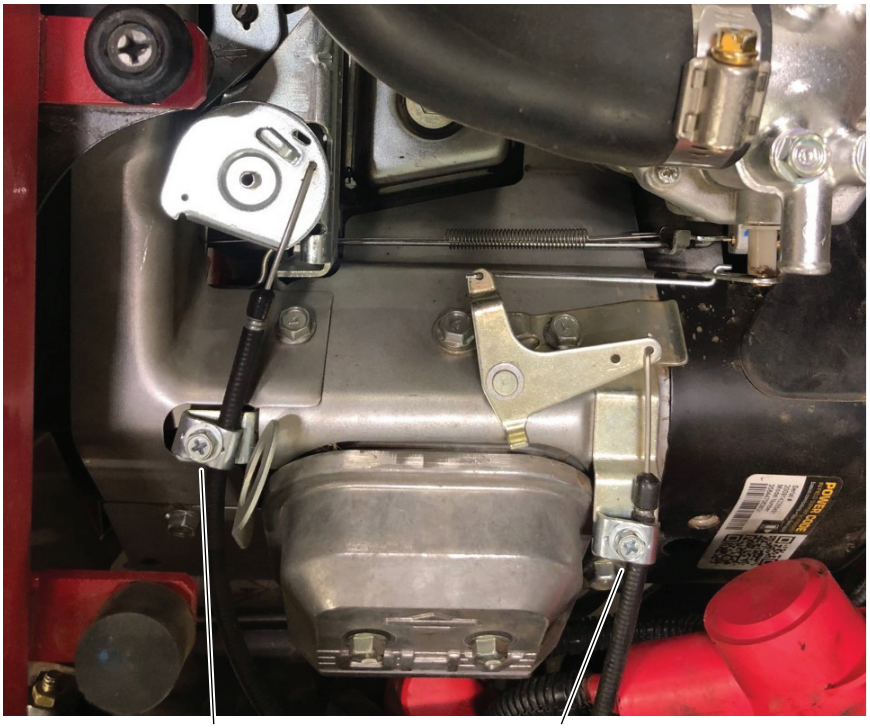

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Figure 16

1. Throttle control cable clamp
2. Choke control cable clamp

9. Close the fuel shut-off valve. Clamp the fuel hose near the engine to prevent fuel spillage, then disconnect the fuel hose from the fuel pump.
10. Disconnect the fuel hose at the engine purge port or at the evaporative control system check valve; refer to Evaporative Control System (page 4–13).
11. Disconnect the machine wire harness from the left side of the engine:
    - Violet wire at the engine magneto lead

- Fusible link at the voltage regulator
- Red wire at the engine fuel solenoid lead

12. Disconnect the red power cable at the starter motor.
13. Remove the fasteners securing the engine to the engine support.

    Note: The engine mounting fastener at the right front corner of the engine secures the ground cable to the crankcase.

14. Loosen the two (2) set screws in the drive hub on the engine stub shaft.

⚠ CAUTION ⚠

Use a hoist or lift to remove the engine once the engine is clear of the machine frame. The engine assembly weighs approximately 41 kg (90 lbs).

15. Remove the engine from the machine.
    A. Slide the engine toward the rear of machine to remove engine stub shaft from drive hub. Take care not to damage the rubber drive coupler.
    B. Once the engine stub shaft is clear of the drive hub, remove the engine from the rear of the machine.
    C. Locate and retrieve the square key between the engine stub shaft and drive hub.
16. Check the condition of the motor mounts and replace if necessary.
17. Continue to disassemble the engine if necessary.
18. Cover or plug all engine openings to prevent contaminants from entering the engine.

Installing the Engine

Refer to Figure 15 for this procedure.

IMPORTANT

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

Ensure that the rotating screen and the blower housing are installed to the engine. Never operate the engine without the blower housing installed or overheating and engine damage will result.

1. If the muffler was removed:
   A. Discard the old gaskets and remove any remaining gasket material.
   B. Install new gaskets and tighten the mounting fasteners from **19 to 22 N·m (170 to 200 in-lb)**.
2. Apply anti-seize lubricant to the bore of the drive hub.

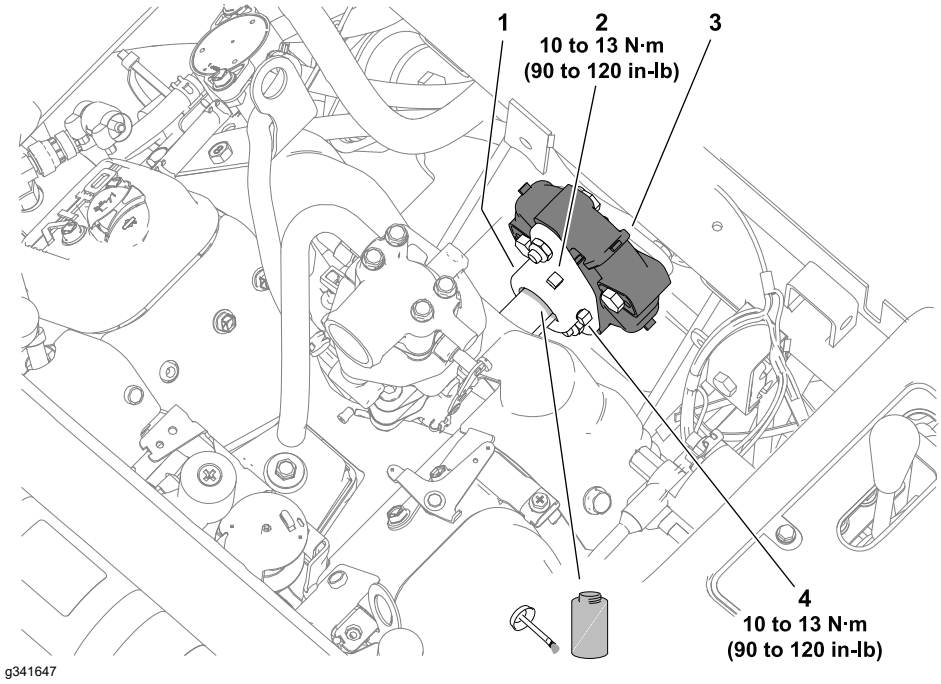

Figure 17

1. Drive hub
2. Set screw (long)
3. Set screw (short)
4. Rubber drive coupler

3. Place the square key into the slot on the engine stub shaft.

⚠ CAUTION ⚠

Use a hoist or lift to remove the engine once the engine is clear of the machine frame. The engine assembly weighs approximately 41 kg (90 lbs).

IMPORTANT

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

4. Align the engine stub shaft with drive hub and slide engine toward the front of machine until the mounting holes in the engine align with the holes in the engine support. Take care not to damage the rubber drive coupling.
5. Position the ground cable at the right front engine mounting hole with the lock washer between the engine and the cable. Install the engine mounting fasteners previously removed. Do not fully tighten the fasteners.
6. Position the engine to best align the coupling assembly and tighten the engine mounting fasteners.
7. Tighten both set screws on the engine drive hub from **10 to 13 N·m (90 to 120 in-lb)**.
8. Connect the red power cable at the starter motor.

9. Connect the machine wire harness at the left side of the engine:
   - Violet wire at the engine magneto lead
   - Fusible link at the voltage regulator
   - Red wire at the engine fuel solenoid lead
10. Connect the fuel supply hose and the evaporative control system vent hose.
11. Connect the throttle control cable to the governor control plate and the choke control cable to the choke lever; refer to Figure 16. Check the cable operation to ensure the choke and throttle linkage is able to move smoothly from fully open to fully closed. Adjust the cables as necessary.

12. Position a new intake gasket on the engine. Install the intake elbow and tighten the fasteners to **7 N·m (60 to 65 in-lbs)**.

IMPORTANT

Make sure that all air cleaner components and breather tube are in good condition and are properly secured during assembly. Any leaks in the air filter system will allow dirt into engine and will cause serious engine damage.

13. Secure the breather tube to the intake elbow with the previously removed hose clamp.
14. Secure the air intake tube to the intake elbow with the previously removed hose clamp; refer to Removing and Installing the Air Cleaner Assembly (page 4–9).
15. Install the hitch assembly with the exhaust shield and muffler guard; refer to Removing and Installing the Hitch Assembly (page 7–22).
16. Install the battery; refer to Removing and Installing the Battery (page 6–31).
17. Ensure that all the wires, fuel lines, hydraulic hoses, and cables are clear of moving parts and secured to their original locations.
18. Check the engine-oil level and adjust if necessary.
19. Start the engine and check for fuel leaks. Repair any leaks as required.
20. Install any previously removed rear attachments.

Chapter 5

Hydraulic System

Table of Contents

Additional Reference Materials

Danfoss DDC20 Axial Piston Pump Service Manual

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

Danfoss OSPM Steering Unit Service Manual

Parker PGP/PGM 500 Series 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 you 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. Park the machine on a level surface.
2. Lower any attachments completely (float).
3. Turn the key switch to the OFF position and allow the engine to stop.
4. Move the traction pedal in both the FORWARD and REVERSE direction.
5. On model 08745 machines, turn the steering wheel in both the left and the right directions.

Towing the Traction Unit

IMPORTANT

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

If it becomes necessary to tow or push the machine, the traction pump must be set to bypass hydraulic fluid. After the bypass valve is opened, move the machine at a speed below **4.8 kph (3 mph)**, and for a very short distance. If the machine needs to be moved more than a short distance, the machine should be transported on a trailer.

1. The traction pump bypass valve is located on the left side of the traction pump. Access the bypass valve from under the machine.

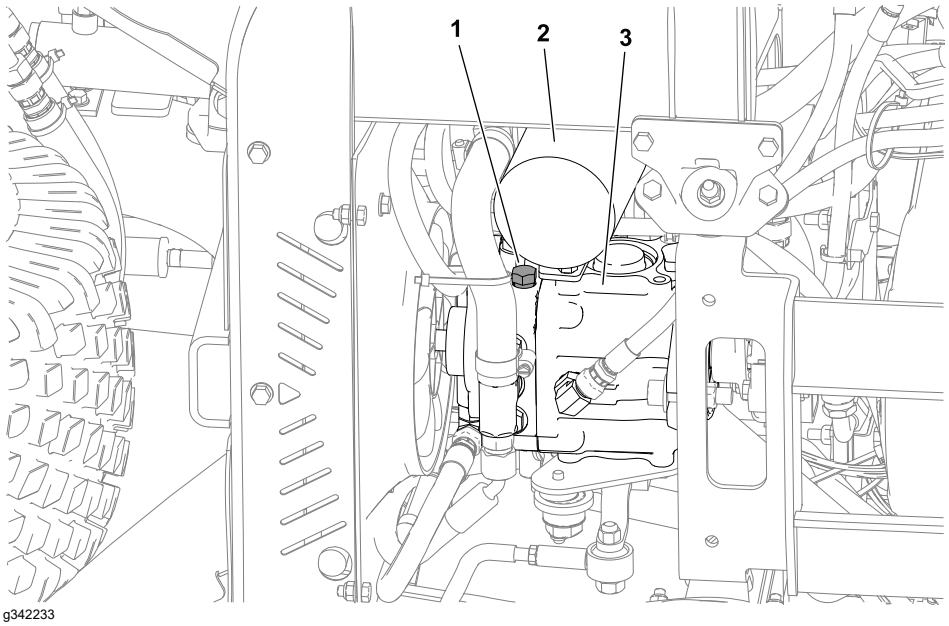

Figure 18

1. Bypass valve
2. Hydraulic filter
3. Traction pump

2. Use an 17 mm wrench to loosen the bypass valve, then open the valve 3 revolutions maximum.

IMPORTANT

Do not start or run the engine when the valve is set to the bypass position.

3. After towing and before starting the engine, tighten the bypass valve to **12 N·m (9 ft-lb)**.

Traction Circuit Component Failure

The traction circuit of the Sand Pro machines is a closed loop system that includes the hydraulic pump, three hydraulic wheel motors, and a remotely mounted relief valve. If a component in the traction circuit 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 to remove contamination from the traction circuit is to temporarily install a Toro high flow hydraulic-fluid filter into the circuit; refer to High Flow Hydraulic Filter Kit (page 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 5–58) for additional information on using the Toro high flow hydraulic filter.

Note: If traction circuit contamination exists, the traction pump case drain 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. Hoses that move during normal machine operation should be replaced every 2 years. Check hydraulic hoses for the following signs of deterioration or damage and replace or repair them if necessary:

- 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 system.

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

When you replace a hydraulic hose, ensure that the hose is straight (not twisted) before you tighten the fittings. Observe the imprint (layline) on the hose to do this. Using two wrenches, hold the hose straight with 1 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 Fitting) (page 5–7).

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

For more hydraulic hose information, refer to the Toro Basics Series Training Book *Hydraulic Hose Servicing* (Part No. 94813SL).

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

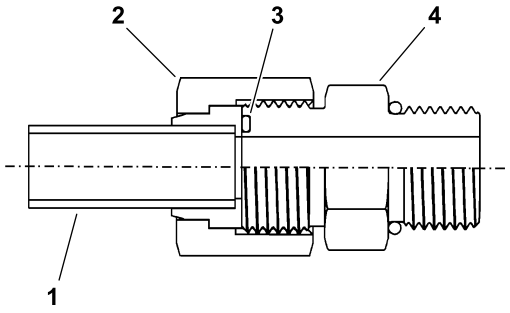

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Figure 19

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

1. Ensure that all the threads, the sealing surfaces of the hose/tube, and the fitting are free of burrs, nicks, scratches, or unwanted material.
2. To help prevent a hydraulic leak, replace the face seal O-ring when you open the connection. Ensure that the O-ring is installed and correctly seated in the groove of the fitting. Lightly lubricate the O-ring with clean hydraulic fluid.
3. Align the hose/tube against the body of the fitting so that the flat face of the hose/tube sleeve fully touches the O-ring in the fitting (Figure 19).
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 5–7). 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 2–6).

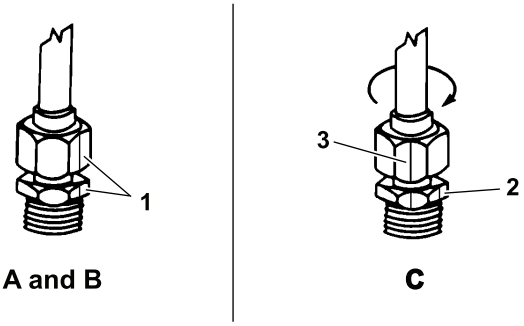

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Figure 20

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

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)

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

Hose/Tube Installation Torque Table (continued)

Fitting Dash Size	Hose/Tube Side Thread Size (inch)—threads per inch)	Installation Torque
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 – 3/4
6 (3/8 inch)	1/2 – 3/4
8 (1/2 inch)	1/2 – 3/4
10 (5/8 inch)	1/2 – 3/4
12 (3/4 inch)	1/3 – 1/2
16 (1 inch)	1/3 – 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 **3.4 N·m (30 in-lb)**.
   B. Put a mark on the swivel nut and body of the fitting (item 1 Figure 20). 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 20).

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

Installing a Non-Adjustable Fitting

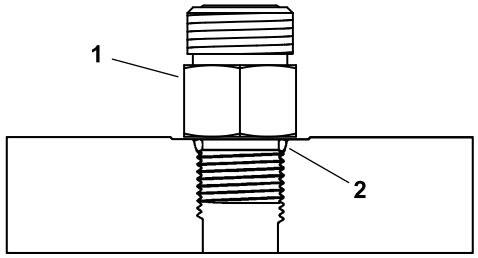

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Figure 21

1. Fitting
2. O-ring

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

IMPORTANT

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

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

   Note: It may be necessary to use a drive-adapter wrench (e.g., crowfoot wrench) to install a hydraulic fitting; refer to Calculating the Torque Values When Using a Drive-Adapter Wrench (page 2–6).
5. If a torque wrench is not available or if space at the port prevents the use of a torque wrench, use the Flats From Finger Tight (FFFT) procedure given below:
   A. Install the fitting into the port and tighten the fitting down full length until finger-tight.
   B. If the port material is steel, tighten the fitting to the listed value; refer to the Flats From Finger Tight (FFFT) Table (page 5–11).
   C. If the port material is aluminum, tighten the fitting to 60% of the listed value; refer to the Flats From Finger Tight (FFFT) Table (page 5–11).

Installing an Adjustable Fitting

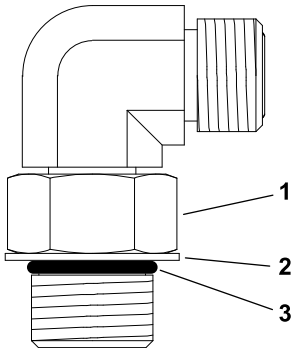

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Figure 22

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

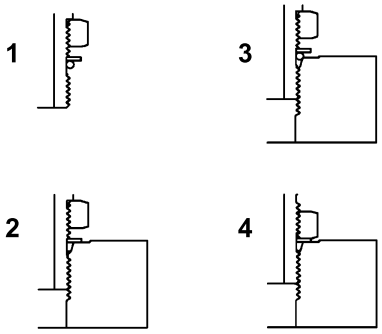

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Figure 23

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 23).
5. Install the adjustable fitting into the port by hand until the washer contacts the face of the port (Step 2 in Figure 23).
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 23). 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 23):

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 5–11). This tightening procedure requires a drive-adapter wrench (e.g., crowfoot wrench); refer to Calculating the Torque Values When Using a Drive-Adapter Wrench (page 2–6).

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

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

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

Fitting Installation Torque Table

Fitting Dash Size	Fitting Port Side Thread Size (inch(es)—threads per inch)	Installation Torque Into Steel Port	Installation Torque Into Aluminum Port
4	7/16—20	21 to 25 N·m (15 to 19 ft-lb)	13 to 15 N·m (9 to 11 ft-lb)
5	1/2—20	25 to 29 N·m (18 to 22 ft-lb)	15 to 20 N·m (11 to 15 ft-lb)
6	9/16—18	47 to 56 N·m (34 to 42 ft-lb)	28 to 35 N·m (20 to 26 ft-lb)
8	3/4—16	79 to 97 N·m (58 to 72 ft-lb)	48 to 58 N·m (35 to 43 ft-lb)
10	7/8—14	135 to 164 N·m (99 to 121 ft-lb)	82 to 100 N·m (60 to 74 ft-lb)
12	1–1/16—12	182 to 222 N·m (134 to 164 ft-lb)	110 to 134 N·m (81 to 99 ft-lb)
14	1–3/16—12	217 to 265 N·m (160 to 196 ft-lb)	131 to 160 N·m (96 to 118 ft-lb)
16	1–5/16—12	274 to 336 N·m (202 to 248 ft-lb)	165 to 202 N·m (121 to 149 ft-lb)
20	1–5/8—12	335 to 410 N·m (247 to 303 ft-lb)	202 to 248 N·m (149 to 183 ft-lb)

Flats From Finger Tight (FFFT) Table

Size	FFFT
4 (1/4 inch nominal hose or tubing)	0.75 to 1.25
6 (3/8 inch)	1.25 to 1.75
8 (1/2 inch)	1.25 to1.75
10 (5/8 inch)	1.25 to 1.75
12 (3/4 inch)	1.25 to 1.75
16 (1 inch)	1.25 to 1.75

Hydraulic Schematics

The hydraulic schematics for the Sand Pro 3040/5040 machines and optional hydraulic accessories are located in Appendix A (page A–1).

Hydraulic Flow Diagrams

Traction Circuit

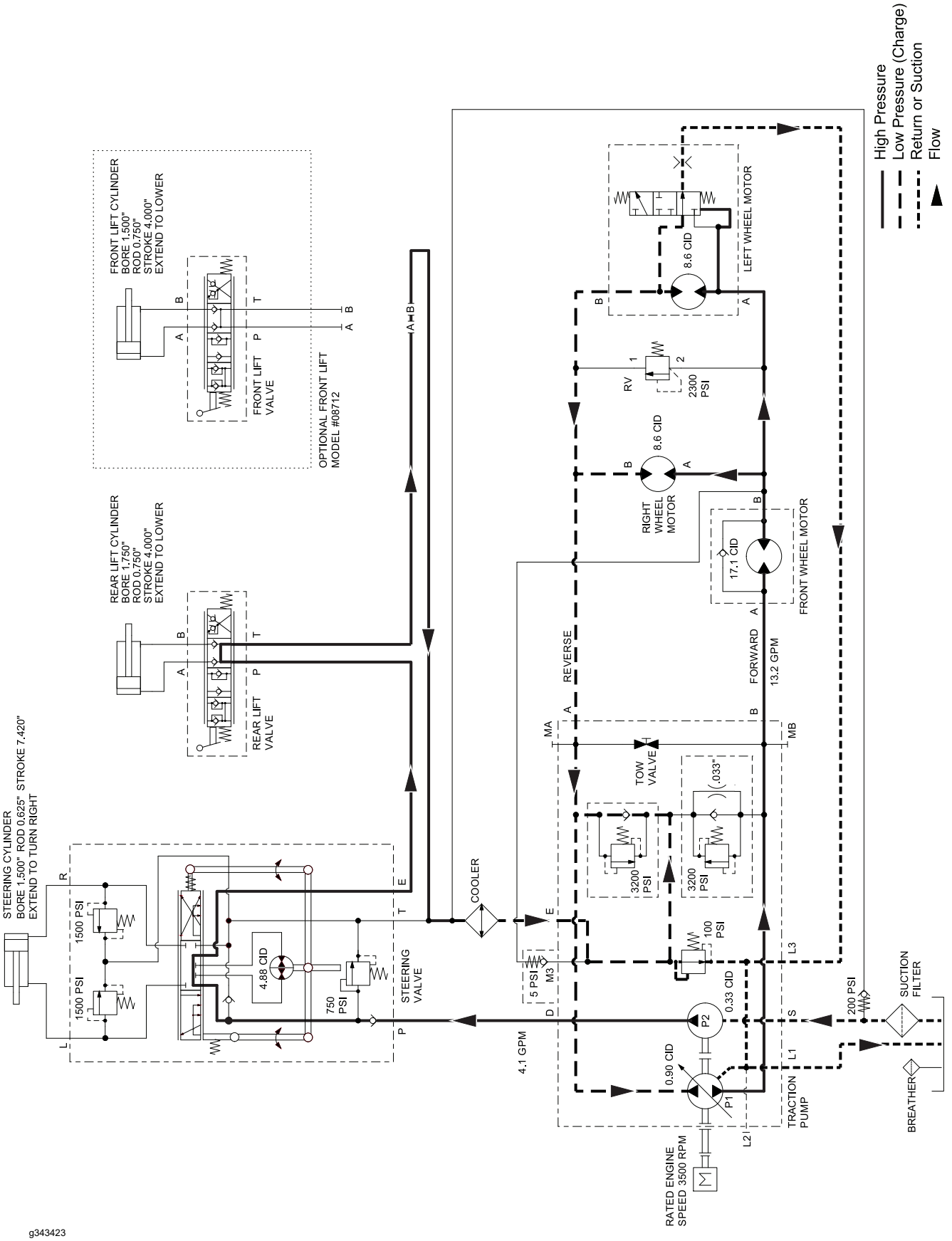

Figure 24

Traction Circuit Diagram (Forward – Model 08745 shown)

The hydraulic traction circuit is a closed loop system consisting of a variable displacement piston (traction) pump, three wheel motors, and a remote mounted relief valve. The traction pump is driven by the engine directly through a rubber drive coupling. The traction pump swash plate and trunnion shaft is moved by the traction pedal through a neutral detent linkage assembly.

Forward Direction

With the engine running and the traction pedal in the neutral position, the traction pump (P1) supplies no flow to the wheel motors. When the traction pedal is pressed to the forward position, the linkage from the pedal positions the swash plate in the traction pump so hydraulic fluid flows out the B port (right side of the pump). Fluid flow out of the B port goes through the front wheel motor first and then through the right and left rear wheel motors. Fluid from the rear wheel motors returns to the traction pump A port (left side of pump). Hydraulic fluid is continuously pumped through the closed loop traction circuit as long as the traction pedal is pressed forward. The traction pump includes a relief valve (forward direction) that limits forward traction circuit pressure to 22,063 kPa (3200 psi) bar).

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

A remote mounted relief valve exists in the traction circuit to prevent the rear wheel motors from engaging too aggressively if the traction pedal is moved in the forward direction abruptly. The relief valve is set to open at 15,858 kPa (2300 psi). The relief valve only operates in the forward direction.

The piston (traction) pump uses a small amount of hydraulic fluid for internal lubrication during operation. The pump is equipped with a case drain to allow the normal internal leakage to be removed from the pump. The left rear wheel motor includes a flushing valve that bleeds off a small amount of hydraulic fluid for cooling the closed loop traction circuit. The flushing valve only operates in the forward direction. The case drain and flushing valve are connected to the hydraulic reservoir. The loss of hydraulic fluid from the closed loop system is replenished by the traction pump's internal implement/charge pump (P2).

The implement/charge pump (P2) is a fixed displacement gerotor pump that is part of the traction pump. The implement/charge pump replenishes the closed loop traction circuit with hydraulic fluid from the tank. The charge relief valve supplies sufficient head pressure so that charge pump flow is guided to the low pressure side of the traction circuit. Charge pressure is limited by the charge relief valve located in the piston (traction) pump to 689 kPa (100 psi). Charge pump flow in excess of traction circuit replenishment requirements is used for the steering circuit on Sand Pro 5040 machines, and the lift circuit for both Sand Pro 3040 and 5040 machines.

The front wheel motor has a check valve across its ports that allows the motor to over run during tight turns in the forward direction.

Reverse Direction

The traction circuit operates essentially the same in reverse as it does in the forward direction. However, the flow through the circuit is reversed. When the traction pedal is pressed to the reverse position, the linkage from the pedal positions the traction pump swash plate so fluid flows out of the A port (left side of pump). Fluid flow out of the A port goes to the rear wheel motors and turns them in the reverse direction. The fluid flow is then directed to the front wheel

Reverse Direction (continued)

motor. Fluid by-passes the front wheel motor in the reverse direction because of the check valve inside the front motor. The front wheel does not provide traction in the reverse direction. Hydraulic fluid is continuously pumped through the closed loop traction circuit as long as the traction pedal is pressed rearward. The traction pump includes a relief valve (reverse direction) that limits reverse traction circuit pressure to 22,063 kPa (3200 psi) bar).

The charge circuit functions the same in reverse as it does in the forward direction. The left rear wheel motor bleed valve and the remote mounted relief valve does not function in the reverse direction.

Steering Circuit (Model 08745)

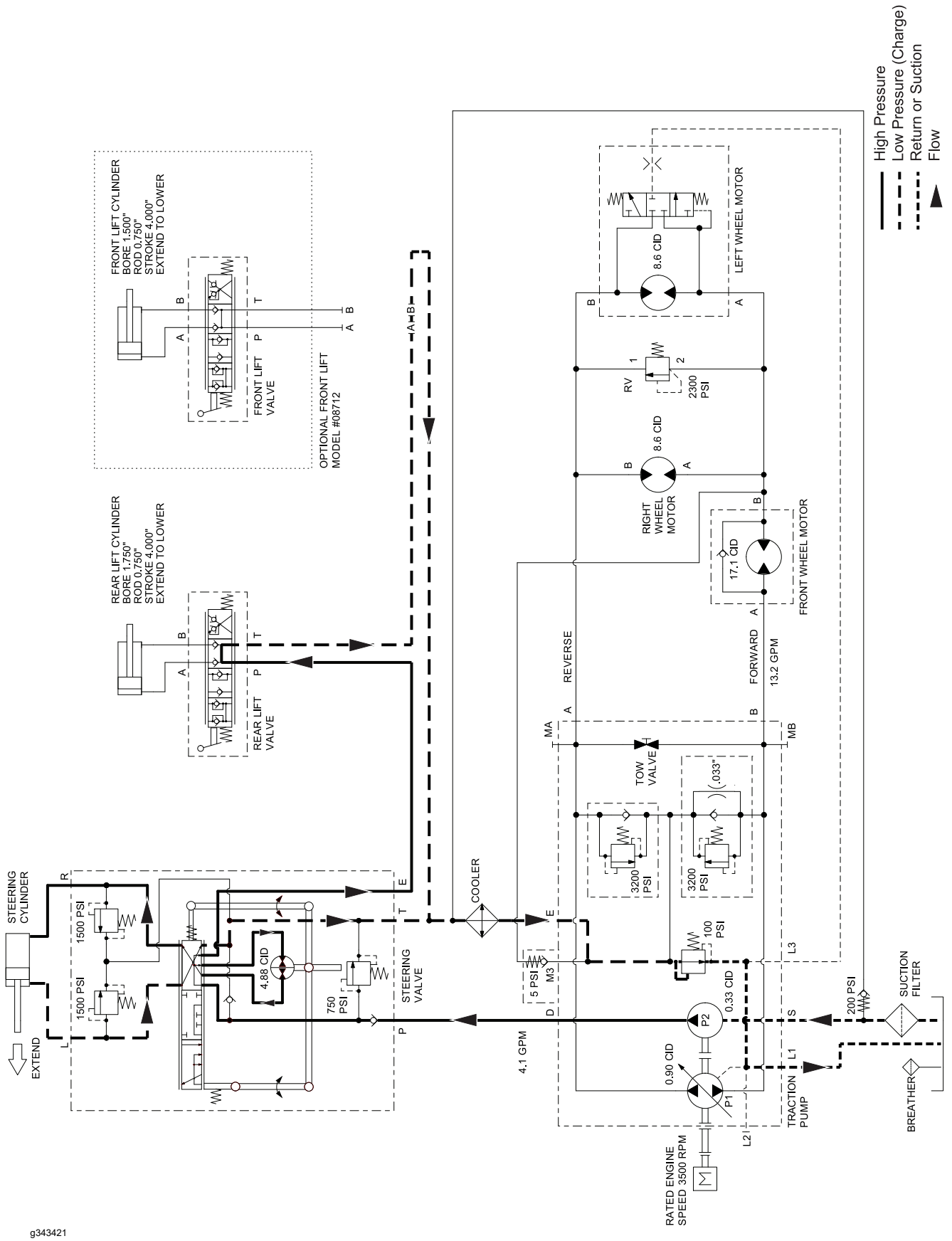

Figure 25
Steering Circuit Diagram

The implement/charge pump (P2) is a fixed displacement gerotor pump that is part of the traction pump. The implement/charge pump supplies oil flow for the steering circuit on model 08745 machines. The implement/charge pump also supplies fluid flow for the lift circuit and the charge circuit of the closed loop traction system for both model 08743 and 08745 machines. The pump output flows to the steering control valve before supplying the lift and charge circuit needs so that the steering circuit has priority. The steering and lift circuit pressure is limited to 5,171 kPa (750 psi) by a relief valve located in the steering valve. The steering valve also includes two 10,342 kPa (1500 psi) relief valves, one for each cylinder supply port L and R. The relief valves absorb shocks in the steering circuit while turning into and over a curb for example.

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

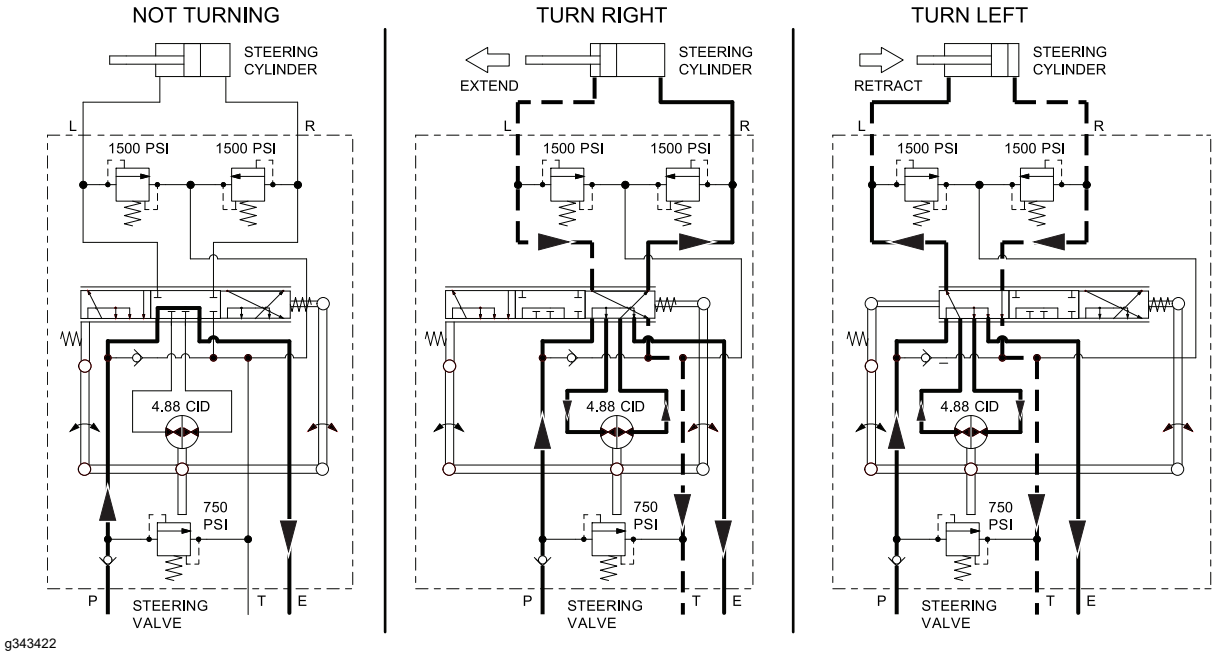

Figure 26

Right Turn

When a right turn is made with the engine running, turning the steering wheel positions the steering control spool valve so that flow goes through the bottom of the spool. Flow entering the steering control valve at the P port passes through the rotary meter and is directed out the R port. Pressure extends the steering cylinder for a right turn. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount of the rotation of the steering wheel. Fluid leaving the steering cylinder flows back through the spool valve, then out the T port of the steering valve and returns to the hydraulic tank. When the steering wheel reaches the end of its rotation, the relief valve in the steering valve opens and directs the hydraulic flow out the steering valve T port to the oil cooler until the steering wheel is released.

Left Turn

When a left turn is made with the engine running, turning the steering wheel positions the steering control spool valve so that flow goes through the top of the spool. Flow entering the steering control valve at the P port passes through

Left Turn (continued)

the rotary meter and is directed out the L port. Pressure retracts the steering cylinder for a left turn. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount of the rotation of the steering wheel. Fluid leaving the steering cylinder flows back through the spool valve, then out the T port of the steering valve and returns to the hydraulic tank. When the steering wheel reaches the end of its rotation, the relief valve in the steering valve opens and directs the hydraulic flow out the steering valve T port to the oil cooler until the steering wheel is released.

Lift Circuit

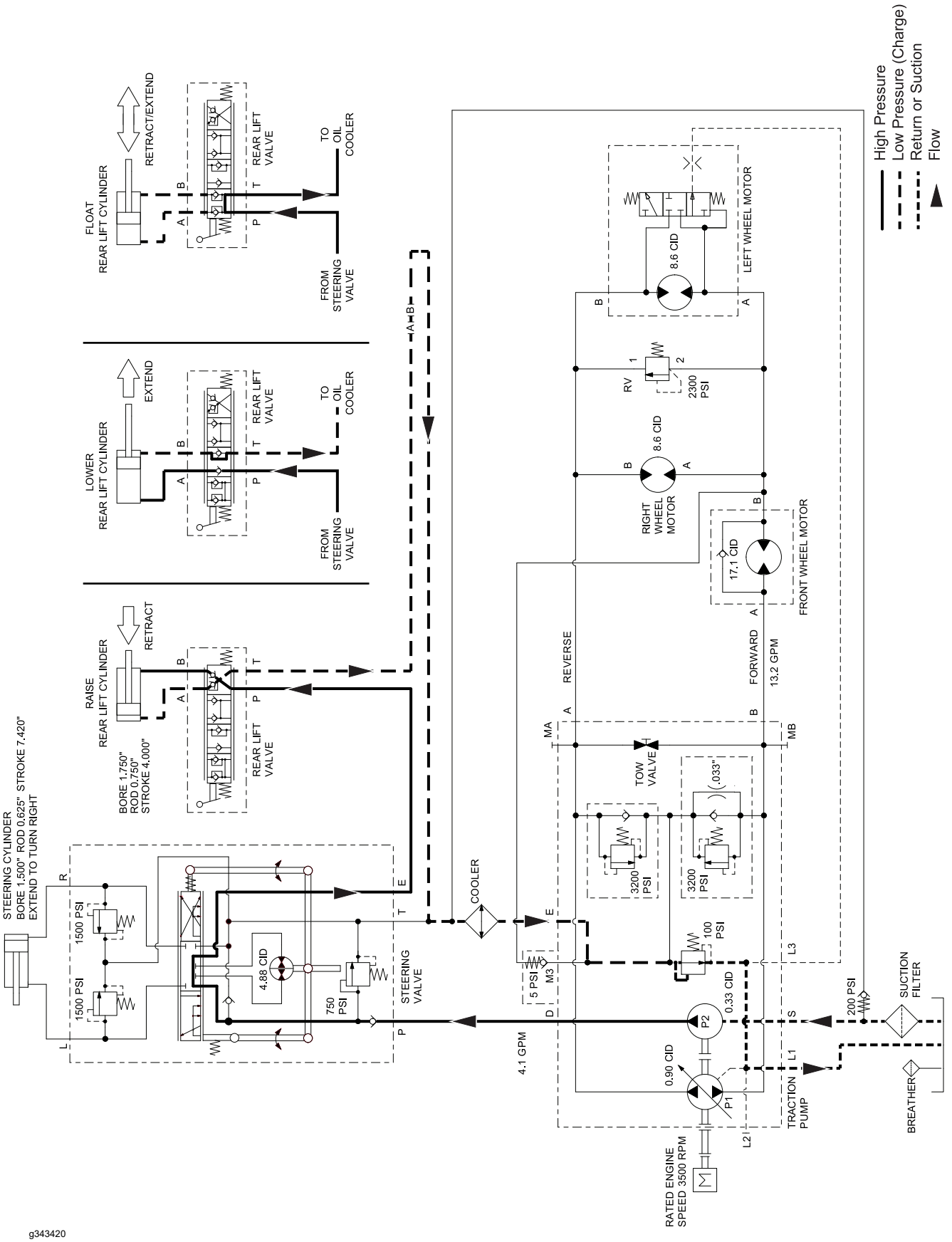

Figure 27
Lift Circuit Diagram (model 08745 shown)

The implement/charge pump (P2) is a fixed displacement gerotor pump that is part of the traction pump. The implement/charge pump also supplies fluid flow for the lift circuit and the charge circuit of the closed loop traction system for both model 08743 and 08745 machines. The implement/charge pump also supplies fluid flow to the steering circuit on model 08745 machines. On model 08745 machines, the pump output flows to the steering control valve before supplying the lift and charge circuit needs so that the steering circuit has priority.

On model 08743 machines, the steering and lift circuit pressure is limited to 5,171 kPa (750 psi) by a relief valve in a remote manifold located near the lift valve. On model 08745 machines, the steering and lift circuit pressure is limited to 5,171 kPa (750 psi) by a relief valve located in the steering valve.

The lift valve has 4 separate operating positions: NEUTRAL, RAISE, LOWER, and FLOAT. The standard rear lift valve and the optional front lift valve operate the same.

Lift Valve in the Neutral Position

When the lift lever is in the NEUTRAL position, the lift system is not actively raising, lowering or floating. Hydraulic fluid flow from the implement/charge pump bypasses the lift cylinder through the lift valve in the NEUTRAL position. The Hydraulic fluid returns to the tank as a normal part of the charge, case drain, and bleed off circuits.

Lift Valve in the Raise Position

Moving the lift lever to the RAISE position allows the lift control valve to direct fluid flow from the implement/charge pump to the rod end of the lift cylinder. The piston moves into the cylinder pushing fluid from the cap end of the cylinder and to the tank. As the cylinder rod retracts, the attachment is raised. When the cylinder reaches the end of its stroke, or if the lift mechanism is prevented from raising, the relief valve in the steering valve opens and directs the hydraulic flow out the steering valve T port to the oil cooler until the lift lever is released. When the lift lever is released, the lift valve returns to the neutral position. The attachment is held in position by check valves in the lift valve.

Lift Valve in the Lower Position

Moving the lift lever to the LOWER position allows the lift control valve to direct fluid flow from the implement/charge pump to the cap end of the lift cylinder. The piston moves out of the cylinder pushing fluid from the rod end of the cylinder and to the tank. As the cylinder rod extends, the attachment is lowered. When the cylinder reaches the end of its stroke, or if the lift mechanism is prevented from lowering, the relief valve in the steering valve opens and directs the hydraulic flow out the steering valve T port to the oil cooler until the lift lever is released. When the lift lever is released, the lift valve returns to the neutral position. The attachment is held in position by check valves in the lift valve.

Lift Valve in the Float Position

As an attachment moves over terrain with changing elevation, the lift mechanism should be allowed to move up and down (float) to follow ground contours during operation. After the attachment is fully lowered, and the lift lever is moved to the FLOAT position, a path is open in the lift valve for fluid at both ends of the lift cylinder to flow in either direction if necessary. An adjustable detent plate allows the lift lever to be held in the float position; refer to the traction unit *Operator's Manual* to adjust the lift lever detent plate.

Rear Remote Hydraulic Circuit (Optional)

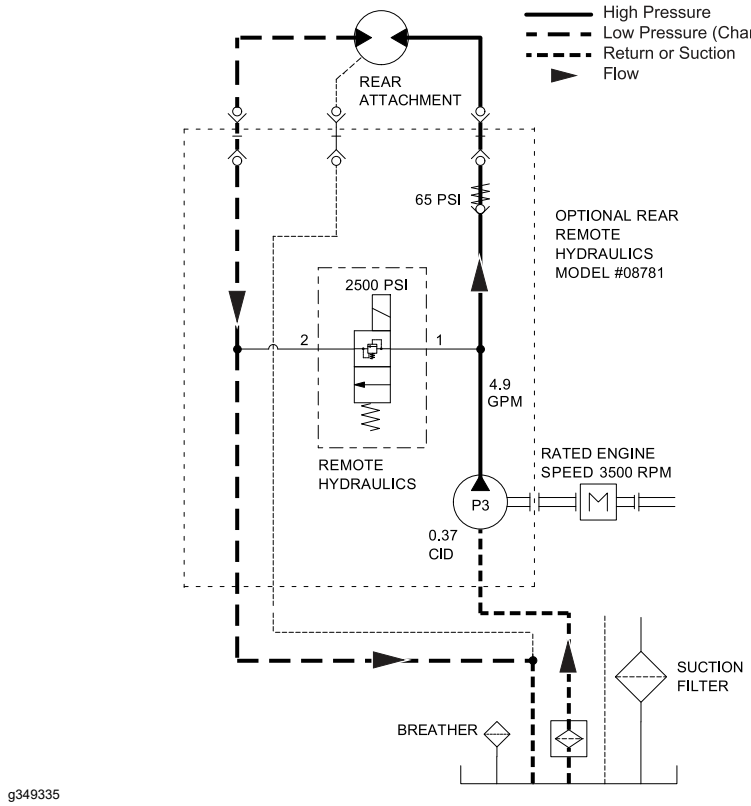

Figure 28
Rear Remote Hydraulic Circuit Diagram

A remote rear hydraulics kit (model 08781) is available for both Sand Pro 3040 and 5040 machines to support the hydraulic needs of various rear attachments. The kit includes its own fixed displacement gear type hydraulic pump (P3) and a separate hydraulic manifold. The pump is driven by the engine directly, and mounted to the rear of the engine through a rubber isolated bracket. The valve manifold is located on the left side of the machine below the hydraulic tank and includes a solenoid operated relief valve.

When the remote rear hydraulics PTO switch is in the OFF position, the valve allows hydraulic fluid to pass through the manifold, out port 2, and back to the hydraulic tank. A kPa (65 psi) check valve in the attachment supply line helps prevent the attachment from rotating while disengaged. When the remote rear hydraulics PTO switch is set to the ON position, the valve coil is energized and fluid flow is directed to the rear female quick disconnect fitting. The attachment circuit pressure is limited to 17,233 kPa (2500 psi) by the solenoid operated relief valve.

Switch Kit Hydraulic Circuit (Optional)

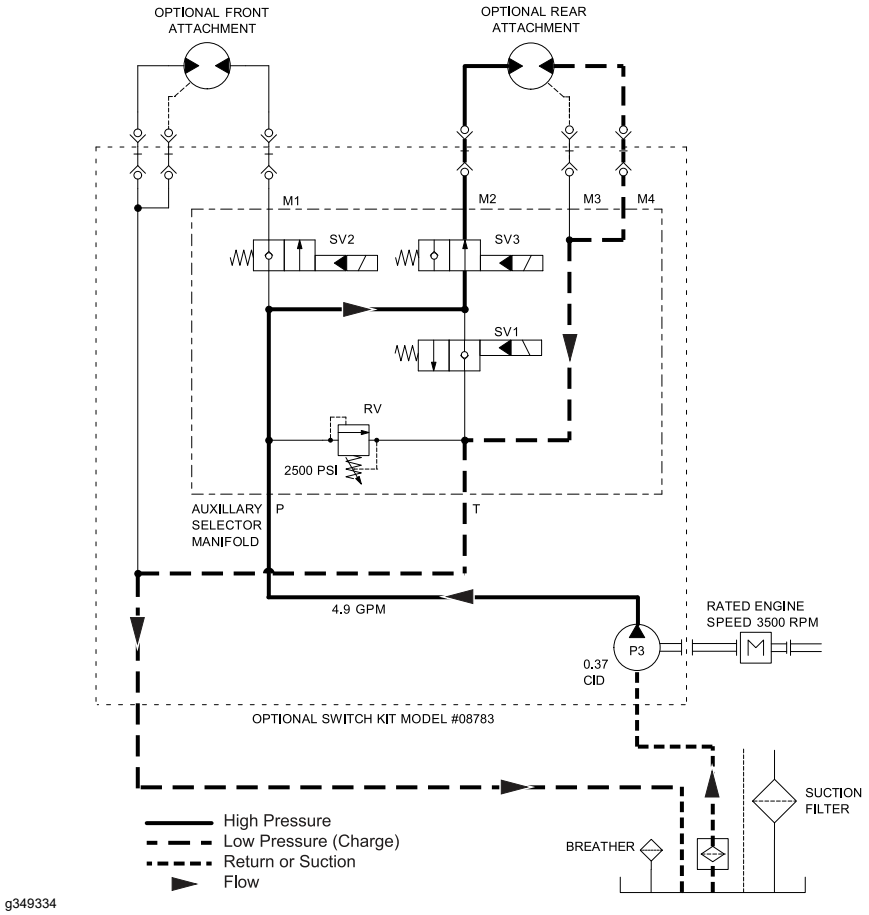

Figure 29

Switch Kit Hydraulic Circuit Diagram (rear attachment selected)

A hydraulics switch kit (model 08783) is available for Sand Pro 5040 machines to support the hydraulic needs of various front and rear attachments. The kit includes its own fixed displacement gear type hydraulic pump (P3) and a separate hydraulic manifold. The pump is driven by the engine directly, and mounted to the rear of the engine through a rubber isolated bracket. The valve manifold is mounted to the machine frame near the kit hydraulic pump and includes three 2 position solenoid valves and a relief valve.

When the switch kit PTO switch is in the OFF position, all of the solenoid valves are de-energized so hydraulic fluid can pass through the manifold and back to the hydraulic tank.

When rear remote hydraulics is selected and the switch kit PTO switch is in the ON position, solenoid valves SV1 and SV3 are energized and fluid flow is directed to the rear female quick disconnect fitting. When front remote hydraulics is selected and the switch kit PTO switch is in the ON position, solenoid valves SV1 and SV2 are energized and fluid flow is directed to the front female quick disconnect fitting. The the front and rear attachment circuit pressure is limited to 17,233 kPa (2500 psi) by the relief valve in the kit manifold.

Testing the Hydraulic System

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

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 (page 5–3).

WARNING

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

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

CAUTION

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

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

IMPORTANT

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

IMPORTANT

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

1. Use the following resources to assist with hydraulic system troubleshooting.
   - The Hydraulic Schematic in Appendix A (page A–1)
   - Hydraulic Flow Diagrams (page 5–13)
   - General and system specific troubleshooting tables in Chapter 3 – Troubleshooting.
2. Always wear the eye protection when you performing 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 a phototach (non-contact tachometer) 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 (aprox. 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 (P1): 100 engine RPM = 1.5 liters (50 ounces) of hydraulic fluid displaced per minute
   - Implement/Charge Pump (P2): 100 engine RPM = 0.5 liters (18 ounces) of hydraulic fluid displaced per minute.
   - Attachment Pump (P3) (optional): 100 engine RPM = 0.6 liters (21 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 test equipment 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 (model 08745 only), lift circuit, or 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, Wheel Motor Efficiency Test, and/or Traction Pump (P1) Flow and Relief Valve Test.

If a steering or lift circuit problem exists, consider performing one or more of the following tests: Steering Relief Valve Pressure Test (model 08745 only), Steering Cylinder Test (model 08745 only), Lift Relief Valve Pressure Test (model 08743 only), Lift Cylinder Test, and/or Implement/Charge Pump (P2) Flow Test.

If an optional attachment circuit problem exists, consider performing one or more of the following tests: Relief Valve Pressure Test, Attachment Motor Efficiency and/or Attachment Pump (P3) Flow Test.

Testing the Traction Circuit – Charge Pressure

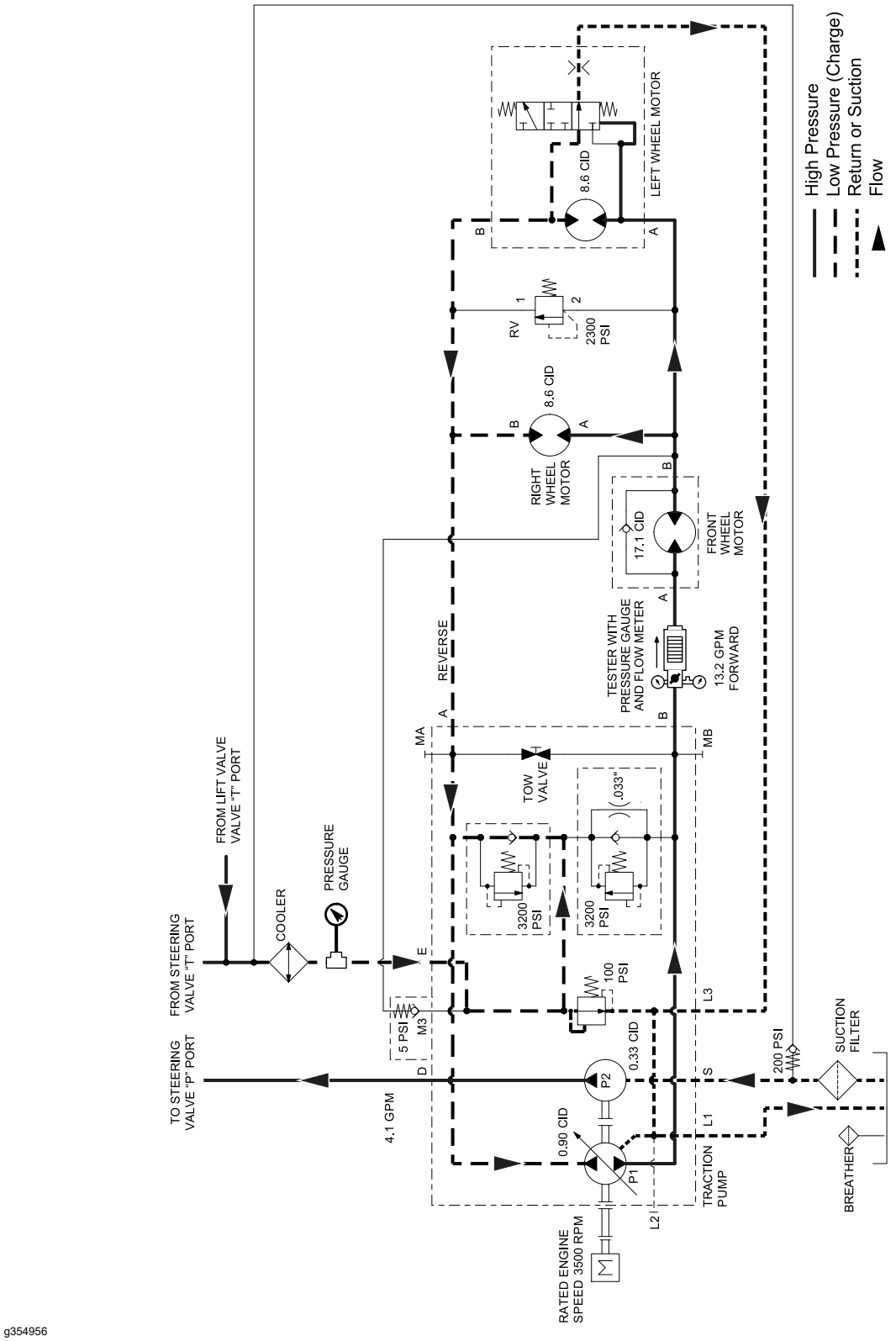

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Figure 30

Traction Circuit – Charge Pressure Test

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

Special Equipment Required:

- Pressure Gauge (accurate below 300 psi)
- Flow meter with pressure gauge that has at least a 57 liters/minute (15 gallons/minute) capacity
- Hydraulic test hose
- Non-contact tachometer (phototach)

Test Procedure

1. Park the machine on a level surface, lower any attachments, engage the parking brake, and set the key switch to the OFF position.
2. Read and adhere to the information provided in Testing the Hydraulic System (page 5–23).
3. Ensure that the traction pedal is correctly adjusted for the NEUTRAL position; refer to Adjusting the Traction System for Neutral (page 5–51).
4. Remove the center shroud.
5. Remove the 3 screws that secure the dash panel to the machine, then carefully raise the dash panel to access the rear fuel tank clamps. Remove the rear fuel tank clamps.

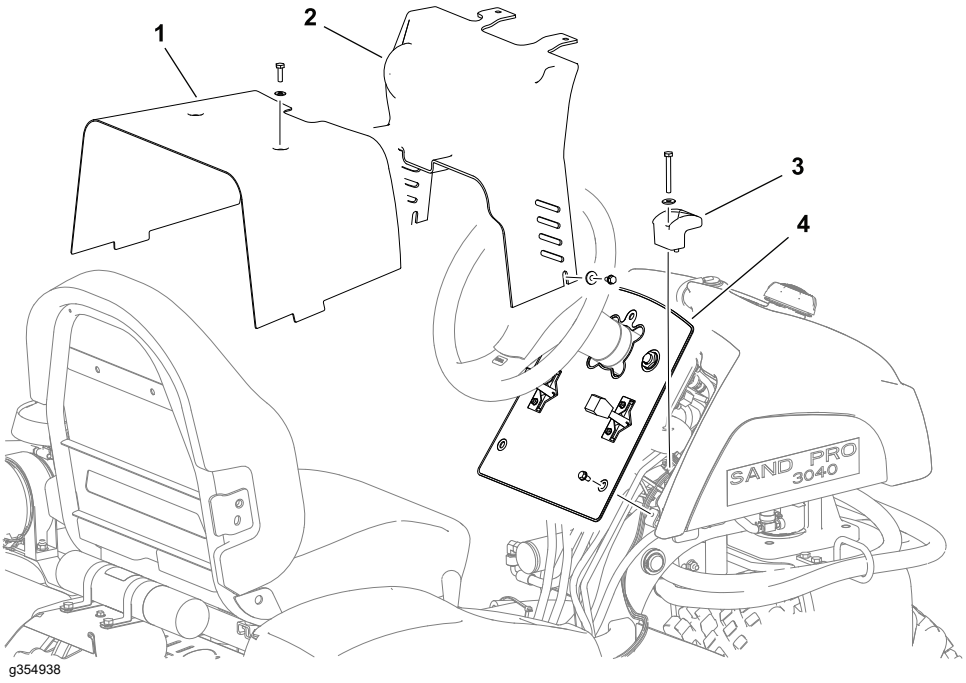

Figure 31

1. Center shroud
2. Dash shroud
3. Rear fuel tank clamp (2 each)
4. Dash panel

6. Remove the fasteners at the bottom of the dash shroud and remove the dash shroud from the machine.
7. Clean the fittings and the hydraulic hose above the front wheel and on the left side of the hydraulic fluid cooler; refer to Figure 32.

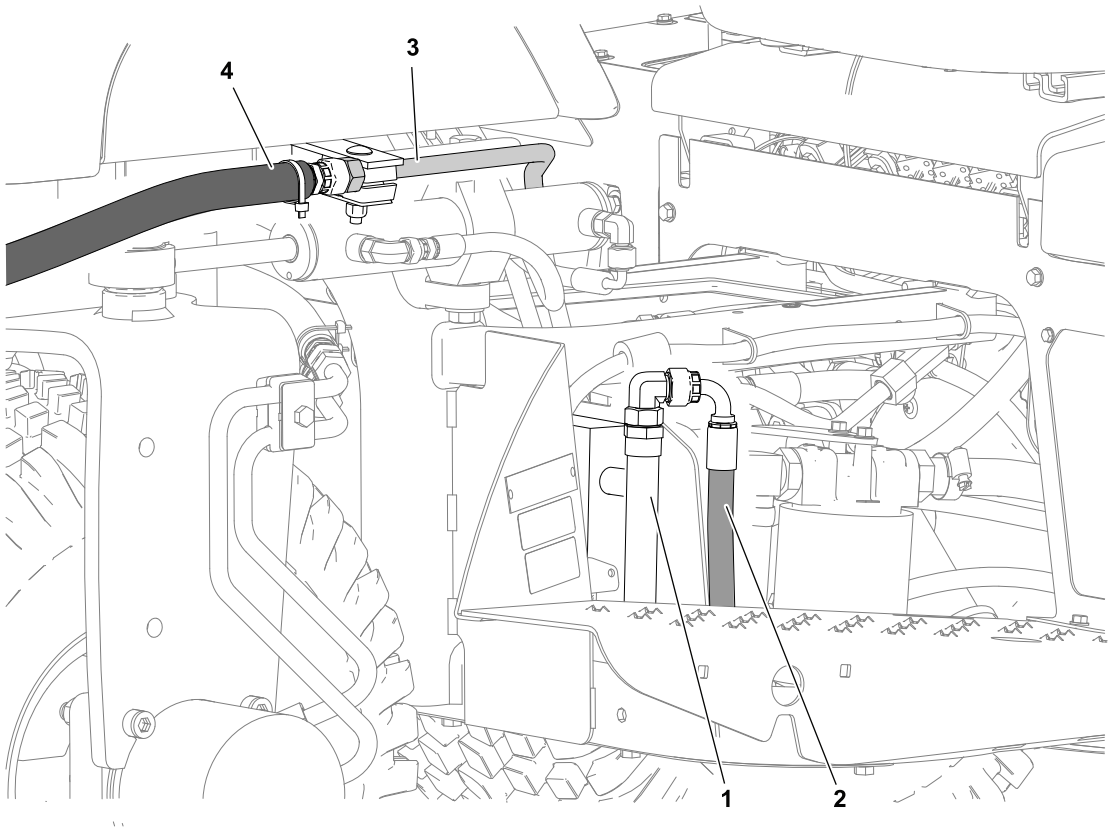

Figure 32

1. Hydraulic fluid cooler
2. Hydraulic hose
3. Hydraulic tube
4. Hydraulic hose

8. Disconnect the hose from the fitting at the fluid cooler, then install a tee fitting with the pressure gauge between the fitting and disconnected hose.
9. Disconnect the hydraulic hose at the hydraulic tube above the front wheel motor. Use an additional hydraulic hose to install the tester to the exposed fittings. Make sure the tester is installed in the correct flow direction (toward the front wheel motor) and the tester flow control valve is fully open.
10. Attach a heavy chain to the rear of the machine frame and an immovable object to prevent the machine from moving during testing.
11. Block the front wheel with chocks to prevent the wheel from rotating during testing.
12. Start the engine and run it at low-idle speed. Correct any hydraulic fluid leaks at the test connections before continuing the test.
13. Set the throttle to the full speed **(3,400 to 3,500 RPM)**. Verify the engine RPM at the drive hubs or rubber coupling with a non-contact tachometer (phototach).
14. Make sure hydraulic fluid is at normal operating temperature by operating the machine for approximately 10 minutes.
15. Record the reading on the pressure gauge at the fluid cooler (not the pressure gauge on the flow meter). The charge pressure (without load) should read approximately **690 kPa (100 psi)**. If the charge pressure specification is not met, consider the following:

A. The piston (traction) pump charge relief valve is damaged. Replace or repair the pump charge relief valve; refer to Servicing the Piston (traction) Pump (page 5–73).

B. The in-line check valve/fitting (near the piston pump suction port) is faulty.

C. The piston (traction) pump implement/charge pump (P2) is faulty (reduced lift circuit performance (and steering circuit performance on model 08745 machines) will also be affected. Test the implement/charge pump (P2) flow; refer to Testing the Lift and Steering Circuit – Implement/Charge Pump (P2) Flow and Circuit Relief (page 5–40).

16. Sit in the operator's seat, release the parking brake, and apply a load to the traction pump by slowly depressing the forward traction pedal until **6200 to 8275 kPa (900 to 1200 PSI)** is reached on the flow meter pressure gauge.
17. Record reading on pressure gauge at the fluid cooler (not the pressure gauge on the flow meter).
18. Release the traction pedal, move the throttle to low speed and set the key switch to the OFF position.
19. Charge pressure (under load) should not drop more than 20% when compared to charge pressure (without load) recorded in step 15.

    If specifications are not met, leave the test equipment installed and perform the Piston (traction) Pump (P1) Flow and Relief Pressure Test as described in Testing the Traction Circuit – Traction Pump (P1) Flow and Relief Pressure (page 5–36).
20. After testing:

    A. Remove the hydraulic tester and hoses then reconnect the hydraulic hose and tube above the front wheel motor.

    B. Remove the pressure gauge and tee then reconnect the hydraulic hose at the fluid cooler.

    C. Check and adjust the level of the hydraulic fluid in the hydraulic reservoir; refer to the traction unit *Operator's Manual*.

    D. Start the engine and check for any hydraulic fluid leaks. Repair hydraulic leaks if necessary before returning the machine to service.

Testing the Traction Circuit – Wheel Motor Efficiency

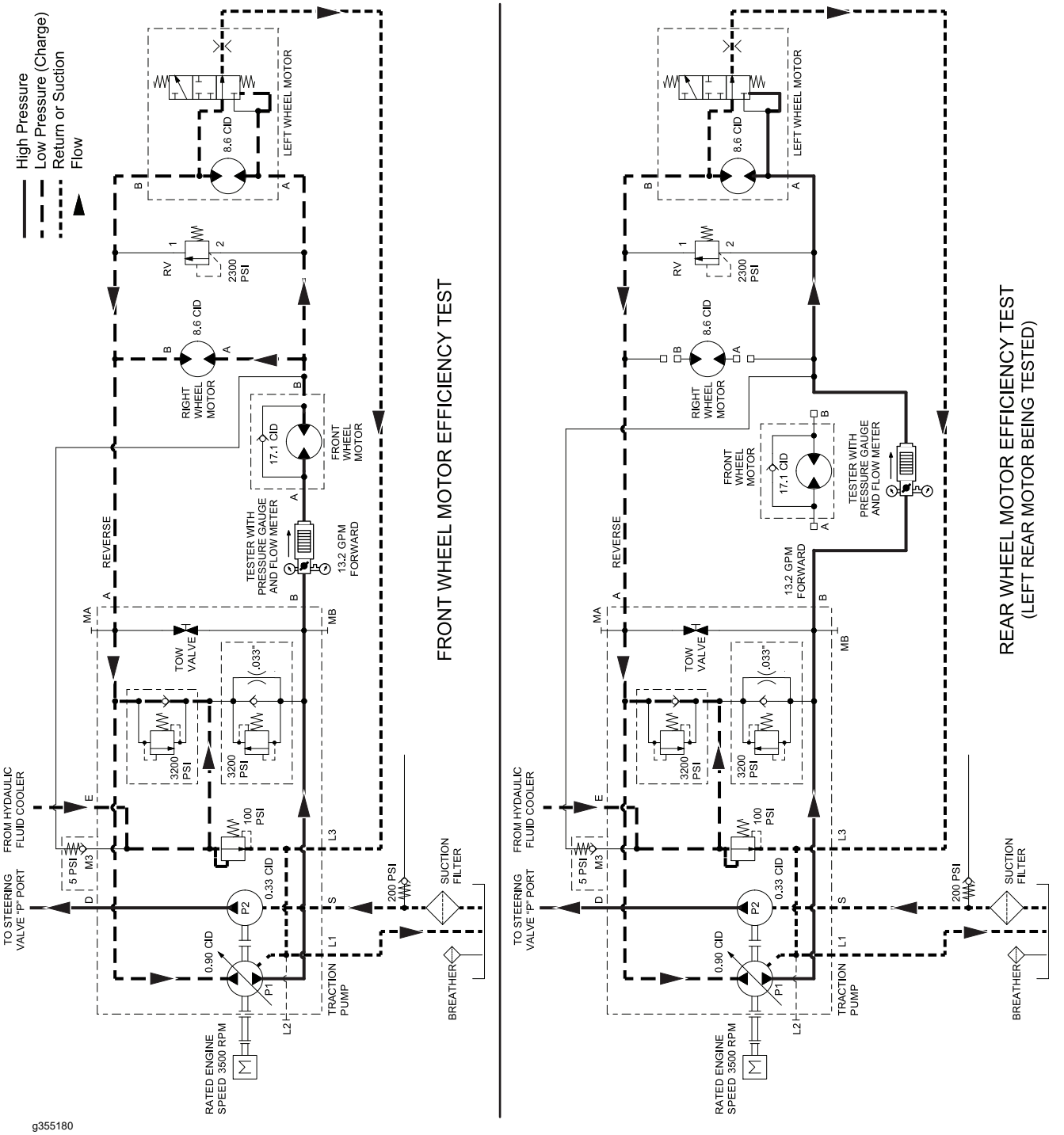

Figure 33

Traction Circuit – Wheel Motor Efficiency Tests

Wheel motor efficiency is the second in a series of tests recommended to determine traction circuit performance. Too much hydraulic fluid flow through a single stationary wheel motor under load indicates an internal leak in the wheel motor. A worn wheel motor is less efficient. Eventually, enough fluid by−pass will cause the wheel motor to stall under heavy load conditions. Continued operation can generate excessive heat, cause damage to seals and other components in the hydraulic system, and affect overall machine performance.

There are moments during wheel motor operation (geroller position) when fluid flow through the motor is less restricted. If a wheel motor is tested in this position, the test results will be higher should not be used to determine wheel motor efficiency. Test the wheel motors in three (3) different wheel positions to obtain accurate test results. Record test readings for all three (3) wheel positions and use the average for the final test result.

Special Equipment Required:

- Flow meter with pressure gauge that has at least a 57 liters/minute (15 gallons/minute) capacity
- Hydraulic test hose
- Non-contact tachometer (phototach)

IMPORTANT

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

Test Procedure

1. Park the machine on a level surface, lower any attachments, and set the key switch to the OFF position.
2. Read and adhere to the information provided in Testing the Hydraulic System (page 5–23).
3. Ensure that the traction pedal is correctly adjusted for the NEUTRAL position; refer to Adjusting the Traction System for Neutral (page 5–51).

⚠ WARNING ⚠

Review and follow the Jacking Instructions (page 1–6) before lifting the machine.

4. Raise the rear wheels off the ground and support the machine with jack stands.
5. To test the front wheel motor:
   A. Clean the hydraulic tube and hose above the front wheel; refer to Figure 34.

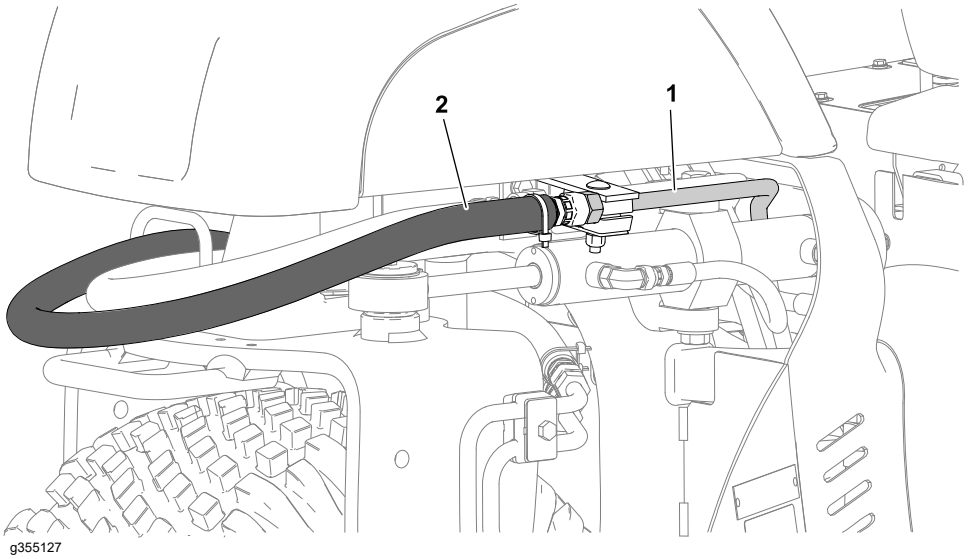

Figure 34

1. Hydraulic tube
2. Hydraulic hose

B. Disconnect the hydraulic hose at the hydraulic tube above the front wheel motor. Use an additional hydraulic hose to install the tester to the exposed fittings. Make sure the tester is installed in the correct flow direction (toward the front wheel motor) and the tester flow control valve is fully open.

C. Block the front wheel with chocks to prevent the wheel from rotating during testing.

D. Start the engine and run it at low-idle speed. Correct any hydraulic fluid leaks at the test connections before continuing the test.

E. Set the throttle to the full speed **(3,400 to 3,500 RPM)**. Verify the engine RPM at the drive hubs or rubber coupling with a non-contact tachometer (phototach).

F. Make sure hydraulic fluid is at normal operating temperature by operating the machine for approximately 10 minutes.

G. Ensure the parking brake is disengaged.

H. Sit in the operator seat and slowly push the traction pedal in the forward direction until **69.0 bar (1000 PSI)** is displayed on the tester pressure gauge.

I. With the front wheel locked (not rotating), the internal leakage for the front wheel motor will be shown on the flow meter. Record the test results.

J. Release the traction pedal, shut off the engine, and rotate the front wheel 90°. Test again and record the flow meter reading.

K. Release the traction pedal, shut off the engine, and rotate the front wheel 180°. Test again and record the flow meter reading.

L. Use the average of the 3 flow meter readings to judge the wheel motor performance. Testing of wheel motor leakage in the 3 different wheel positions will provide the most accurate test results. The flow through front wheel motor should be **less than 4 LPM (1 GPM)**.

M. Remove the test hydraulic hose and tester, then reconnect the hydraulic tube and hose above the front wheel.

6. To test either of the rear wheel motors:

A. Isolate the front wheel motor from the traction circuit by disconnecting both of the hydraulic hoses from the hydraulic tubes above the front wheel motor. Cap the hydraulic tubes and connect the hydraulic tester to the 2 disconnected hoses. Make sure the tester is installed in the correct flow direction and the tester flow control valve is fully open; refer to Figure 35.

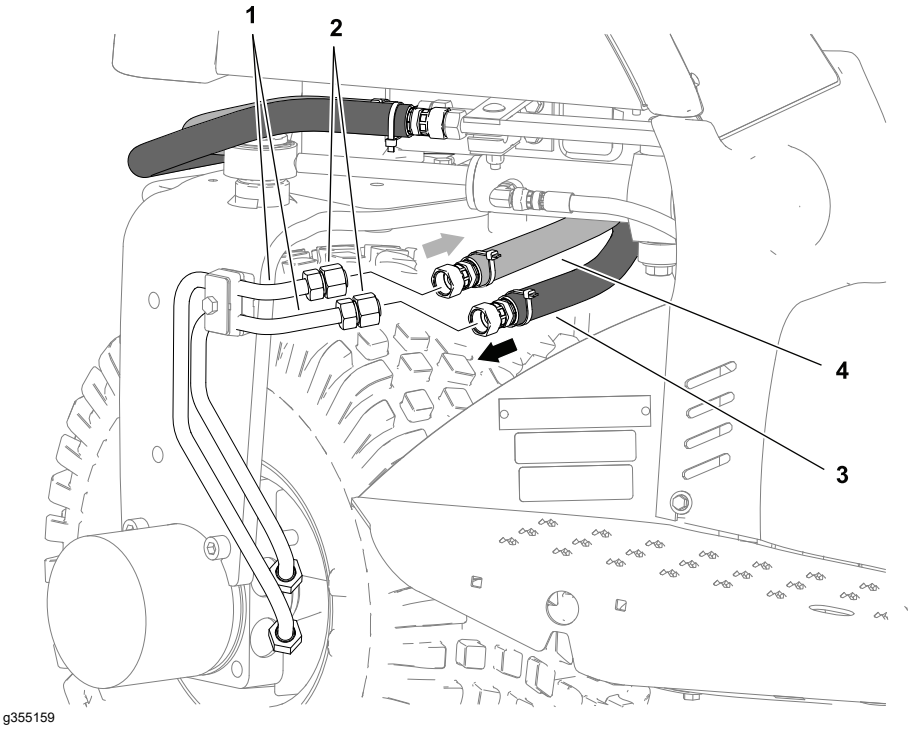

Figure 35

1. Hydraulic tubes
2. Caps
3. Hydraulic hose (forward direction pressure)
4. Hydraulic hose (forward direction return)

B. Clean the hydraulic fittings and hydraulic tubes at each rear wheel motor.

C. Remove one of the rear wheel motors from the traction circuit by disconnecting the two hydraulic lines at the motor. Cap the hydraulic fittings and lines at the disconnected motor.

D. Start the engine and run it at low-idle speed. Correct any hydraulic fluid leaks at the test connections before continuing the test.

E. Set the throttle to the full speed **(3,400 to 3,500 RPM)**. Verify the engine RPM at the drive hubs or rubber coupling with a non-contact tachometer (phototach).

F. Make sure hydraulic fluid is at normal operating temperature by operating the machine for approximately 10 minutes.

G. Engage the parking brake.

H. Sit in the operator seat and slowly push the traction pedal in the forward direction until **69.0 bar (1000 PSI)** is displayed on the tester pressure gauge.

I. The internal leakage for the connected wheel motor will be shown on the flow meter. Record the test results.

J. Release the traction pedal, shut off the engine, and rotate the connected wheel motor 90°. Test again and record the flow meter reading.

K. Release the traction pedal, shut off the engine, and rotate the connected wheel motor 180°. Test again and record the flow meter reading.

L. Use the average of the 3 flow meter readings to judge the wheel motor performance. Testing of wheel motor leakage in the 3 different wheel positions will provide the most accurate test results. The flow through a rear wheel motor should be **less than 2 LPM (0.5 GPM)**

M. Remove the caps and reconnect the hydraulic lines at the rear wheel motor.

N. To test the remaining rear wheel motor; follow steps C through L

7. Repair or replace the worm wheel motor(s) as necessary.

8. After testing:

   A. Remove the hydraulic tester then reconnect the hydraulic hoses and tubes above the front wheel motor.

   B. Remove the caps and reconnect the hydraulic lines at the rear wheel motor.

   C. Remove the test hydraulic hose and tester, then reconnect the hydraulic tubes and hoses above the front wheel.

   D. Check and adjust the level of the hydraulic fluid in the hydraulic reservoir; refer to the traction unit *Operator's Manual*.

   E. Start the engine and check for any hydraulic fluid leaks. Repair hydraulic leaks if necessary before returning the machine to service.

Testing the Traction Circuit – Traction Pump (P1) Flow and Relief Pressure

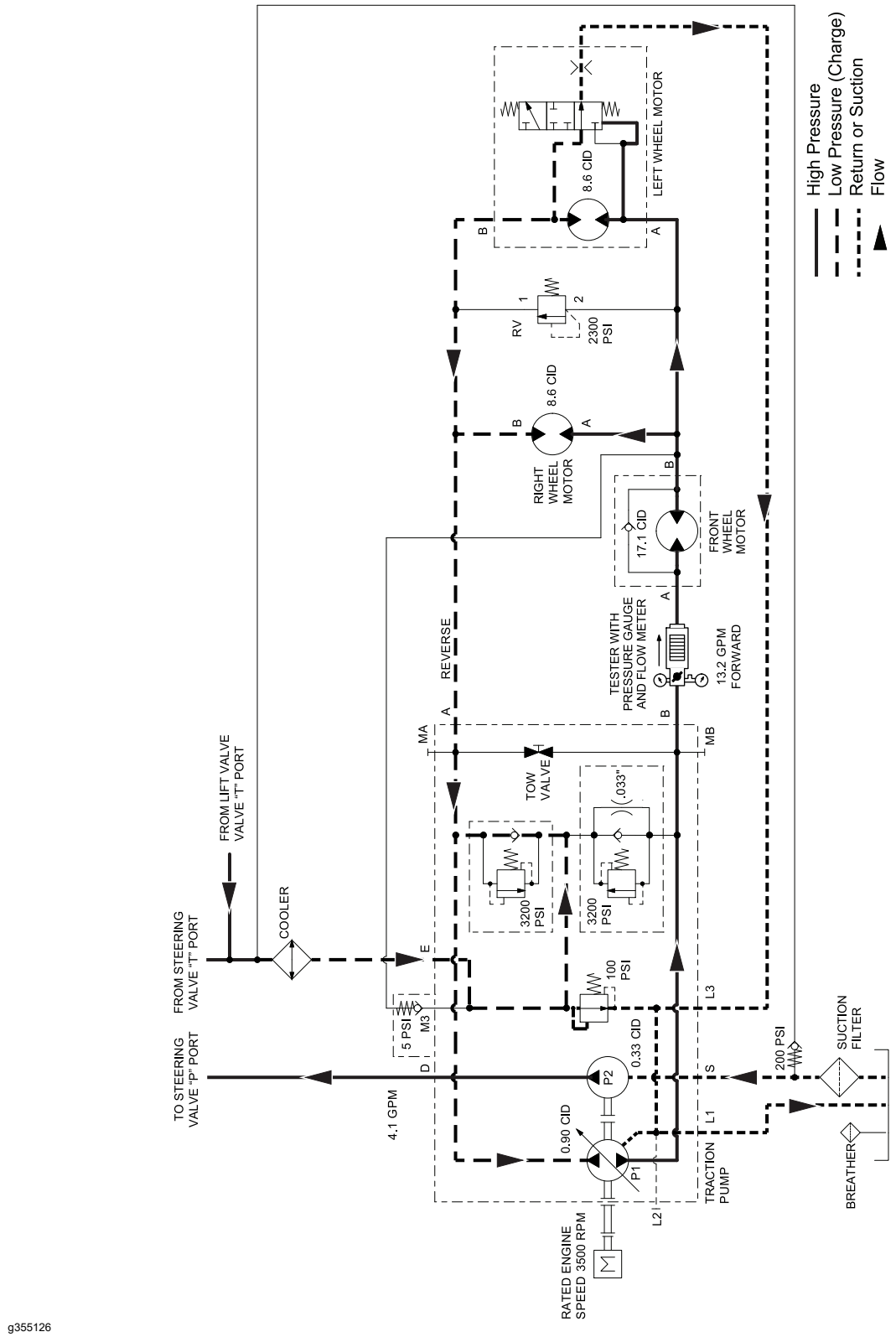

Figure 36

Traction Circuit – Piston (traction) Pump (P1) Flow and Relief Pressure Test

The hydraulic pump (P1) flow test is the third in a series of tests recommended to determine the traction circuit performance. This test compares fluid flow at No Load with fluid flow Under Load. A drop in flow under load of more than 12% indicates an internal leak or malfunctioning relief valve in the hydraulic pump. The final traction circuit test is verifying the hydraulic pump forward direction relief valve operation. A worn hydraulic pump or malfunctioning relief valve is less efficient. Eventually, enough fluid bypass will cause the unit to stall under heavy load conditions. Continued operation can generate excessive heat, cause damage to seals and other components in the hydraulic system, and affect overall machine performance.

Special Equipment Required:

- Flow meter with pressure gauge that has at least a 57 liters/minute (15 gallons/minute) capacity
- Hydraulic test hose
- Non-contact tachometer (phototach)

IMPORTANT

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

Test Procedure

1. Park the machine on a level surface, lower any attachments, and set the key switch to the OFF position.
2. Read and adhere to the information provided in Testing the Hydraulic System (page 5–23).
3. Ensure that the traction pedal is correctly adjusted for the NEUTRAL position; refer to Adjusting the Traction System for Neutral (page 5–51).

⚠ WARNING ⚠

Review and follow the Jacking Instructions (page 1–6) before lifting the machine.

4. Raise all of the wheels off the ground and support the machine with jack stands.
5. Ensure the parking brake is disengaged.
6. Clean the hydraulic hose and hydraulic tube above the front wheel; refer to Figure 37.

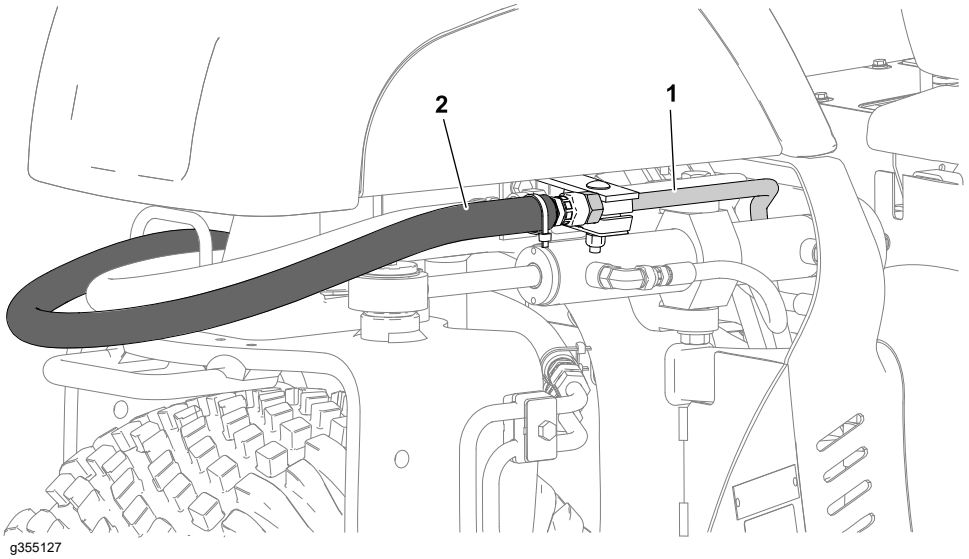

Figure 37

1. Hydraulic tube
2. Hydraulic hose

7. Disconnect the hydraulic hose at the hydraulic tube above the front wheel motor. Use an additional hydraulic hose to install the tester to the exposed fittings. Make sure the tester is installed in the correct flow direction (toward the front wheel motor) and the tester flow control valve is fully open.
8. Start the engine and run it at low-idle speed. Correct any hydraulic fluid leaks at the test connections before continuing the test.
9. Set the throttle to the full speed **(3,400 to 3,500 RPM)**. Verify the engine RPM at the drive hubs or rubber coupling with a non-contact tachometer (phototach).
10. Make sure hydraulic fluid is at normal operating temperature by operating the machine for approximately 10 minutes.
11. Sit in the operator seat and slowly push the traction pedal to the full FORWARD position.
12. Verify the pump flow at No Load as follows:
    A. Sit in the operator seat and slowly press the traction pedal to the fully FORWARD position.
    B. Unrestricted pump output should be approximately **51 LPM (13.5 GPM)**.
    C. Record the tester pressure and flow readings.
13. Verify the pump flow Under Load as follows:
    A. Slowly press the traction pedal to fully FORWARD position.
    B. Apply an additional load of **8,274 to 12,410 kPa (1,200 to 1,800 psi)** by slowly closing the flow meter.
    C. Record the tester pressure and flow readings under load.
14. Verify the forward traction relief valve operation as follows:
    A. With the traction pedal in the NEUTRAL position, fully close the flow meter flow control valve.
    B. Slowly press the traction pedal toward the FORWARD position.
    C. The system pressure should reach approximately **25,750 kPa (3,300 psi)** before the relief valve opens. Record the tester pressure reading.

Note: The relief valve setting is **22,050 kPa (3,200 psi)**. An additional **690 kPa (100 psi)** is necessary to overcome system charge pressure before the relief valve opens.

D. Release the traction pedal, open the flow control valve fully, move the throttle to low speed, and set the key switch to the OFF position.

15. If the relief pressure can not be met or is greater than specified, the forward traction relief valve is damaged and should be repaired or replaced.
16. The under load test flow reading (step 13) should not drop more than 12% (6 LPM (1.6 GPM)) when compared to the no load test flow reading (step 12). A difference of more than 12% (Under Load > No Load X 0.88) may indicate the hydraulic pump is worn and should be replaced or repaired; refer to Piston (traction) Pump (page 5–69) or Servicing the Piston (traction) Pump (page 5–73).
17. After testing:
    A. Remove the hydraulic test hose and tester.
    B. Remove the caps and connect the hydraulic hoses and tubes.
    C. Check and adjust the level of the hydraulic fluid in the hydraulic reservoir; refer to the traction unit *Operator's Manual*.
    D. Start the engine and check for any hydraulic fluid leaks. Repair hydraulic leaks if necessary before returning the machine to service.
    E. Remove the jack stands and lower the machine to the ground.

Testing the Lift and Steering Circuit – Implement/Charge Pump (P2) Flow and Circuit Relief

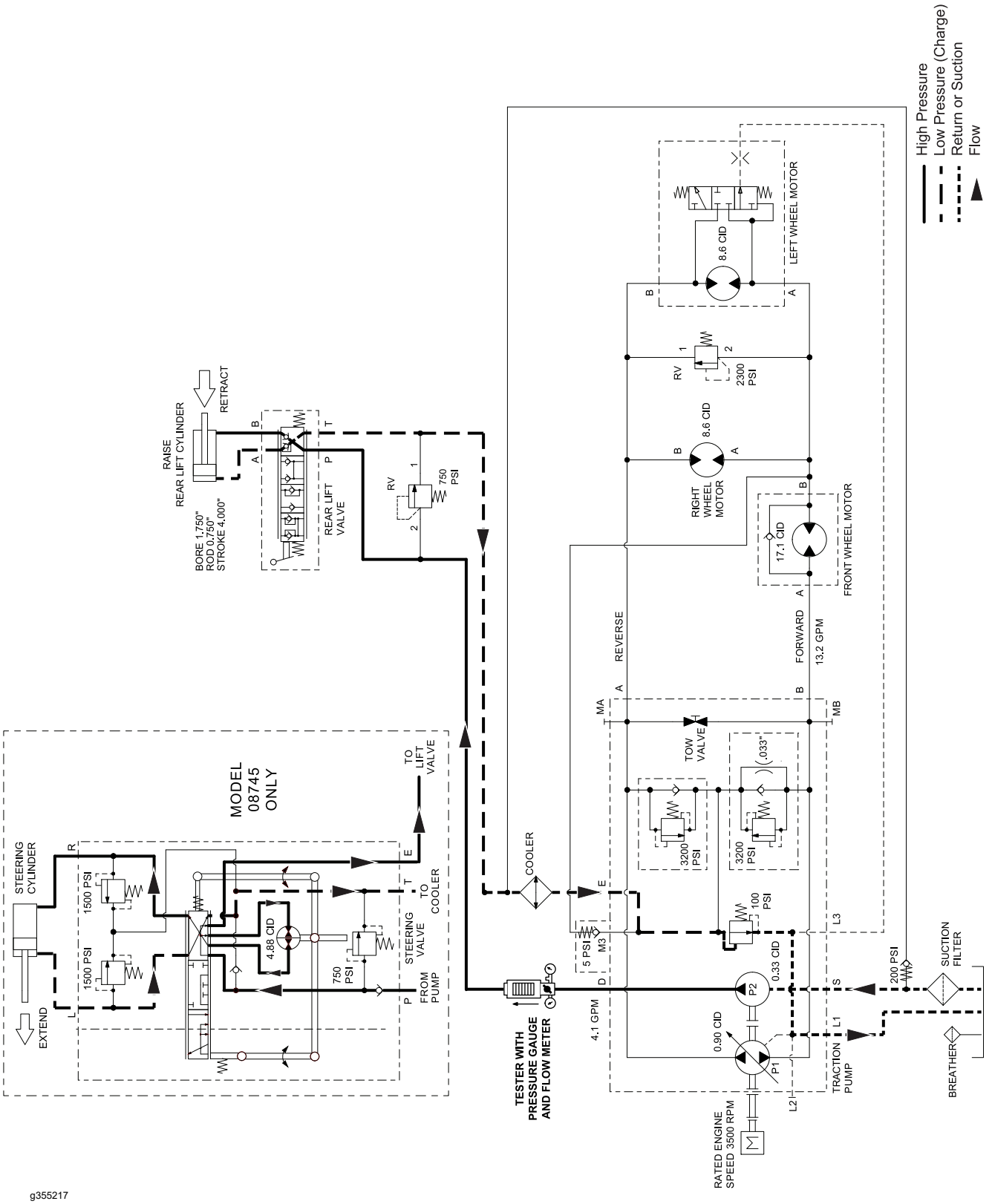

Figure 38

Implement/Charge Pump (P2) Flow and Circuit Relief Test

The implement/charge pump (P2) is part of the piston (traction) pump assembly. The implement/charge pump is designed to satisfy the needs of the lift cylinder (and steering cylinder on model 08745 machines) simultaneously at full speed throttle. The Implement/Charge Pump (P2) Flow and Circuit Relief Test compares fluid flow at No Load with fluid flow Under Load. A drop in flow under load of more than 20% indicates the internal components of the pump have worn. Continued operation with a worn pump can generate excessive heat and cause damage to the seals and other components in the hydraulic system.

On model 08743 machines, the circuit relief valve is part of remote manifold near the lift valve. On model 08745 machines, the relief valve for the steering and lift circuit is integrated into the steering control valve.

If both steering and lift operations perform poorly, perform the implement/charge pump (P2) flow test and the circuit relief valve test.

Special Equipment Required:

- Flow meter with pressure gauge that has at least a 16 liter/minute (5 gallons/minute) capacity.
- 1 or 2 hydraulic test hoses

Test Procedure

1. Park the machine on a level surface, lower any attachments, engage the parking brake, and set the key switch to the OFF position.
2. Read and adhere to the information provided in Testing the Hydraulic System (page 5–23).
3. Remove the center shroud.
4. Clean the fitting and the hydraulic hose on the right side of the hydraulic pump shown; refer to Figure 39.

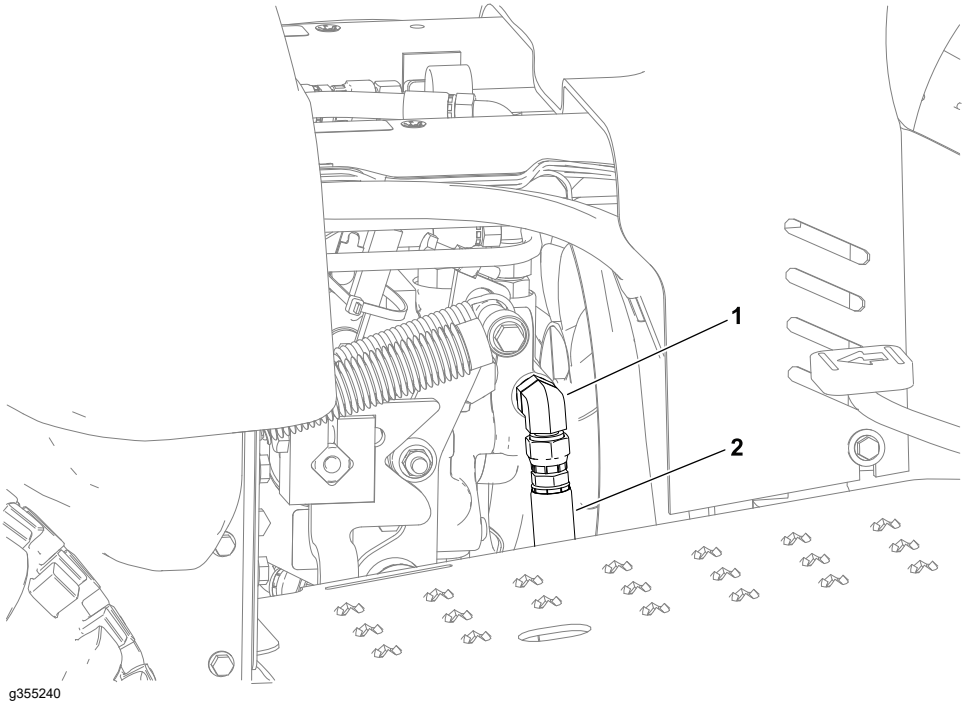

Figure 39

1. Elbow fitting at hydraulic pump
2. Hydraulic hose

5. Disconnect the hydraulic hose and install the tester between the exposed fitting and the disconnected hose. Make sure the tester is installed in the

correct flow direction (away from the pump) and the tester flow control valve is fully open.

6. Start the engine and run it at low-idle speed. Correct any hydraulic fluid leaks at the test connections before continuing the test.
7. Set the throttle to the full speed **(3,400 to 3,500 RPM)**. Verify the engine RPM at the drive hubs or rubber coupling with a non-contact tachometer (phototach).
8. Make sure hydraulic fluid is at normal operating temperature by operating the machine for approximately 10 minutes.
9. Verify the pump flow at No Load as follows:
   A. Unrestricted pump output should be approximately **19 LPM (5 GPM)**.
   B. Record the tester pressure and flow readings at no load.
10. Verify the pump flow Under Load as follows:

⚠ CAUTION ⚠

Do not close tester valve fully when performing this test. In this test, the hydraulic tester is positioned before the circuit relief valve. Pump damage can occur if the fluid flow is completely restricted by fully closing the tester flow control valve.

   A. Monitor the tester pressure gauge carefully while slowly closing the flow control valve until **5,516 kPa (800 psi)** is obtained on the tester pressure gauge.
   B. Record the tester pressure and flow readings under load.
   C. Open the tester flow control valve fully.
11. Verify the circuit relief valve operation as follows:

⚠ CAUTION ⚠

When performing the test, do not allow the tester pressure to exceed 8300 kPa (1400 PSI).

IMPORTANT

Hold the lift lever in the fully raised position or hold the steering wheel at the fully locked position only long enough to obtain a system pressure reading.

   A. Open the circuit relief valve via the lift system. Watch the pressure gauge on the tester and move the lift lever to the RAISE position. Momentarily hold the lever with the hitch fully raised causing the circuit relief valve to open. Record the pressure at which the relief valve opens.
   B. On model 08745 machines, open the circuit relief valve via the steering system. Watch the pressure gauge on the tester and turn the steering wheel completely in one direction. The circuit relief valve should open just after the front wheel gets to the full lock position. Record the pressure at which the relief valve opens.

Test Procedure (continued)

12. Move the throttle to low speed position and set the key switch to the OFF position.
13. The under load test flow reading (step 10) should not drop more than 20% (3.8 LPM (1 GPM)) when compared to the no load test flow reading (step 9). A difference in flow of more than 20% (Under Load > No Load X 0.8) may indicate:
    A. A restriction in the pump inlet line.
    B. The implement/charge pump is worn and should be replaced or repaired; refer to Piston (traction) Pump (page 5–69) or Servicing the Piston (traction) Pump (page 5–73).
14. The circuit relief valve pressure should be **4825 to 5500 kPa (700 to 800 PSI)**. If the relief pressure can not be met or is greater than specified, the lift relief valve (model 08743) or steering control valve (model 08745) is damaged and should be repaired or replaced; refer to Rear Lift Relief Manifold (Model 08743) (page 5–84) or Steering Control Valve (Model 08745) (page 5–98) and Servicing the Steering Control Valve (Model 08745) (page 5–100).
15. After testing:
    A. Remove the hydraulic test hose(s) and tester.
    B. Connect the hydraulic hose previously removed.
    C. Check and adjust the level of the hydraulic fluid in the hydraulic reservoir; refer to the traction unit *Operator's Manual*.
    D. Start the engine and check for any hydraulic fluid leaks. Repair hydraulic leaks if necessary before returning the machine to service.

Testing the Steering Circuit (Model 08745 only) – Steering Cylinder Internal Leakage

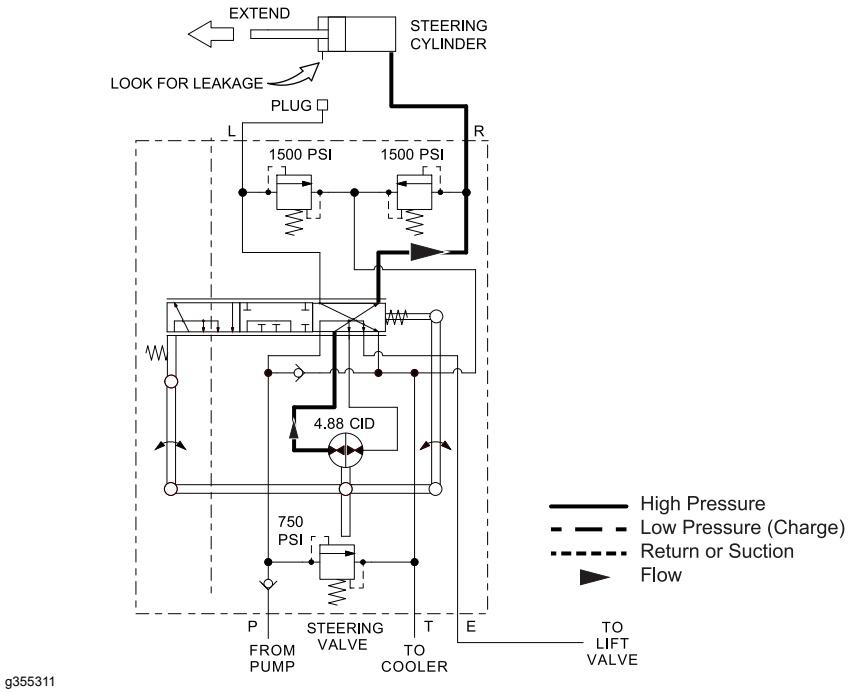

Figure 40

Steering Circuit (Model 08745 only) – Steering Cylinder Internal Leakage Test

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

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

Test Procedure

1. Ensure that the hydraulic fluid is at normal operating temperature by operating the machine for at least 10 minutes.
2. Drive the machine slowly in a figure eight on a flat level surface.
   A. There should be no shaking or vibration in the steering wheel or front wheel.
   B. The steering wheel movements should be followed immediately by a corresponding front wheel movement without the steering wheel continuing to turn.
3. Stop the unit with the engine running. Turn the steering wheel with small quick movements in both directions. Let go of the steering wheel after each movement.
   A. The steering control valve should respond to each steering wheel movement.
   B. When steering wheel is released, steering control valve should return to the neutral position with no additional turning.
4. Determine if the steering cylinder has internal leakage using the following procedure:

A. Park the machine on a level surface, lower any attachments, and engage the parking brake.

B. With the engine running, turn the steering wheel to the right (clockwise) until the steering cylinder rod is fully extended and set the key switch to the OFF position.

C. Read and adhere to the information provided in Testing the Hydraulic System (page 5–23).

D. Clean the hydraulic fitting and hydraulic hose at the rod end of the steering cylinder. Disconnect and plug the hydraulic hose.

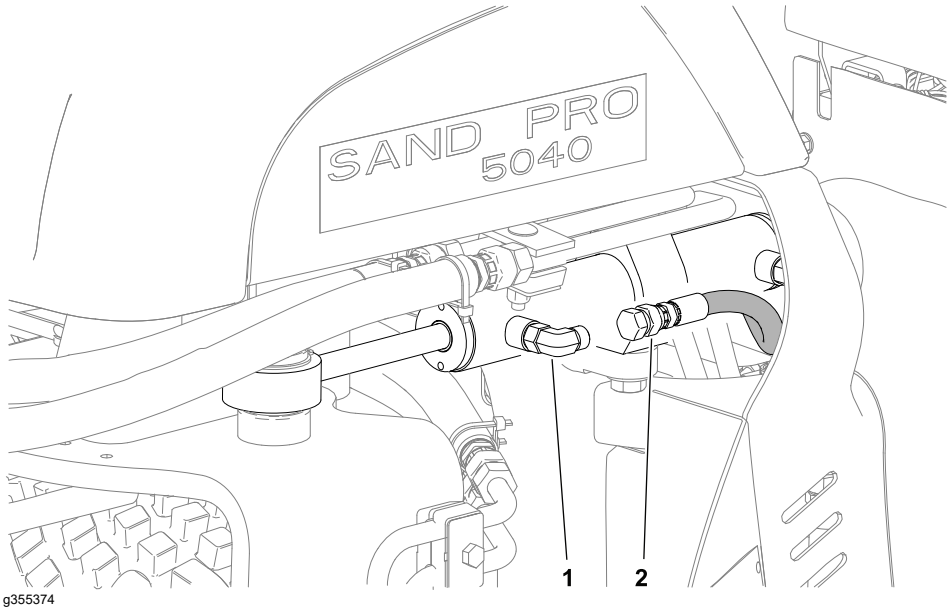

Figure 41

1. Elbow fitting at steering cylinder rod end
2. Hydraulic hose – plugged

E. With the engine not running, continue turning the steering wheel to the right (clockwise). Monitor the hydraulic fluid at the open fitting on the steering cylinder as the steering wheel is turned to the right.

If oil comes out of the fitting while turning the steering wheel to the right, the steering cylinder has internal leakage and should be repaired or replaced; refer to Steering Cylinder (Model 08745) (page 5–101) or Servicing the Steering Cylinder (Model 08745) (page 5–103).

5. If a steering problem exists and the steering cylinder tested acceptably, the steering control valve may require repair or replacement; refer to Steering Control Valve (Model 08745) (page 5–98) or Servicing the Steering Control Valve (Model 08745) (page 5–100).

6. After testing:

A. Connect the hydraulic hose.

B. Check and adjust the level of the hydraulic fluid in the hydraulic reservoir; refer to the traction unit *Operator's Manual*.

C. Start the engine and operate the steering system. Check for any hydraulic fluid leaks. Repair hydraulic leaks if necessary before returning the machine to service.

Testing the Lift Circuit – Lift Cylinder Internal Leakage

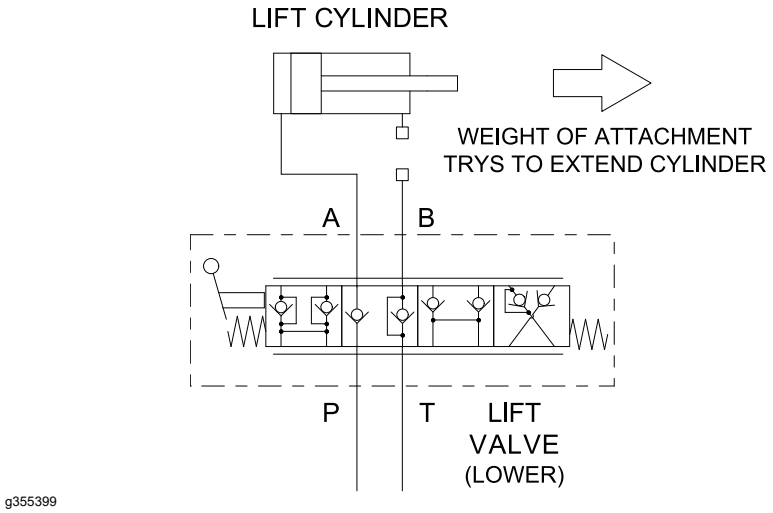

Figure 42
Lift Circuit – Lift Cylinder Internal Leakage Test

Perform the lift cylinder internal leakage test if you identify an attachment lift or lower problem. This test determines if the lift cylinder being tested is damaged. When performing the lift cylinder internal leakage test, the attachment should be attached to the hitch assembly.

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

Note: On model 08743 machines, the relief valve for the lift circuit is part of a remote manifold located near the lift valve. On model 08745 machines, the relief valve for the lift circuit is integrated into the steering control valve.

Test Procedure

1. Park the machine on a level surface, raise any attachments, engage the parking brake, and set the key switch to the OFF position.
2. Use a jack to support the attachment and prevent it from lowering. This removes the load from the lift cylinder and relieves the lift cylinder hydraulic pressure.
3. Clean and disconnect the hydraulic hose and fitting at the rod end of the lift cylinder; refer to Figure 43.

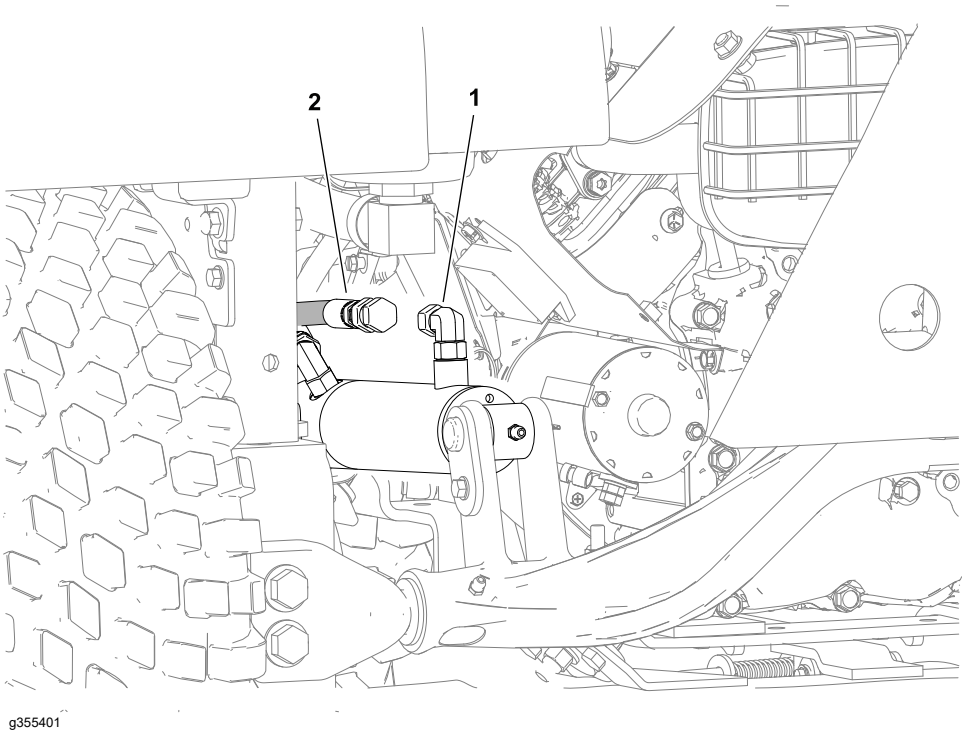

Figure 43

1. Elbow fitting at lift cylinder rod end – capped
2. Hydraulic hose – plugged

4. Cap the disconnected fitting and plug the disconnected hose.
5. Remove the block or jack stand supporting the attachment, then lower and remove the jack.
6. Sit in the operator's seat hold the lift lever in the LOWER position.
7. The capped lift cylinder should be able to support the attachment for a short period (long enough for the machine to move from one area of the work site to another during operation).
8. Release the lift lever.
9. If the lift cylinder allows the attachment to lower too quickly, replace or repair the lift cylinder; refer to Rear Lift Cylinder (page 5–93), Servicing the Rear Lift Cylinder (page 5–95), Front Lift Cylinder (Optional) (page 5–106), or Servicing the Front Lift Cylinder (Optional) (page 5–108).
10. After testing:
    A. Use a jack to raise the attachment slightly. Support the attachment with blocks or jack stands to prevent it from lowering. This removes the load from the lift cylinder and relieves the lift cylinder hydraulic pressure.
    B. Remove the cap and plug and connect the hydraulic hose.
    C. Check and adjust the level of the hydraulic fluid in the hydraulic reservoir; refer to the traction unit *Operator's Manual*.
    D. Start the engine and operate the lift cylinder. Check for any hydraulic fluid leaks. Repair hydraulic leaks if necessary before returning the machine to service.

Testing the Optional Attachment Circuit – Attachment Pump (P3) Flow and Circuit Relief

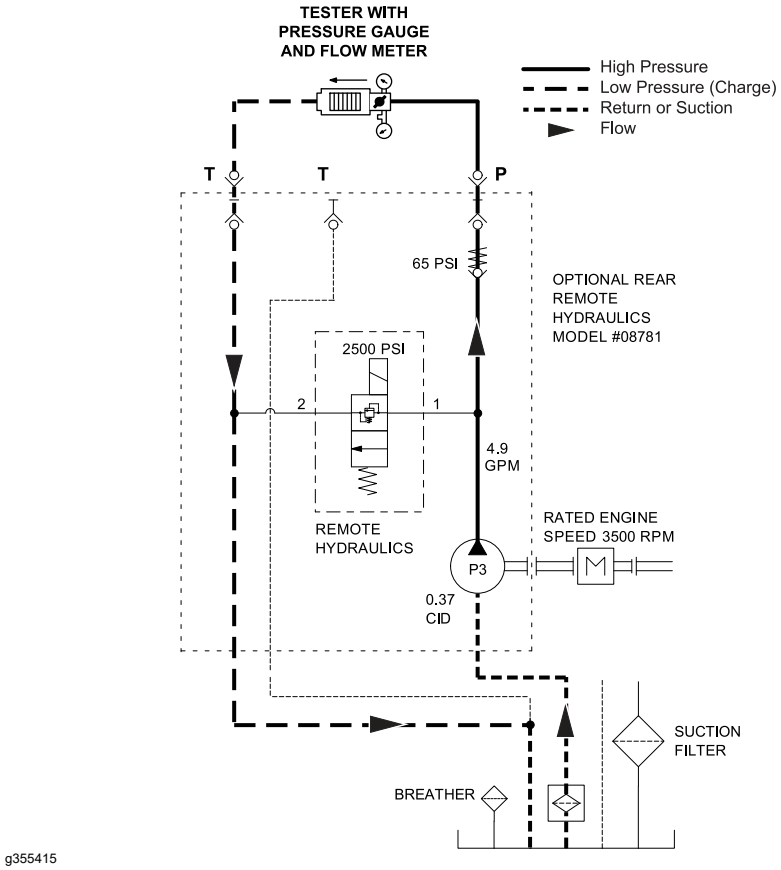

Figure 44

Optional Attachment Circuit – Attachment Pump (P3) Flow and Circuit Relief

A remote rear hydraulics kit (model 08781) is available for both Sand Pro 3040 and 5040 machines to support the hydraulic needs of various rear attachments. A hydraulics switch kit (model 08783) is available for Sand Pro 5040 machines to support the hydraulic needs of various front and rear attachments. Each kit includes its own fixed displacement gear type hydraulic pump (P3) driven directly by the engine. The Attachment Pump (P3) Flow Test compares fluid flow at No Load with fluid flow Under Load. A drop in flow under load of more than 15% indicates the gears and wear plates in the pump have worn. Continued operation with a worn pump can generate excessive heat and cause damage to the seals and other components in the hydraulic system.

The relief valve for the remote rear hydraulics kit (model 08781) is part of the solenoid valve on the kit hydraulic manifold. The relief valve for the hydraulics switch kit (model 08783) is a separate cartridge style valve on the kit manifold.

Special Equipment Required:

- Flow meter with pressure gauge that has at least a 32 liter/minute (10 gallons/minute) capacity.
- 2 hydraulic test hoses with quick-disconnect fittings
- Non-contact tachometer (phototach)

Test Procedure

1. Park the machine on a level surface, lower any attachments, engage the parking brake, and set the key switch to the OFF position.

2. Read and adhere to the information provided in Testing the Hydraulic System (page 5–23).
3. Disconnect the attachment from the kit quick-disconnect fittings or remove the covers and plugs from the quick-disconnect fittings.
4. Use 2 hydraulic test hoses to install the tester to the kit quick-disconnect fittings. Make sure the tester is installed in the correct flow direction (from the “P” connector to the “T” connector) and the tester flow control valve is fully open; refer to Figure 45.

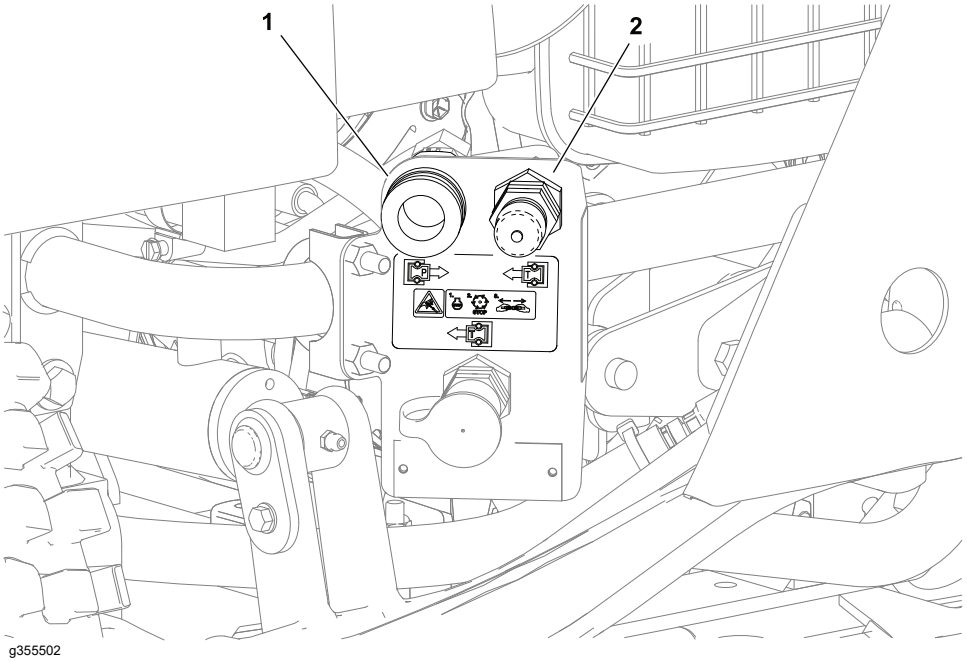

Figure 45

1. Rear remote hydraulic kit “P” connector
2. Rear remote hydraulic kit “T” connector

5. Start the engine and run it at low-idle speed. Correct any hydraulic fluid leaks at the test connections before continuing the test.
6. Set the throttle to the full speed **(3,400 to 3,500 RPM)**. Verify the engine RPM at the drive hubs or rubber coupling with a non-contact tachometer (phototach).
7. Make sure hydraulic fluid is at normal operating temperature by operating the machine for approximately 10 minutes.
8. Sit in the operator’s seat and engage the kit PTO switch.
9. Verify the pump flow at No Load as follows:
   A. Unrestricted pump output should be approximately **21 LPM (5.5 GPM)**.
   B. Record the tester pressure and flow readings at no load.
10. Verify the pump flow Under Load as follows:
    A. Monitor the tester pressure gauge carefully while slowly closing the flow control valve until **5,516 kPa (800 psi)** is obtained on the tester pressure gauge.
    B. Record the tester pressure and flow readings under load.
    C. Open the tester flow control valve fully.
11. Verify the kit relief valve operation as follows:

A. Monitor the tester pressure gauge carefully while slowly closing the flow control valve

B. The system pressure should reach approximately **17,235 kPa (2,500 psi)** before the relief valve opens. Record the tester pressure reading.

C. Open the flow control valve fully, move the throttle to low speed, and set the key switch to the OFF position.

12. If the relief pressure can not be met or is greater than specified, the kit relief valve is damaged and should be repaired or replaced.

13. The under load test flow reading (step 10) should not drop more than 20% (3.8 LPM (1 GPM)) when compared to the no load test flow reading (step 9). A difference in flow of more than 20% (Under Load > No Load X 0.8) may indicate:

    A. A restriction in the pump inlet line.

    B. The optional attachment pump is worn and should be repaired or replaced; refer to Rear Remote Hydraulics (Optional) or Switch Kit (Optional) Hydraulic Pump (page 5–111) or Servicing the Optional Rear Remote Hydraulics or Optional Switch Kit Hydraulic Pump (page 5–113).

14. After testing:

    A. Remove the hydraulic test hose(s) and tester.

    B. Protect the kit quick-disconnect fittings from contamination by installing with the covers and plugs provided with the kit.

    C. Check and adjust the level of the hydraulic fluid in the hydraulic reservoir; refer to the traction unit *Operator's Manual*.

    D. Start the engine and check for any hydraulic fluid leaks. Repair hydraulic leaks if necessary before returning the machine to service.

Adjustments

Adjusting the Traction System for Neutral

The traction pedal must return to the NEUTRAL position when released from either the forward or reverse position. The machine must not creep in either direction on level ground when in the traction pedal is in the NEUTRAL position. Adjust the traction system for neutral as follows:

1. Park the machine on a level surface, lower any attachments and set the key switch to the OFF position.
2. Remove the center shroud.

WARNING

Review and follow the Jacking Instructions (page 1–6) before lifting the machine.

3. Raise all of the wheels off the ground and support the machine with jack stands.
4. Loosen the lock nut on the traction (piston) pump adjustment cam.

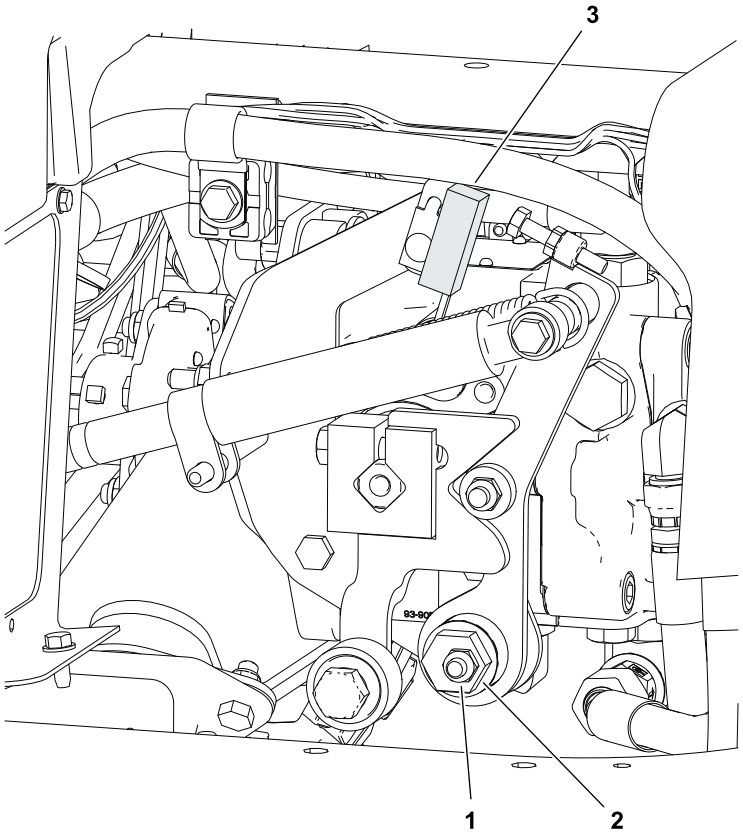

Figure 46

1. Lock nut
2. Traction adjustment cam
3. Traction neutral switch

5. Have an assistant sit in the Operator's seat, start the engine, and set the throttle to high idle.
6. Use the large hex on the adjust the cam to adjust the NEUTRAL position:

Adjusting the Traction System for Neutral (continued)

A. Turn the adjustment cam slowly until the wheel begins to rotate in the forward direction (position F).

B. Turn the adjustment cam slowly in the opposite direction until the wheel begins to rotate in the reverse direction (position R).

C. Turn the adjustment cam to the mid point between position F and R. The wheels should not rotate in either direction.

7. Tighten the locknut securing the adjustment cam.
8. Shut off the engine.
9. Check the transmission neutral switch air gap and adjust if necessary; refer to Adjusting the Traction Neutral Switch (page 6–16).
10. Install the center shroud.
11. Remove the jack stands and lower the machine to the ground.
12. Test the traction system operation before returning the machine to service.

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 any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the 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. Record 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 or plug the opening as soon as the opening 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 tank and change the oil filter 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.
4. Use proper tightening procedures when installing the hydraulic hoses and fittings; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal

Fitting) (page 5–7) and Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9).

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 5–62).
7. After you disconnect or replace any hydraulic components, operate the machine functions slowly until the air is out of the system; refer to Charging the Hydraulic System (page 5–63).
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 pin-hole leaks or nozzles that eject high-pressure hydraulic fluid.**
- **Use a piece of cardboard or paper to find hydraulic leaks.**
- **Release all pressure in the hydraulic system before performing any work on the system.**
- **Seek immediate medical attention if hydraulic fluid is injected into your skin.**

IMPORTANT

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

Flushing the Hydraulic System

IMPORTANT

If a component failure occurs in the traction circuit; refer to Filtering the Closed-loop Traction Circuit (page 5–58) 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 the any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–53).

⚠ 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 filter; refer to the traction unit *Operator's Manual*.
6. Inspect and clean hydraulic tank. Remove the hydraulic tank if necessary; refer to Removing the Hydraulic Tank (page 5–65).
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 Fitting) (page 5–7).

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 5–62).
10. Charge the hydraulic system; refer to Charging the Hydraulic System (page 5–63).

Filtering the Closed-loop Traction Circuit

Filtering of a closed−loop hydraulic system after a major component failure (e.g. traction (piston) pump or wheel motor) is required to prevent debris from transmitting throughout the system. If a filtering tool is not used (to ensure that the system is clean), 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, lower any attachments, set the key switch to the OFF position and remove the key from the switch.
2. Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–53).

⚠ WARNING ⚠

Review and follow the Jacking Instructions (page 1–6) before lifting the machine.

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3. Raise all of the wheels off the ground and support the machine with jack stands.
4. Install the hydraulic filter directly upstream of the new component to prevent system contamination from entering and damaging the new component.
   A. If the traction (piston) pump or front wheel motor was replaced, remove the center shroud.
   B. Thoroughly clean the connection between the hydraulic hose and tube shown in Figure 47, then disconnect the hydraulic hose from the tube.

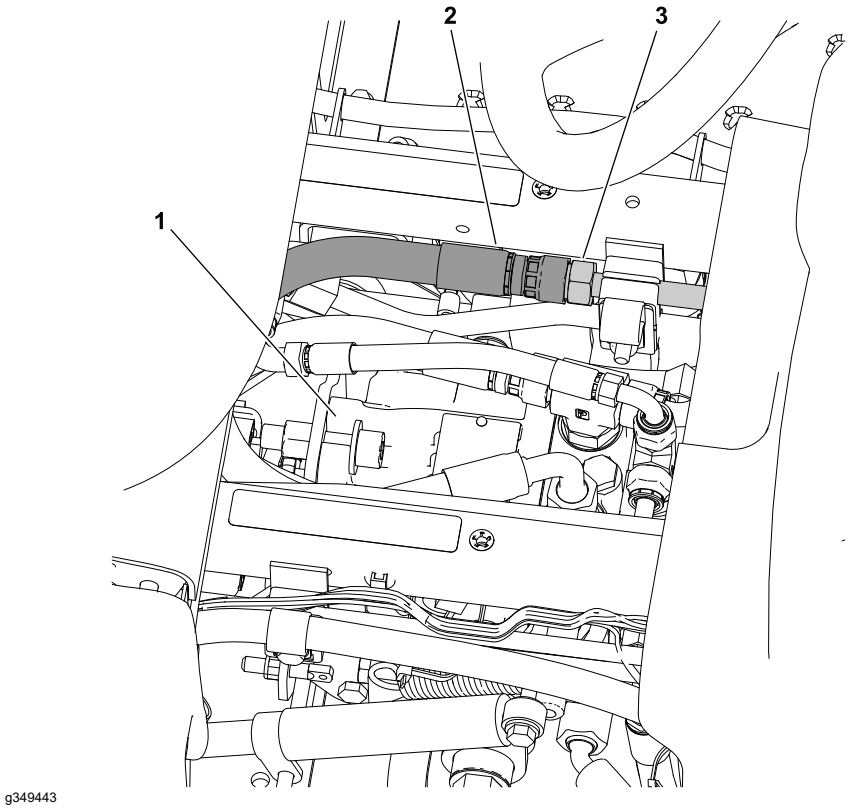


Figure 47

1. Traction (piston) Pump
2. Hydraulic hose
3. Hydraulic tube

C. If rear wheel motor was replaced, remove the wheel at the new wheel motor; refer to Removing and Installing the Rear Wheels (page 7–5).

D. Thoroughly clean the junction of the wheel motor fitting and the hydraulic tube as shown in Figure 48, then disconnect the tube from the fitting.

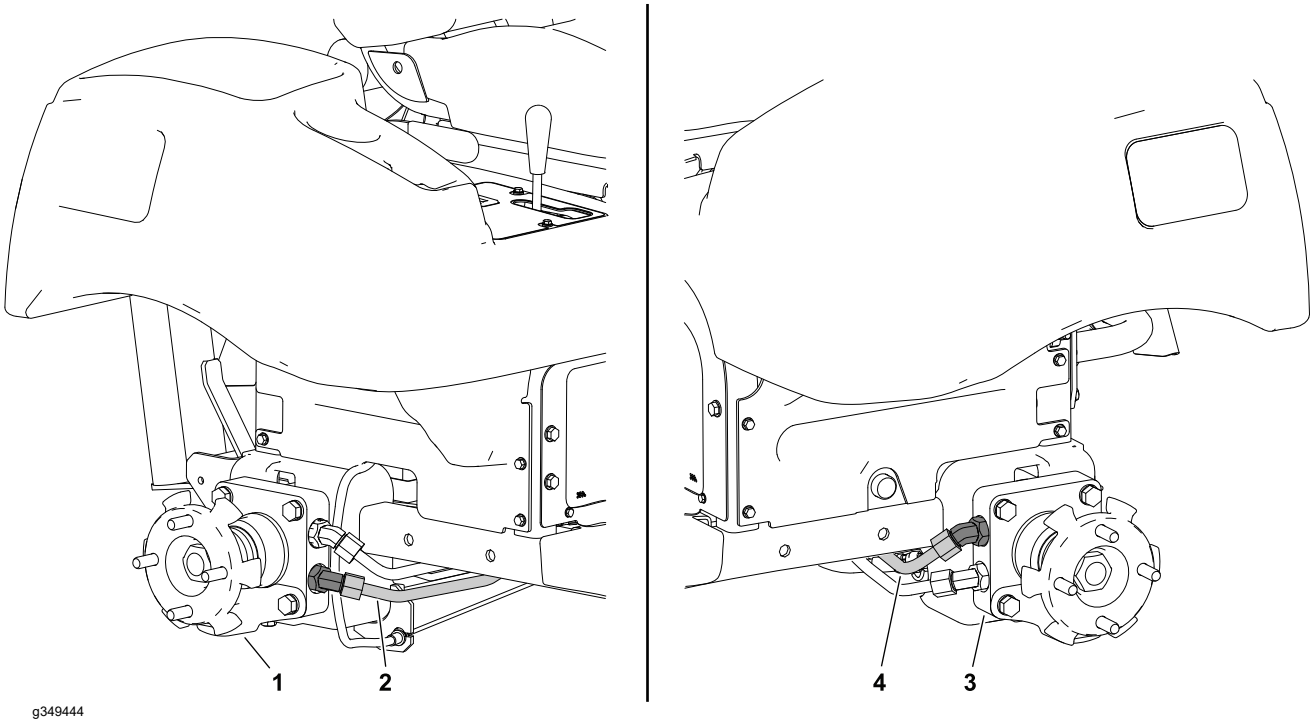


Figure 48

1. Right side rear wheel motor
2. Hydraulic tube
3. Left side rear wheel motor
4. Hydraulic tube

IMPORTANT

If using a hydraulic filter that is not bidirectional, install the filter with the flow direction toward the traction pump for a traction pump failure, and toward the wheel motors for a wheel motor failure.

5. Connect the Toro high flow hydraulic filter in series between the disconnected fittings and tube or hose. Use the hydraulic hose kit to connect the filter to the machine if necessary; refer to Hydraulic Hose Kit (page 2–15). Ensure that all hydraulic 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.

⚠ CAUTION ⚠

Use extreme caution when performing this test. The traction unit 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 shows red, either reduce the pressure on the traction pedal or reduce the engine speed to decrease the hydraulic flow through the filter.

8. With the engine running at low-idle speed, slowly move the traction pedal to the reverse direction for a traction (piston) pump failure, or to the forward direction for a wheel motor failure to allow flow through the traction circuit and high-flow filter. Keep the traction circuit engaged for 5 minutes while gradually increasing the traction pedal pressure and the engine speed. Monitor the filter indicator to ensure that the green color is showing during the operation.

IMPORTANT

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

9. When using a high flow bi-directional filter, alternately move the traction pedal in opposite directions with the engine running at high-idle speed. While monitoring the filter indicator, continue this process for 5 more minutes.
10. Shut off the engine and remove the key from the key switch.
11. Remove the high flow hydraulic filter and hydraulic hose kit from the machine. Flush clean and install the hydraulic tube previously removed, or connect the disconnected hydraulic hose. Ensure that you properly tighten the hydraulic tube or hose; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal Fitting) (page 5–7).
12. Lower the machine to the ground.
13. Check the hydraulic fluid level in the tank and adjust if 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

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. Priming the hydraulic pumps ensures that the gear pumps and piston (traction) pump have sufficient fluid while charging the hydraulic system.

IMPORTANT

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

1. Make sure all hydraulic connections are properly tightened.
2. Check the hydraulic fluid level in the hydraulic tank and add the correct type and quantity of fluid if necessary; refer to the traction unit *Operator's Manual*.
3. Disconnect and ground the engine spark plug wires to prevent the engine from starting.
4. Make sure that the traction pedal and the lift control lever are in the NEUTRAL position.
5. Set the key switch to the START position and engage starter for 10 seconds. Pause, then engage the starter for an additional 10 seconds.
6. Connect the spark plug wires to the spark plugs.
7. Charge the hydraulic system; refer to Charging the Hydraulic System (page 5–63).

Charging the Hydraulic System

IMPORTANT

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

When initially starting the hydraulic system with new or rebuilt components such as wheel 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 5–56).

1. Park the machine on a level surface and set the key switch to the OFF position.
2. Ensure that all of the hydraulic connections 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. If the piston (traction) pump or the gear pump was replaced or repaired, prime the hydraulic pumps; refer to Priming the Hydraulic Pumps (page 5–62).

⚠ WARNING ⚠

Review and follow the Jacking Instructions (page 1–6) before lifting the machine.

5. Raise all of the wheels off the ground and support the machine with jack stands.
6. Make sure the traction pedal is in neutral, then start the engine and let it idle at low speed. 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.

IMPORTANT

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

7. After the hydraulic system starts to show the signs of fill, operate the lift valve(s) until the lift cylinder(s) move in and out several times.
8. If the cylinder(s) does not move after 15 seconds or the pump emits abnormal sounds:
   A. Immediately set the key switch to the OFF position.
   B. Make sure the hydraulic fluid filter or the suction line is not loose.
   C. Check for incorrect hose routing.
   D. Ensure that the suction line is not blocked.
   E. Test the implement/charge pump (P2) for damage.

Charging the Hydraulic System (continued)

9. For model 08745 machines, turn the steering wheel in both directions so that the steering cylinder moves in and out several times.
10. Operate the traction pedal in the forward and reverse directions. Make sure the wheels are turning in the proper direction. If the traction (piston) pump or a wheel motor was replaced or rebuilt, operate the traction circuit slowly for 10 minutes.
11. Ensure that the traction pedal returns to the NEUTRAL position when released. and adjust if necessary; refer to the traction unit *Operator's Manual*.
12. Stop the machine, check the hydraulic components for leaks and tighten any loose connections.
13. Check and adjust the fluid level in the hydraulic tank if necessary; refer to the traction unit *Operator's Manual*.

    Note: If new fluid shows any signs of contamination, flush the hydraulic system again until the fluid is clean; refer to Flushing the Hydraulic System (page 5–56).
14. Operate the machine for 2 hours under normal operating conditions.
15. Check and adjust the fluid level in the hydraulic tank if necessary; refer to the traction unit *Operator's Manual*.

    Note: If new fluid shows any signs of contamination, flush the hydraulic system again until the fluid is clean; refer to Flushing the Hydraulic System (page 5–56).

Hydraulic Tank

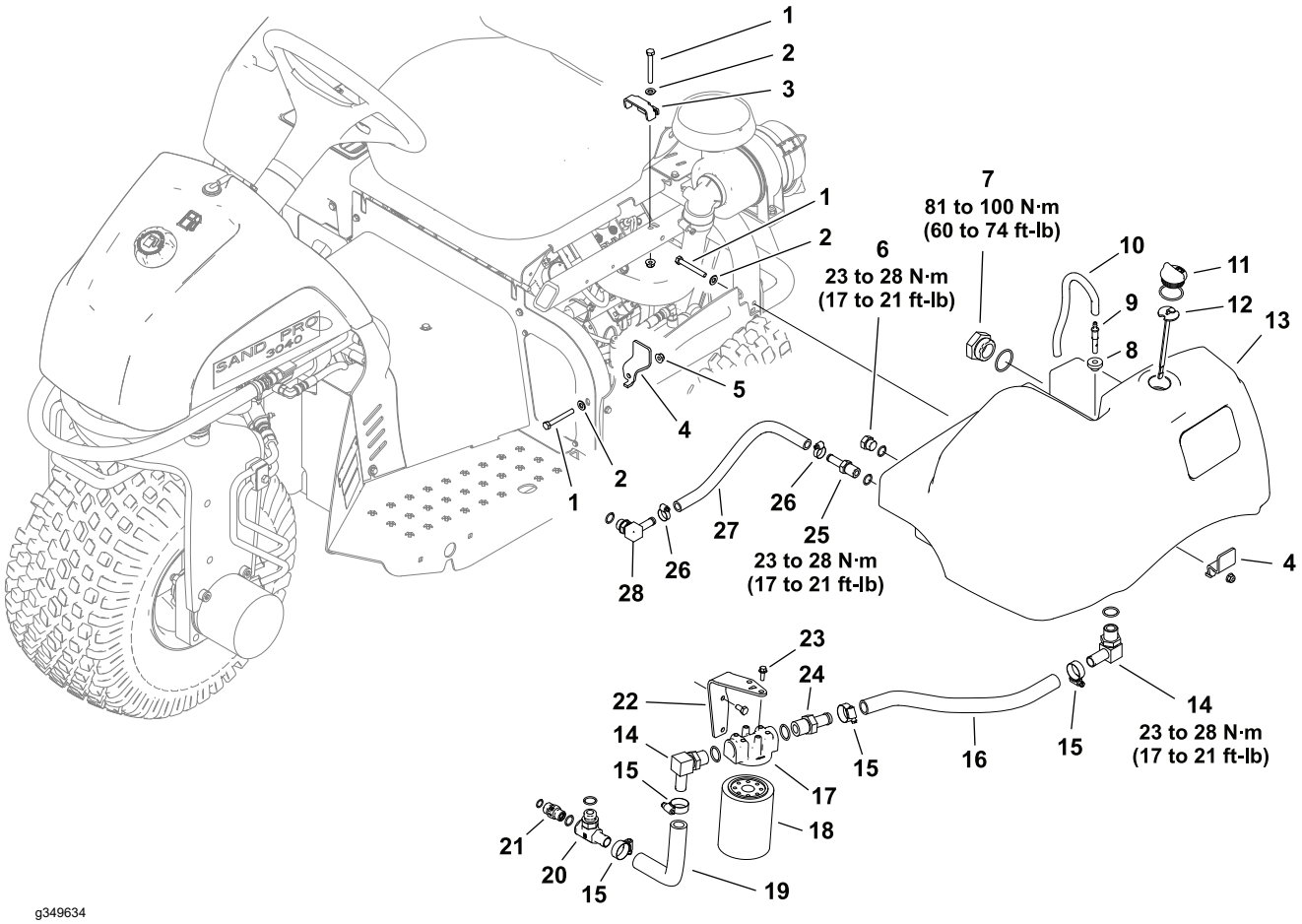


Figure 49

1. Cap screw (3 each)
2. Flat washer (3 each)
3. Clamp
4. Clamp (2 each)
5. Lock nut (3 each)
6. Plug w/O-ring
7. Plug w/O-ring
8. Grommet
9. Barb fitting
10. Hose – vent
11. Cap
12. Dipstick
13. Hydraulic tank
14. Elbow fitting (2 each)
15. Hose clamp (4 each)
16. Hose – suction
17. Filter head
18. Filter element
19. Hose – suction
20. Tee fitting
21. Check valve
22. Filter bracket
23. Cap screw (2 each)
24. Barb fitting
25. Barb fitting
26. Hose clamp (2 each)
27. Hose – case drain
28. Elbow fitting

Removing the Hydraulic Tank

Refer to Figure 49 for this procedure.

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Remove the center shroud from the machine.
3. Place a drain pan under the hydraulic fluid filter. Make sure that drain pan is large enough to hold 19 L (5 gal).
4. Remove the hydraulic fluid filter element and allow the hydraulic tank to drain.

Removing the Hydraulic Tank (continued)

5. Remove the left rear wheel from the machine; refer to Removing and Installing the Rear Wheels (page 7–5).
6. Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–53).
7. Clean the hydraulic hose ends and fittings on the hydraulic tank before disconnecting the hoses to prevent contaminating the hydraulic system.

IMPORTANT

To prevent damage to the hydraulic hoses and tubes, cable ties and clamps may be used to secure the hoses and tubes 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. For assembly purposes, label all the hydraulic connections. Loosen the hose clamps and disconnect the hoses from the hydraulic tank.
9. Cap or plug the hydraulic fittings and hoses to prevent contamination from entering the hydraulic system.
10. Remove the 3 clamps that secure the hydraulic tank to the machine.
11. Remove the hydraulic tank from the machine.
12. If hydraulic fittings are to be removed from the hydraulic tank, mark the fitting orientation to allow for correct assembly before removing the fittings.

Installing the Hydraulic Tank

Refer to Figure 49 for this procedure.

1. If any of the hydraulic fittings were removed from the tank, use new O-rings and tighten the fittings to the correct torque:
   - 1-5/8 inch plug = **81 to 100 N·m (60 to 74 ft-lbs)**
   - 1-1/16 inch fitting = **23 to 28 N·m (17 to 21 ft-lbs)**
   - 3/4 inch plug or fitting = **23 to 28 N·m (17 to 21 ft-lbs)**
2. Position the hydraulic tank in the machine and secure the tank to the machine with the 3 previously removed clamps.
3. Remove any caps or plugs from the hydraulic lines and fittings and connect the hydraulic lines to the tank.
4. Install a new hydraulic fluid filter; refer to the traction unit *Operator's Manual*.
5. Charge the hydraulic system; refer to Charging the Hydraulic System (page 5–63).
6. Install the left rear wheel; refer to Removing and Installing the Rear Wheels (page 7–5).
7. Install the center shroud.

Hydraulic Fluid Cooler

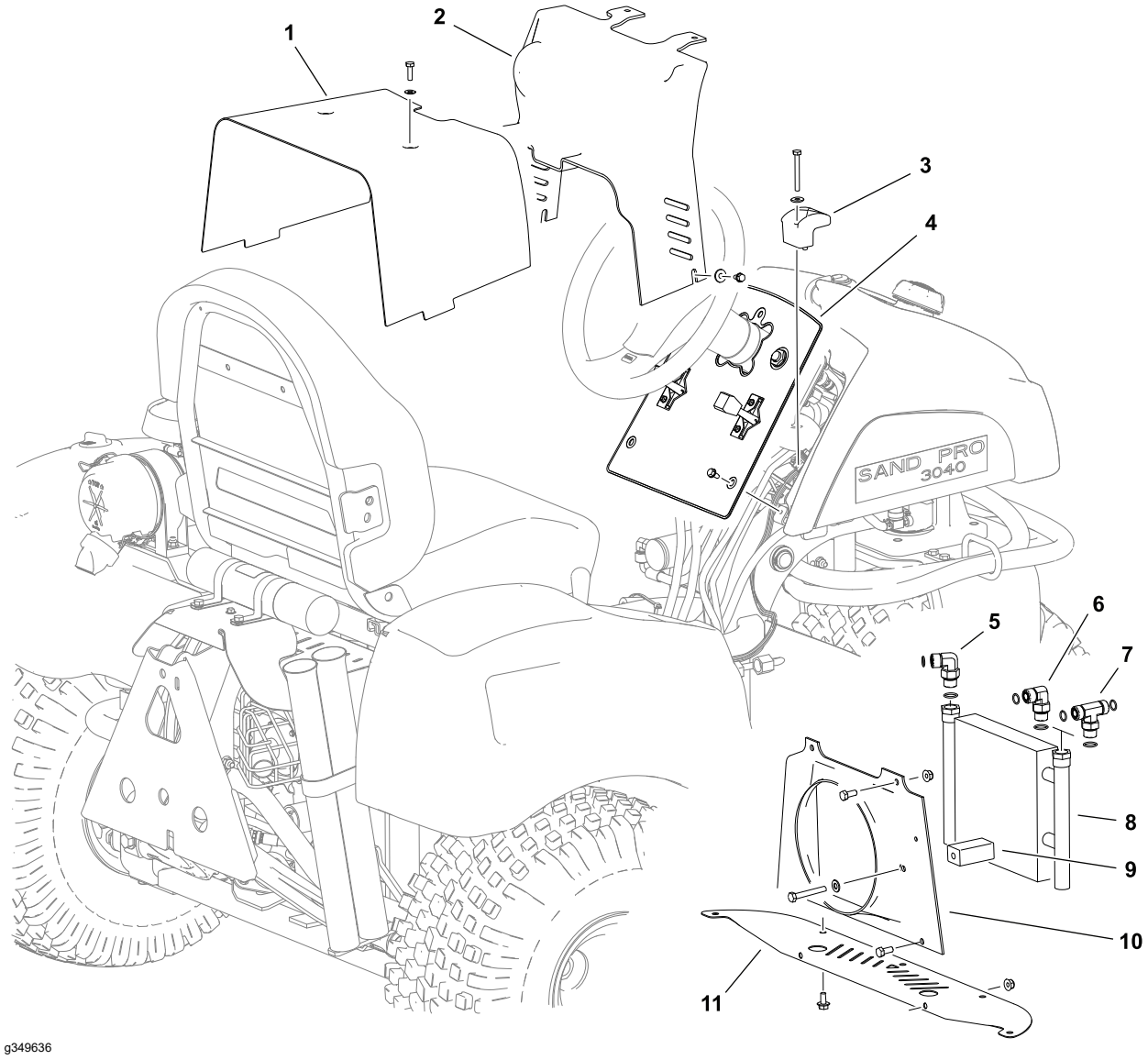


Figure 50

1. Center Shroud
2. Dash Shroud
3. Rear fuel tank clamp (2 each)
4. Dash Panel
5. Elbow fitting
6. Elbow fitting (model 08743)
7. Tee fitting (model 08745)
8. Hydraulic fluid cooler
9. Rubber clamp (2 each)
10. Fan shroud
11. Cooler panel

Removing and Installing the Hydraulic Fluid Cooler

Refer to Figure 50 for this procedure.

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Remove the center shroud (above) and the cooler panel (below) from the machine.
3. Remove the 3 screws that secure the dash panel to the machine, then carefully raise the dash panel to access the rear fuel tank clamps. Remove the rear fuel tank clamps.

4. Remove the fasteners at the bottom of the dash shroud and remove the dash shroud from the machine.
5. Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–53).
6. Clean the hydraulic hose ends and fittings on the fluid cooler before disconnecting the hoses to prevent contaminating the hydraulic system.

IMPORTANT

To prevent damage to the hydraulic hoses and tubes, cable ties and clamps may be used to secure the hoses and tubes 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.

7. Disconnect hydraulic hoses from the fluid cooler and allow the hoses to drain into a suitable container.
8. Cap or plug the hydraulic fittings and hoses to prevent contamination from entering the hydraulic system.
9. Remove the fasteners that secure the fan shroud to the frame and carefully remove the fan shroud and fluid cooler assembly out the bottom of the machine.
10. Remove the fasteners and rubber clamps that secure the fluid cooler to the fan shroud and separate the shroud and cooler if necessary.
11. If hydraulic fittings are to be removed from the fluid cooler, mark the fitting orientation to allow for correct assembly before removing the fittings.
12. Install the fluid cooler in the reverse order.
13. Check and adjust the hydraulic fluid level in the hydraulic tank; refer to the traction unit *Operator's Manual*.

Piston (traction) Pump

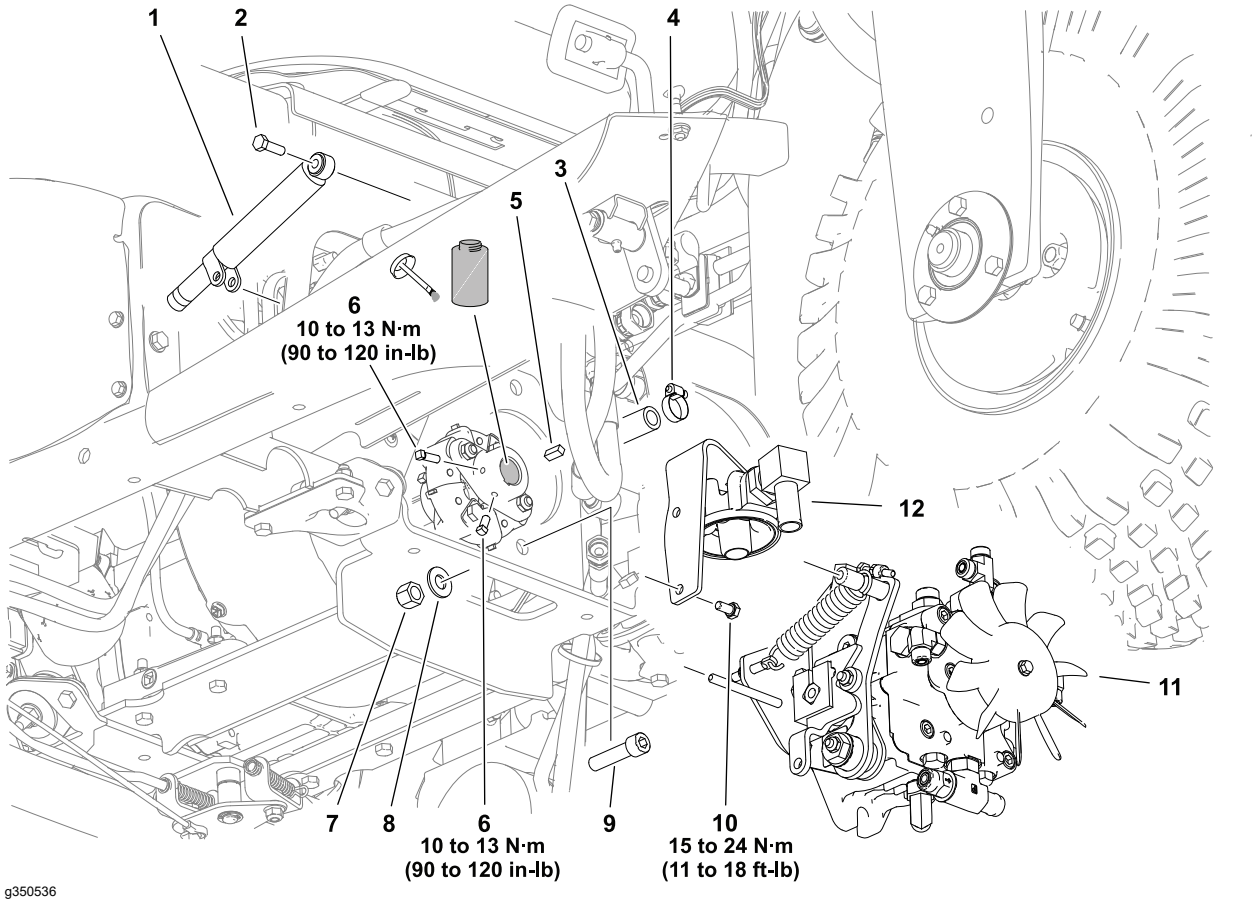


Figure 51

1. Damper
2. Cap screw
3. Hydraulic hose – filter
4. Hose clamp
5. Key
6. Set screw (2 each)
7. Lock nut (2 each)
8. Washer – hardened (2 each)
9. Cap screw (2 each)
10. Cap screw (2 each)
11. Piston (traction) pump assembly
12. Hydraulic fluid filter assembly

Removing the Piston (traction) Pump

Refer toFigure 51 for this procedure.

1. Park the machine on a level surface, lower any attachments, set the key switch to the OFF position and remove the key from the switch.
2. Remove the center shroud.
3. Place a drain pan with at least a 13.2 liter (5 gallon) capacity under the hydraulic fluid filter and remove the hydraulic fluid filter from the filter head to drain the hydraulic tank.
4. Remove the traction rod assembly and discard the cotter pin.
5. Disconnect the traction neutral switch connector from the machine wire harness.
6. Remove the traction control damper.
7. Remove hydraulic fluid cooler from the machine; refer to Removing and Installing the Hydraulic Fluid Cooler (page 5–67).
8. Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–53).

9. Clean the hydraulic pump and all hydraulic connections to prevent hydraulic system contamination.
10. Remove the suction hose between the hydraulic fluid filter and the pump.
11. For assembly purposes, label all the hydraulic connections. Record the location of cable ties and routing of the hydraulic hoses for assembly purposes.
12. Disconnect the hoses and tubes from the fittings on the piston (traction) pump and allow the hydraulic lines to drain into a suitable container.
13. Install clean caps or plugs on the openings of pump and disconnected lines to prevent hydraulic system contamination.
14. Remove the fasteners securing the hydraulic fluid filter assembly to the piston pump.
15. Loosen the 2 set screws on the pump hub.
16. Support the piston pump and remove the fasteners securing the pump to the engine support.

IMPORTANT

Be careful not to damage the pump, pump coupling, fuel and hydraulic lines, electrical harness or other parts while removing the piston (traction) pump from the machine.

17. Slide the pump toward the front of machine until the pump shaft is clear of the pump hub. Remove the piston (traction) pump from the machine.
18. Inspect the pump drive coupling for wear or damage and replace as necessary.
19. Locate and retrieve the square key from the pump shaft.
20. If necessary, loosen the cap screw that secures the fan to the pump and remove the fan.
21. If necessary, remove the traction control assembly from the traction pump; refer to Traction Pedal and Control Assembly (page 7–10).
22. If necessary, remove the hydraulic fittings from the pump. Record the locations and orientations of the fittings for assembly purposes.

Removing the Piston (traction) Pump (continued)

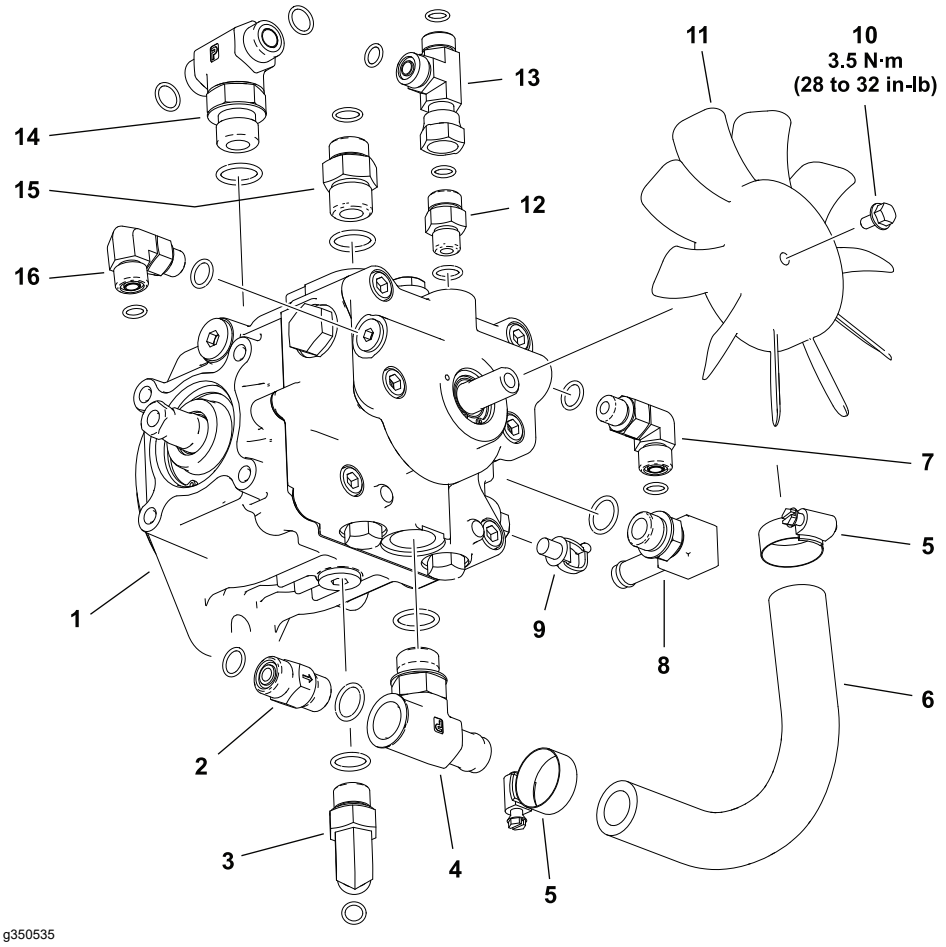


Figure 52

1. Piston (traction) pump
2. Check valve
3. Elbow fitting
4. Tee fitting
5. Hose clamp (2 each)
6. Suction hose
7. Elbow fitting
8. Elbow fitting
9. Harness retainer
10. Cap screw
11. Fan
12. Straight fitting
13. Tee fitting
14. Tee fitting
15. Straight fitting
16. Elbow fitting

23. Remove and discard all the O-rings from the hydraulic hoses, tubes, and fittings that were disconnected or removed.

Installing the Piston (traction) Pump

Refer to Figure 51 for this procedure.

1. Lubricate new O-rings and place them onto the fittings. If previously removed, install the fittings into the pump ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9).
2. If previously removed, secure the traction control components to the traction pump; refer to Installing Traction Pedal and Control Components (page 7–11). Do not install the traction control damper at this time.

3. If previously removed, install the fan. The fan must bottom against the end of the pump shaft. Tighten the cap screw securing the fan to the pump shaft from **3.0 to 3.5 N·m (28 to 32 in-lb)**.
4. Apply a thin layer of anti-seize lubricant to the bore of the pump hub.
5. Install the key in the pump shaft.

IMPORTANT

Be careful not to damage the pump, pump coupling, fuel and hydraulic lines, electrical harness or other parts while installing the piston (traction) pump to the machine.

6. Align the pump shaft to the pump hub. Slide the pump toward the rear of machine until the mounting flange contacts the engine support and install the fasteners securing the pump to the engine support.

7. Ensure the pump hub is at least **2.5 mm (0.1 inch)** from the face of the piston pump and tighten the pump hub set screws from **10 to 13 N·m (90 to 120 in-lb)**.
8. Install the fasteners securing the hydraulic fluid filter assembly to the piston pump, then tighten the fasteners from **15 to 24 N·m (11 to 18 ft-lb)**.
9. Install the traction control damper.
10. Remove the caps and plugs from the hydraulic fittings and hydraulic lines then install the hydraulic lines to the piston (traction) pump; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal Fitting) (page 5–7).
11. Install the hydraulic fluid cooler; refer to Removing and Installing the Hydraulic Fluid Cooler (page 5–67)
12. Connect the neutral switch to the machine wire harness.
13. Use a new cotter pin and install the traction rod assembly.
14. Install a new hydraulic fluid filter; refer to the traction unit *Operator's Manual*.
15. Prime the hydraulic pump; refer to Priming the Hydraulic Pumps (page 5–62).
16. Charge the hydraulic system; refer to Charging the Hydraulic System (page 5–63).
17. Check and adjust the traction control for NEUTRAL if necessary; refer to Adjusting the Traction System for Neutral (page 5–51).
18. Check and adjust the traction neutral switch if necessary; refer to Adjusting the Traction Neutral Switch (page 6–16)
19. Install the center shroud.

Servicing the Piston (traction) Pump

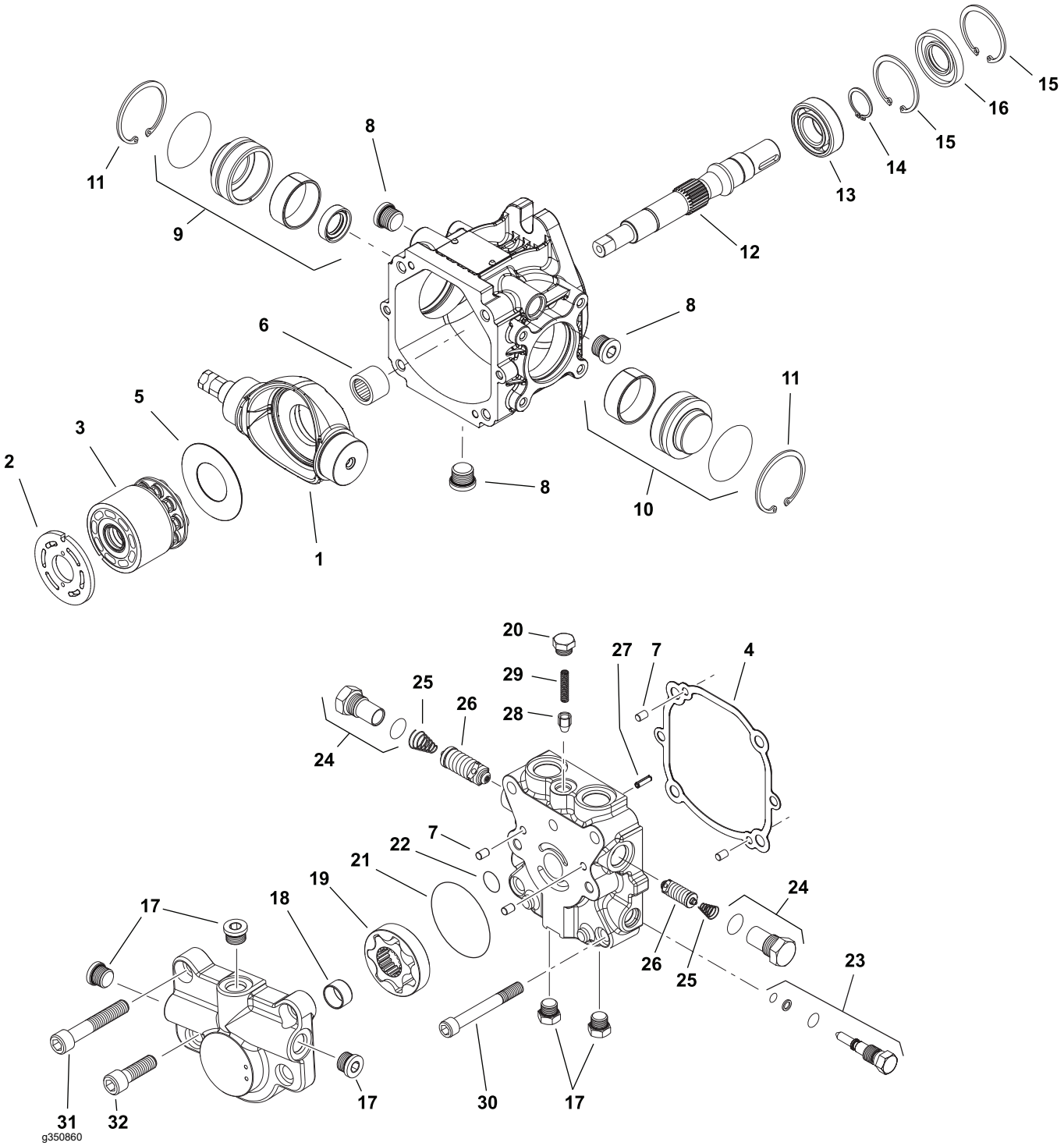


Figure 53

1. Swashplate
2. Plate - Valve CCW
3. Cylinder Block Kit
4. Gasket-Cap, End
5. Plate-Thrust
6. Bearing-Needle
7. Pin (4 each)
8. Plug (3 each)
9. Journal Bearing Carrier Asm
10. Journal Bearing Carrier Asm
11. Ring-Retaining (2 each)
12. Shaft-Drive
13. Bearing-Ball
14. Ring-Retaining
15. Ring-Retaining (2 each)
16. Seal-Lip, Shaft
17. Plug Asm (5 each)
18. Bearing-Journal
19. Gerotor Asm
20. Plug Asm
21. O-Ring
22. O-Ring
23. Bypass Valve Asm
24. Plug Asm (2 each)
25. Spring (2 each)
26. Relief Valve (2 each)
27. Pin-Slotted
28. Cone-Valve, Relief
29. Spring
30. Cap screw (2 each)
31. Cap screw (2 each)
32. Cap screw (2 each)

Servicing the Piston (traction) Pump (continued)

Note: For the piston (traction) pump repair information; refer to the Danfoss DDC20 Axial Piston Pump Service Manual.

IMPORTANT

If a piston (traction) pump failure occurs, refer to Filtering the Closed-loop Traction Circuit (page 5–58) for information regarding the importance of removing contamination from the traction circuit.

Wheel Motors

Front Wheel Motor

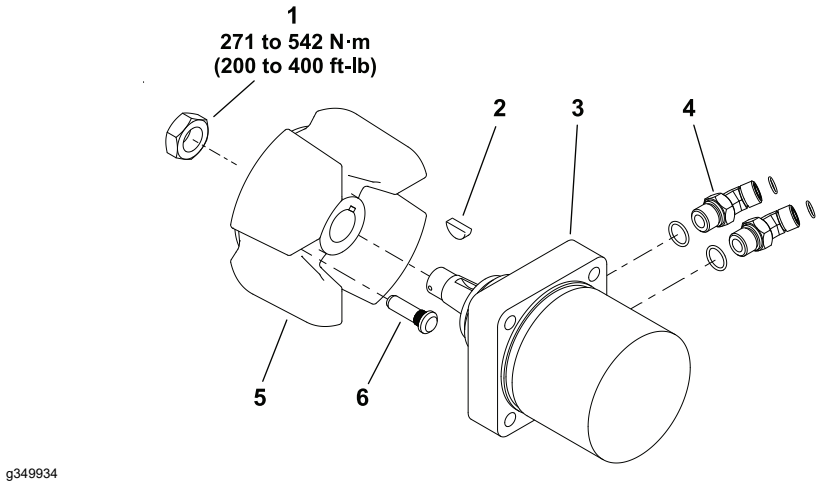


Figure 54

1. Lock nut
2. Woodruff key
3. Front wheel motor
4. Elbow fitting (2 each)
5. Wheel hub
6. Drive stud (4 each)

Removing the Front Wheel Motor

Refer to Figure 54 for this procedure.

1. Remove the front wheel; refer to Removing the Front Wheel (page 7–3).
2. Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–53).
3. Clean the hydraulic tube ends and fittings on the wheel motor to prevent contaminants from entering into the hydraulic system.
4. Label and remove the hydraulic tubes from the fittings on the wheel motor. Allow the tubes to drain into a suitable container.
5. Install clean caps and plugs on the hydraulic tubes and fittings to prevent system contamination.
6. Mark the wheel motor assembly as “Front” and remove the wheel motor assembly from the machine.
7. Secure the wheel hub in a vise. Use a torque multiplier to loosen the lock nut that secures the hub to the motor. Do not remove the lock nut from the motor shaft.

IMPORTANT

DO NOT hit the wheel hub, wheel hub puller, or wheel motor with a hammer during wheel hub removal. Hammering may cause damage to the wheel motor.

8. Use a hub puller to loosen the wheel hub from the wheel motor; refer to Wheel Hub Puller (page 2–18).
9. Remove the wheel motor assembly from the vise and remove the lock nut, hub, and woodruff key from the motor shaft.

10. If the hydraulic fittings are to be removed from the wheel motor, mark the fitting orientation for assembly purposes. Remove the fittings from the wheel motor and discard the O-rings from the fittings.

Installing the Front Wheel Motor

IMPORTANT

Because of the internal differences in the wheel motors, do not interchange the wheel motors on the machine (e.g., do not put a rear motor on the front of the machine).

Refer to Figure 54 for this procedure.

1. If the hydraulic fittings were removed from the wheel motor, lubricate and install new O-rings to the fittings. Align and install the fittings into the wheel motor ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9).

IMPORTANT

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

Do not use the locknut previously removed to attach the wheel hub to the wheel motor.

2. Clean the tapers of the wheel hub and wheel motor shaft and install the woodruff key, wheel hub, and a new lock nut on the wheel motor shaft.

3. Use a torque multiplier to tighten the lock nut from **271 to 542 N·m (200 to 400 ft–lb)**. Remove the wheel motor assembly from the vise.

4. Install the front wheel; refer to Installing the Front Wheel (page 7–4).
5. Remove the caps and plugs then connect the hydraulic tubes to the wheel motor fittings; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal Fitting) (page 5–7).
6. Charge the hydraulic system; refer to Charging the Hydraulic System (page 5–63).

Rear Wheel Motor

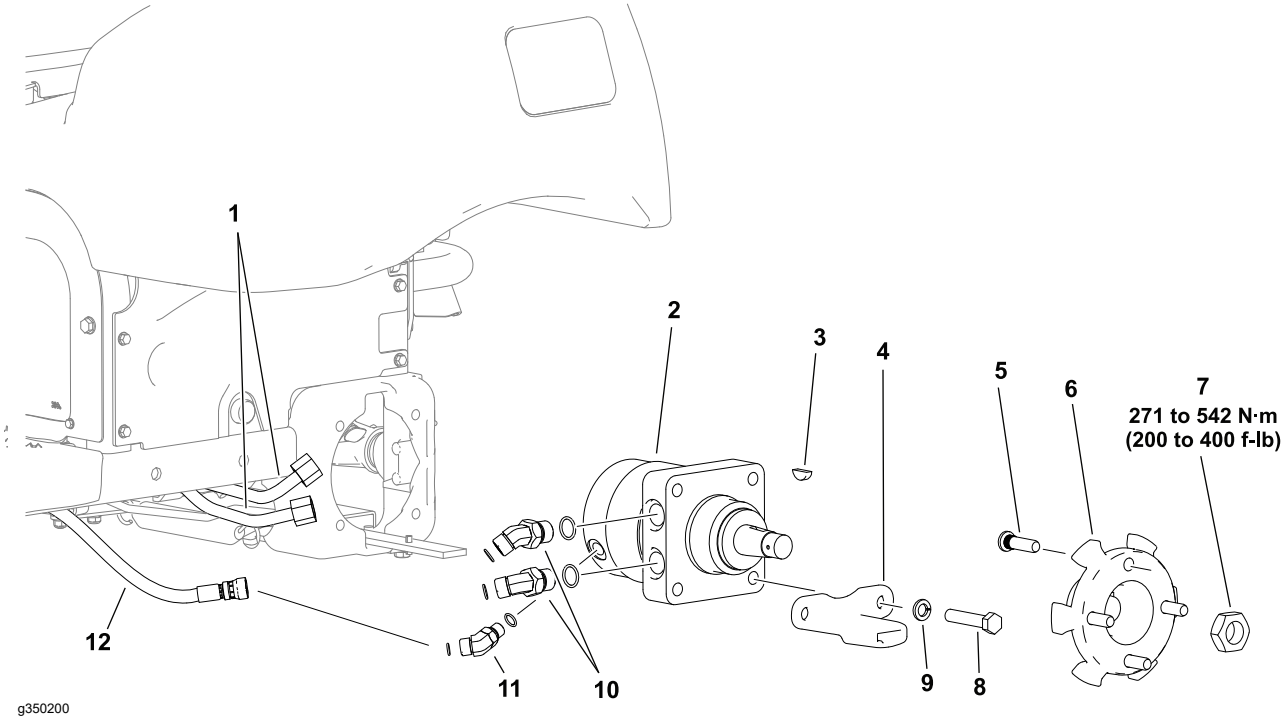


Figure 55

1. Hydraulic tube assembly
2. Rear wheel motor
3. Woodruff key
4. Parking brake bracket
5. Drive stud (4 each)
6. Wheel hub
7. Wheel hub nut
8. Cap screw (4 each)
9. Lock washer (4 each
10. Elbow fitting (2 each)
11. Elbow fitting
12. Hydraulic hose assembly

Removing the Rear Wheel Motor

Refer toFigure 55 for this procedure.

1. Remove the rear wheel; refer to Removing and Installing the Rear Wheels (page 7–5).
2. Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–53).
3. Clean the hydraulic tube ends and fittings on the wheel motor to prevent contaminants from entering into the hydraulic system.
4. Label and remove the hydraulic lines from the fittings on the wheel motor. Allow the lines to drain into a suitable container.
5. Install clean caps and plugs on the hydraulic tubes and fittings to prevent system contamination.
6. Mark the wheel motor assembly as “Left Rear” or “Right Rear” and remove the wheel motor assembly from the machine.
7. Use a torque multiplier to loosen the lock nut that secures the hub to the motor. Do not remove the lock nut from the motor shaft.

IMPORTANT

DO NOT hit the wheel hub, wheel hub puller, or wheel motor with a hammer during wheel hub removal. Hammering may cause damage to the wheel motor.

8. Use a hub puller to loosen the wheel hub from the wheel motor; refer to Wheel Hub Puller (page 2–18).
9. Remove the lock nut, hub, and woodruff key from the motor shaft.
10. Support the wheel motor to prevent it from falling. Remove the 4 fasteners that secure the motor to the frame.
11. Slide the parking brake bracket from brake bar and remove the wheel motor from the machine.
12. If the hydraulic fittings are to be removed from the wheel motor, mark the fitting orientation for assembly purposes. Remove the fittings from the wheel motor and discard the O-rings from the fittings.

Installing the Rear Wheel Motor

IMPORTANT

Because of the internal differences in the wheel motors, do not interchange the wheel motors on the machine (e.g., do not put the right motor on the left side of the machine, or a front motor on the rear of the machine).

Refer to Figure 55 for this procedure.

1. If the hydraulic fittings were removed from the wheel motor, lubricate and install new O-rings to the fittings. Align and install the fittings into the wheel motor ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9).
2. Position the wheel motor to frame and slide the parking brake bracket onto the brake bar.
3. Secure the motor and parking brake bracket to the frame with the 4 previously removed fasteners.
4. Remove the caps and plugs then connect the hydraulic lines to the wheel motor fittings; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal Fitting) (page 5–7).

IMPORTANT

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

Do not use the locknut previously removed to attach the wheel hub to the wheel motor.

5. Clean the tapers of the wheel hub and wheel motor shaft and install the woodruff key, wheel hub, and a new lock nut on the wheel motor shaft.

6. Use a torque multiplier to tighten the lock nut from **271 to 542 N·m (200 to 400 ft–lb)**.
7. Install the rear wheel; refer to Removing and Installing the Rear Wheels (page 7–5).

8. Charge the hydraulic system; refer to Charging the Hydraulic System (page 5–63).

Servicing the Wheel Motors

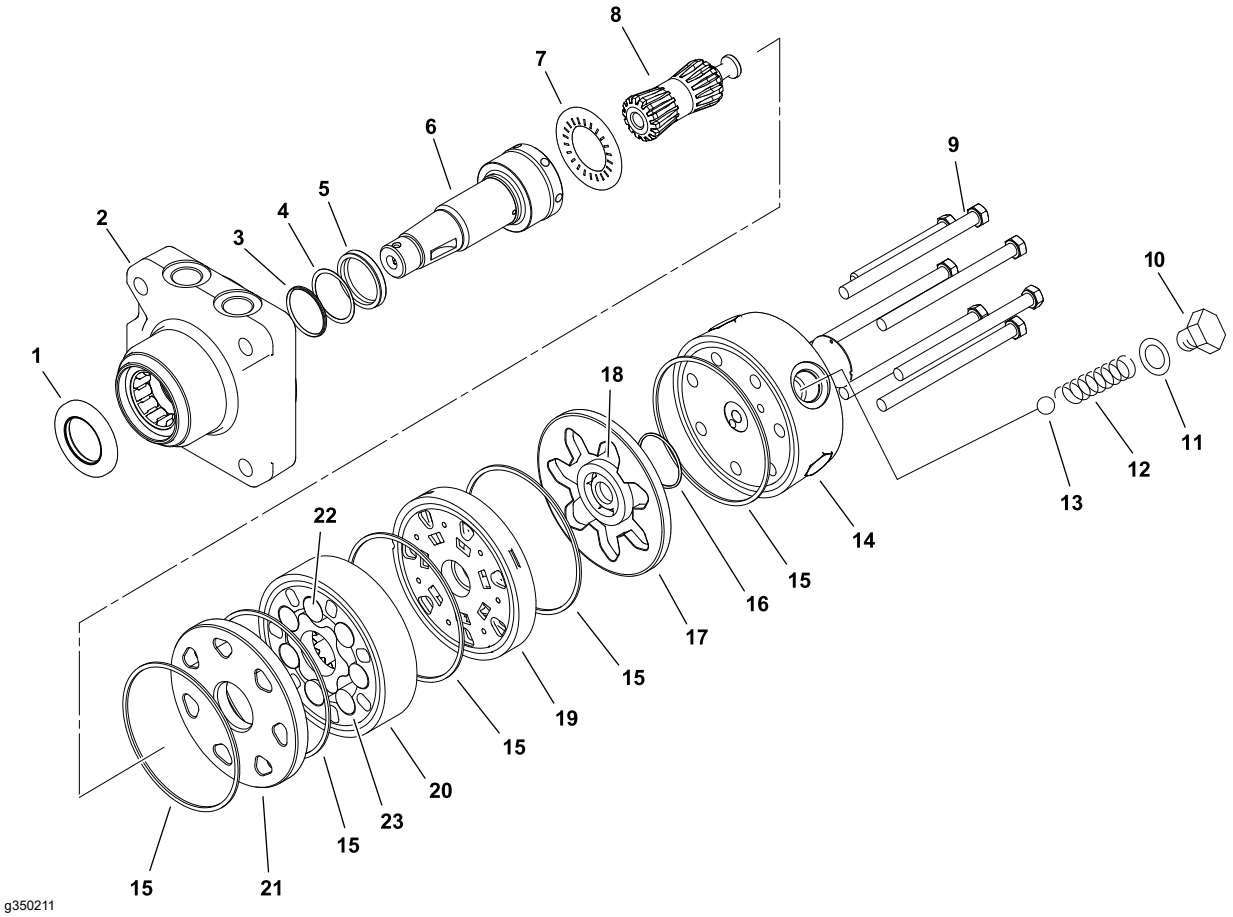


Figure 56
(Front Wheel Motor Shown)

1.	Dirt and water seal	9.	Cap screw (7 each)	17.	Commutator ring
2.	Housing	10.	Plug	18.	Commutator
3.	Back-up washer	11.	O-Ring	19.	Manifold
4.	Back-up ring	12.	Spring	20.	Stator
5.	Shaft seal	13.	Ball	21.	Wear plate
6.	Coupling shaft	14.	End cover	22.	Rotor
7.	Thrust bearing	15.	Body seal (5 each)	23.	Vane (7 each)
8.	Drive link	16.	Commutator seal		

The wheel motors used on the Sand Pro machines have the same basic construction. The motors do however have internal differences that make them unique to their location on the machine (front, left rear, and right rear).

The front wheel motor has a 280 cc (17.1 cu inch) per revolution displacement and rotates in the clockwise direction for forward operation. The front motor is also equipped with a check valve that allows the motor to over run during tight turns in forward operation and by-passes flow in reverse operation.

The right and left rear wheel motors have a 141 cc (8.6 cu inch) per revolution displacement but have different rotation for forward operation. The right rear motor has a clockwise drive direction for forward operation and the left rear motor has a counter-clockwise direction for forward operation. Additionally, the left rear motor has a hot oil shuttle valve to bleed off a small amount of hydraulic fluid for cooling the closed loop traction circuit.

Servicing the Wheel Motors (continued)

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

IMPORTANT

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

Traction Relief Manifold

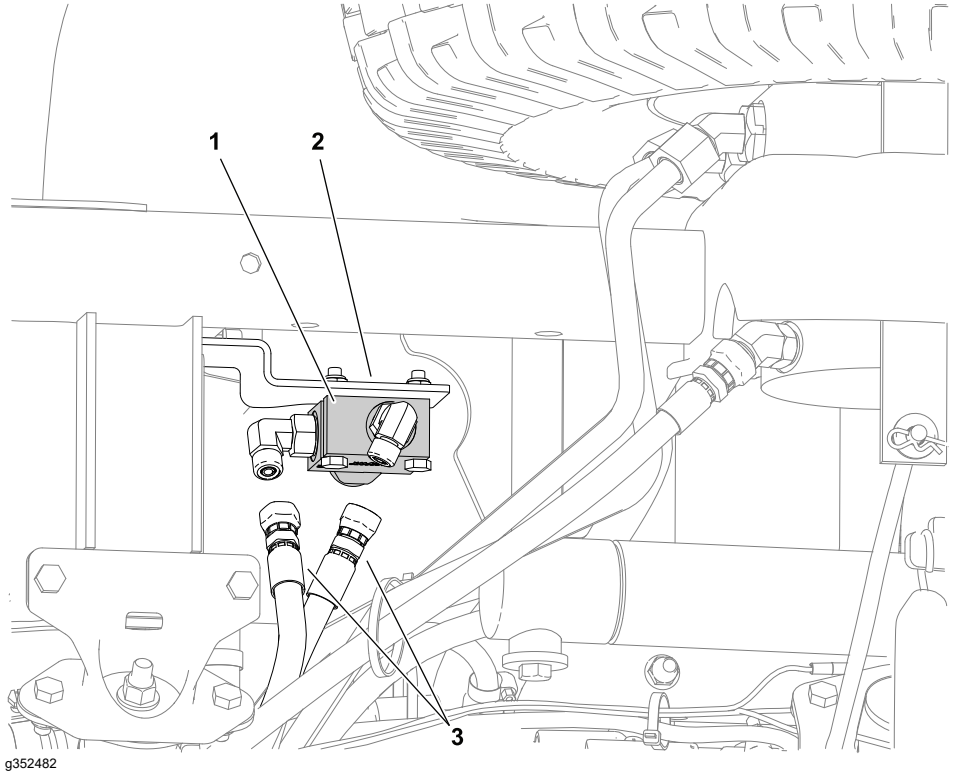


Figure 57
(view from under machine)

1. Traction relief manifold
2. Manifold bracket
3. Hydraulic hose (2 each)

For cartridge valve service procedures, refer to Servicing a Hydraulic Cartridge Valve (page 5–86).

Removing and Installing the Traction Relief Manifold

The traction relief manifold is located near the left rear wheel and is best accessed from under the machine.

⚠ WARNING ⚠

Review and follow the Jacking Instructions (page 1–6) before lifting the machine.

1. Raise all of the wheels off the ground and support the machine with jack stands.
2. Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–53).
3. Clean the fitting and hydraulic hose connections before disconnecting the hydraulic hoses to prevent system contamination.
4. Label all hydraulic connections for assembly purposes and disconnect the hydraulic hoses.
5. Cap the fittings and plug the hydraulic hoses to prevent system contamination.
6. Remove the fasteners securing the manifold to the bracket and remove the manifold assembly from the machine.

7. If the hydraulic fittings are to be removed from the manifold, mark the fitting orientation for assembly purposes and remove the fittings from the manifold. Discard the O-rings from the fittings.
8. If the hydraulic fittings were removed from the manifold, lubricate new O-rings with clean hydraulic fluid, position the O-rings to the fittings, and install the fittings in the marked orientation; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9).
9. Secure the manifold assembly to the bracket with the previously removed fasteners.
10. Remove the caps and plugs then connect the hydraulic hoses to the manifold fittings; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal Fitting) (page 5–7).
11. Charge the hydraulic system; refer to Charging the Hydraulic System (page 5–63).

Rear Lift Relief Manifold (Model 08743)

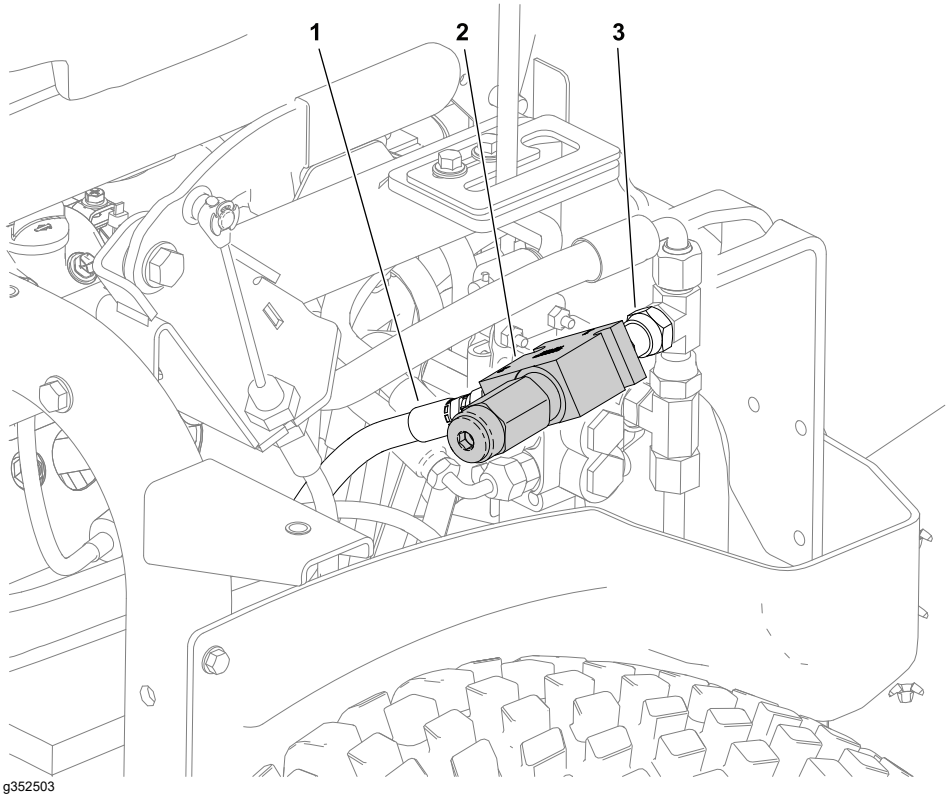


Figure 58

1. Hydraulic hose
2. Rear lift relief manifold
3. Hydraulic tube

For cartridge valve service procedures, refer to Servicing a Hydraulic Cartridge Valve (page 5–86).

Removing and Installing the Rear Lift Relief Manifold

The rear lift relief manifold is located near the rear lift valve, and is supported by the lift valve plumbing (hydraulic tube).

1. Remove the console from the machine; refer to Removing and Installing the Operator's Console (page 7–24).
2. Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–53).
3. Clean the fitting and hydraulic line connections before disconnecting the hydraulic lines to prevent system contamination.
4. Disconnect the hydraulic lines and remove the manifold assembly from the machine.
5. Cap the fittings and plug the hydraulic lines to prevent system contamination.
6. If the hydraulic fittings are to be removed from the manifold, mark the fitting orientation for assembly purposes and remove the fittings from the manifold. Discard the O-rings from the fittings.
7. If the hydraulic fittings were removed from the manifold, lubricate new O-rings with clean hydraulic fluid, position the O-rings to the fittings, and install the fittings in the marked orientation; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9).

8. Remove the caps and plugs then connect the hydraulic lines to the manifold fittings; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal Fitting) (page 5–7).
9. Charge the hydraulic system; refer to Charging the Hydraulic System (page 5–63).
10. Install the console to the machine; refer to Removing and Installing the Operator's Console (page 7–24).

Servicing a Hydraulic Cartridge Valve

Remove the following manifolds from the machine before removing the cartridge valves; refer to Traction Relief Manifold (page 5–82), Rear Lift Relief Manifold (Model 08743) (page 5–84), or Hydraulic Switch Kit Manifold (Optional) (page 5–116).

The optional Rear Remote Hydraulics Manifold is difficult to remove; refer to Rear Remote Hydraulics Manifold (Optional) (page 5–114). Carefully service the rear remote hydraulics solenoid valve with the manifold in place.

Note: For solenoid style cartridge valve coil testing information; refer to Hydraulic Solenoid Valve Coils (Optional) (page 6–23).

1. Ensure that the manifold is clean before you remove the cartridge valve from the manifold.
2. 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.
3. 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.
4. 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.

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

6. 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 following specifications:

      - Traction relief valve = **32 to 35 N·m (24 to 26 ft-lb)**.
      - Rear lift relief valve (model 08743) = **32 to 35 N·m (24 to 26 ft-lb)**.
      - Optional rear remote hydraulics solenoid valve = **32 to 35 N·m (24 to 26 ft-lb)**.
      - Optional hydraulic switch kit valves = refer to Servicing the Optional Hydraulic Switch Kit Manifold (page 5–118).

   D. For solenoid valves, slide the solenoid coil onto the cartridge valve. Tighten the coil nut to **0.6 N·m (60 in-lb)**

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

Lift Control Valve

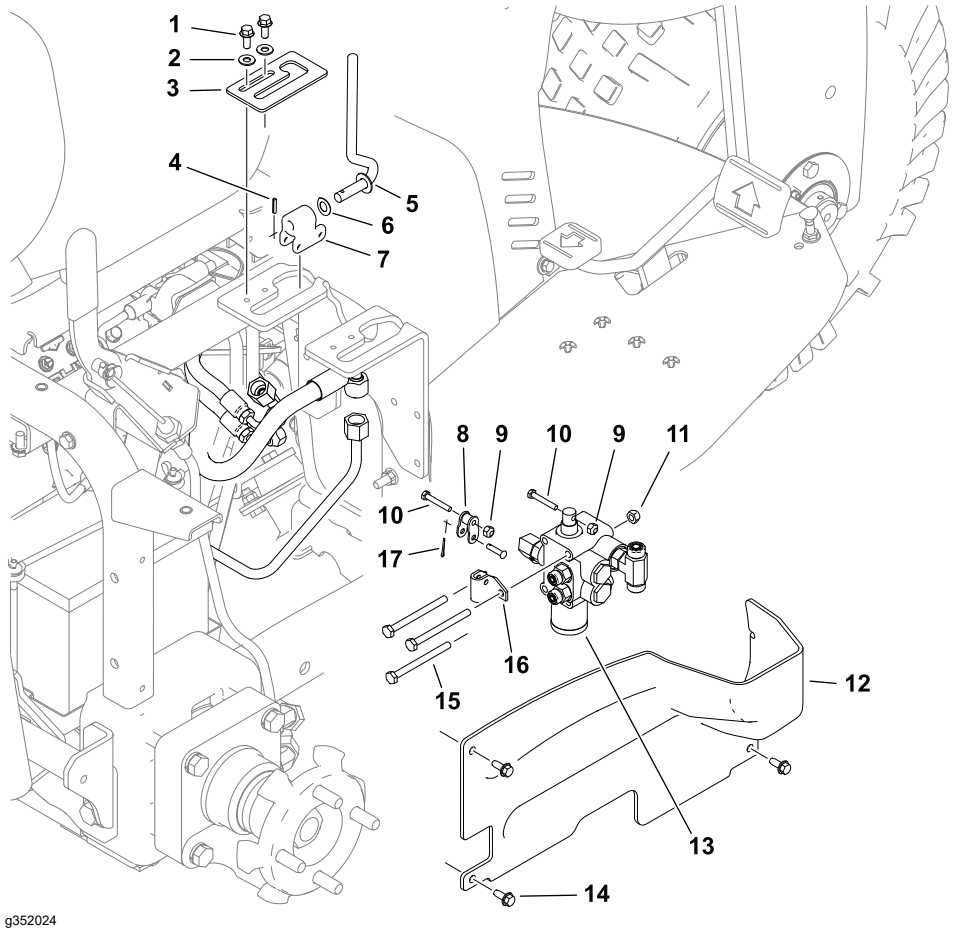


Figure 59
(standard rear lift valve shown)

1. Cap screw (2 each)
2. Flat washer (2 each)
3. Lever guide plate
4. Roll pin
5. Lift lever
6. Curved washer
7. Lift lever pivot
8. Offset link
9. Lock nut (2 each)
10. Cap screw (2 each)
11. Lock nut (3 each)
12. Right side wheel shroud
13. Lift control valve
14. Cap screw (4 each)
15. Cap screw (3 each)
16. Pivot bracket
17. Cotter pin

The following procedures apply to the standard rear lift valve and the optional front lift valve (kit model no 08712).

Removing the Lift Control Valves

Refer to Figure 59 for this procedure.

1. Park the machine on a level surface, lower any attachments, set the key switch to the OFF position and remove the key from the switch.
2. Remove the console from the machine; refer to Removing and Installing the Operator's Console (page 7–24).
3. Remove the right side wheel shroud.
4. Remove the fasteners securing the lever guide plate to the frame and remove the guide plate from the machine.

Removing the Lift Control Valves (continued)

5. Remove the fasteners that secure the lift lever pivot (item 7) to the lift control valve and the pivot bracket. Remove the lift lever assembly from the machine.
6. Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–53).
7. Clean the fitting and hydraulic hose connections before disconnecting the hydraulic hoses to prevent system contamination.
8. Label all hydraulic connections for assembly purposes.
9. Disconnect the hydraulic lines. Cap the fittings and plug the hydraulic lines to prevent system contamination.
10. Remove the 3 cap screws and lock nuts that secure the lift control valve and pivot bracket assembly to the frame, then remove the lift control valve and bracket assembly from the machine.
11. Disassemble the lift lever and pivot bracket assemblies as necessary. Discard the pivot bracket offset link cotter pin if removed.
12. If the hydraulic fittings are to be removed from the lift valve, mark the fitting orientation for assembly purposes and remove the fittings from the valve. Discard the O-rings from the fittings.

Installing the Lift Control Valves

Refer to Figure 59 for this procedure.

1. If the hydraulic fittings were removed from the lift control valve, lubricate new O-rings with clean hydraulic fluid, position the O-rings to the fittings, and install the fittings in the marked orientation; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9).

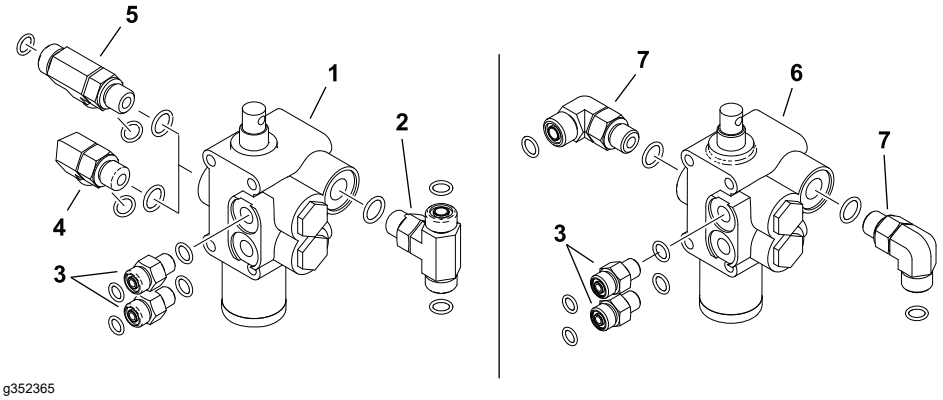


Figure 60

1. Rear lift control valve
2. Tee fitting – branch
3. Straight fitting (2 each)
4. Elbow fitting (model 8745)
5. Tee fitting – run (model 08743)
6. Optional front lift control valve
7. Elbow fitting (2 each)

2. Assemble the lift lever and pivot bracket assemblies if necessary. Use a new cotter pin to install the pivot bracket offset link.
3. Position the lift control valve and the pivot bracket assembly in the machine and secure them to the frame with the previously removed fasteners.
4. Remove the caps and plugs then connect the hydraulic lines to the lift valve fittings; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal Fitting) (page 5–7).

Installing the Lift Control Valves (continued)

5. Install the lift lever pivot (item 7) to the lift control valve and the pivot bracket with the previously removed fasteners.
6. Install the lever guide plate with the previously removed fasteners.
7. Install the right side wheel shroud.
8. Install the console to the machine; refer to Operator's Console (page 7–24).

   Note: Do not secure the dash assembly to the console until lift lever float position has been checked.
9. Charge the hydraulic system; refer to Removing and Installing the Operator's Console (page 7–24).
10. Check the float position of the lift lever and adjust the lever guide plate if necessary; refer to the traction unit *Operator's Manual.*

Servicing the Lift Control Valve

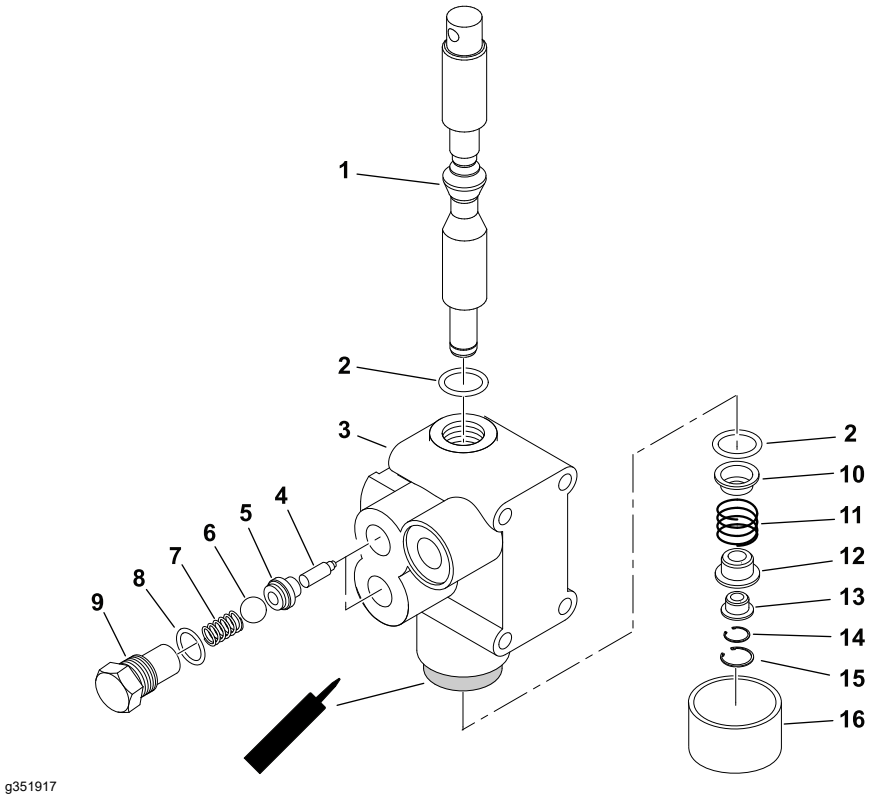


Figure 61

1. Spool
2. O-ring (2 each)
3. Valve body
4. Pin (2 each)
5. Seat – valve (2 each)
6. Ball (2 each)
7. Spring (2 each)
8. O-ring (2 each)
9. Plug (2 each)
10. Spring retainer, inner
11. Spring
12. Spring retainer, outer
13. Spacer
14. Retaining ring, spool
15. Retaining ring
16. Cap

The same valve is used for the standard rear lift valve and the optional front lift valve (kit model no 08712).

Disassembling the Lift Valve

Refer to Figure 61 for this procedure.

1. Wash the lift valve in solvent and dry thoroughly
2. Carefully mount the lift valve in a vise so that the valve mounting surfaces are against the jaws of the vise and the cap of the lift valve is facing upward.
3. Remove the 2 hex cap plugs from the side of the valve body. Remove the spring, check ball, and cam pin from behind each hex cap plug.
4. Remove the check ball seats (item 5) only if they need replacement; the seats are press fit into the valve body.
5. Carefully remove the cap.

   Note: The cap has a light press fit to the valve body.
6. Remove the retaining ring (item 15). Remove the spool retaining ring (item 14), outer spring retainer, spacer, spring, and the inner spring retainer.

Disassembling the Lift Valve (continued)

7. Carefully push and twist the spool from the valve body.
8. Being careful not to scratch the valve bore finish, remove the O-rings (spool seals) from the inside bore of the valve body.
9. Inspect all the components for wear, paying special attention to the spool. Signs of wear on one side of the spool may indicate a bent spool. Inspect the spool for run-out (straightness) and replace it if necessary.

Assembling the Lift Valve

Refer to Figure 61 for this procedure.

1. Clean all components thoroughly before assembly. Remove any residual silicone sealer from the valve body and cap.
2. Use new O-rings when assembling. Coat all O-rings and the spool with clean hydraulic fluid before installation into the valve body.
3. Install the spool into the valve body before inserting the cam pins, check balls, springs and hex cap plugs. Assemble the components in reverse order of disassembly.

   Note: The spool retaining ring is a stamped ring and must be installed with the sharp edge away from the spacer.
4. Apply a thin film of silicone sealer to the undercut of the valve body before installing the cap (item 16).

Rear Lift Cylinder

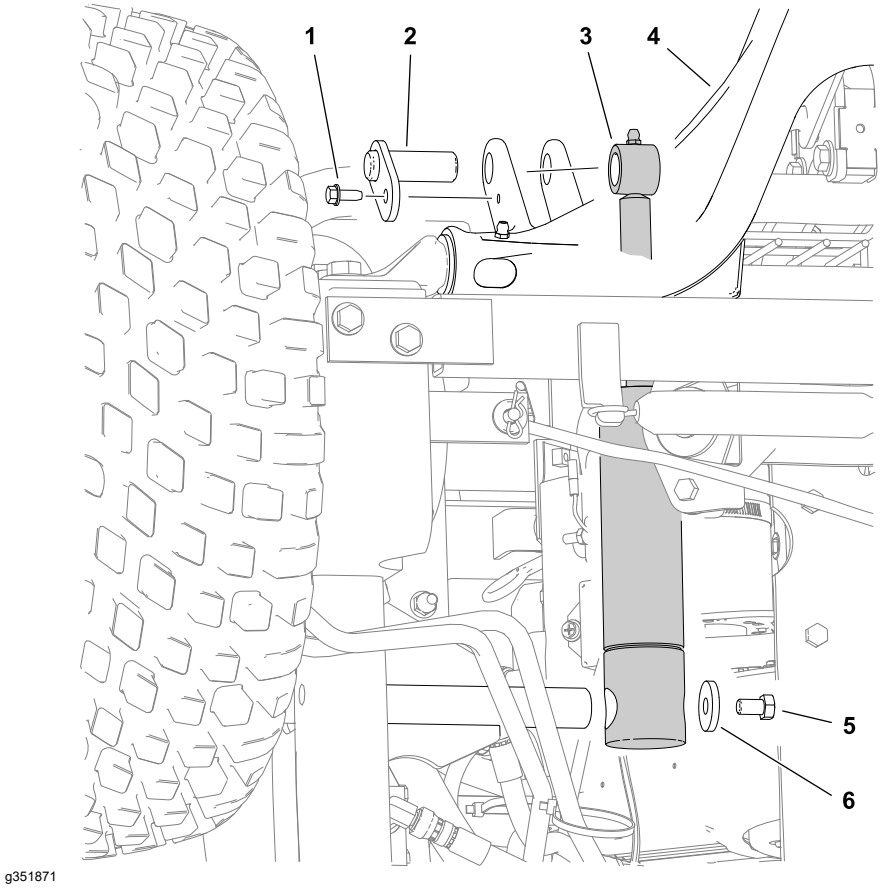


Figure 62
(view from under machine)

1. Cap screw
2. Pin
3. Lift cylinder
4. Rear hitch
5. Cap screw
6. Flat washer

Removing the Rear Lift Cylinder

Refer to Figure 62 for this procedure. The rear lift cylinder is located on the left side of the machine.

1. Park the machine on a level surface, lower any attachments, set the key switch to the OFF position and remove the key from the switch.
2. Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–53).
3. Clean the fitting and hydraulic hose connections before disconnecting the hydraulic hoses to prevent system contamination.
4. Disconnect the hydraulic hoses. Cap the fittings and plug the hoses to prevent system contamination.
5. Remove the fastener from the pin that secures the cylinder clevis to the rear hitch and slide the pin from the hitch and the lift cylinder.
6. Remove the fasteners that secure the lift cylinder to the frame and remove the lift cylinder from the machine.
7. If the hydraulic fittings are to be removed from the cylinder, mark the fitting orientation for assembly purposes and remove the fittings from the cylinder. Discard the O-rings from the fittings.

Installing the Rear Lift Cylinder

Refer to Figure 62 for this procedure.

1. If the hydraulic fittings were removed from the cylinder, lubricate new O-rings with clean hydraulic fluid, position the O-rings to the fittings, and install the fittings in the marked orientation; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9).
2. Secure the barrel end of the lift cylinder to the frame with the previously removed fasteners.
3. Install the pin to secure the lift cylinder clevis to the hitch and secure the pin with the previously removed fastener.
4. Lubricate the grease fitting on the cylinder clevis with #2 general purpose grease.
5. Remove the caps and plugs then connect the hydraulic tubes to the cylinder fittings; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal Fitting) (page 5–7).
6. Charge the hydraulic system; refer to Charging the Hydraulic System (page 5–63).

Servicing the Rear Lift Cylinder

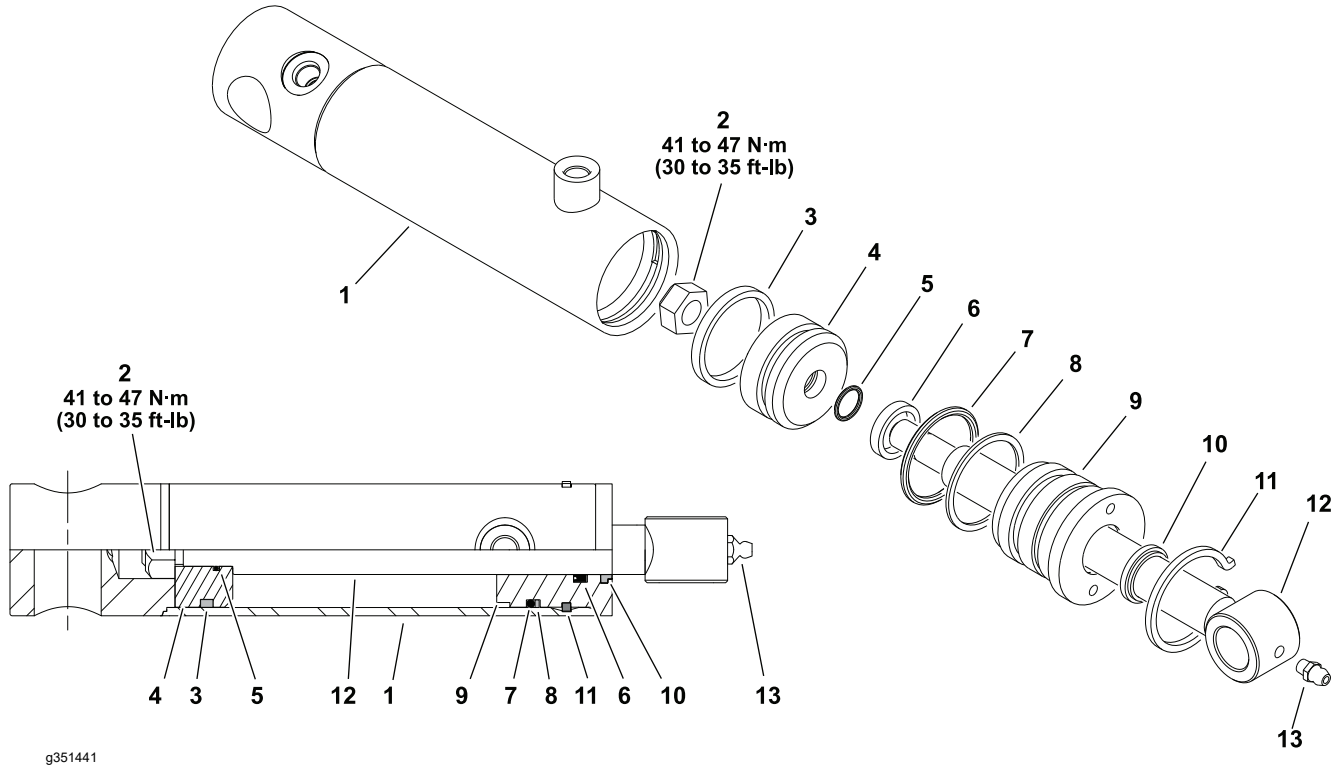


Figure 63

1. Barrel
2. Lock nut
3. Piston wear ring
4. Piston
5. Rod O-ring
6. Rod seal
7. Head O-ring
8. Head back-up ring
9. Cylinder head
10. Rod wiper
11. Retaining ring
12. Cylinder rod
13. Grease fitting

If items other than the cylinder seals are worn or damaged, the cylinder must be replaced as a complete assembly. Disassemble, inspect, and assemble the cylinder for inspection and seal replacement only.

Disassembling the Rear Lift Cylinder

Refer to Figure 63 for this procedure.

1. Remove hydraulic fluid from the cylinder into a drain pan by slowly pumping the cylinder shaft. Plug both ports and clean the outside of the cylinder.
2. Secure the cylinder in a vise by lightly clamping on the mounting collar on the barrel.
3. Remove the retaining ring from the head and barrel:
   A. Using a spanner wrench, rotate the head clockwise until the edge of the retaining ring appears in the barrel opening.
   B. Insert a screwdriver under the beveled edge of the retaining ring to start the retaining ring out the barrel opening.
   C. Rotate the head counterclockwise to fully remove retaining ring.
4. Remove the plugs from the ports. Extract the shaft, head and piston by carefully twisting and pulling on the shaft.

IMPORTANT

Do not clamp the vise jaws against the shaft surface. Clamp on the clevis ONLY.

5. Mount the shaft securely in a vise by clamping on the clevis of the shaft. Remove the lock nut and piston from the shaft. Carefully slide the head off the shaft.
6. Taking care to not scratch or damage the piston, remove the wear ring and O-ring from the piston.
7. Taking care to not scratch or damage the head, remove the O-ring, back–up ring, rod seal and wiper from the head.

Assembling the Rear Lift Cylinder

Refer to Figure 63 for this procedure.

1. Make sure all the cylinder parts are clean before assembly.
2. Coat the new O-rings, back–up ring and other seals with clean hydraulic fluid.
   A. Carefully fit the wear ring and the O-ring to the piston.
   B. Carefully fit the rod seal, O-ring, back–up ring, and the wiper to the head.

IMPORTANT

Do not clamp the vise jaws against the shaft surface. Clamp on the clevis ONLY.

3. Mount the shaft securely in a vise by clamping on the clevis of the shaft.
   A. Coat the shaft with clean hydraulic fluid.
   B. Slide the head onto the shaft.
   C. Install the piston onto the shaft and secure with the lock nut. Tighten the lock nut from **41 to 47 N·m (30 to 35 ft-lb)**.
   D. Remove the shaft assembly from the vise.

IMPORTANT

Prevent damage when clamping the hydraulic cylinder into a vise; clamp on the mounting collar on the barrel ONLY.

4. Mount the barrel securely in a vise by lightly clamping on the mounting collar on the barrel.
5. Coat all internal parts with a light coat of clean hydraulic fluid. Slide the piston, shaft, and the head assembly into the barrel being careful not to damage the seals.

   Note: When installing the head into the barrel, pay careful attention to the retaining ring slot in the barrel to insure that the backup ring does not lodge in the slot.
6. Install the retaining ring to secure the head in the barrel:

Assembling the Rear Lift Cylinder (continued)

A. Using a spanner wrench, rotate the head until the retaining ring hole appears in the barrel opening.

B. Insert the retaining ring hook through the barrel opening and into the hole in the head.

C. Rotate the head clockwise 1–1/4 turns until the retaining ring is completely pulled into the barrel and the ends are covered.

Steering Control Valve (Model 08745)

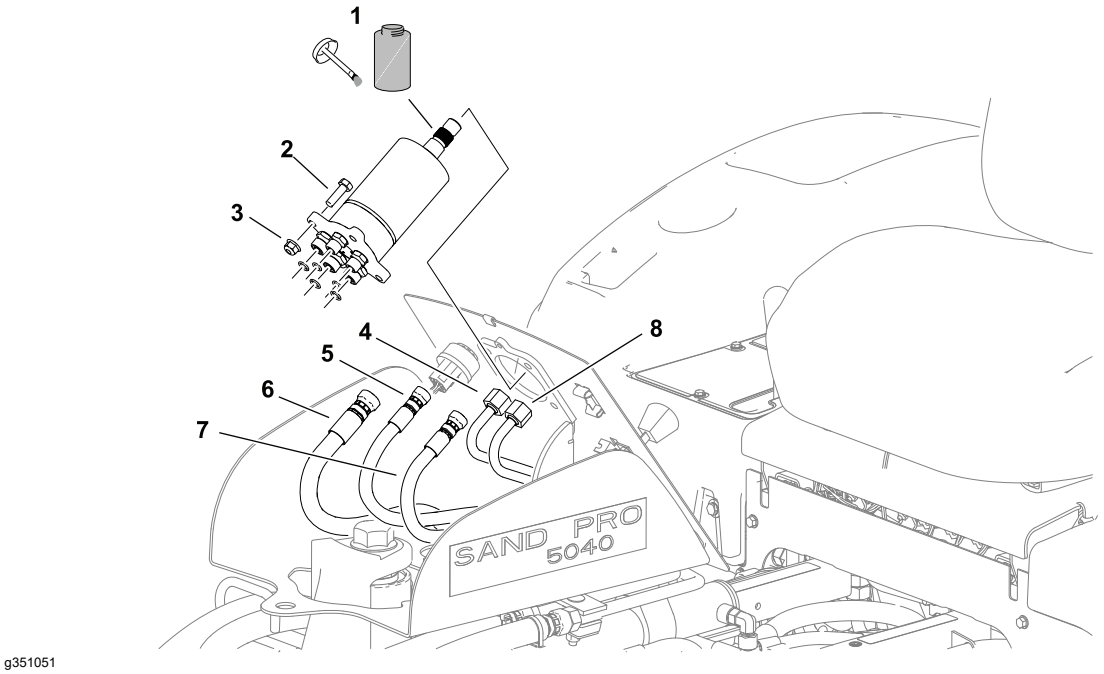


Figure 64

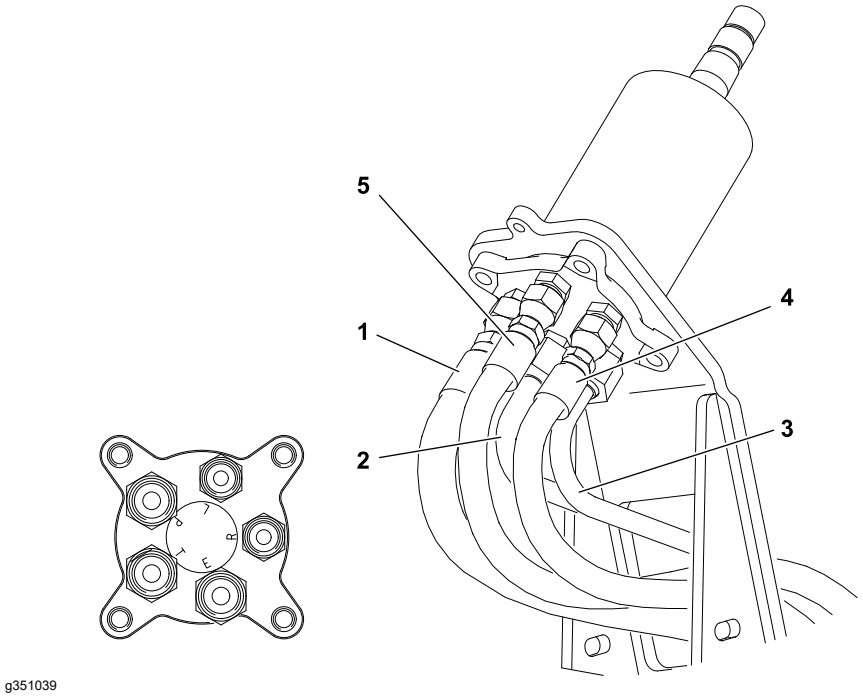
1. Steering control valve
2. Cap screw (4 each)
3. Lock nut (4 each)
4. Hydraulic tube
5. Hydraulic hose
6. Hydraulic hose
7. Hydraulic hose
8. Hydraulic tube

Removing the Steering Control Valve

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Remove the fuel tank from the machine; refer to Removing and Installing the Fuel Tank (page 4–12).
3. Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–53).
4. Clean the hydraulic tube ends, and fittings on the steering control valve to prevent contaminants from entering into the hydraulic system.
5. Label and remove the hydraulic hoses and tubes from the fittings on the control valve. Allow the hydraulic lines to drain into a suitable container.
6. Install clean caps and plugs on the hydraulic tubes and fittings to prevent system contamination.
7. Remove the steering wheel from the machine; refer to Removing and Installing the Steering Wheel (page 7–13).
8. Support the steering control valve and remove the fasteners that secure the steering control valve to the machine.

Installing the Steering Control Valve

1. Slide the steering control valve onto the valve support and secure the steering control valve to the machine with the previously removed fasteners.
2. Remove the caps and plugs then connect the hydraulic lines to the control valve fittings; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal Fitting) (page 5–7).



g351039

Figure 65

1. Hose from piston (taction) pump – Port P
2. Tube to oil cooler Tee fitting – Port T
3. Tube to lift control Tee fitting – Port E
4. Hose to steering cylinder barrel end – Port R
5. Hose to steering cylinder rod end – Port L

3. Install the steering wheel; refer to Removing and Installing the Steering Wheel (page 7–13).
4. Install the fuel tank; refer to Removing and Installing the Fuel Tank (page 4–12).
5. Charge the hydraulic system; refer to Charging the Hydraulic System (page 5–63).
6. Operate the steering system from full stop to full stop. Ensure the hydraulic hoses do not contact anything prior to returning the machine to service.

Servicing the Steering Control Valve (Model 08745)

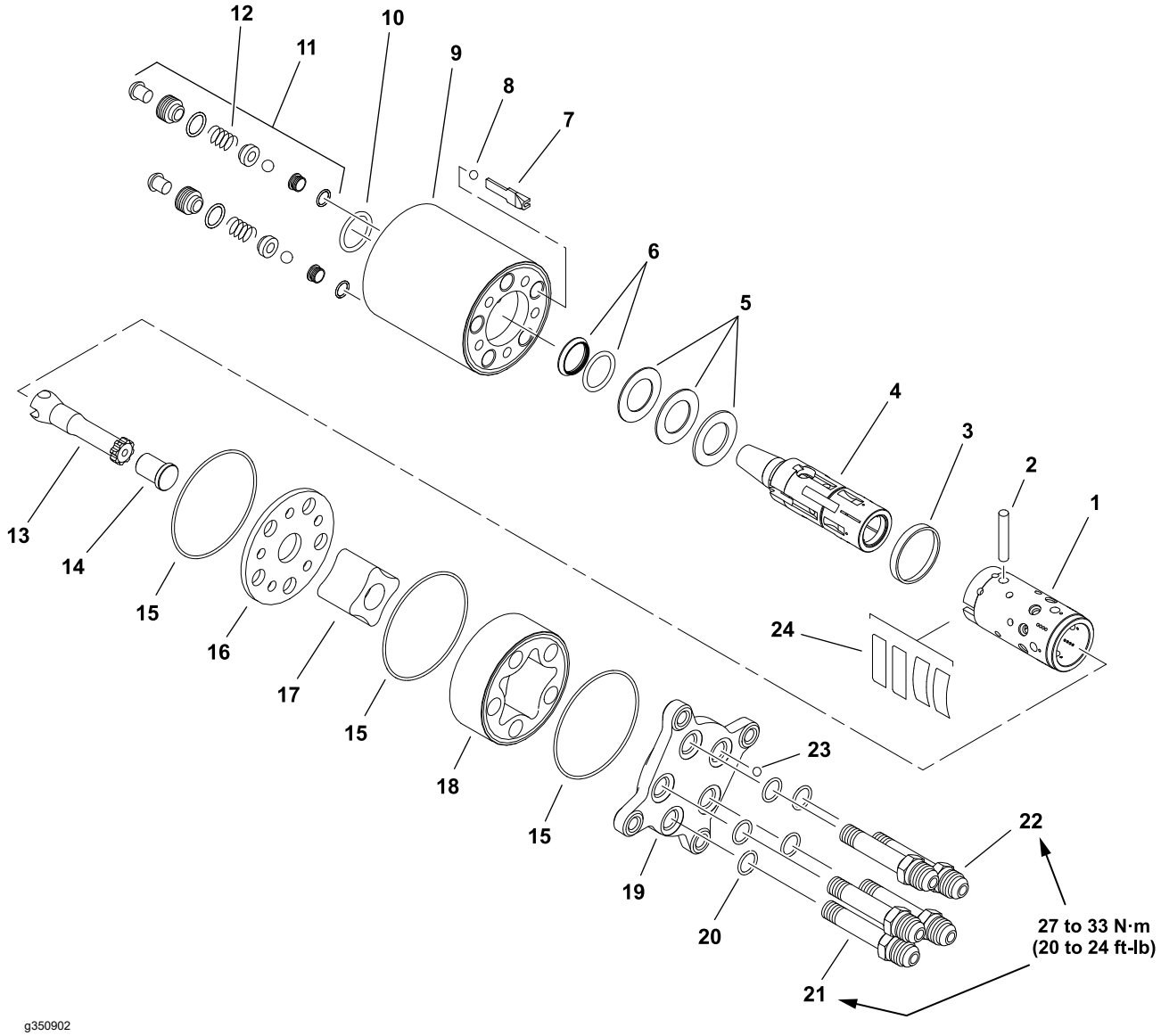


Figure 66

1.	Sleeve	9.	Housing	17.	Inner gearwheel
2.	Cross pin	10.	Dust seal ring	18.	Outer gearwheel
3.	Ring	11.	Relief valve (2 each)	19.	End cover
4.	Spool	12.	Relief valve spring (2 each)	20.	O–ring (5 each)
5.	Bearing assembly	13.	Cardan shaft	21.	Screw/fitting (ports L, R, T)
6.	Shaft seal	14.	Spacer	22.	Screw/fitting (ports P and E)
7.	Ball stop	15.	O–ring	23.	P port check ball
8.	Ball	16.	Distribution plate	24.	Spring set

For the steering control valve repair procedures; refer to the Danfoss Steering Unit Type OSPM Service Manual.

Steering Cylinder (Model 08745)

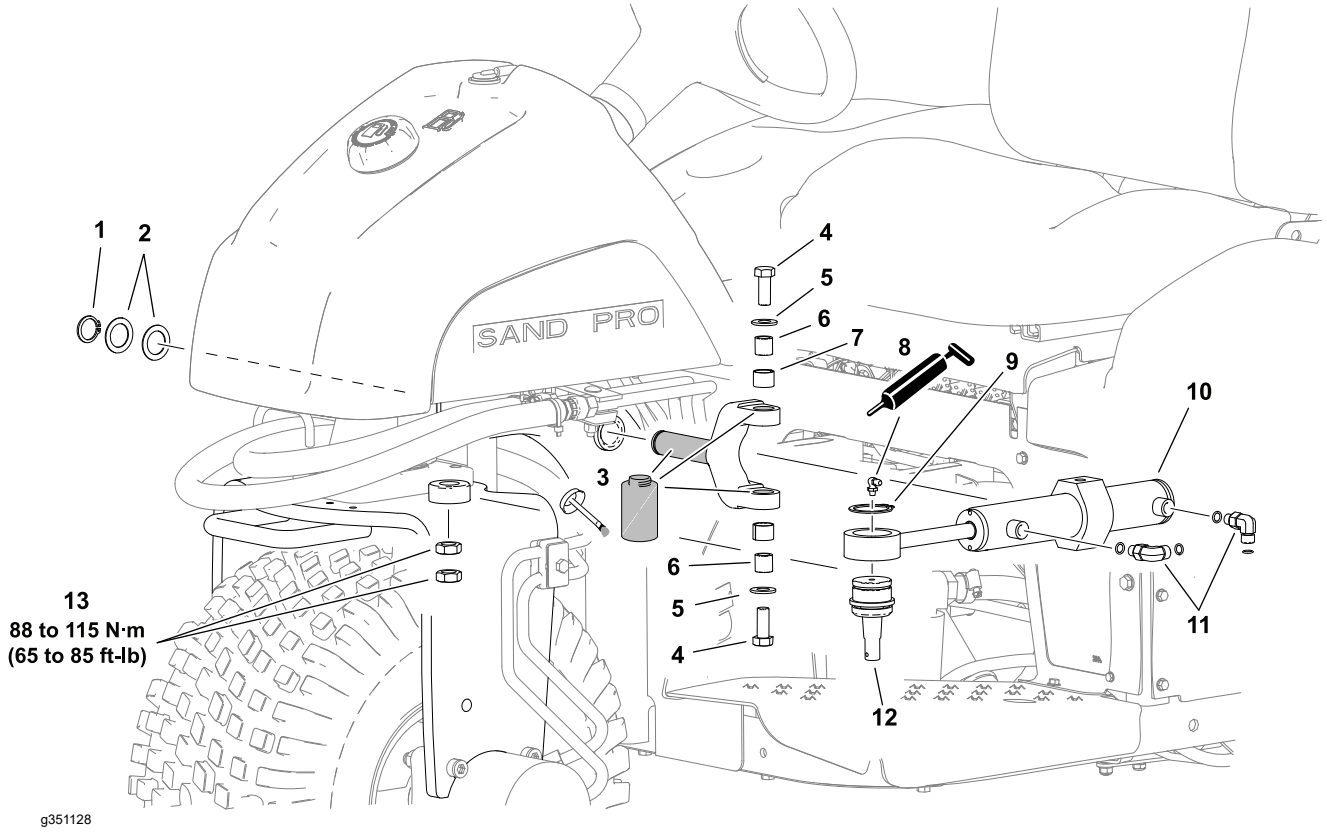


Figure 67

1. Retaining ring
2. Washer (2 each)
3. Yoke
4. Cap screw (2 each)
5. Washer (2 each)
6. Spacer (2 each)
7. Bushing (2 each)
8. Grease fitting
9. Retaining ring
10. Steering cylinder
11. Elbow fitting (2 each)
12. Ball joint
13. Jam nut (2 each)

Removing the Steering Cylinder

Refer to Figure 67 for this procedure.

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–53).
3. Clean the fitting and hydraulic hose connections before disconnecting the hydraulic hoses to prevent system contamination.
4. Disconnect the hydraulic hoses. Cap the fittings and plug the hoses to prevent system contamination.
5. Remove the 2 jam nuts that secure the steering cylinder ball joint to the front fork.
6. Use a suitable tool (pickle fork) to separate the ball joint from the front fork.
7. Remove the 2 cap screws and flat washers that secure the steering cylinder to the yoke and remove the cylinder from the machine. Locate and retrieve the spacers.

Removing the Steering Cylinder (continued)

8. Remove the retaining ring and washers from the yoke shaft and remove the yoke from the machine if necessary.
9. Inspect the cylinder ball joint boot and replace the ball joint if necessary.
10. If the hydraulic fittings are to be removed from the cylinder, mark the fitting orientation for assembly purposes and remove the fittings from the cylinder. Discard the O-rings from the fittings.

Installing the Steering Cylinder

Refer to Figure 67 for this procedure.

1. If previously removed, press the ball joint into the cylinder and install the ball joint retaining ring.
2. If the hydraulic fittings were removed from the cylinder, lubricate new O-rings with clean hydraulic fluid, position the O-rings to the fittings, and install the fittings in the marked orientation; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9).
3. If previously removed, apply a thin layer of anti-seize compound to the shaft and bores of the yoke before installing the yoke.
4. Thoroughly clean the ball joint taper and the boss in the front fork.
5. Position the steering cylinder to the front fork and yoke, then secure the steering cylinder ball joint to the front fork with 2 jam nuts.
   A. Install the first jam nut and tighten from **88 to 115 N·m (65 to 80 ft-lb)**.
   B. While retaining the first jam nut with a wrench, install the second jam nut and tighten from **88 to 115 N·m (65 to 80 ft-lb)**.
6. Secure the steering cylinder to the yoke with the previously removed fasteners.
7. Remove the caps and plugs then connect the hydraulic hoses to the cylinder fittings; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal Fitting) (page 5–7).
8. Lubricate the cylinder ball joint grease fitting.
9. Charge the hydraulic system; refer to Charging the Hydraulic System (page 5–63).

Servicing the Steering Cylinder (Model 08745)

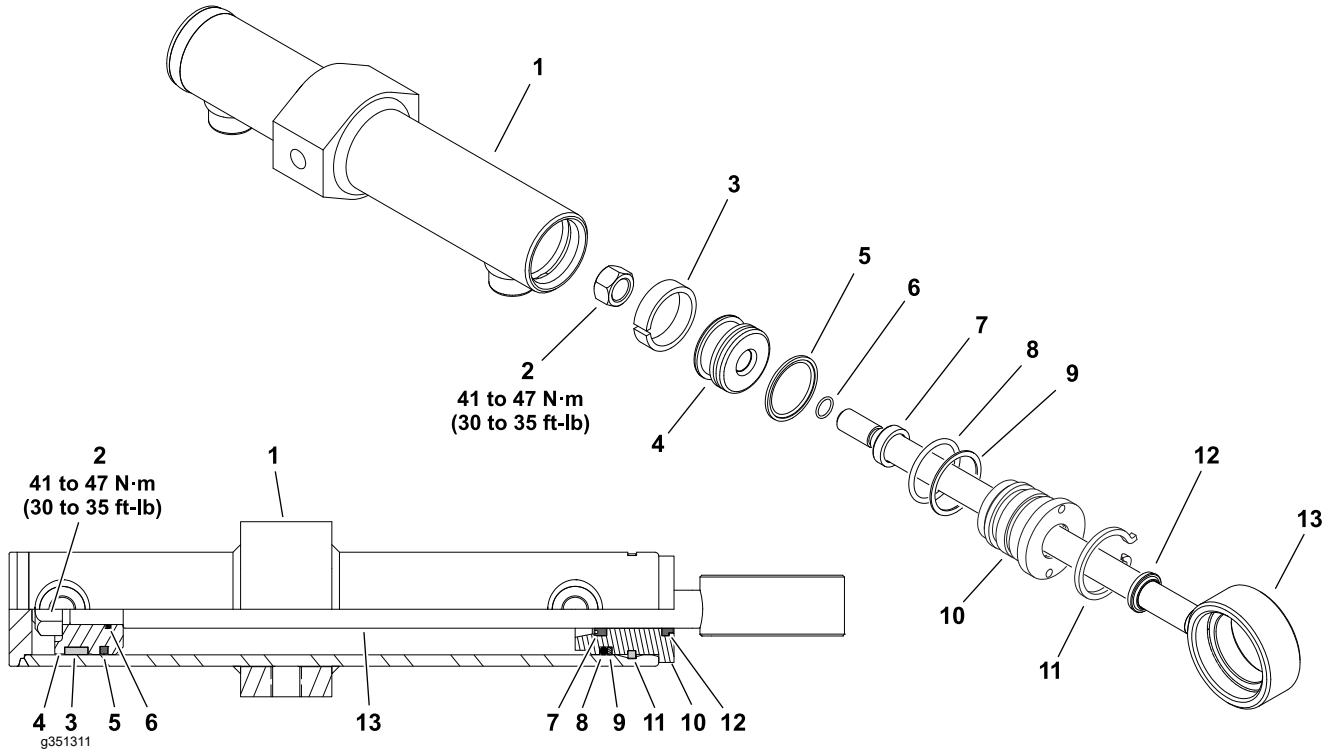


Figure 68

1. Barrel
2. Lock nut
3. Piston wear ring
4. Piston
5. Piston seal
6. Rod O-ring
7. Rod seal
8. Head O-ring
9. Head back-up ring
10. Head
11. Retaining ring
12. Rod wiper
13. Cylinder rod

If items other than the cylinder seals are worn or damaged, the cylinder must be replaced as a complete assembly. Disassemble, inspect, and assemble the cylinder for inspection and seal replacement only.

Disassembling the Steering Cylinder

Refer to Figure 68 for this procedure

1. Remove hydraulic fluid from the cylinder into a drain pan by slowly pumping the cylinder shaft. Plug both ports and clean the outside of the cylinder.
2. Secure the cylinder in a vise by lightly clamping on the mounting collar on the barrel.
3. Remove the retaining ring from the head and barrel:
   A. Using a spanner wrench, rotate the head clockwise until the edge of the retaining ring appears in the barrel opening.
   B. Insert a screwdriver under the beveled edge of the retaining ring to start the retaining ring out the barrel opening.
   C. Rotate the head counterclockwise to fully remove retaining ring.
4. Remove the plugs from the ports. Extract the shaft, head and piston by carefully twisting and pulling on the shaft.

Disassembling the Steering Cylinder (continued)

IMPORTANT

Do not clamp the vise jaws against the shaft surface. Clamp on the clevis ONLY.

5. Mount the shaft securely in a vise by clamping on the clevis of the shaft. Remove the lock nut and piston from the shaft. Carefully slide the head off the shaft.
6. Taking care to not scratch or damage the piston, remove the wear ring, seal and O-ring from the piston.
7. Taking care to not scratch or damage the head, remove the O-ring, back–up ring, rod seal and wiper from the head.

Assembling the Steering Cylinder

Refer to Figure 68 for this procedure

1. Make sure all the cylinder parts are clean before assembly.
2. Coat the new O-rings, back–up ring and other seals with clean hydraulic fluid.
   A. Carefully fit the wear ring, seal, and the O-ring to the piston.
   B. Carefully fit the rod seal, O-ring, back–up ring, and the wiper to the head.

IMPORTANT

Do not clamp the vise jaws against the shaft surface. Clamp on the clevis ONLY.

3. Mount the shaft securely in a vise by clamping on the clevis of the shaft.
   A. Coat the shaft with clean hydraulic fluid.
   B. Slide the head onto the shaft.
   C. Install the piston onto the shaft and secure with the lock nut. Tighten the lock nut from **41 to 47 N·m (30 to 35 ft-lb)**.
   D. Remove the shaft assembly from the vise.

IMPORTANT

Prevent damage when clamping the hydraulic cylinder into a vise; clamp on the mounting collar on the barrel ONLY.

4. Mount the barrel securely in a vise by lightly clamping on the mounting collar on the barrel.
5. Coat all internal parts with a light coat of clean hydraulic fluid. Slide the piston, shaft, and the head assembly into the barrel being careful not to damage the seals.

   Note: When installing the head into the barrel, pay careful attention to the retaining ring slot in the barrel to insure that the backup ring does not lodge in the slot.
6. Install the retaining ring to secure the head in the barrel:

Assembling the Steering Cylinder (continued)

A. Using a spanner wrench, rotate the head until the retaining ring hole appears in the barrel opening.

B. Insert the retaining ring hook through the barrel opening and into the hole in the head.

C. Rotate the head clockwise 1–1/4 turns until the retaining ring is completely pulled into the barrel and the ends are covered.

Front Lift Cylinder (Optional)

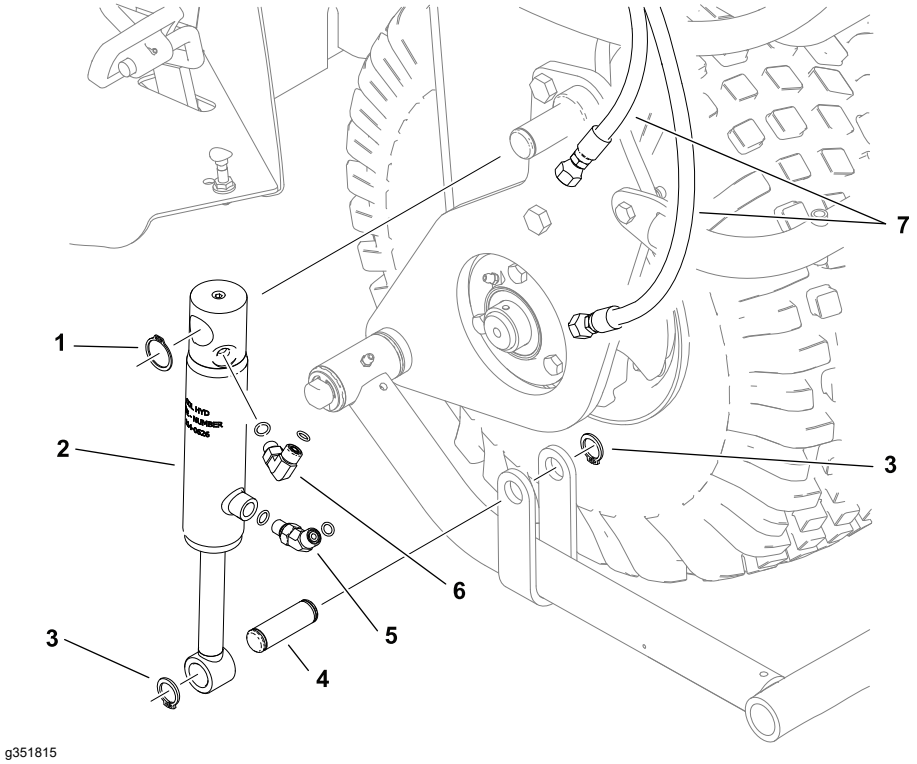


Figure 69

1. Retaining ring
2. Lift cylinder
3. Retaining ring (2 each)
4. Cylinder pin
5. Elbow fitting
6. Elbow fitting
7. Hydraulic hose assemblies

Removing and Installing the Optional Front Lift Cylinder

Refer to Figure 69 for this procedure.

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–53).
3. Clean the fitting and hydraulic hose connections before disconnecting the hydraulic hoses to prevent system contamination.
4. Disconnect the hydraulic hoses. Cap the fittings and plug the hoses to prevent system contamination.
5. Remove the retaining rings that secure the cylinder to the machine, then remove the cylinder and cylinder pin from the machine.
6. If the hydraulic fittings are to be removed from the cylinder, mark the fitting orientation for assembly purposes and remove the fittings from the cylinder. Discard the O-rings from the fittings.
7. Install the optional front lift cylinder in the reverse order.
8. If the hydraulic fittings were removed from the cylinder, lubricate new O-rings with clean hydraulic fluid, position the O-rings to the fittings, and install the fittings in the marked orientation; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9).

9. Remove the caps and plugs then connect the hydraulic hoses to the cylinder fittings; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal Fitting) (page 5–7).
10. Charge the hydraulic system; refer to Charging the Hydraulic System (page 5–63).

Servicing the Front Lift Cylinder (Optional)

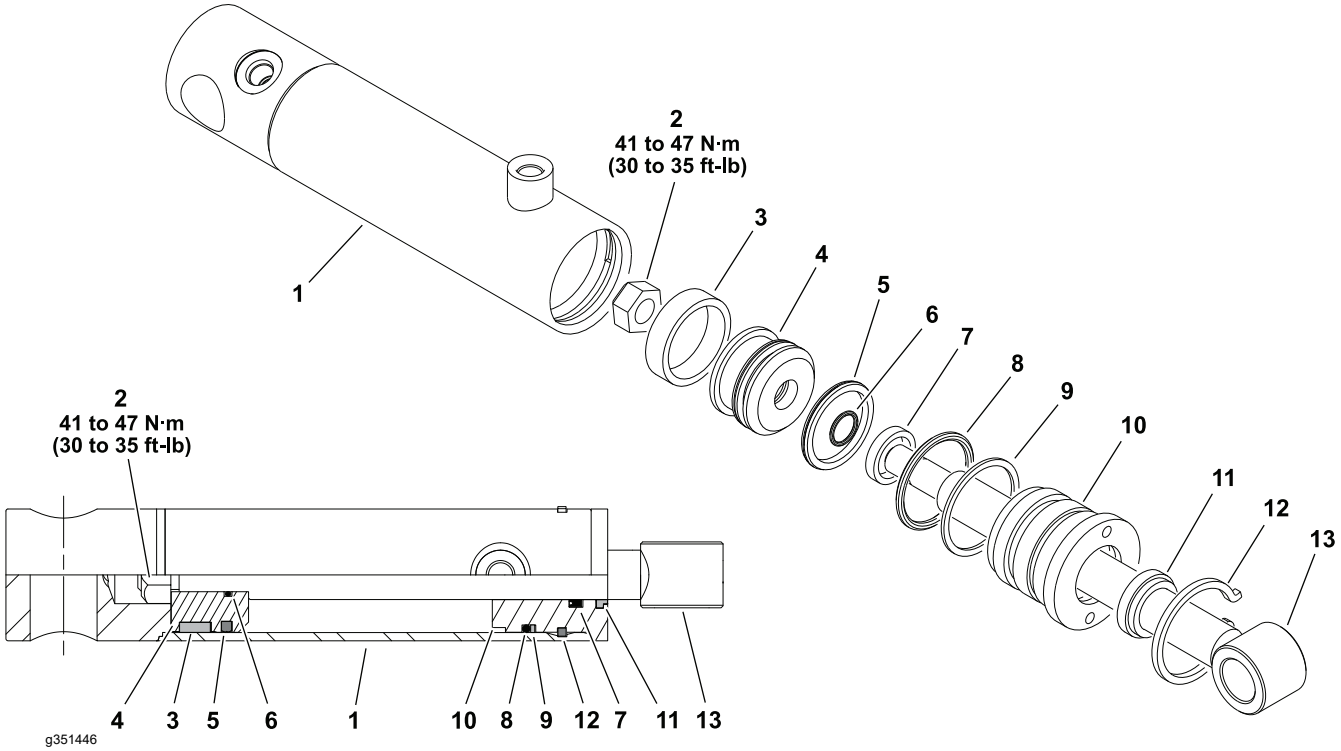


Figure 70

1. Barrel
2. Lock nut
3. Piston wear ring
4. Piston
5. Piston seal
6. Rod O-ring
7. Rod seal
8. Head O-ring
9. Head back-up ring
10. Head
11. Retaining ring
12. Rod wiper
13. Cylinder rod

If items other than the cylinder seals are worn or damaged, the cylinder must be replaced as a complete assembly. Disassemble, inspect, and assemble the cylinder for inspection and seal replacement only.

Disassembling the Optional Front Lift Cylinder

Refer to Figure 70 for this procedure

1. Remove hydraulic fluid from the cylinder into a drain pan by slowly pumping the cylinder shaft. Plug both ports and clean the outside of the cylinder.
2. Secure the cylinder in a vise by lightly clamping on the mounting collar on the barrel.
3. Remove the retaining ring from the head and barrel:
   A. Using a spanner wrench, rotate the head clockwise until the edge of the retaining ring appears in the barrel opening.
   B. Insert a screwdriver under the beveled edge of the retaining ring to start the retaining ring out the barrel opening.
   C. Rotate the head counterclockwise to fully remove retaining ring.
4. Remove the plugs from the ports. Extract the shaft, head and piston by carefully twisting and pulling on the shaft.

IMPORTANT

Do not clamp the vise jaws against the shaft surface. Clamp on the clevis ONLY.

5. Mount the shaft securely in a vise by clamping on the clevis of the shaft. Remove the lock nut and piston from the shaft. Carefully slide the head off the shaft.
6. Taking care to not scratch or damage the piston, remove the wear ring, seal and O-ring from the piston.
7. Taking care to not scratch or damage the head, remove the O-ring, back–up ring, rod seal and wiper from the head.

Assembling the Optional Front Lift Cylinder

Refer to Figure 70 for this procedure

1. Make sure all the cylinder parts are clean before assembly.
2. Coat the new O-rings, back–up ring and other seals with clean hydraulic fluid.
   A. Carefully fit the wear ring, seal, and the O-ring to the piston.
   B. Carefully fit the rod seal, O-ring, back–up ring, and the wiper to the head.

IMPORTANT

Do not clamp the vise jaws against the shaft surface. Clamp on the clevis ONLY.

3. Mount the shaft securely in a vise by clamping on the clevis of the shaft.
   A. Coat the shaft with clean hydraulic fluid.
   B. Slide the head onto the shaft.
   C. Install the piston onto the shaft and secure with the lock nut. Tighten the lock nut from **41 to 47 N·m (30 to 35 ft-lb)**.
   D. Remove the shaft assembly from the vise.

IMPORTANT

Prevent damage when clamping the hydraulic cylinder into a vise; clamp on the mounting collar on the barrel ONLY.

4. Mount the barrel securely in a vise by lightly clamping on the mounting collar on the barrel.
5. Coat all internal parts with a light coat of clean hydraulic fluid. Slide the piston, shaft, and the head assembly into the barrel being careful not to damage the seals.

   Note: When installing the head into the barrel, pay careful attention to the retaining ring slot in the barrel to insure that the backup ring does not lodge in the slot.
6. Install the retaining ring to secure the head in the barrel:

Assembling the Optional Front Lift Cylinder (continued)

A. Using a spanner wrench, rotate the head until the retaining ring hole appears in the barrel opening.

B. Insert the retaining ring hook through the barrel opening and into the hole in the head.

C. Rotate the head clockwise 1–1/4 turns until the retaining ring is completely pulled into the barrel and the ends are covered.

Rear Remote Hydraulics (Optional) or Switch Kit (Optional) Hydraulic Pump

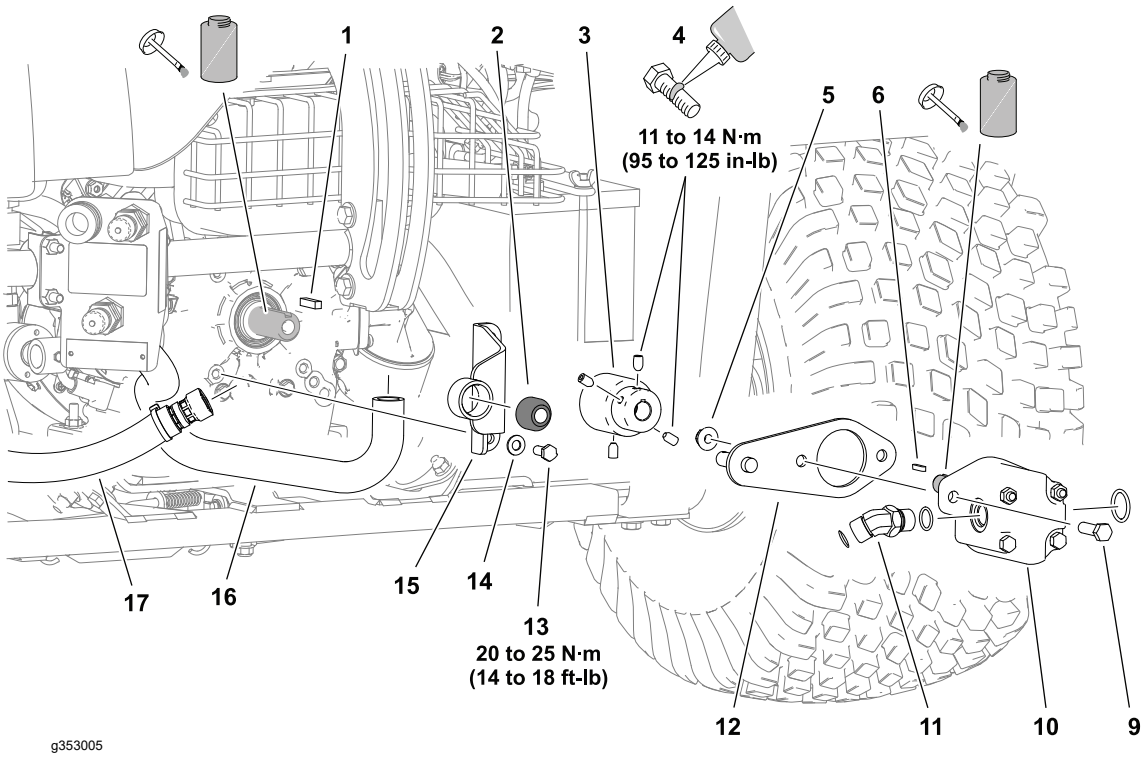


Figure 71

(rear remote hydraulics kit shown with hitch removed)

1.	Square key	7.	Barb fitting – suction	13.	Cap screw (2 each)
2.	Rubber bushing	8.	Hose clamp	14.	Washer (2 each)
3.	Coupler	9.	Cap screw (2 each)	15.	Bracket
4.	Set screw (4 each)	10.	Hydraulic pump	16.	Suction hose
5.	Flange nut (2 each)	11.	Elbow fitting	17.	Hydraulic hose
6.	Square key	12.	Torque arm		

Refer to Servicing the Optional Rear Remote Hydraulics or Optional Switch Kit Hydraulic Pump (page 5–113) for pump service information.

Removing the Optional Hydraulic Pump

Note: Refer to Figure 71 for this procedure.

1. Park the machine on a level surface, lower any attachments, set the key switch to the OFF position and remove the key from the switch.
2. You may want to remove the hitch assembly to improve access to the optional hydraulic pump; refer to Removing and Installing the Hitch Assembly (page 7–22).
3. Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–53).
4. Clean the hydraulic pump and all hydraulic connections to prevent hydraulic system contamination.
5. Disconnect the hydraulic hoses from the fittings on the hydraulic pump and allow the hydraulic lines to drain into a suitable container.
6. Install clean caps or plugs on the fittings and in the disconnected hoses to prevent contamination.

Removing the Optional Hydraulic Pump (continued)

7. Loosen the set screws securing the optional hydraulic pump to the coupler and remove the pump assembly from the machine. Retrieve the pump shaft key.
8. If necessary, remove the fasteners securing the hydraulic pump to the torque plate and remove the torque plate.
9. Inspect the rubber bushing in the engine bracket for damage or wear and replace if necessary.
10. If necessary, mark the location of the coupler on the engine shaft and remove the coupler.
11. If the hydraulic fittings are to be removed from the pump, mark the fitting orientation for assembly purposes and remove the fittings from the pump. Discard the O-rings from the fittings.

Installing the Optional Hydraulic Pump

Refer to Figure 71 for this procedure.

1. Lubricate new O-rings and place them onto the fittings. If previously removed, install the fittings into the pump ports; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9).

2. If the coupler was removed from the engine:
   A. Install the key in the engine shaft and apply a thin layer of anti-seize compound to the engine shaft and key.
   B. Position the coupler on the engine shaft at the marked location.
   C. Apply medium strength thread locking compound and install the set screws. Tighten the set screws from **11 to 14 N·m (95 to 125 in-lb)**.

3. If removed, install the engine bracket and tighten the fasteners from **20 to 25 N·m (14 to 18 ft-lb)**.
4. If removed, install the torque plate to the optional hydraulic pump with the previously removed fasteners.
5. Install the key in the pump shaft and apply a thin layer of anti-seize compound to the pump shaft and key.
6. Align the torque plate pin and pump shaft and slide the gear pump into the coupler.

7. Apply medium strength thread locking compound and install the set screws. Tighten the set screws from **11 to 14 N·m (95 to 125 in-lb)**.
8. Remove the caps and plugs from the hydraulic fittings and hydraulic hoses then install the hydraulic hoses to the optional hydraulic pump; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal Fitting) (page 5–7).
9. Charge the hydraulic system; refer to Charging the Hydraulic System (page 5–63).

Servicing the Optional Rear Remote Hydraulics or Optional Switch Kit Hydraulic Pump

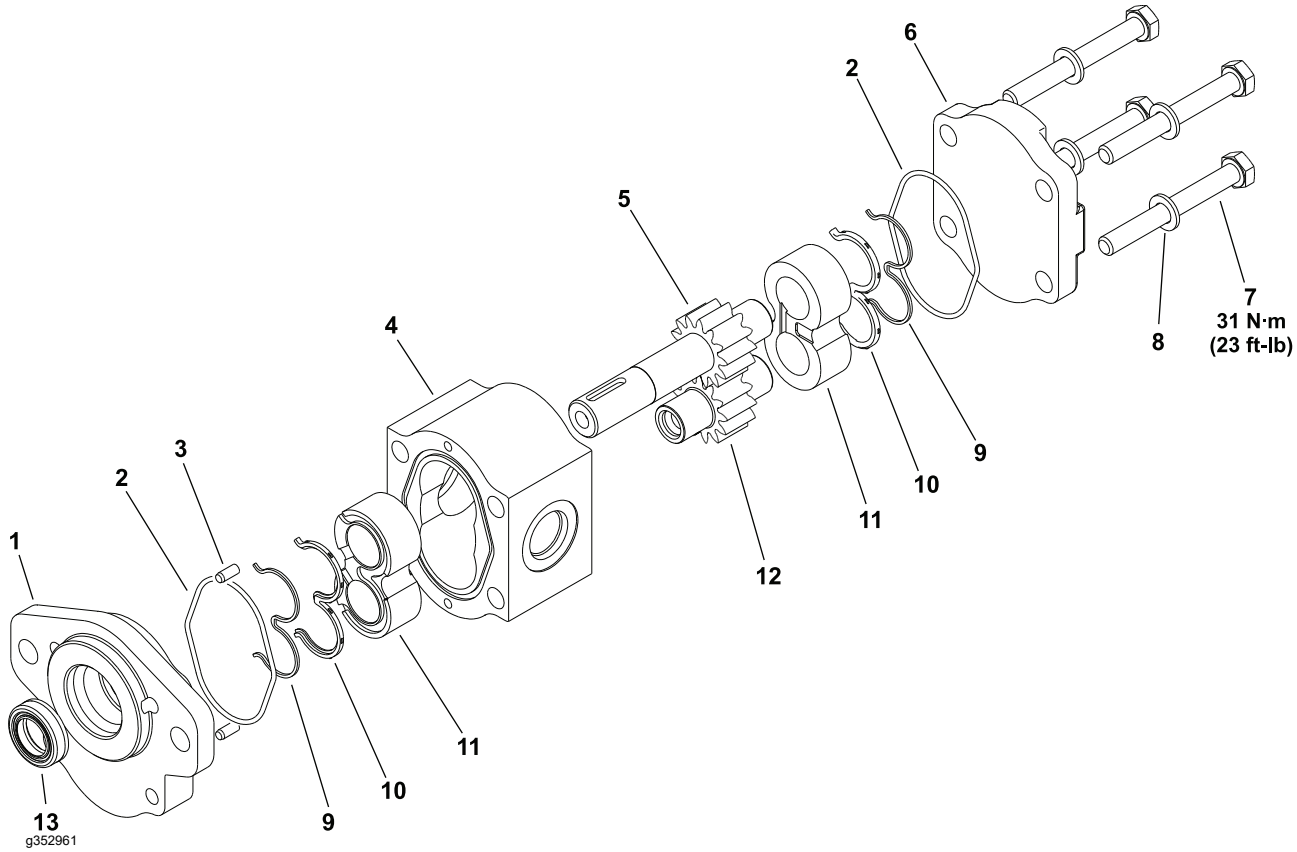


Figure 72

1.	Front cover	6.	Rear cover	11.	Thrust block (2 each)
2.	Seal- O-ring (2 each)	7.	Cap screw (4 each)	12.	Driven gear
3.	Dowel pin (2 each)	8.	Washer (4 each)	13.	Shaft seal
4.	Body	9.	Back–up seal (2 each)		
5.	Drive gear	10.	Channel seal (2 each)		

If items other than the 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 the gear pump for cleaning, inspection and seal replacement only.

For the pump repair procedures; refer to the Parker PGP/PGM 500 Series Service Manual.

Rear Remote Hydraulics Manifold (Optional)

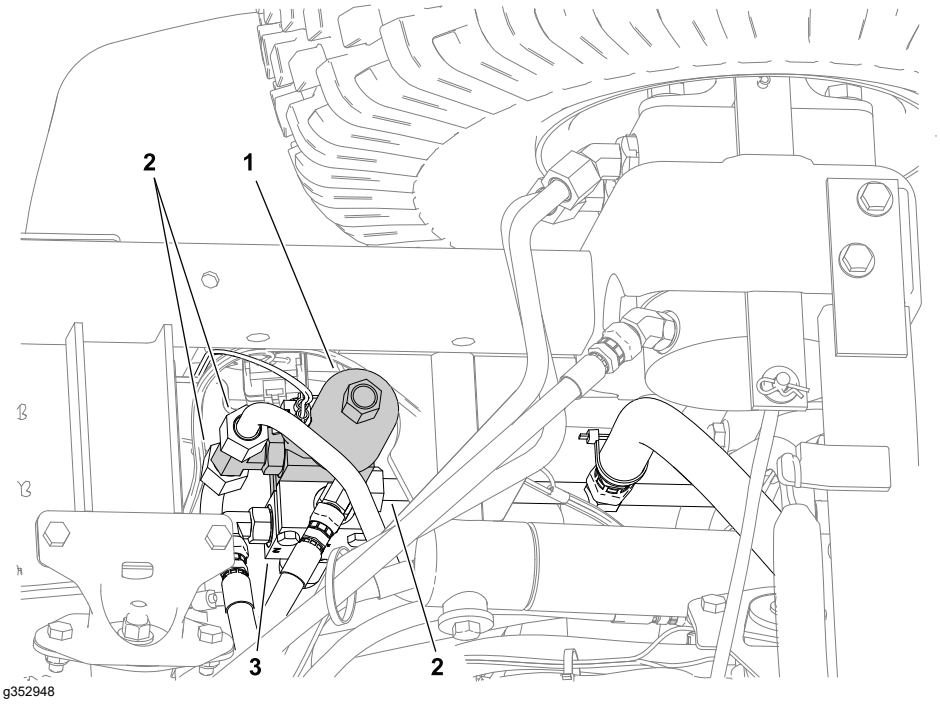


Figure 73
(view from under machine)

1. Rear remote hydraulics manifold assembly
2. Hydraulic tube (3 each)
3. Traction relief manifold assembly

The rear remote hydraulics manifold is located near the left rear wheel.

For cartridge valve service procedures, refer to Servicing a Hydraulic Cartridge Valve (page 5–86).

Removing the Optional Rear Remote Hydraulics Manifold

Refer to Figure 73 for this procedure.

1. Remove the left rear wheel; refer to Removing and Installing the Rear Wheels (page 7–5).
2. Remove the left side wheel shroud and the left side screen panel.
3. Disconnect the wire harness from the rear remote hydraulics solenoid valve
4. Read and adhere to the information provided in General Precautions for Removing and Installing the Hydraulic System Components (page 5–53).
5. Clean the fitting and hydraulic tube connections before disconnecting the hydraulic tubes to prevent system contamination.
6. Label all hydraulic connections for assembly purposes and disconnect the hydraulic tubes.
7. Cap the fittings and plug the hydraulic tubes to prevent system contamination.
8. Remove the fasteners securing the traction relief manifold and the rear remote hydraulics manifold to the bracket and remove the rear remote hydraulics manifold assembly from the machine.
9. If the hydraulic fittings are to be removed from the manifold, mark the fitting orientation for assembly purposes and remove the fittings from the manifold. Discard the O-rings from the fittings.

Removing the Optional Rear Remote Hydraulics Manifold

Refer to Figure 73 for this procedure.

1. If the hydraulic fittings were removed from the manifold, lubricate new O-rings with clean hydraulic fluid, position the O-rings to the fittings, and install the fittings in the marked orientation; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9).
2. Secure the rear remote hydraulics manifold assembly and the traction relief manifold to the bracket with the previously removed fasteners.
3. Remove the caps and plugs then connect the hydraulic tubes to the manifold fittings; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal Fitting) (page 5–7).
4. Connect the wire harness to the rear remote hydraulics solenoid valve.
5. Charge the hydraulic system; refer to Charging the Hydraulic System (page 5–63).
6. Install the left side screen panel and the left side wheel shroud.
7. Install the rear wheel; refer to Removing and Installing the Rear Wheels (page 7–5).

Hydraulic Switch Kit Manifold (Optional)

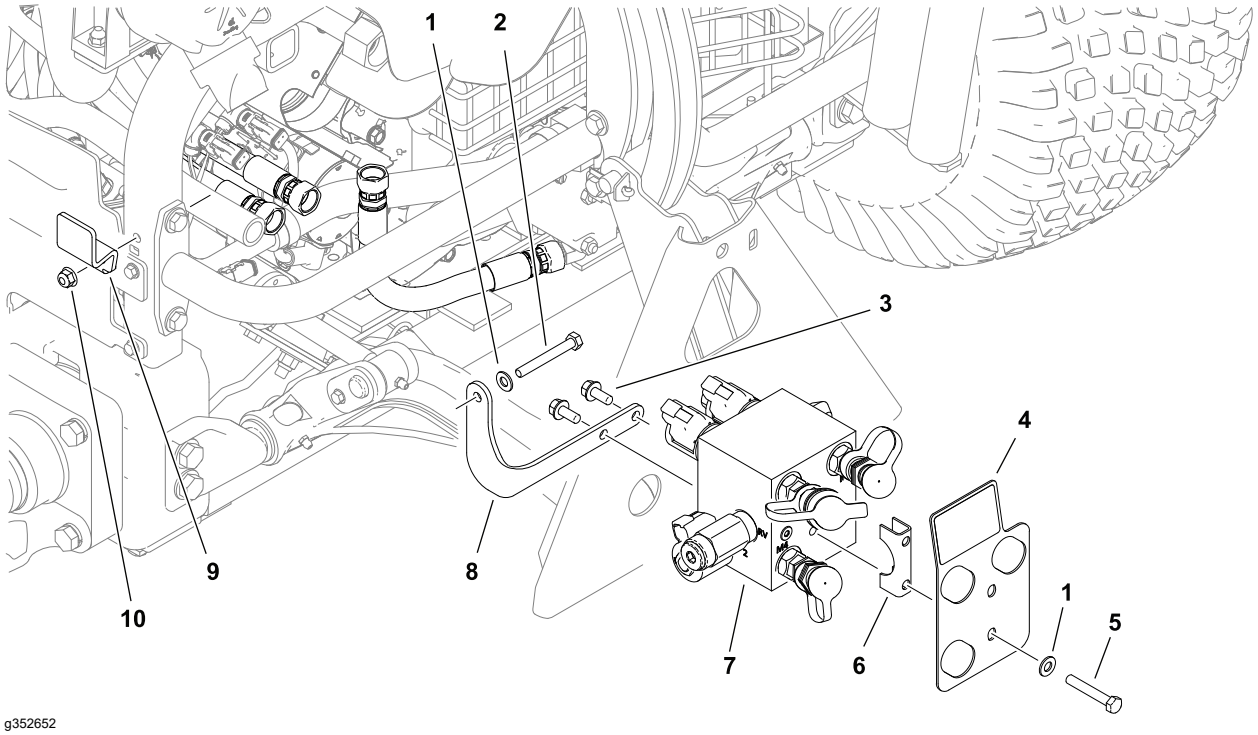


Figure 74

1. Flat plain (3 each)
2. Cap screw
3. Cap screw (2 each)
4. Coupler panel
5. Cap screw (2 each)
6. Clamp
7. Hydraulic manifold assembly
8. Manifold bracket
9. Hydraulic tank clamp
10. Lock nut

Removing the Hydraulic Switch Kit Manifold

Refer to Figure 74 for this procedure.

1. Remove the hydraulic tank; refer to Removing the Hydraulic Tank (page 5–65).
2. Clean the hydraulic hose ends, and fittings on the manifold to prevent contaminants from entering into the hydraulic system.
3. Label and remove the hydraulic hoses from the fittings on the manifold. Allow the tubes and hoses to drain into a suitable container.
4. Install clean caps and plugs on the hydraulic hoses, and fittings to prevent system contamination.
5. Label and disconnect the wire harness connectors from the solenoid valves.
6. Remove the fasteners securing the manifold bracket to the machine.

   Note: The manifold bracket should be loose once the hydraulic tank clamps have been removed.
7. Support the manifold assembly, remove the fasteners securing the coupler panel and the manifold assembly to the hitch tube and remove the manifold assembly from the machine.
8. Dismantle the manifold assembly if necessary; refer to Servicing the Optional Hydraulic Switch Kit Manifold (page 5–118).
9. If the hydraulic fittings are to be removed from the manifold, mark the fitting orientation for assembly purposes and remove the fittings from the manifold. Discard the O-rings from the fittings.

Installing the Hydraulic Switch Kit Manifold

Refer to Figure 74 for this procedure.

1. If the hydraulic fittings were removed from the manifold, lubricate new O-rings with clean hydraulic fluid, position the O-rings to the fittings, and install the fittings in the marked orientation; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9).

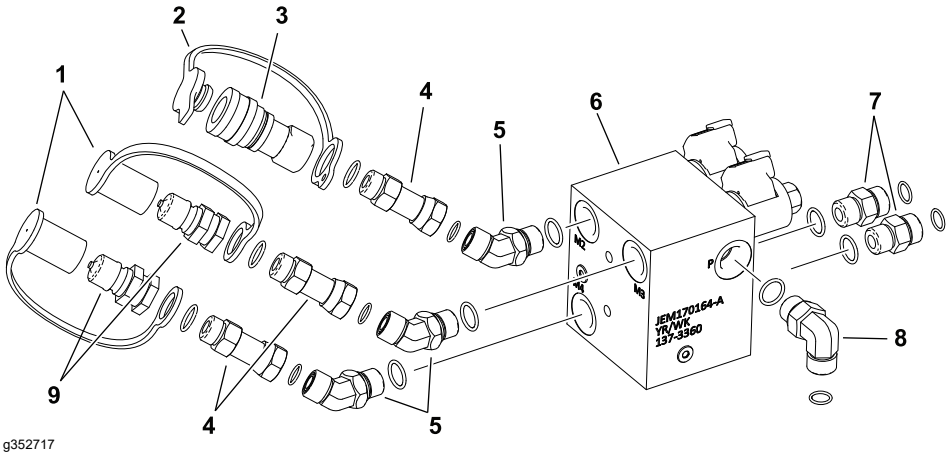


Figure 75

1. Cap – male coupler (2 each)
2. Cap – female coupler
3. Coupler – female
4. Adapter (3 each)
5. Elbow fitting (3 each)
6. Manifold assembly
7. Straight fitting (2 each)
8. Elbow fitting
9. Coupler – male (2 each)

2. Ensure that all manifold components are properly installed prior to installing the manifold into the machine; refer to Servicing the Optional Hydraulic Switch Kit Manifold (page 5–118).
3. Secure the manifold assembly and the coupler panel to the hitch tube with the previously removed fasteners.
4. Position the previously removed fastener through the R-clamp, manifold bracket, and frame tube.

   Note: Install the hydraulic tank clamp and locknut when installing the hydraulic tank later in this procedure.
5. Remove the caps and plugs then connect the hydraulic tubes and hoses to the manifold fittings; refer to Installing Hydraulic Hoses and Tubes (O-Ring Face Seal Fitting) (page 5–7).
6. Connect the wire harness connectors to the solenoid valves.
7. Install the hydraulic tank; refer to Installing the Hydraulic Tank (page 5–66).

Servicing the Optional Hydraulic Switch Kit Manifold

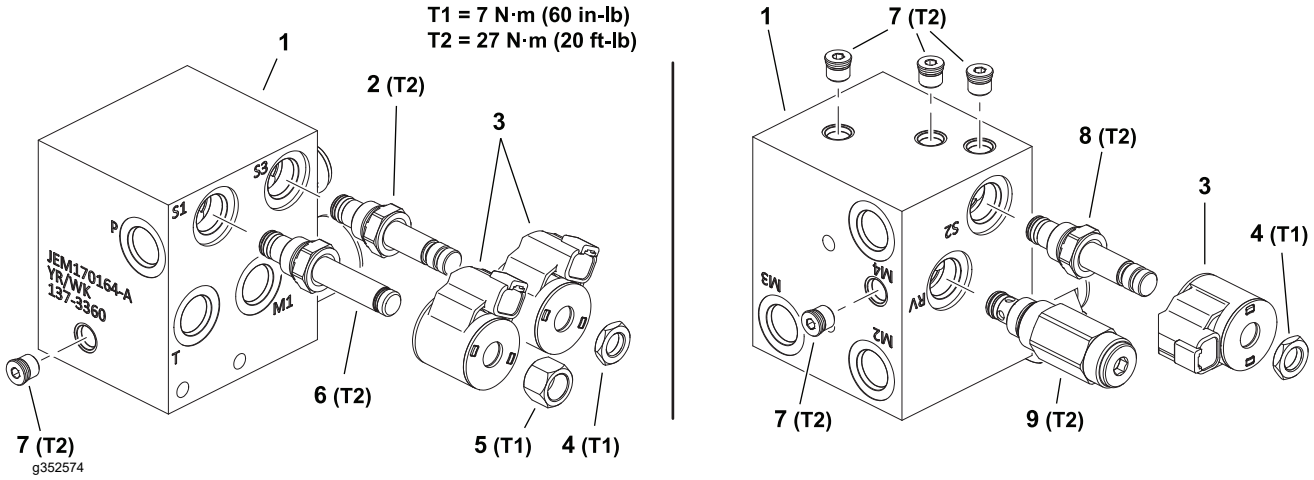


Figure 76

1. Manifold block
2. Solenoid valve – S3
3. Solenoid coil (3 each)
4. Coil nut (2 each)
5. Coil nut
6. Solenoid valve – S1
7. #4 zero-leak plug with O-ring (5 each)
8. Solenoid valve – S2
9. Relief valve – RV

The ports on the manifold are marked for easy identification of components and connections. Example: P is the pressure connection port from the switch kit hydraulic pump, and S1 (SV1) is the location for the tank (return) 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.

For cartridge valve service procedures, refer to Servicing a Hydraulic Cartridge Valve (page 5–86).

The hydraulic manifold include several zero−leak plugs. These plugs have a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero−leak plugs also have an O−ring as a secondary seal. If 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.

If the hydraulic fittings are to be removed from the manifold:

1. Mark the fitting orientation for assembly purposes.
2. Remove the fittings from the manifold and discard the O-rings.
3. Lubricate and install new O-rings to the fittings.
4. Align and install the fittings into the manifold and tighten the fittings to the specified torque; refer to Installing the Hydraulic Fittings (SAE Straight Thread O-Ring Fittings) (page 5–9).

Chapter 6

Electrical System

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.

Electrical Schematics and Wire Harness Drawings/Diagrams

The electrical schematics and wire harness drawings for the Sand Pro 3040/5040 machine are located in Appendix A (page A–1).

Electrical System Quick Checks

Testing the Charging System

The Sand Pro 3040/5040 machines use a single 12 Volt maintenance free battery mounted behind the right side rear wheel. The battery is charged by a 15 Amp 12 volt alternator with separate voltage regulator supplied by the engine manufacturer.

The following is a simple test used to determine if the charging system is functioning. It will tell you if the charging system has an output, but not its capacity.

1. Use a digital multimeter set to DC volts and connect the positive (+) multimeter lead to the positive battery post and the negative (–) multimeter lead to the negative battery post.
2. Record the battery voltage. The battery voltage must be greater than 5 VDC for the alternator system to have any output. If the battery voltage is less than 5 VDC, charge the battery before performing this charging system test.
3. Start the engine and run at high idle (3400 RPM). Allow the battery to charge for at least 3 minutes. Record the battery voltage.

   Note: Upon starting the engine, the battery voltage will drop and then should increase once the engine is running.

   Depending upon the condition of the battery charge and battery temperature, the charging system voltage will increase at different rates as the battery charges.
4. After running the engine for at least 3 minutes, the battery voltage should be at least 0.50 volt higher than the initial battery voltage.

Checking the Operation of the Safety Interlock Switches

⚠ CAUTION ⚠

Do not disconnect safety interlock switches. They are for the operator's protection. Check the operation of the safety interlock switches daily for proper operation. Replace any malfunctioning switches before operating the machine.

The machine interlock components include:

- Operator seat switch
- Traction neutral switch
- Interlock relay
- Diodes D1 and D2
- Seat switch relay (optional)
- PTO switch (optional)

On standard machines, the interlock relay is used in conjunction with the seat switch, the traction neutral switch, and diodes D1 and D2 to form the interlock system. The traction neutral switch must be properly adjusted and the traction pedal must be in the Neutral position for the engine to crank; refer to Adjusting the Traction Neutral Switch (page 6–16). The interlock relay must be energized through the traction neutral switch or the Operator seat switch for the engine ignition system (magneto) to function. During operation, if the interlock relay should be de-energized (e.g. operator rises out of the seat with the traction pedal depressed), the magneto will be grounded and the engine will stop.

On machines with an optional rear remote hydraulics kit or optional hydraulic switch kit, the seat switch relay and the PTO switch also become part of the interlock system. The engine will not crank if the Operator is out of the seat and the PTO switch is engaged (even if the traction neutral switch is in the NEUTRAL position). During operation, if the seat switch relay should be de-energized (e.g. operator rises out of the seat with the PTO engaged), the magneto will be grounded and the engine will stop.

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

Testing the Electrical Components

For accurate resistance and/or continuity checks, electrically disconnect the component being tested from the circuit (e.g., unplug the key switch connector before doing a continuity check of the switch). Always check the item being tested and the harness connector for damage or corrosion and clean or repair if necessary.

Note: Refer to the Briggs & Stratton V-Twin Engine Service Manual for additional engine electrical component repair information.

IMPORTANT

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

Fusible Links

The Sand Pro 3040/5040 machines use 2 fusible links for circuit protection. The fusible links are located in the machine wire harness. One fusible link connects the starter solenoid B+ terminal to the fuse block at pin 2. The other fusible link connects the voltage regulator to the fuse block at pin 1. If a fusible link fails, current to the protected circuit is interrupted; refer to Appendix A (page A–1) for additional circuit information.

Testing the Fusible Links

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Disconnect the negative battery cable from the battery terminal, and then disconnect the positive cable from the battery; refer to Removing and Installing the Battery (page 6–31).
3. Locate and disconnect the machine wire harness connector for the fusible link to be tested:
   - at the starter solenoid B+ terminal
   - at the voltage regulator output

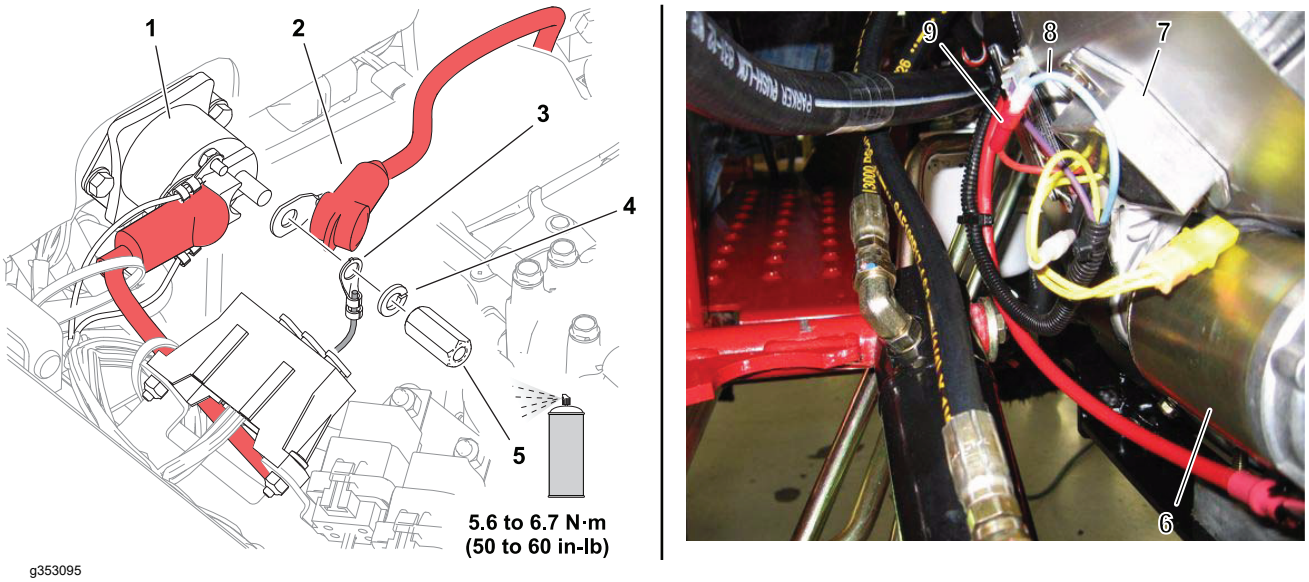


Figure 77

1. Starter solenoid
2. Positive (+) battery cable
3. Machine wire harness
4. Lock washer
5. Stand-off nut
6. Starter motor (left side of engine)
7. Voltage regulator
8. Machine wire harness
9. Voltage regulator output (red connector)

Check the harness connector for damage or corrosion and clean or repair if necessary.

4. Use a multimeter to ensure that the continuity exists between the disconnected connector and fuse F1 (fuse block pins 1 or 2).
5. If any of the fusible links are open, repair or replace the machine wire harness.

6. After you complete the testing, connect any disconnected machine wire harness connectors. If the wire harness connector at the starter solenoid B+ terminal was disconnected, tighten the stand-off nut to **5.6 to 6.7 N·m (50 to 60 in-lb)**. Apply battery terminal protector to the starter solenoid B+ terminal

and cable connectors before installing the boot; refer to Battery Terminal Protector (page 2–17).

7. Connect the positive battery cable to the battery terminal and then connect the negative cable to the battery; refer to Removing and Installing the Battery (page 6–31).

Fuses

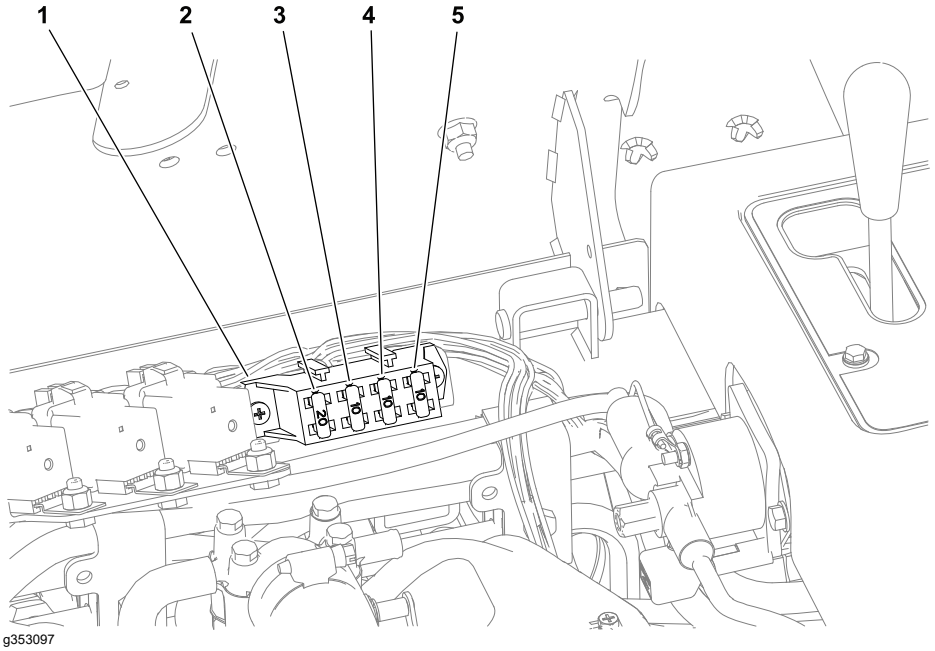


Figure 78
(shown with seat raised)

1. Fuse block
2. Fuse F1 (20 Amp)
3. Fuse F2 (10 Amp)
4. Fuse F3 (10 Amp)
5. Fuse F4 (open slot or optional 10 Amp)

The individual control circuits are protected by a variety of fuses found in the main fuse block located under the operator's seat. Refer to the electrical schematic in Appendix A (page A–1) for specific circuit information.

Fuse Identification and Function

Fuse Block

- F1: (20 Amp) supplies unswitched power to the key switch and telematics connector.
- F2: (10 Amp) supplies switched power (via the key switch) to the fuel solenoid and the telematics connector.
- F3: (10 Amp) supplies switched power (via the main relay) to the hour meter, seat switch, traction neutral switch, start relay coil, and optional kit relay coil.
- F4: (open slot or optional 10 Amp) available to supply switched power (via the main relay) to the optional light, rear remote hydraulics, and hydraulic switch kits.

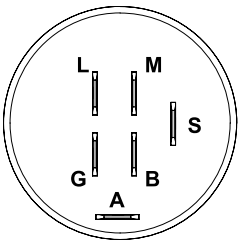
Testing the Fuses

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Remove the fuse from the fuse block for testing. Check the fuse, fuse block or fuse holder for damage or corrosion and clean or repair if necessary.
3. Use a multimeter (ohms setting) and test the fuse for continuity across the fuse terminals.
4. Replace the fuse if testing determines that it is damaged.

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

Key Switch

POSITION	CLOSED CIRCUITS
OFF	G + M + A
RUN	B + L + A
START	B + L + S



The key switch is located on the operator's console and has 3 positions: OFF, RUN, and START.

Testing the Key Switch

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Disconnect the battery negative (-) cable at the battery; refer to Removing and Installing the Battery (page 6–31).
3. Remove the 3 screws that secure the dash panel to the fuel tank and raise the dash panel to access the back of the key switch.
4. Disconnect the wire harness connector from the switch. Check the switch and the harness connector for damage or corrosion and clean or repair if necessary. Remove the switch from the dash 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 after testing.
9. Secure the dash panel to the fuel tank.
10. Connect the battery negative (-) cable at the battery.

Starter Solenoid

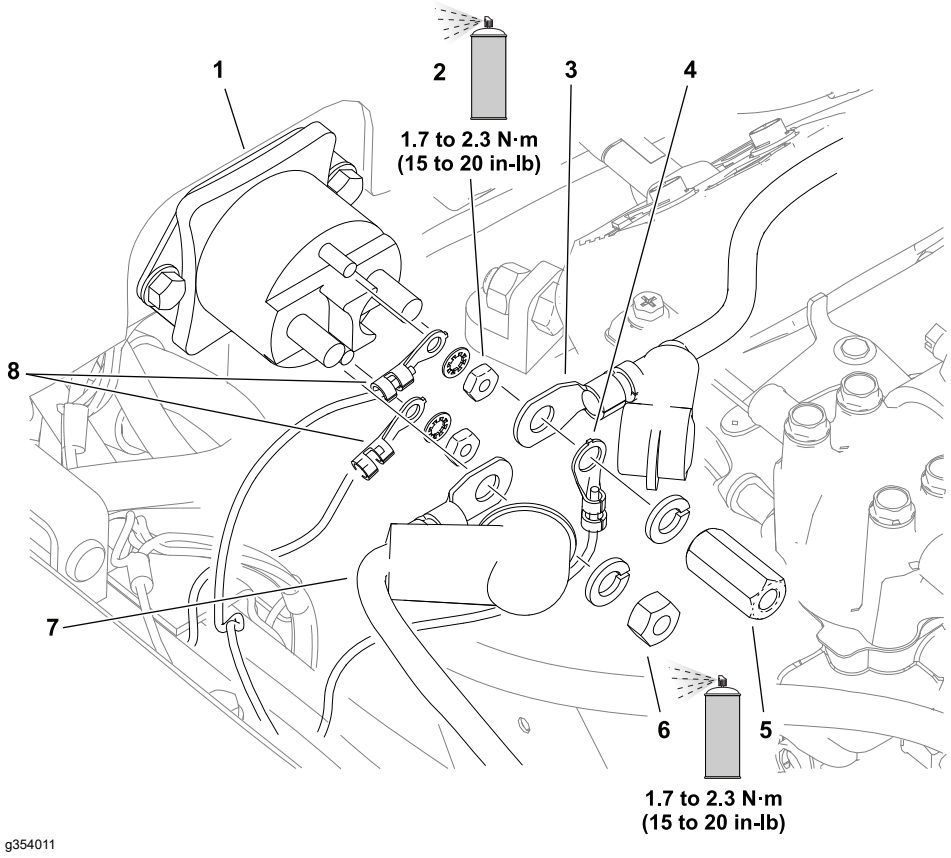


Figure 79

1. Starter solenoid
2. Hex nut – coil post (2 each)
3. Positive (+) battery cable
4. Wire harness
5. Stand-off nut – contact post
6. Hex nut – contact post (2 each)
7. Starter cable
8. Wire harness

The starter solenoid is located on the right side frame rail under the operator seat.

Testing the Starter Solenoid

Refer to Figure 79 for this procedure.

1. Park the machine on a level surface, lower the cutting unit (or attachment), engage the parking brake, set the key switch to the OFF position and remove the key from the key switch.
2. Raise the seat.
3. Disconnect negative battery cable from battery and then disconnect positive battery cable; refer to Removing and Installing the Battery (page 6–31).
4. Disconnect the wires and cables from the starter solenoid.
5. Use multimeter (ohms setting) and check the continuity of the starter solenoid across the contact posts. Resistance across the contact posts should be infinite ohms (no continuity).
6. Apply 12 VDC across the solenoid coil posts to energize the solenoid. The solenoid should “click” as it is energized. While energized, resistance across the contact posts should be less than 1 ohm (continuity).
7. Remove voltage from solenoid coil posts. The solenoid should “click” as it de-energized. Make sure resistance across the contact posts is infinite ohms (no continuity).

8. Replace the starter solenoid if necessary.
9. If the starter solenoid tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).

10. Reconnect the wires and cables to the starter solenoid. Tighten the nuts on the coil posts from **1.7 to 2.3 N·m (15 to 20 in-lb)**, and the nuts on the main contact posts from **5.7 to 6.8 N·m (50 to 60 in-lb)**. Apply battery terminal protector to the starter solenoid posts before installing the boots; refer to Battery Terminal Protector (page 2–17).
11. Connect positive battery cable to battery first and then attach negative battery cable; refer to Removing and Installing the Battery (page 6–31).

Hour Meter

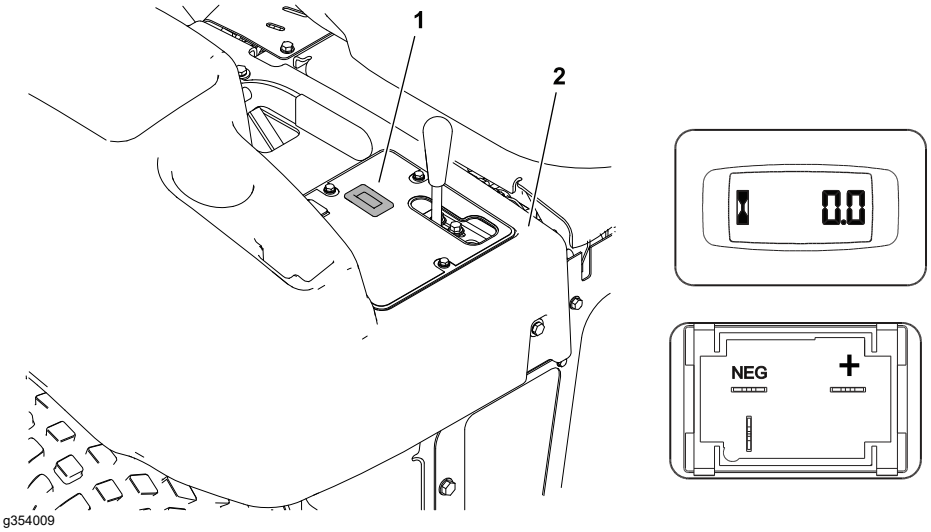


Figure 80

1. Hour meter
2. Operators console

The hour meter is located on the dash panel of the operator's console.

Testing the Hour Meter

Refer to Figure 80 for this procedure.

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Disconnect the battery negative (-) cable at the battery; refer to Removing and Installing the Battery (page 6–31).
3. Remove the 4 fasteners that secure the dash panel to the operator's console and raise the dash panel to access the back of the hour meter.
4. Disconnect the wire harness connector from the hour meter. Check the hour meter and the harness connector for damage or corrosion and clean or repair if necessary. Remove the hour meter from the dash panel if necessary.
5. Connect the positive (+) terminal of the hour meter to the positive (+) terminal of a 12 VDC power source.
6. Connect the negative (-) terminal of the 12 VDC power source to the other terminal of the hour meter.
7. The hour meter should move 1/10 of an hour in 6 minutes.
8. Disconnect the voltage source from the hour meter.
9. Replace the hour meter if necessary.
10. If the hour meter tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
11. Install the hour meter and connect the wire harness after testing.
12. Connect the battery negative (-) cable at the battery.

Seat Switch

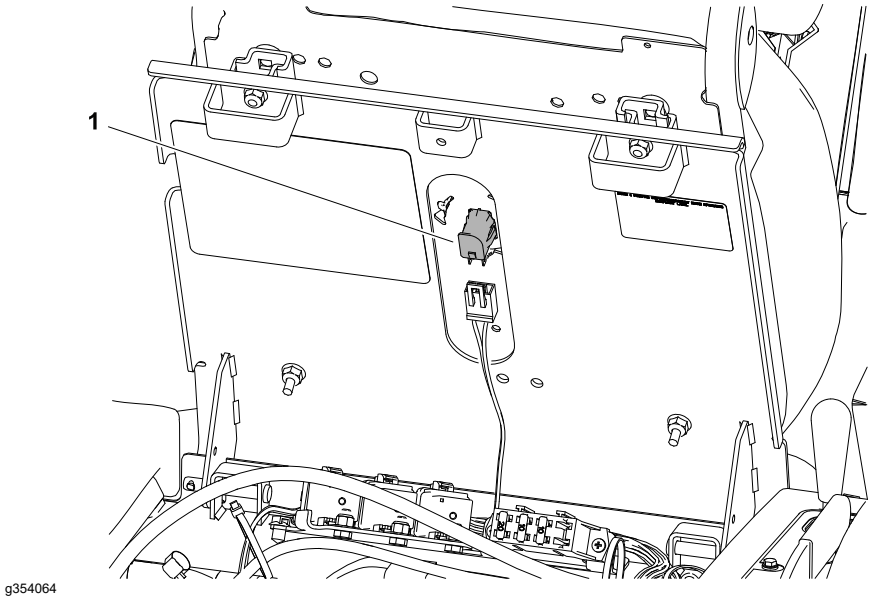


Figure 81

1. Seat switch

The seat switch is normally open and closes when the operator is on the seat. The seat switch is part of the safety interlock system. The seat switch is located directly under the seat cushion. Testing the switch can be done without removing the seat by disconnecting the seat switch wire harness from the machine wire harness.

Testing the Seat Switch

Refer to Figure 81 for this procedure.

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Disconnect the wire harness connector from the seat switch. Check the harness connector and switch for damage or corrosion and clean or repair if necessary.
3. Check the continuity of the switch by connecting a multimeter (ohms setting) across the switch terminals.
   A. With no operator in the seat, should be no continuity between the terminals.
   B. Press directly onto the seat switch through the seat cushion. There should be continuity as the seat cushion approaches the bottom of its travel.
4. Replace the switch if necessary.
5. If the seat switch testing is correct and the circuit problem still exists, check the machine wire harness; refer to Appendix A (page A–1).
6. Connect the wire harnesses to the switch and test the seat switch operation before returning the machine to service.

Traction Neutral Switch

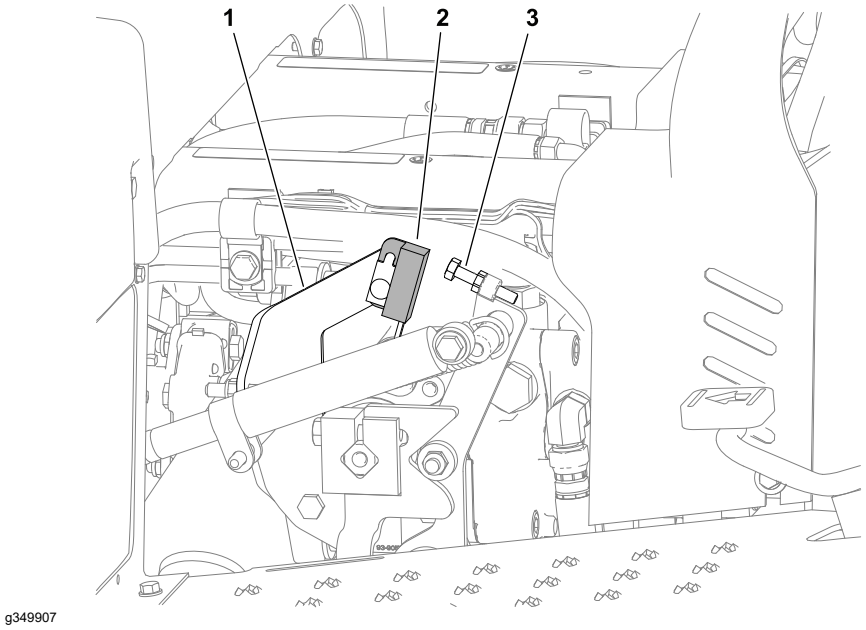


Figure 82

1. Pump plate
2. Neutral switch
3. Cap screw (target)

The traction neutral switch is a normally open proximity switch that closes when the traction pedal is in the neutral position. The switch is mounted to a plate on the right side of the traction (piston) pump. The sensing element or target for the traction neutral switch is the head of a cap screw that is secured to the neutral arm. When the traction control linkage is in the NEUTRAL position, the cap screw (target) will be near the switch face and the switch will be closed. When the traction linkage moves toward Forward or Reverse, the neutral arm moves away from the switch face and the switch opens.

The neutral switch is part of the starter relay circuit. The neutral switch and the PTO switch must be closed for the engine starter to engage.

Adjusting the Traction Neutral Switch

1. Check and adjust traction system NEUTRAL position; refer to Adjusting the Traction System for Neutral (page 5–51).

IMPORTANT

To prevent damage to the traction neutral switch, make sure that nothing contacts the switch face during operation or adjustment. Do not scratch the face of the neutral switch.

2. When the traction lever is in the NEUTRAL position, the clearance between the face of the neutral switch and the head of the cap screw (target) should be from **2.4 to 3.8 mm (0.09 to 0.15 inch)**.

Adjusting the Traction Neutral Switch (continued)

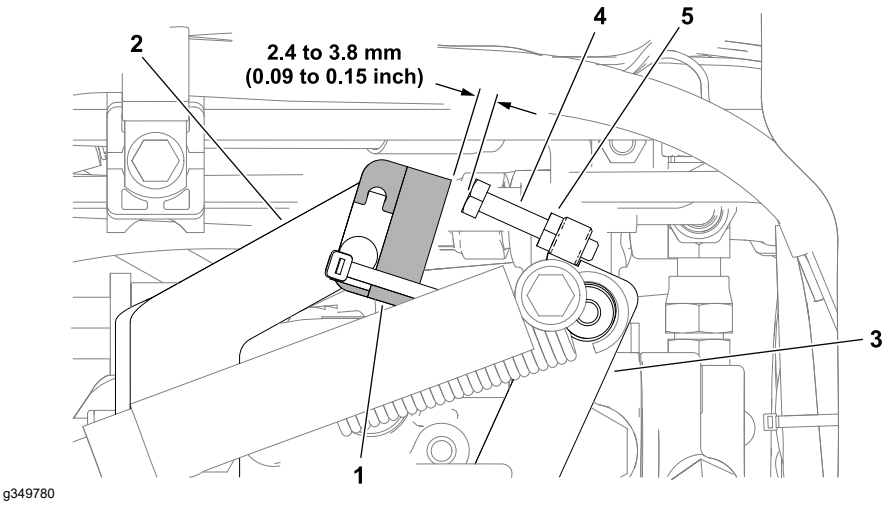


Figure 83

1. Neutral switch
2. Pump plate
3. Neutral lever
4. Cap screw (target)
5. Lock nut

3. If the clearance is incorrect, loosen the lock nut that secure cap screw (target) to the neutral laver and adjust the cap screw. Tighten the lock nut and re-check the switch to cap screw clearance.

4. After adjusting the neutral switch, test the interlock system to verify that neutral switch and circuit wiring are functioning correctly before returning the machine to service. If the neutral switch and its circuit wiring are functioning correctly:

   A. Disconnect the spark plug wires from the engine spark plugs and ensure the PTO switch is set to OFF.

   B. Set the key switch to the START position. The starter should engage while the traction pedal is in the NEUTRAL position and an Operator is not in the seat.

   C. Set the key switch to the START position. The engine starter should not engage while the traction pedal is in the FORWARD or REVERSE position and an Operator is not in the seat.

   D. Connect the spark plug wires to the engine spark plugs after testing.

Testing the Traction Neutral Switch

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Remove the center shroud.
3. Ensure that the traction neutral switch is correctly adjusted; refer to Adjusting the Traction Neutral Switch (page 6–16).
4. Disconnect the traction neutral switch from the machine wire harness. Check the harness connectors for damage or corrosion and clean or repair if necessary.
5. Check the continuity of the switch by connecting a multimeter (ohms setting) across the switch connector terminals.

Testing the Traction Neutral Switch (continued)

6. There should be continuity across the switch terminals when the traction pedal is in the NEUTRAL position.
7. Slowly push the traction pedal in the forward or reverse direction while watching the multimeter. There should be no continuity across the switch terminals in either the forward or reverse position.
8. Allow the traction pedal to return to the neutral position. There should again be continuity across the terminals when the pedal returns to NEUTRAL.
9. Replace the switch if necessary.
10. If the switch tests correctly and a circuit problems still exists, test the machine wire harness; refer to Appendix A (page A–1).
11. Connect the switch to the wire harness and install the center shroud.
12. Operate the machine and test the traction neutral switch operation before returning the machine to service.

Relays with 5 Terminals

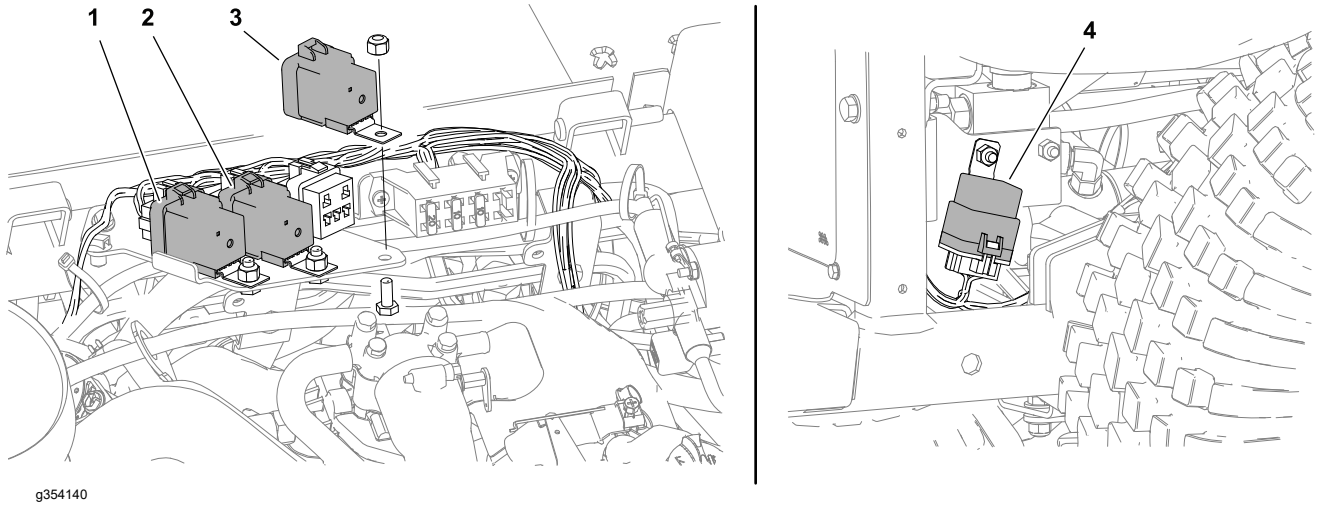


Figure 84

1. Relay – main
2. Relay – start
3. Relay – interlock
4. Optional relay – seat switch

The Sand Pro 3040/5040 machines use up to 4 relays that have 5 terminals. The standard relays are located along the frame crossmember under the operator's seat. A tag near each wire harness relay connector can be used to identify each relay.

An additional 5 terminal relay is used to control the optional rear remote hydraulics kit or the hydraulic switch kit. This relay is located behind the left side rear wheel shroud.

Relays with 5 terminals:

- The main relay supplies power to the machine control circuits. The main relay is energized by the key switch when in the RUN or START position.
- The start relay supplies power to the starter solenoid. The start relay is energized the appropriate interlocks are in position to start the engine.
- The interlock relay is used to open the engine ignition (magneto) circuit to allow the engine to run. The relay is energized by the seat switch, the traction neutral switch, diodes D1 and D2, and/or the optional seat switch relay as part of the interlock system.
- The optional seat switch relay is incorporated into the interlock circuit when an optional rear hydraulics kit or hydraulic switch kit is installed. The relay supplies power to the optional PTO switch. The relay is energized through the seat switch when an operator is in the seat.

Testing Relays with 5 Terminals

Refer to Figure 84 for this procedure.

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Disconnect the ground cable at the battery; refer to Removing and Installing the Battery (page 6–31).
3. Raise the operator's seat.
4. Locate the relay that is to be tested and disconnect the wire harness connectors from the relay. Check the relay and the harness connector for damage or corrosion and clean or repair if necessary.

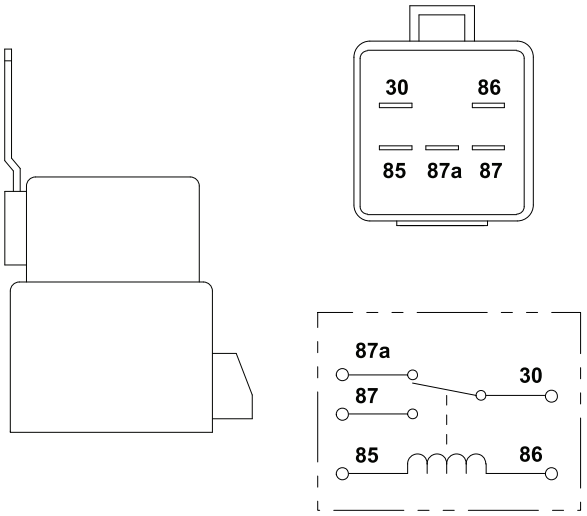


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Figure 85
Relay with 5 terminals

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.

5. Using a multimeter, verify that coil resistance between terminals 85 and 86 is from 71 to 88 ohms.
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. 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.
8. Replace the relay if necessary.
9. If the relay tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
10. Connect the wire harness, install any items removed to access the relay, and connect the battery ground cable.

Diode Assemblies

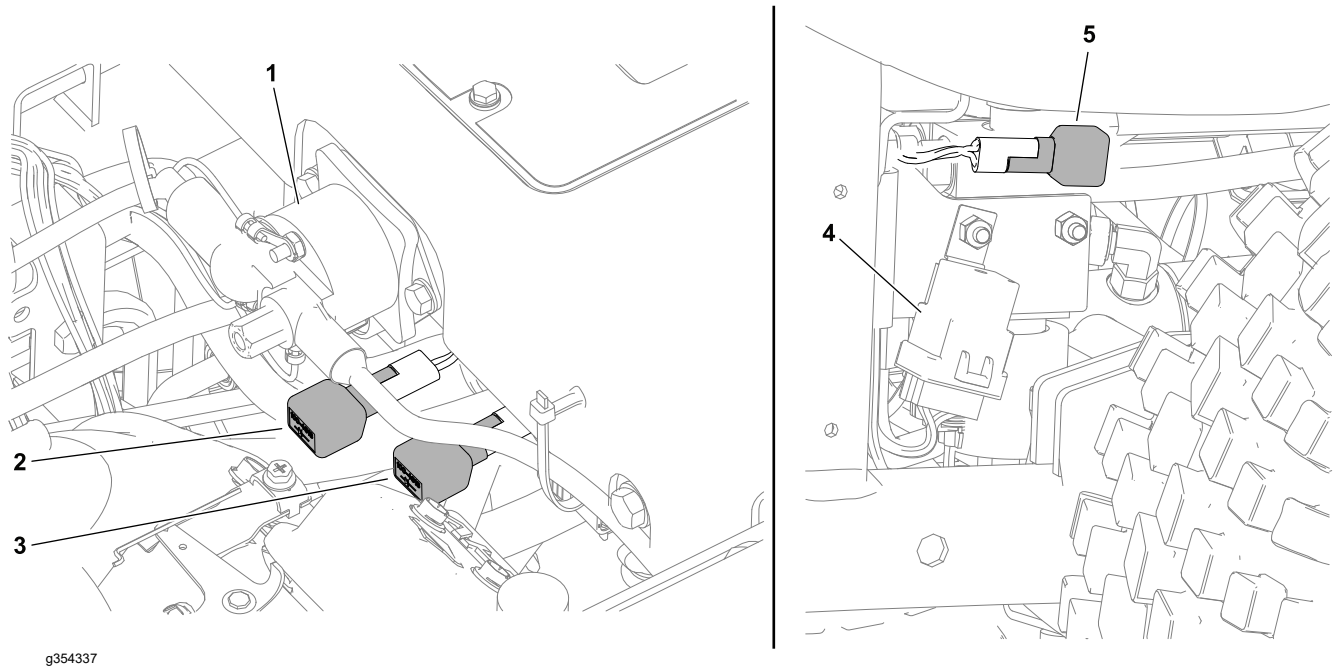


Figure 86

1. Starter solenoid
2. Main wire harness diode D1
3. Main wire harness diode D2
4. Optional rear remote hydraulics kit relay
5. Optional rear remote hydraulics wire harness diode D1

Two diodes plug into the main wire harness below the right side frame rail near the starter solenoid. These diodes (D1 and D2) provide logic for the interlock system. One diode plugs into the optional rear remote hydraulics kit wire harness under the left rear wheel shroud near the rear remote hydraulics kit relay. This diode (D1) provides circuit protection form the rear remote hydraulics solenoid valve coil. The diodes can be identified by their black color and diode symbol on the end of the diode body. The maximum current allowed through any of the diodes is 6 amps.

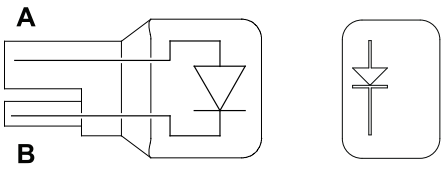
Testing the Diode Assemblies

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Locate and remove the diode from the wire harness. Check the diode and the diode holder for damage or corrosion and clean or repair if necessary.
3. 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.

Testing the Diode Assemblies (continued)

Multimeter Red (+) Lead	Multimeter Black (-) Lead	Resistance	
DIODE TERMINAL A	DIODE TERMINAL B	VERY LOW	
DIODE TERMINAL B	DIODE TERMINAL A	VERY HIGH	

4. If testing determines the diode is faulty, replace the diode.
5. If the diode tests correctly and a circuit problem still exists, check the wire harnesses; refer to Appendix A (page A–1).
6. After testing is complete, make sure the diode is fully installed into the connector and secured to the wire harness.

Hydraulic Solenoid Valve Coils (Optional)

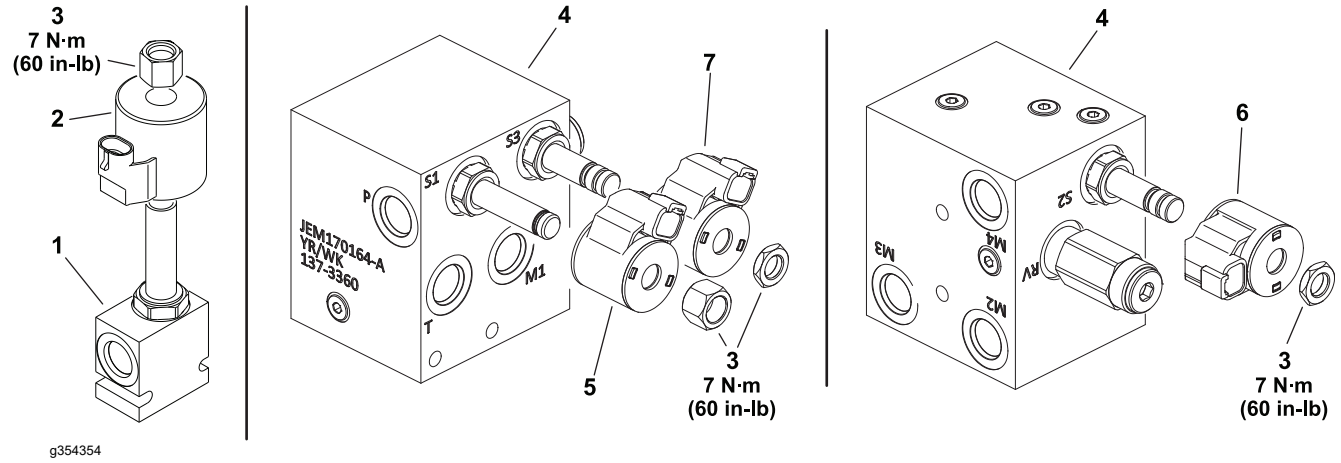


Figure 87

1. Rear remote hydraulics kit manifold
2. Valve coil (rear attachment)
3. Coil nut
4. hydraulics switch kit manifold
5. Valve SV1 coil (tank)
6. Valve SV2 coil (front attachment)
7. Valve SV3 coil (rear attachment)

Electric coil actuated hydraulic valves are used on the optional rear remote hydraulics kit manifold and the optional hydraulics switch kit manifold. When the coil is energized, the hydraulic valve shifts to control hydraulic flow.

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. Check the harness connectors for damage or corrosion and clean or repair if necessary.

   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.

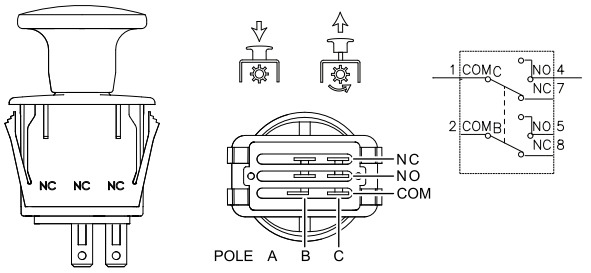
2. Using a multimeter (ohms setting), measure the resistance between the two (2) connector terminals on the solenoid coil. The resistance for the solenoid coils is identified below:
   A. The coil of the rear attachment solenoid valve on the optional rear remote hydraulics manifold should measure approximately **7.1 ohms when tested at 20° C (68° F)**.
   B. The coils of solenoid valves SV1, SV2, and SV3 on the optional hydraulics switch kit manifold are the same. Resistance of these coils should be approximately **8.8 ohms when tested at 20° C (68° F)**.
3. Replace solenoid valve coils if 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.

PTO Switch (Optional)

POSITION	CLOSED CIRCUITS
OFF (DOWN)	COM B + NC B COM C+ NC C
ON (UP)	COM B + NO B COM C+ NO C



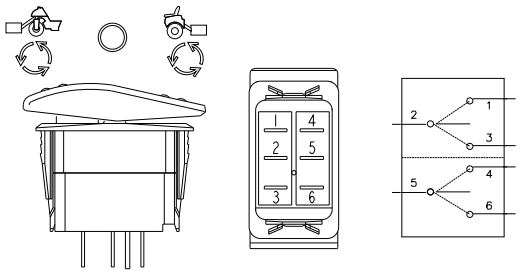
The power take off (PTO) switch is located on the dash panel of the operator's console. This switch is pulled up to engage the PTO shaft and pushed down to disengage the PTO shaft.

Testing the PTO Switch

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Disconnect the battery negative (-) cable at the battery; refer to Removing and Installing the Battery (page 6–31).
3. Remove the fasteners securing the dash panel to the operators console and raise the dash panel.
4. Disconnect the wire harness connector from the switch and remove the switch from the dash panel if necessary. Check the switch and the harness connector for damage or corrosion and clean or repair 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 after testing.
9. Install the dash panel.
10. Connect the battery negative (-) cable at the battery.

Mode Select Switch (Optional)

POSITION	CLOSED CIRCUITS
ENGAGE FRONT ATTACHMENT	2 + 1, 5 + 4
OFF	NONE
ENGAGE REAR ATTACHMENT	2 + 3, 5 + 6



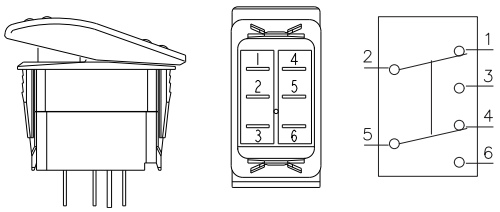
The mode select switch is a 3 position switch located on the dash panel of the operator's console. Press the switch forward to engage the front attachment and rearward to engage the rear attachment. Neither attachment is engaged (OFF) when the switch is in the center position.

Testing the Mode Select Switch

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Disconnect the battery negative (-) cable at the battery; refer to Removing and Installing the Battery (page 6–31).
3. Remove the fasteners securing the dash panel to the operators console and raise the dash panel.
4. Disconnect the wire harness connector from the switch and remove the switch from the dash panel if necessary. Check the switch and the harness connector for damage or corrosion and clean or repair 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 after testing.
9. Install the dash panel.
10. Connect the battery negative (-) cable at the battery.

Light Switch (Optional)

POSITION	CLOSED CIRCUITS
OFF	2 + 1, 5 + 4
ON	2 + 3, 5 + 6



The light switch is located on the dash panel near the steering wheel.

Testing the Light Switch

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Disconnect the battery negative (-) cable at the battery; refer to Removing and Installing the Battery (page 6–31).
3. Remove the fasteners securing the dash panel to the operators console and raise the dash panel.
4. Disconnect the wire harness connector from the switch and remove the switch from the dash panel if necessary. Check the switch and the harness connector for damage or corrosion and clean or repair 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 after testing.
9. Install the dash panel.
10. Connect the battery negative (-) cable at the battery.

Service and Repairs

Note: For engine component repair information, see the Briggs & Stratton V-Twin Engine Service 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.**

The original machine battery is a maintenance free battery. A maintainable battery of the same size and power may be used as a replacement.

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 battery terminal protector or petroleum jelly to prevent corrosion; refer to Battery Terminal Protector (page 2–17).

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.

Caring for the Battery (continued)

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 positive (+) cable first. Apply a coating of battery terminal protector or a light coat of petroleum jelly to the terminals to reduce corrosion after you make the connections; refer to Battery Terminal Protector (page 2–17).
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 Removing and Installing the Battery (page 6–31).
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

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

⚠ CAUTION ⚠

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

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

Battery Specifications

Battery-electrolyte specific gravity	Fully Charged: 1.25 to 1.28 at 27°C (80°F) Discharged: less than 1.24
Battery specifications	BCI Group UI 300 CCA at -18°C (0°F) Reserve Capacity of 28 minutes at 27°C (80°F)
Battery dimensions (including terminal posts and caps)	Length 19.6 cm (7.7 inches) Width 13.2 cm (5.2 inches) Height 18.3 cm (7.2 inches)

Removing and Installing the Battery

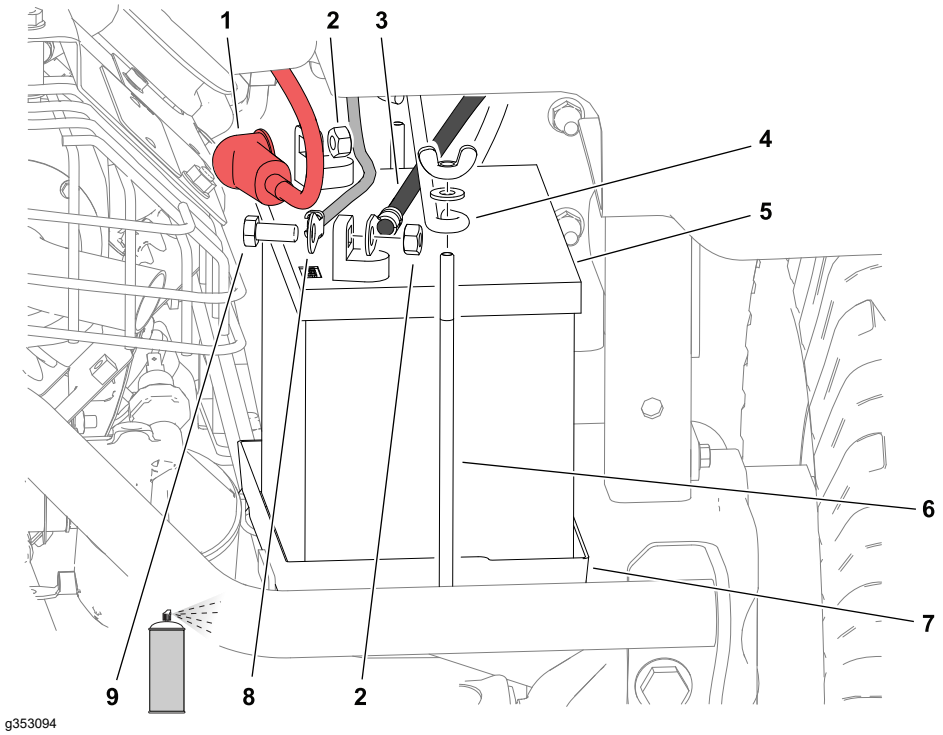


Figure 88

1. Positive (+) cable
2. Hex nut (2 each)
3. Negative (-) cable
4. Hold-down rod
5. Battery
6. Hold-down post (2 each)
7. Battery tray
8. Wire harness ground connection
9. Cap screw (2 each)

IMPORTANT

Be careful when removing the battery cables and ensure that you do not damage the terminal posts or cable connectors.

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Locate battery at rear of machine and disconnect the negative (-) cable from the battery terminal, then disconnect the positive (+) cable from the battery terminal.
3. Remove the fasteners and hold-down rod that secure the to the battery tray.
4. Make sure that the battery filler caps are secure (if applicable) and remove the battery from the battery tray.
5. Clean the battery tray. Neutralize and refinish any damaged areas of the battery tray.
6. Inspect the battery cables and connectors for damage and corrosion. Clean, repair, or replace the battery cables and connectors if necessary.
7. Install the battery in the reverse order:

IMPORTANT

To prevent possible electrical problems, install only a fully charged battery.

A. Connect the positive (+) cable connector onto the positive (+) battery terminal.

B. 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.

C. Connect the negative (-) cable connector to the negative (-) battery terminal.

8. After you make the connections, apply battery terminal protector or a light layer of petroleum jelly to the battery terminals and cable connectors; refer to Battery Terminal Protector (page 2–17).
9. Make sure that the rubber boots are in place over the positive cable end at the battery post and at the starter solenoid.

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. Temperature 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 6–32).

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 6–34) 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 can not meet these charging conditions, replace the battery.

3. Do a high-discharge test with an adjustable load tester. This is a very 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 6–30).

G. Take a test voltage reading while still under load after 15 seconds, then immediately remove the load.

H. Use Minimum Voltage (page 6–32) 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

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 6–34) 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 6–34) 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.

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

Wheels

Removing the Front Wheel

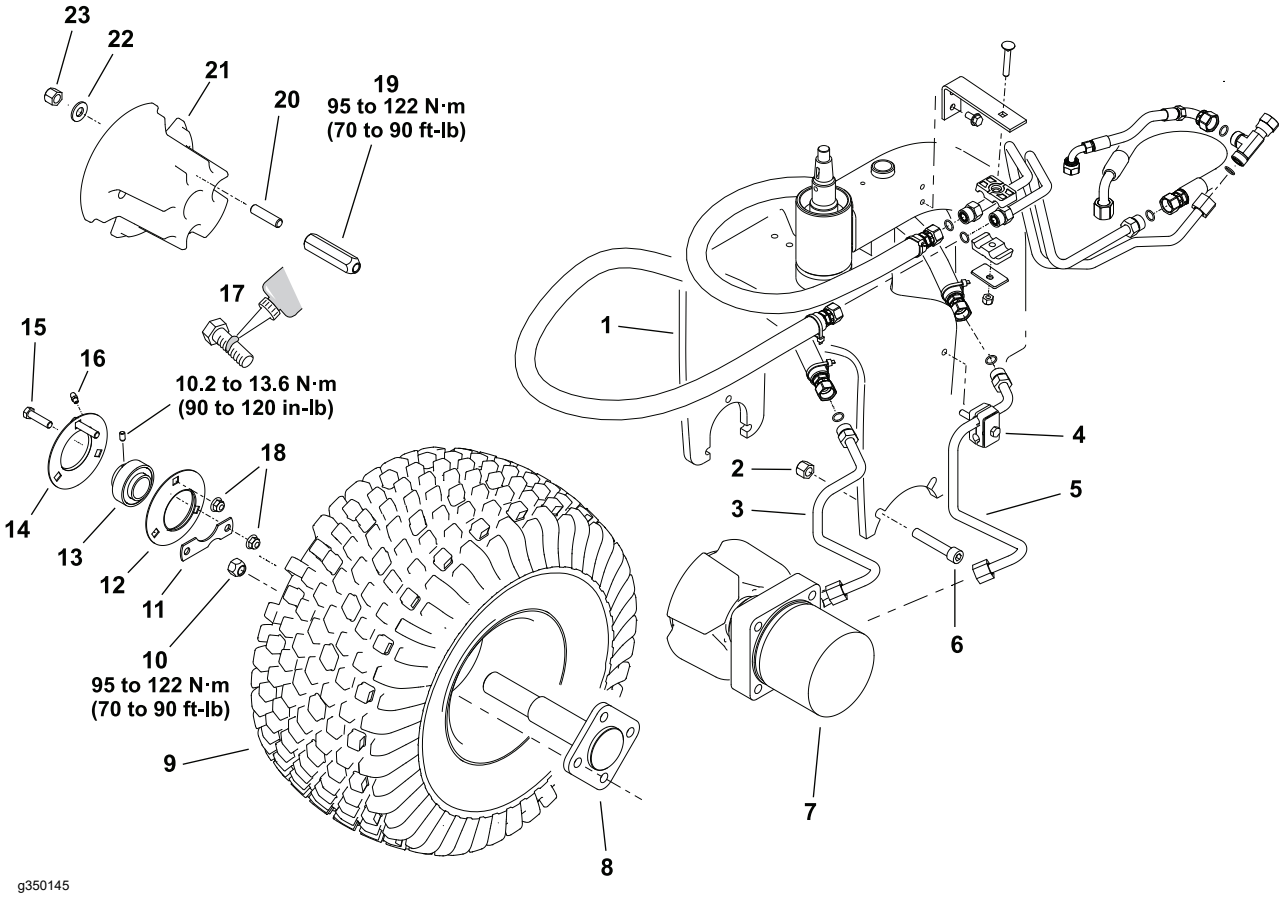


Figure 89

1. Front fork
2. Lock nut (2 each)
3. Hydraulic tube
4. Tube clamp assembly
5. Hydraulic tube
6. Cap screw (2 each)
7. Front wheel motor assembly
8. Spindle
9. Wheel and tire
10. Lug nut (2 or 4 each)
11. Bearing tab
12. Flangette – standard
13. Bearing
14. Flangette – lube
15. Cap screw (3 each)
16. Grease fitting
17. Set screw
18. Flange nut (3 each)
19. Wheel weight adapter (2 each)
20. Stud (2 each)
21. Wheel weight
22. Thrust washer (2 each)
23. Lock nut (2 each)

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.

IMPORTANT

Before lifting the machine with a jack, review and follow Jacking Instructions (page 1–6).

2. Support but do not raise the front of the machine.
3. Remove the fasteners that secure the hydraulic tube clamp to the front fork.

Removing the Front Wheel (continued)

4. Loosen the set screw on the bearing locking collar.
5. Remove the fasteners securing the bearing assembly and bearing tab to the front fork.
6. Remove the fasteners securing the hydraulic motor to the fork.

IMPORTANT

Support the wheel and motor assembly when raising the front of the machine to prevent hydraulic tube damage.

7. Raise the front of the machine slowly until the wheel and motor assembly can be removed from the fork. Support the machine with appropriate jack stands.
8. Slide the bearing assembly from the spindle. Separate the flangettes from the bearing.
9. For model 08743 machines, remove the wheel weight.
   A. Remove the 2 lock nuts and thrust washers that secure the wheel weight to the wheel, and carefully slide the wheel weight from the studs.
   B. Remove the wheel weight adapters with studs.
10. Remove the lug nuts and remove the wheel from the motor and hub assembly.
11. Separate the spindle from the wheel motor and hub assembly.
12. Secure the wheel motor and hub assembly to the fork with the previously removed fasteners to prevent damaging the hydraulic lines.
13. If wheel motor or hub removal is necessary, refer to Removing the Front Wheel Motor (page 5–75).

Installing the Front Wheel

Refer to Figure 89 for this procedure.

1. Fit the spindle over the hub drive studs and install the wheel.

2. Install the lug nuts and tighten them evenly in a crossing pattern from **95 to 122 N·m (70 to 90 ft–lb)**.

3. For model 08743 machines, install the wheel weight.
   A. If the studs were removed from the wheel weight adapters, thread studs all the way into the correct end of the adapter.

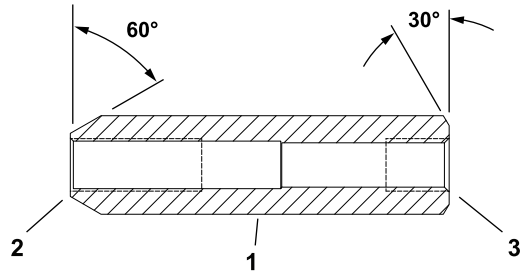


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Figure 90

1. Wheel weight adapter
2. Hub drive stud end – 1/2–20 threads
3. Wheel weight stud end – 1/2–13 threads

   B. Install the wheel weight adapters with studs and tighten them evenly in a crossing pattern from **95 to 122 N·m (70 to 90 ft–lb)**.

Installing the Front Wheel (continued)

C. Carefully slide the wheel weight onto the studs and secure the weight to the wheel with the 2 thrust washers and lock nuts previously removed.

4. Assemble the flangettes and bearing then slide the bearing assembly onto the spindle shaft so the bearing locking collar faces the wheel.
5. Align the wheel and motor assembly and bearing assembly with the fork and carefully lower the machine. Make sure the bearing assembly and wheel motor fit snugly against the fork.
6. Secure the wheel motor to the outside of the fork with the previously removed fasteners. Tighten the fasteners finger tight.
7. Secure the bearing assembly to the outside of the fork with the bearing tab and previously removed fasteners. Tighten the fasteners finger tight.
8. Remove the jack stands and lower the machine to the ground.
9. Make sure fearing assembly and hydraulic motor are positioned correctly in the fork and tighten the bearing and motor fasteners.
10. Apply medium strength thread locking compound to the bearing locking collar set screw and tighten from **10.2 to 13.6 N·m (90 to 120 in–lb)**.
11. Use the previously removed fasteners to secure the hydraulic tube clamp to the front fork.
12. Check and adjust the tire pressure; refer to Chassis Specifications (page 2–4).

Removing and Installing the Rear Wheels

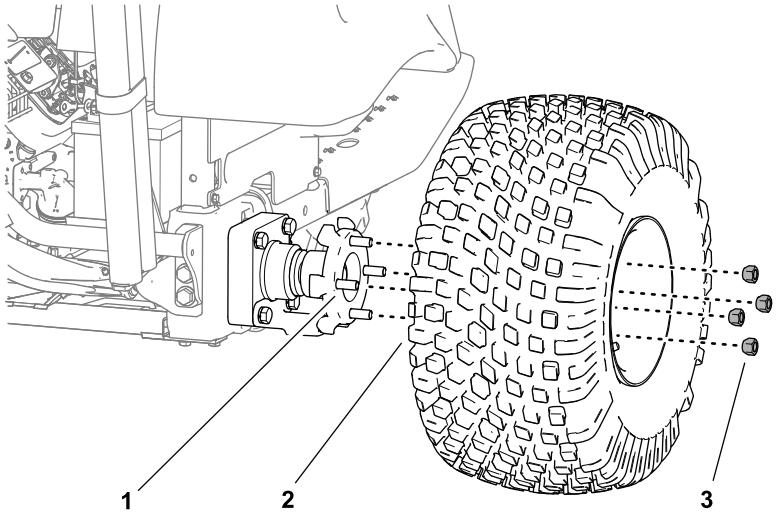

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Figure 91

1. Hub
2. Wheel and tire
3. Lug nut (4 each)

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.

IMPORTANT

Before lifting the machine with a jack, review and follow Jacking Instructions (page 1–6).

2. Raise the machine so the rear wheel is off ground.
3. Remove the 4 lug nuts and remove the rear wheel.

4. To install the rear wheel, secure the wheel to the hub with the previously removed lug nuts and tighten the nuts from **95 to 122 N·m (70 to 90 ft–lb)**.

Parking Brake

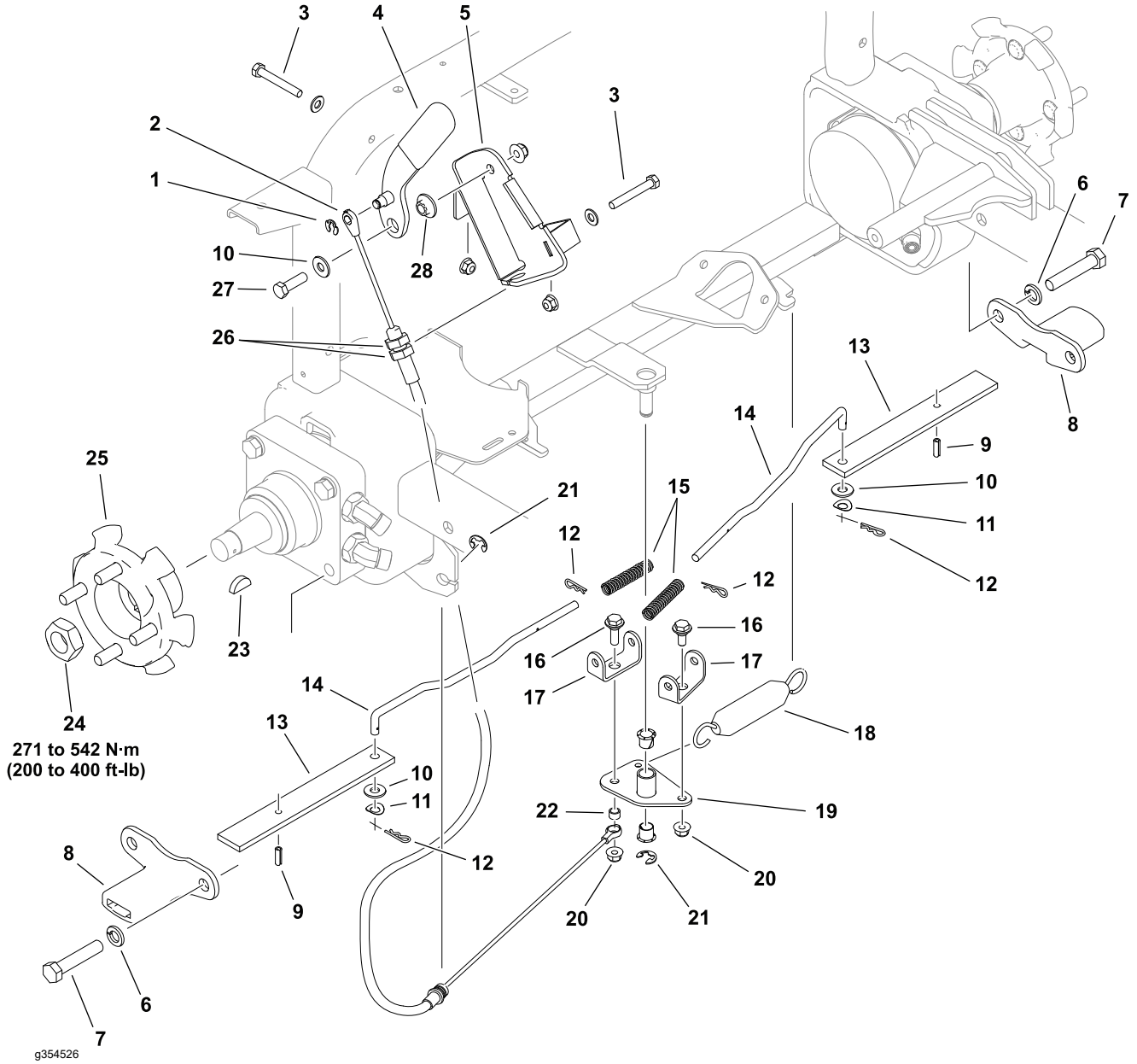


Figure 92

1. Retaining ring
2. Brake cable
3. Cap screw (2 each)
4. Brake lever
5. Brake lever bracket
6. Lock washer (4 each)
7. Cap screw (4 each)
8. Park brake bracket (2 each)
9. Roll pin (2 each)
10. Flat washer (3 each)
11. Spring washer (2 each)
12. Hair pin (4 each)
13. Latch bar (2 each)
14. Latch link (2 each)
15. Compression spring (2 each)
16. Shoulder bolt (2 each)
17. Latch clevis (2 each)
18. Extension spring
19. Bellcrank
20. Flange nut (4 each)
21. Retaining ring (2 each)
22. Spacer
23. Woodruff key
24. Locknut
25. Wheel hub
26. Cable jam nuts (2 each)
27. Cap screw
28. Bushing

Disassembling and Assembling the Parking Brakes

Refer toFigure 92 for this procedure.

1. Remove the rear wheels; refer to Removing and Installing the Rear Wheels (page 7–5).

⚠ CAUTION ⚠

Be careful when removing extension spring from parking brake bellcrank. The spring is under heavy load and may cause personal injury.

2. Remove parking brake components as necessary.
3. Clean all parts. Inspect brake cable, brake bar, and brake lugs on wheel hub for excessive wear or damage. Replace any damaged parts.
4. If a wheel hub requires removal:
   A. Use a torque multiplier to loosen the lock nut that secures the hub to the wheel motor. Do not remove the lock nut from the motor shaft.

IMPORTANT

DO NOT hit the wheel hub, wheel hub puller, or wheel motor with a hammer during wheel hub removal. Hammering may cause damage to the wheel motor.

   B. Use a hub puller to loosen the wheel hub from the wheel motor; refer to Wheel Hub Puller (page 2–18).
   C. Remove the lock nut, hub, and woodruff key from the motor shaft.
5. Install any parking brake components previously removed.
6. If a wheel hub was removed:

IMPORTANT

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

Do not use the locknut previously removed to attach the wheel hub to the wheel motor.

   A. Clean the tapers of the wheel hub and wheel motor shaft and install the woodruff key, wheel hub, and a new lock nut on the wheel motor shaft.

   B. Use a torque multiplier to tighten the lock nut from **271 to 542 N·m (200 to 400 ft–lb)**.

7. Install the rear wheels and test the parking brake operation before returning the machine to service.

Replacing the Parking Brake Cable

Refer to Figure 92 for this procedure.

Replacing the Parking Brake Cable (continued)

1. Park the machine on a level surface, lower any attachments, set the key switch to the Off position and remove the key from the switch. Ensure that the parking brake is not engaged.
2. Remove the operator's console; refer to Removing and Installing the Operator's Console (page 7–24).
3. Loosen the jam nuts (item 26) that secure the brake cable to brake lever bracket.
4. Remove the retaining ring (item 1) that secures brake cable to the brake lever and slide the brake cable off the lever pin.
5. Remove the retaining ring (item 21) that secures brake cable to the bracket below the left rear wheel motor and slide the brake cable from the frame.
6. Remove the brake cable from the parking brake bellcrank on the rear cross tube of the frame:
   A. Remove the flange nut that secures the brake cable end to the bellcrank.
   B. Slide the brake cable and spacer from the shoulder bolt.
7. Record the location of cable ties and routing of the brake cable for assembly purposes. Remove the brake cable from the machine.
8. Disassemble any additional brake linkage components as necessary. Repair or replace the components that are worn or damaged.
9. Using the notes recorded during brake cable removal, route and secure the brake cable through the machine.
10. Secure the brake cable to the bellcrank on the rear cross tube of the frame:
    A. Slide the spacer and the brake cable end onto the shoulder bolt.
    B. Secure the brake cable end to the bellcrank with the previously removed flange nut.
11. Secure the brake cable to the bracket below the left rear wheel motor with the previously removed retaining ring.
12. Secure the brake cable end to the brake lever pin with the previously removed retaining ring.
13. Secure the brake cable to the brake lever bracket with the cable jam nuts.
14. Install the operator's console; refer to Removing and Installing the Operator's Console (page 7–24).
15. Test the parking brake operation before returning the machine to service.

Traction Pedal and Control Assembly

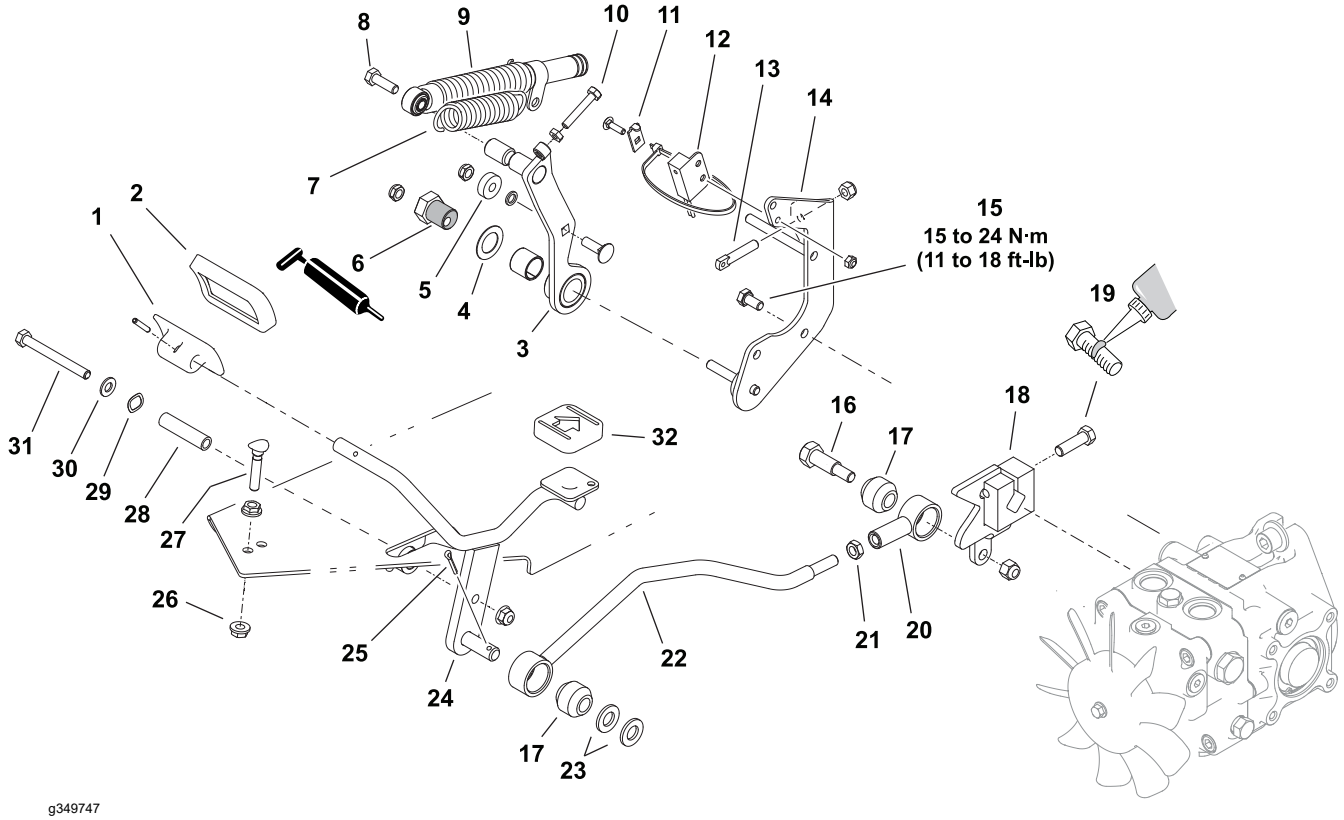


Figure 93

1. Forward pedal
2. Pad – forward
3. Neutral arm
4. Thrust washer
5. Bearing
6. Traction stud
7. Extension spring
8. Cap screw
9. Damper
10. Cap screw – (neutral switch target)
11. Plate
12. Traction neutral switch
13. Adjustment pin
14. Pump plate
15. Cap screw (3 each)
16. Shoulder bolt
17. Rubber bushing (2 each)
18. Pump input cam
19. Cap screw
20. Rod end
21. Jam nut
22. Traction rod
23. Flat washer (2 each)
24. Traction pedal assembly
25. Cotter pin
26. Flange lock nut (2 each)
27. Pedal stop
28. Spacer
29. Wave washer
30. Plain washer
31. Cap screw
32. Pad – reverse

Removing Traction Pedal and Control Components

Refer to Figure 93 for this procedure.

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Remove the center shroud from the machine.
3. Disconnect the traction rod assembly from the traction pedal and the pump input cam. Remove the traction rod from the machine and discard the cotter pin.
4. Remove the damper.

CAUTION

The extension spring is under tension. Use caution when removing the spring to avoid personal injury.

5. Loosen the adjustment pin lock nut to allow the extension spring to relax. Unhook the spring from the neutral arm.
6. Disassemble the remaining traction pedal and control components as necessary.

Installing Traction Pedal and Control Components

Refer to Figure 93 for this procedure.

1. Assemble the traction pedal and control components as necessary.
   - Apply #2 general purpose grease to the traction stud prior to assembly.
   - If the pump input cam was removed, apply medium strength thread locking compound to the clamping screw prior to installation.
   - If the pump plate was removed, tighten the fasteners that secure the pump plate to the piston pump from **15 to 24 N·m (11 to 18 ft-lb)**.

CAUTION

The extension spring is under tension. Use caution when installing the spring to avoid personal injury.

2. Install the extension spring and tighten the adjustment pin lock nut until **4.6 to 11.0 mm (0.18 to 0.43 inch)** of the adjustment pin threads extend beyond the lock nut.

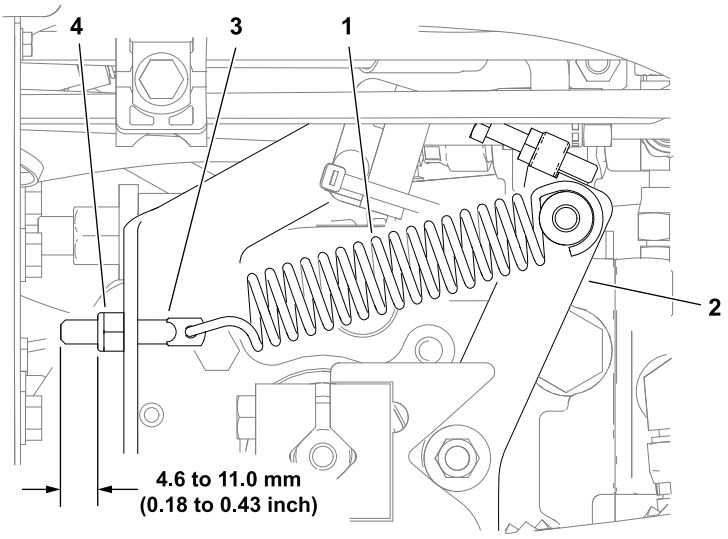


Figure 94

1. Extension spring
2. Neutral arm
3. Adjustment pin
4. Lock nut

3. Install the damper.

4. If the rod end was removed from the traction rod, install the rod end so that the distance from the center of one rod end to the other is **35.8 cm (14.11 inch)**.
5. Inspect the rubber bushings in the traction rod for wear or damage and replace if necessary.
6. Use a new cotter pin and to the install the traction rod assembly to the traction pedal and the pump input cam.
7. After assembly, adjust the traction control assembly for the NEUTRAL position (the machine must not creep in either direction on level ground when the traction pedal is in the NEUTRAL position); refer to Adjusting the Traction System for Neutral (page 5–51).
8. Ensure the traction neutral switch is connected to the machine wire harness.
9. Install the center shroud.

Steering Wheel

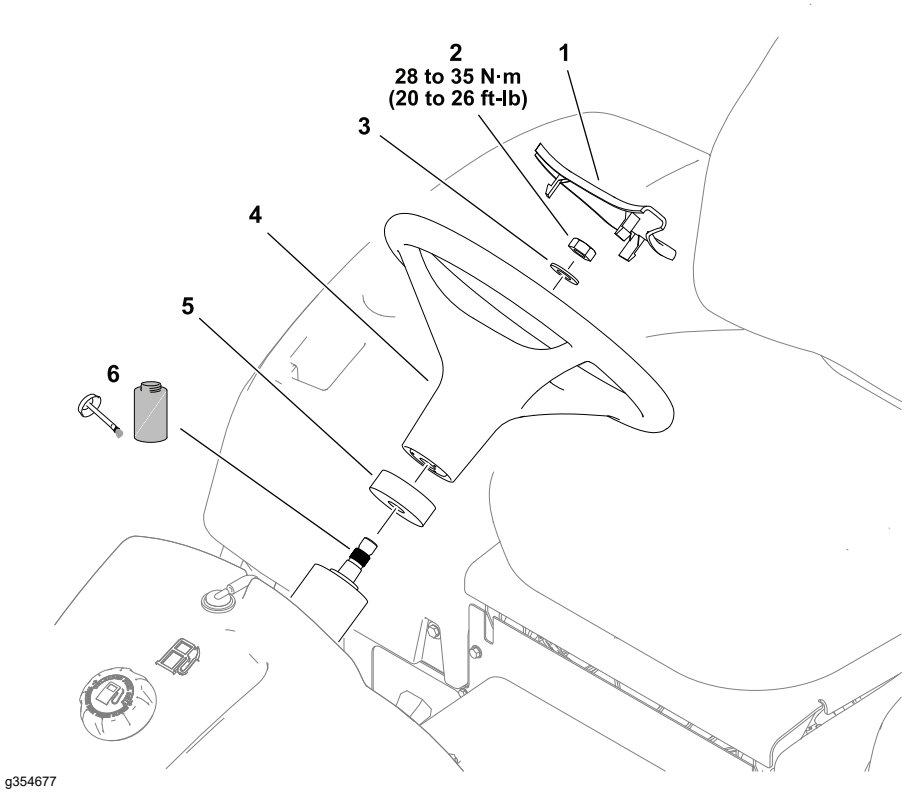


Figure 95
(model 08745 shown)

1. Steering wheel cover
2. Lock nut
3. Flat washer
4. Steering wheel
5. Foam collar
6. Steering shaft

Removing and Installing the Steering Wheel

1. Carefully remove the steering wheel cover from the steering wheel.
2. Remove the locknut and flat washer that secure the steering wheel to the steering control valve or steering shaft.
3. Use a suitable puller to remove the steering wheel from the steering control valve or steering shaft.
4. Remove the foam collar.
5. Apply a small amount of anti-seize lubricant to the splines of the steering control valve or steering shaft, then install the foam collar and the steering wheel.
6. Secure the steering wheel to the steering control valve or steering shaft with the flat washer and lock nut. Tighten the lock nut from **28 to 35 N·m (20 to 26 ft-lb)**.
7. Install the steering wheel cover.

Steering Gear Box (Model 08743)

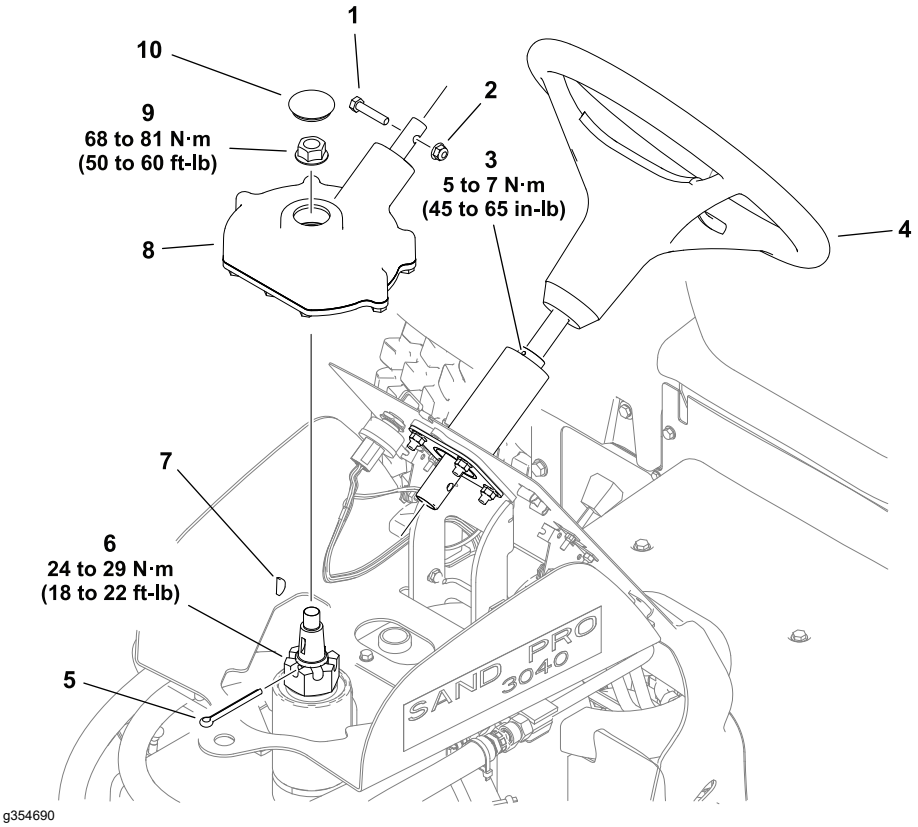


Figure 96

1. Cap screw
2. Lock nut
3. Bearing set screw
4. Steering wheel and shaft assembly
5. Cotter pin
6. Slotted hex nut
7. Woodruff key
8. Steering gear box
9. Flange nut
10. Cap

Removing the Steering Gear Box

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Remove the fuel tank; refer to Removing and Installing the Fuel Tank (page 4–12).
3. Remove the fasteners that secure the steering shaft to the steering gear box.

   Note: If removing the steering wheel is necessary; refer to Removing and Installing the Steering Wheel (page 7–13).
4. Loosen the set screw that secures the extended race of the steering shaft bearing to the steering shaft.
5. Lift on the steering wheel and shaft assembly to separate the steering shaft from the gear box pinion shaft. Position the steering wheel and shaft assembly away from the gear box.
6. Remove the cap from the top of the steering gear box.
7. Remove the flange nut that secures the steering gear box to the front fork shaft.

Removing the Steering Gear Box (continued)

Note: The steering box sector gear and castor fork shaft have tapered shafts that must be loosened before steering box can be separated from castor fork.

8. Separate the gear box from the front fork shaft using one of the following procedures:

   A. Remove and discard the cotter pin from the castor fork shaft. Carefully loosen the slotted hex nut to push the gear box from the front fork shaft then lift the gear box from the machine.

   B. Remove the fasteners securing the gear box plate to the gear box cover; refer to Servicing the Steering Gear Box (Model 08743) (page 7–16). Lift the gear box cover assembly from the machine. Use a suitable puller to remove the sector gear from the front fork shaft then remove the gear box plate from the machine.

9. Locate and retrieve the woodruff key.

10. If the slotted hex nut securing the front fork was loosened while removing the steering gear box, tighten the slotted hex nut from **24 to 29 N·m (18 to 22 ft-lb)**. Make sure that the fork does not have any end play and it rotates without binding. Secure the slotted hex nut with a new cotter pin.

Installing the Steering Gear Box

1. Thoroughly clean the tapered surfaces of the front fork shaft and the steering gear box sector gear bore.
2. Place the woodruff key in the slot of the front fork shaft.
3. Align the keyway in the gear box sector gear with the key and slide the gear box onto the front fork shaft.

4. Secure steering gear box to the front fork with the flange nut. Tighten the flange nut from **68 to 81 N·m (50 to 60 ft-lb)**. Fit the cap to the top of the gear box.
5. Apply anti-seize lubricant to the steering gear box pinion shaft.
6. Position the front wheel straight ahead.
7. Slide the steering shaft assembly onto the gear box pinion shaft.
8. Secure the steering shaft to the steering gear box pinion shaft with the previously removed fasteners.

9. Tighten the steering shaft bearing set screw from **5 to 7 N·m (45 to 65 in-lb)**.
10. If previously removed, install the steering wheel; refer to Removing and Installing the Steering Wheel (page 7–13).
11. Install the fuel tank; refer to Removing and Installing the Fuel Tank (page 4–12).

Servicing the Steering Gear Box (Model 08743)

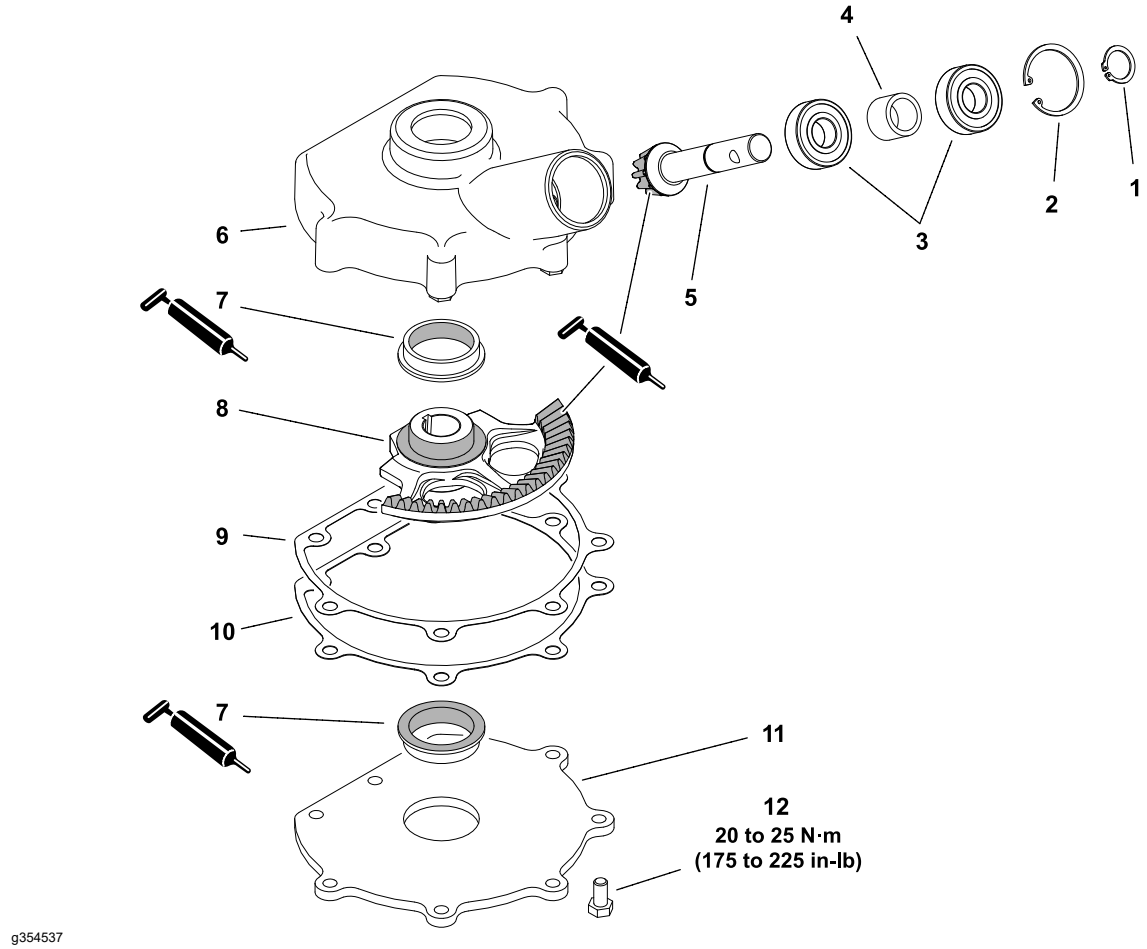


Figure 97

1. Retaining ring
2. Retaining ring
3. Ball bearing (2 each)
4. Spacer
5. Pinion gear
6. Gear box cover
7. Bushing (2 each)
8. Sector gear
9. Shim (as required)
10. Gasket
11. Gear box plate
12. Cap screw (8 each)

Disassembling the Steering Gear Box

1. Remove the retaining ring that secures the pinion gear assembly in the steering cover. Pull the pinion gear and bearings from the gear box cover.
2. Remove the fasteners that secure the gear box plate to the gear box cover.
3. Remove the gear box plate, gasket, shim(s) and the sector gear from the gear box cover.
4. If necessary, remove the bearings from the pinion gear:
   A. Remove the retaining ring from the pinion gear shaft.
   B. Press the bearings and spacer tube from the pinion gear shaft.
   C. Discard the removed bearings.
5. If necessary, remove the bushings from the gear box cover and the gear box plate.
6. Thoroughly clean all the steering gear box components. Inspect the components for wear or damage and replace them if necessary.

Assembling the Steering Gear Box

1. If removed, install the bushings into the gear box cover and the gear box plate. Make sure that the bushing flange is fully seated.
2. Apply Mobilgrease XHP high temperature grease (or equivalent) to the bearing surfaces of the flange bushings.
3. If the bearings were removed from the pinion gear shaft:
   A. Press the first bearing onto the shaft by applying pressure to the inner bearing race.
   B. Slide the spacer tube onto the pinion shaft and then press second bearing onto shaft by applying pressure to the inner bearing race.
   C. Install the retaining ring to secure the bearings to the pinion gear shaft.
4. Slide the pinion gear assembly into the steering cover and secure the assembly with the retaining ring.
5. Apply Mobilgrease XHP high temperature grease (or equivalent) to the pinion gear and sector gear teeth, and to the sector gear bearing surfaces.
6. Install the sector gear into the gear box cover making sure to align the sector gear and pinion gear teeth.
7. Fill the gear box cover with Mobilgrease XHP high temperature grease (or equivalent).
8. Install the shim(s), gasket, and the gear box plate to the gear box cover.

9. Secure the gear box plate to the cover with the previously removed fasteners. Tighten the fasteners in a crossing pattern from **20 to 25 N·m (175 to 225 in-lb)**.

10. After assembling the gear box, make sure that sector gear has minimal end play in the cover and plate assembly. Check that the pinion shaft rotates freely. The maximum input torque to rotate the pinion shaft must be less than **0.56 N·m (5 in-lb)**. If necessary, add or remove shims to adjust the end play and input torque.

Front Fork

Removing the Front Fork (Model 08743)

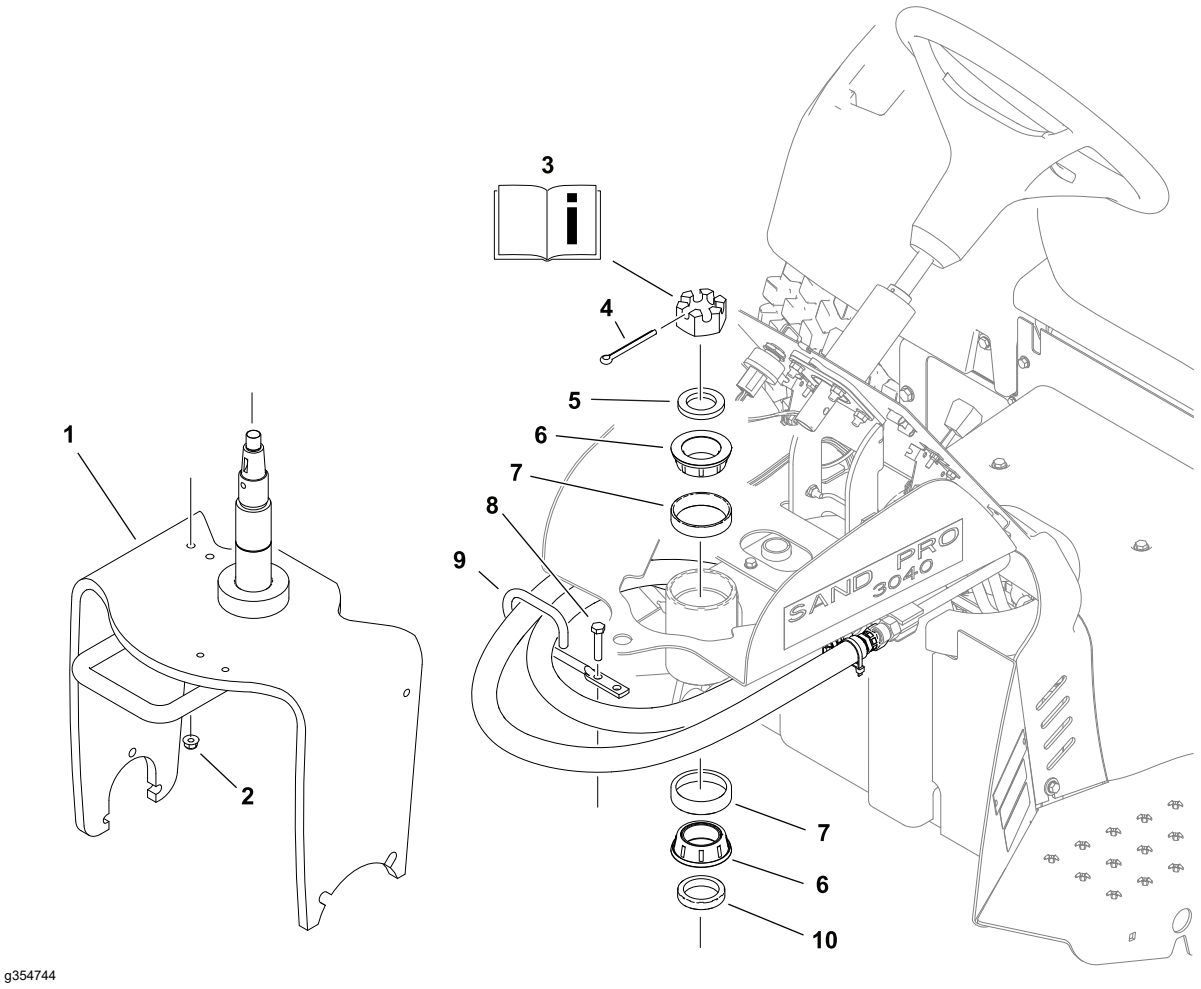


Figure 98

1. Front fork
2. Flange nut (2 each)
3. Slotted nut
4. Cotter pin
5. Washer
6. Bearing cone (2 each)
7. Bearing cup (2 each)
8. Cap screw (2 each)
9. Hose guide
10. Spacer

1. Remove the steering gear box; refer to Removing the Steering Gear Box (page 7–14).
2. Remove the front wheel; refer to Removing the Front Wheel (page 7–3).
3. Remove the hose guide from the front fork. Carefully position the hydraulic hoses away from the fork.
4. Remove the front fork from the machine:
   A. Support the front fork to prevent it from falling.
   B. Remove and discard the cotter pin, then remove the slotted hex nut that secures the front fork to the frame.
   C. Lower the front fork from the machine.
   D. Locate and retrieve the washer.
5. Remove the bearing cones and the bearing spacer.
6. Clean and inspect the bearing cups and cones for wear or damage and replace the bearings if necessary.

Installing the Front Fork (Model 08743)

Refer to Figure 98 for this procedure.

1. If the bearing cups were removed from the frame, press new bearing cups into the frame making sure that they fully contact the shoulder in the frame.
2. Pack the bearing cones with Mobilgrease XHP high temperature grease (or equivalent).
3. Slide the bearing spacer onto the front fork shaft, then press the lower bearing cone onto the fork shaft.
4. Raise the front fork up through the frame. Place the upper bearing cone and flat washer on the front fork shaft. Thread the slotted hex nut onto the fork shaft but do not fully tighten.

5. Set the fork bearings by tightening the slotted hex nut from **10 to 13 N·m (8 to 10 ft-lb)** while rotating the front fork by hand. Then, loosen the nut until the fork has end play.
6. Next, tighten the slotted hex nut from **25 to 29 N·m (18 to 22 ft-lb)** while rotating the fork by hand. After final tightening, make sure that the fork does not have any end play and it rotates without binding.
7. Secure the slotted hex nut with a new cotter pin.

   Note: If the hole in the fork shaft does not line up with a slot in the slotted nut, tighten the nut enough to expose the hole in the shaft.
8. Install the front wheel; refer to Installing the Front Wheel (page 7–4).
9. Install the hose guide.
10. Install the steering gear box; refer to Installing the Steering Gear Box (page 7–15).
11. Check steering operation before returning the machine to service.

Removing the Front Fork (Model 08745)

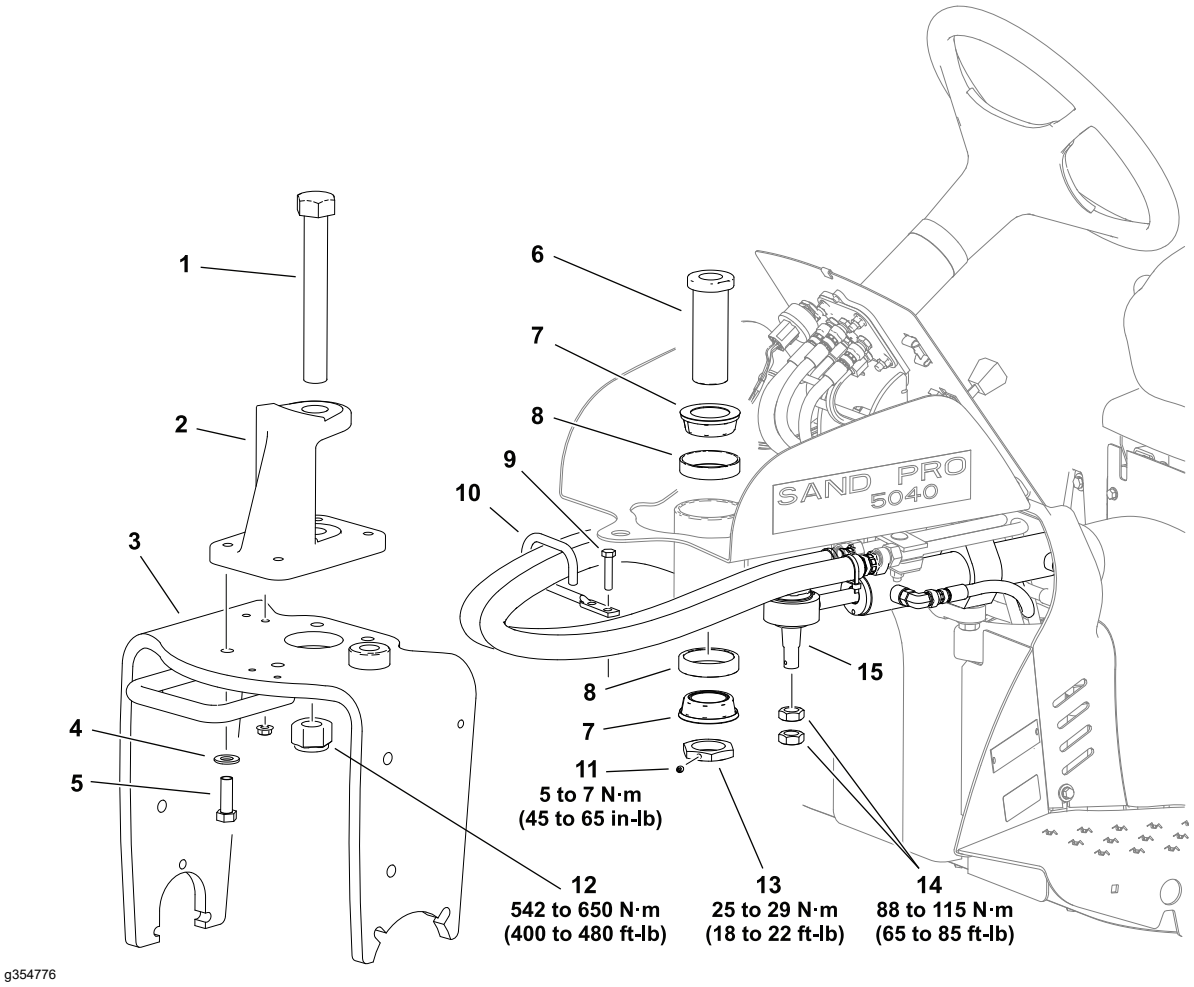


Figure 99
(model 08745)

1. Cap screw
2. Steering pivot
3. Front fork
4. Flat washer (4 each)
5. Cap screw (4 each)
6. Steering sleeve
7. Bearing cone (2 each)
8. Bearing cup (2 each)
9. Cap screw (2 each)
10. Hose guide
11. Set screw
12. Lock nut
13. Steering nut
14. Jam nut (2 each)
15. Steering cylinder ball joint

1. Remove the fuel tank; refer to Removing and Installing the Fuel Tank (page 4–12).
2. Remove the front wheel; refer to Removing the Front Wheel (page 7–3).
3. Remove the hose guide from the front fork. Carefully position the hydraulic hoses away from the fork.
4. Remove the 2 jam nuts securing the steering cylinder ball joint to the front fork. Use a suitable tool (pickle fork) to separate the ball joint from the front fork.
5. Support the front fork to prevent it from falling.
6. Remove the 4 cap screws that secure the front fork to the steering pivot and remove the fork from the machine.
7. If necessary, remove the steering pivot components from the machine:
   A. Remove the lock nut and cap screw that retains the steering pivot and slide the steering pivot from the machine.

Removing the Front Fork (Model 08745) (continued)

B. Loosen the set screw in the steering nut.

C. Remove the steering nut and the lower bearing cone.

D. Remove the steering sleeve and the upper bearing cone.

E. Clean and inspect the bearing cups and cones for wear or damage and replace the bearings if necessary.

Installing the Front Fork (Model 08745)

Refer to Figure 99 for this procedure.

1. If removed, install the bearings, steering sleeve, and steering pivot:
   A. If the bearing cups were removed from the frame, press new bearing cups into the frame making sure that they fully contact the shoulder in the frame.
   B. Pack the bearing cones with Mobilgrease XHP high temperature grease (or equivalent).
   C. Install the upper bearing cone and slide the steering sleeve down through the upper bearing and frame.
   D. Install the lower bearing cone.

   E. Install the steering nut and tighten from **25 to 29 N·m (18 to 22 ft-lb)**.
   F. Tighten the set screw in the steering nut from **5 to 7 N·m (45 to 65 in-lb)**.
   G. Position the steering pivot over the steering sleeve and install the large cap screw.
   H. Install the lock nut and tighten from **542 to 650 N·m (400 to 480 ft-lb)**.
2. Fit the front fork to the steering pivot and install the 4 previously removed fasteners.
3. Thoroughly clean the ball joint taper and the boss in the front fork.

4. Secure the steering cylinder ball joint to the front fork with 2 jam nuts.
   A. Install the first jam nut and tighten from **88 to 115 N·m (65 to 85 ft-lb)**.
   B. While retaining the first jam nut with a wrench, install the second jam nut and tighten from **88 to 115 N·m (65 to 85 ft-lb)**.
5. Install the front wheel; refer to Installing the Front Wheel (page 7–4).
6. Install the hose guide.
7. Install the fuel tank; refer to Removing and Installing the Fuel Tank (page 4–12).
8. Check steering operation before returning the machine to service.

Hitch Assembly

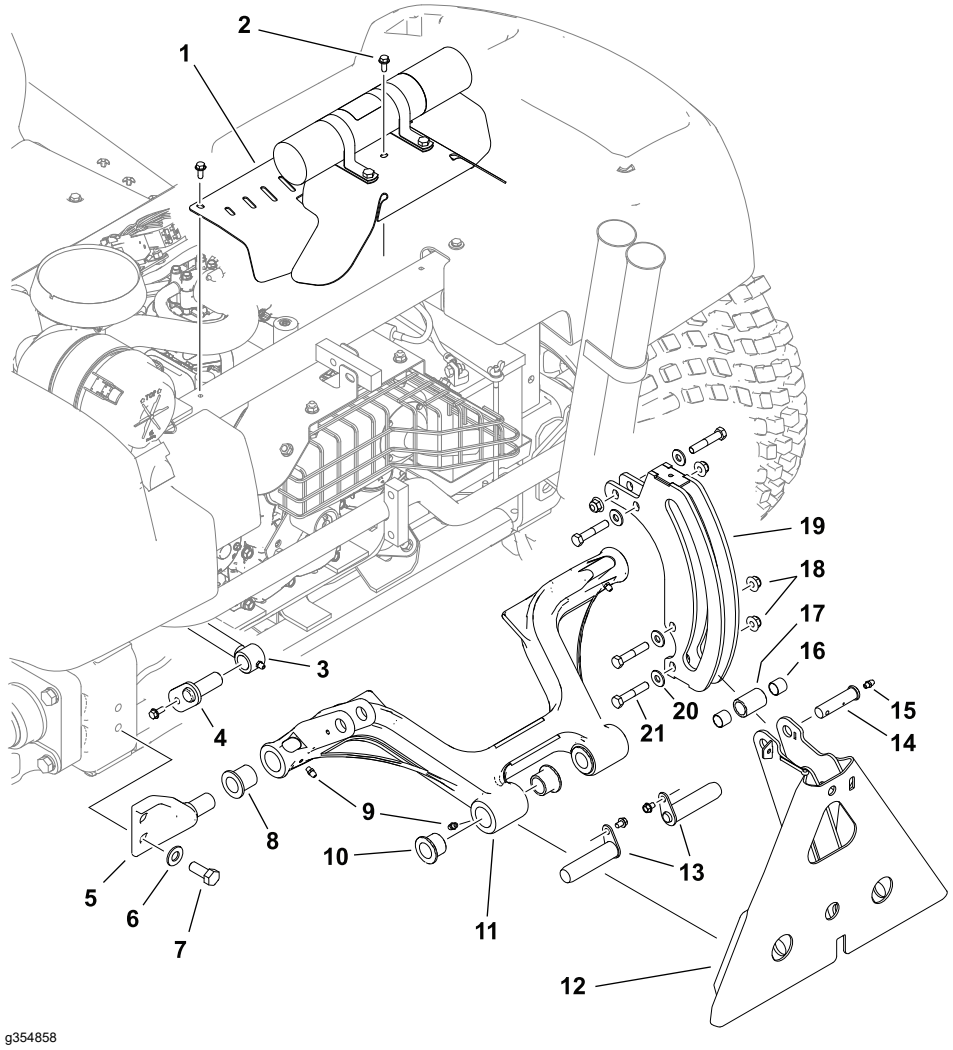


Figure 100
(shown with rear left wheel removed)

1. Rear cover and manual tube assembly
2. cap screw (3 each)
3. Lift cylinder
4. Pivot pin
5. Pivot hub (2 each)
6. Flat washer (4 each)
7. Cap screw (4 each)
8. Flange bushing (2 each)
9. Grease fitting (4 each)
10. Flange bushing (4 each)
11. Hitch
12. Hitch adapter
13. Pivot pin (2 each)
14. Clevis pin
15. Grease fitting
16. Bushing (2 each)
17. Roller tube
18. Flange nut (4 each)
19. Roller plate
20. Flat washer (4 each)
21. Cap screw (4 each)

Removing and Installing the Hitch Assembly

Refer to Figure 100 for this procedure.

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Remove any rear mounted attachments.

3. Remove the rear cover and manual tube assembly.
4. Remove the hitch adapter from the machine:
   A. Support the hitch adapter to prevent it from falling during removal.
   B. Remove the 2 lower hitch adapter pivot pins.
   C. Remove and discard the cotter pin from the clevis pin at the top of the hitch adapter.
   D. Remove the clevis pin, hitch adapter, and roller tube from the machine.
   E. Inspect the roller tube bushings for wear or damage and replace if necessary.
5. If the hitch is being removed from the machine:
   A. Remove the lift cylinder pivot pin.
   B. Remove the hitch pivot hubs.
   C. Remove the hitch from the machine.
6. Remove any remaining hitch assembly components from machine as needed.
7. Inspect the hitch flange bushings for wear or damage and replace if necessary.
8. Install all previously removed hitch assembly components. Use a new cotter pin when installing the hitch adapter.
9. Lubricate the hitch assembly grease fittings with Mobilgrease XHP high temperature grease (or equivalent).
10. Install any previously removed attachments and test the hitch operation before returning the machine to service.

Operator’s Console

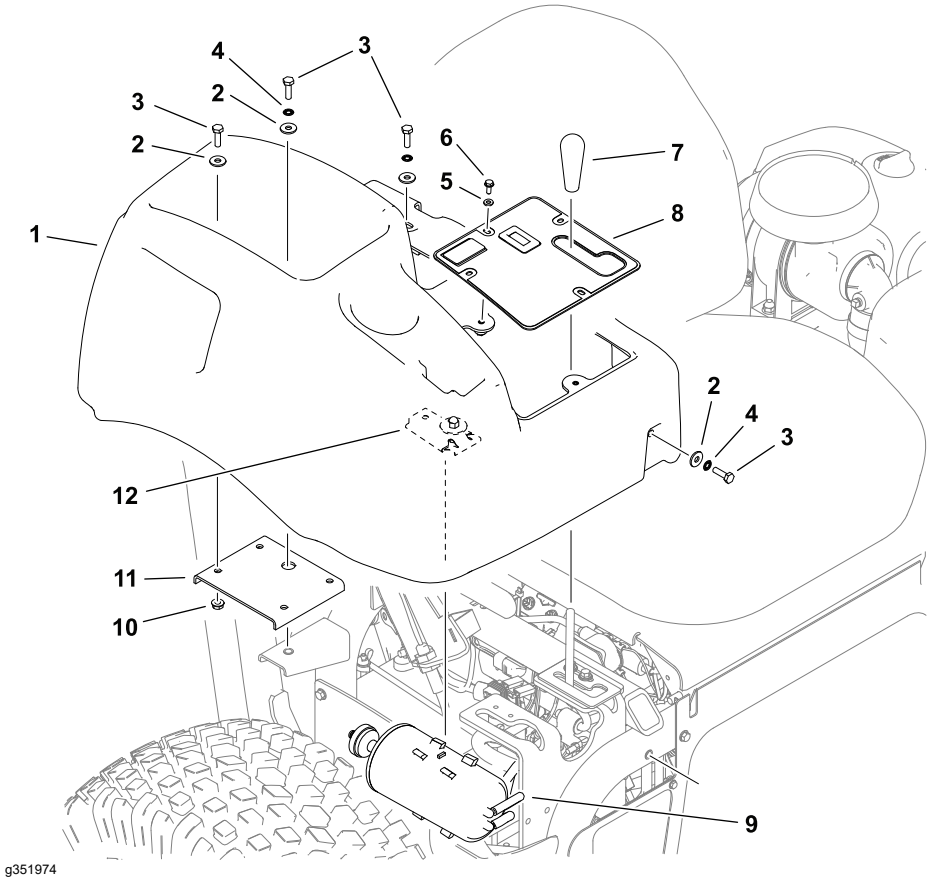


Figure 101

1. Operator’s console
2. Flat washer (7 each)
3. Cap screw (7 each)
4. Lock washer (3 each)
5. Flat washer (4 each)
6. Cap screw (4 each)
7. Knob
8. Dash panel assembly
9. Carbon canister
10. Lock nut (4 each)
11. Console support plate
12. Carbon canister bracket

Removing and Installing the Operator’s Console

Refer to Figure 101 for this procedure.

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Remove the knob(s) from the lift control valve lever(s).
3. Remove the fasteners securing the dash panel to the console. Raise the dash panel and disconnect the wire harness from the hour meter and the optional PTO switch, then remove the dash panel assembly from the machine.
4. Press the tang of the carbon canister bracket upward and slide the carbon canister forward and out of the bracket.
5. Remove the 3 cap screws, lock washers and flat washers that secure the console to the frame and remove the operator’s console from the machine.

   Note: The console support plate is fastened to the console.
6. Install the operator’s console in the reverse order.

Operator Seat

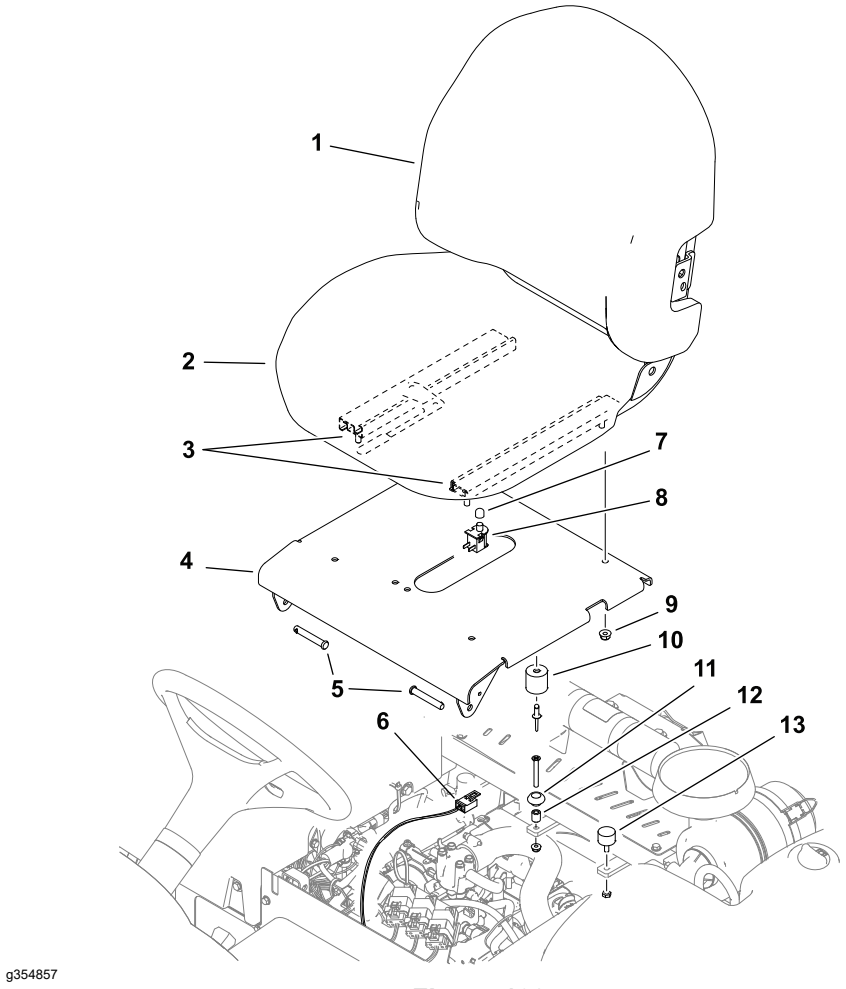


Figure 102

1. Seat back cover
2. Seat cushion cover
3. Track assembly
4. Seat base
5. Slic pin (2 each)
6. Wire harness connector
7. Switch actuator cap
8. Seat switch
9. Flange nut (4 each)
10. Receptacle – rubber
11. Centering post – rubber
12. Spacer
13. Bumper – rubber (2 each)

Removing and Installing the Operator Seat

1. Park the machine on a level surface, lower any attachments, engage the parking brake, set the key switch to the OFF position and remove the key from the switch.
2. Raise the seat and disconnect the electrical connector from the seat switch.
3. Inspect the rubber seat bumpers for wear or damage and replace them as necessary.
4. Remove and install the seat components as necessary.
5. Connect the wire harness to the seat switch and test the seat switch operation before returning the machine to service.

Appendix A

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

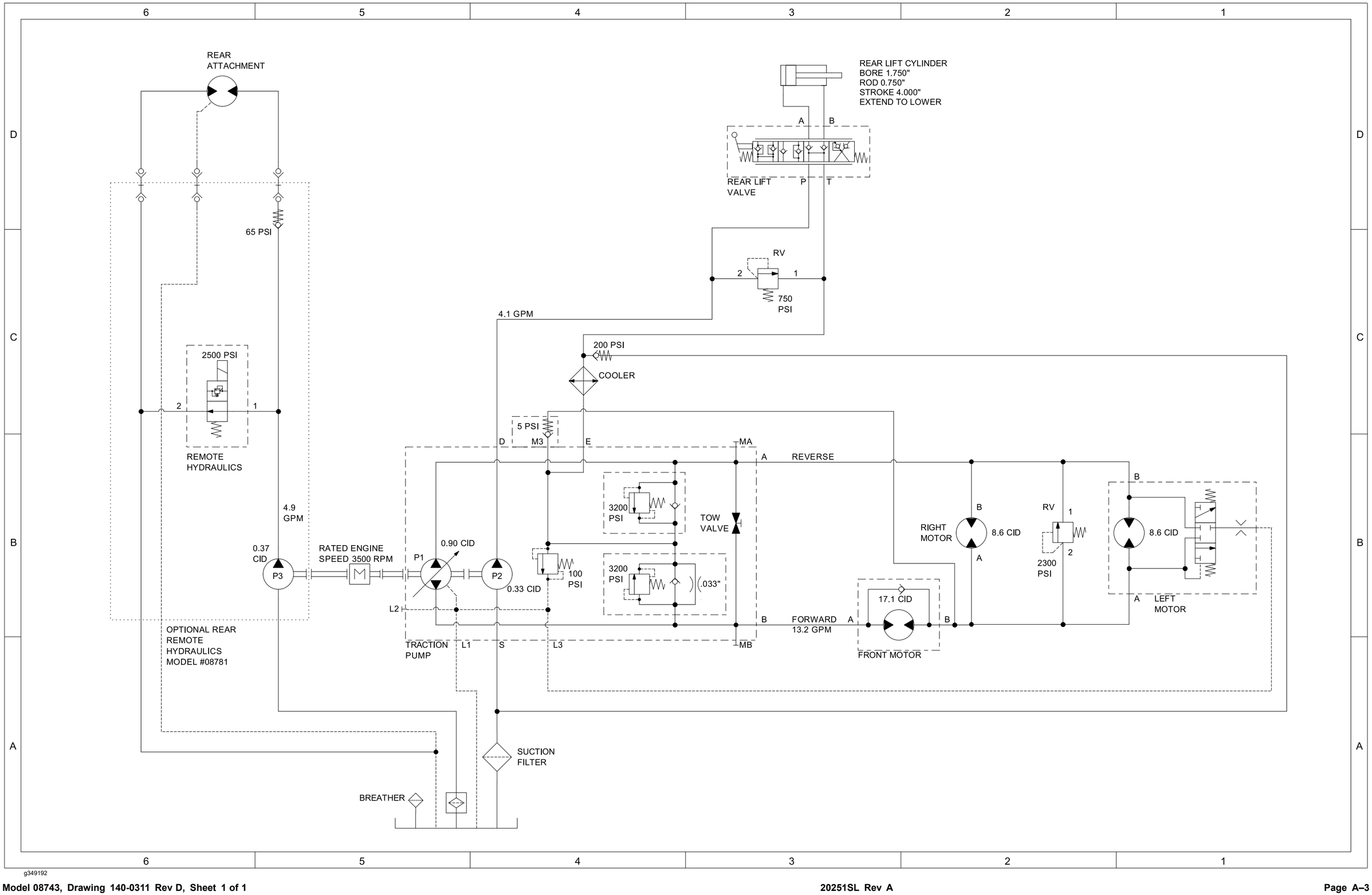
The individual wires of the electrical harness diagrams in this chapter identify both the wire color and the wire size.

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 – Sand Pro 3040



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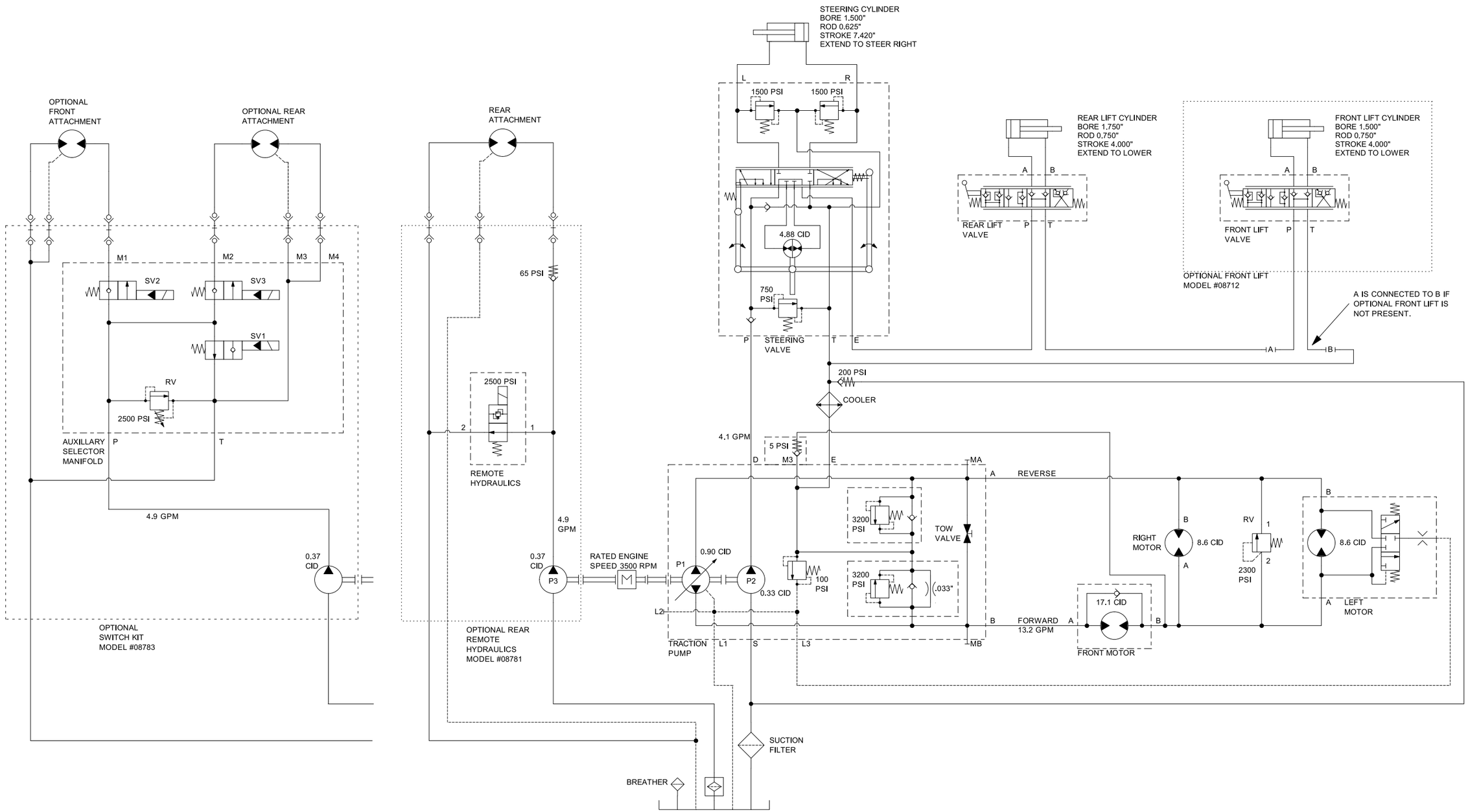
Hydraulic Schematic – Sand Pro 5040



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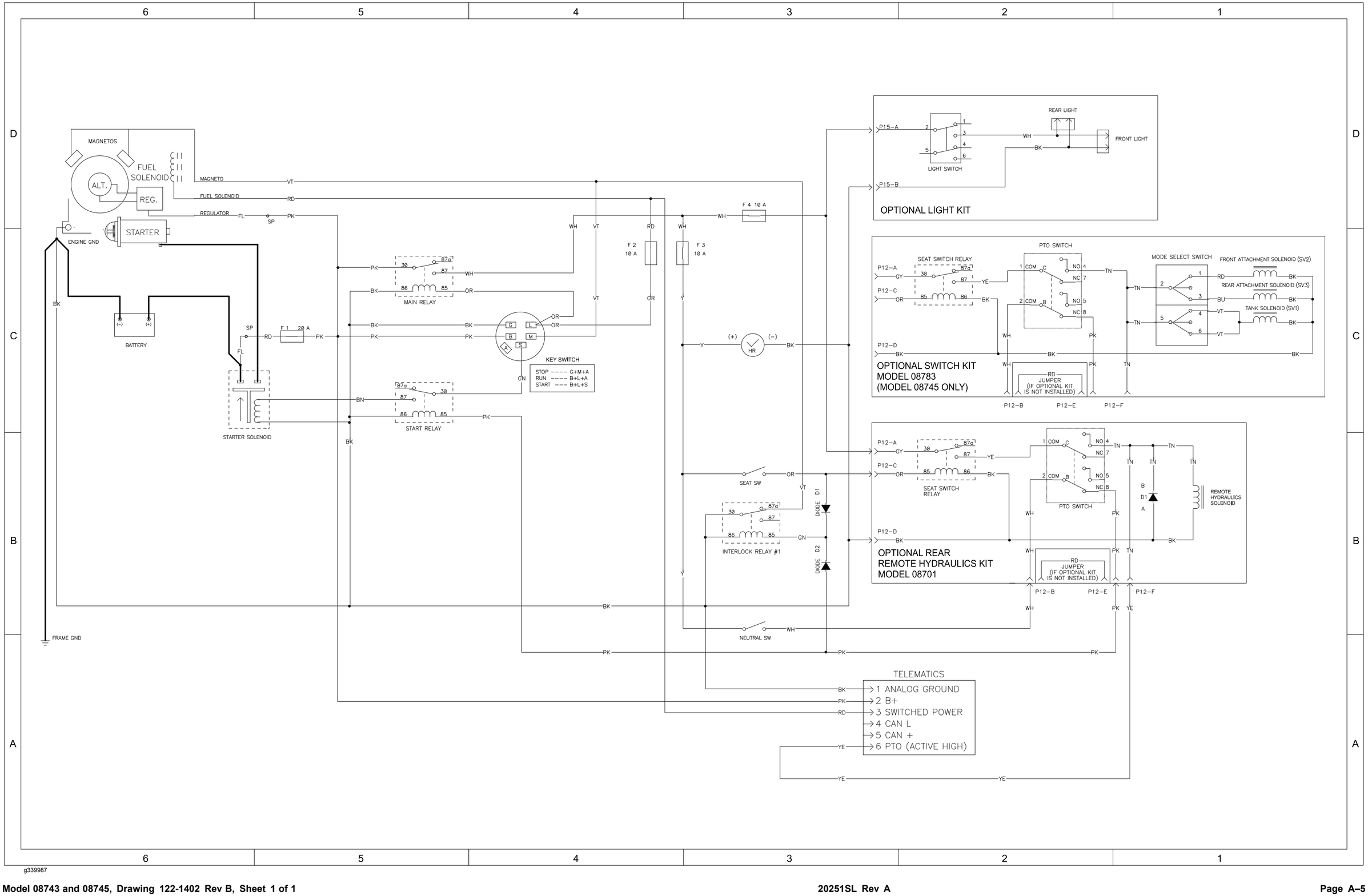
Electrical Schematic – Sand Pro 3040/5040



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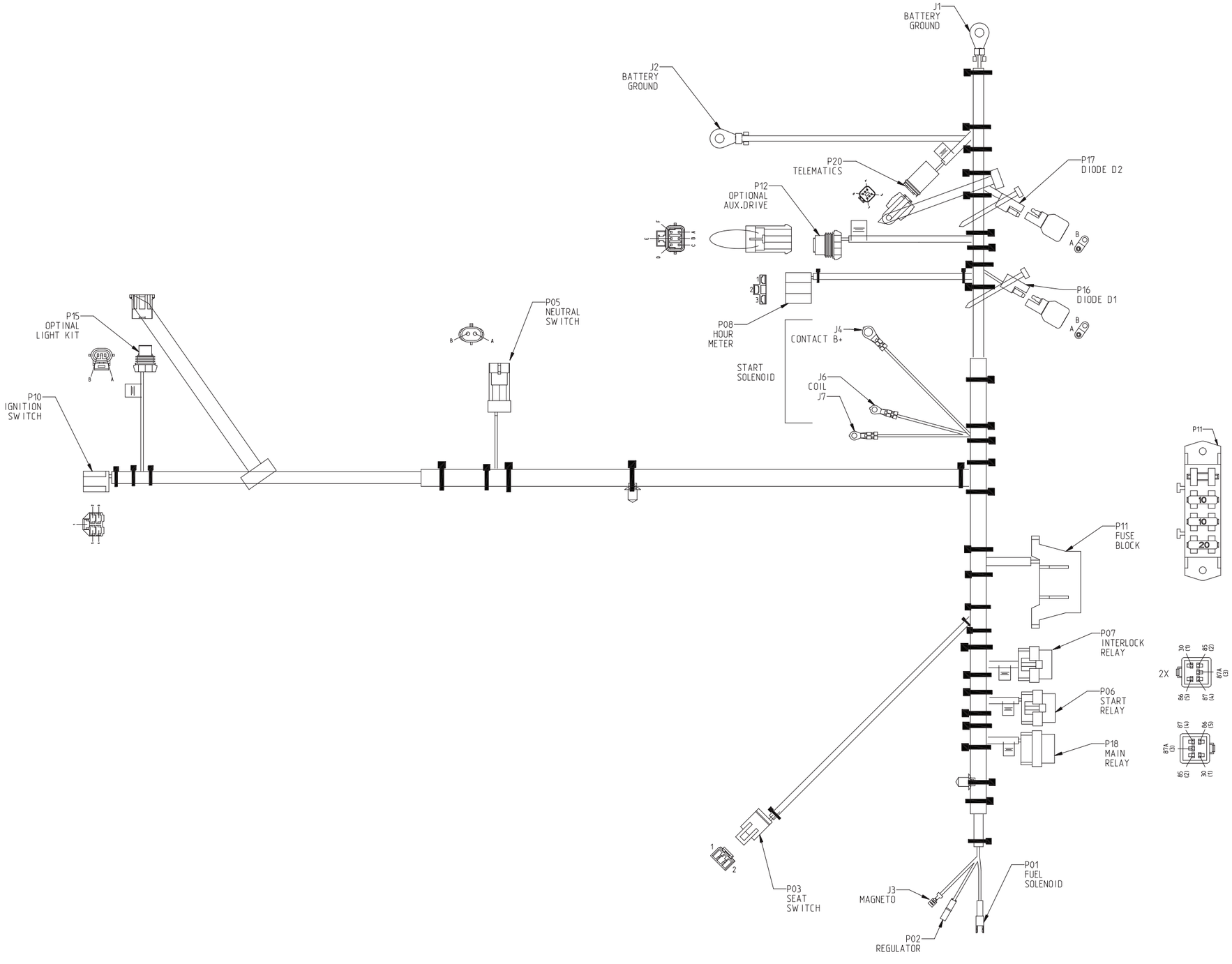
Wire Harness Drawing – Sand Pro 3040/5040



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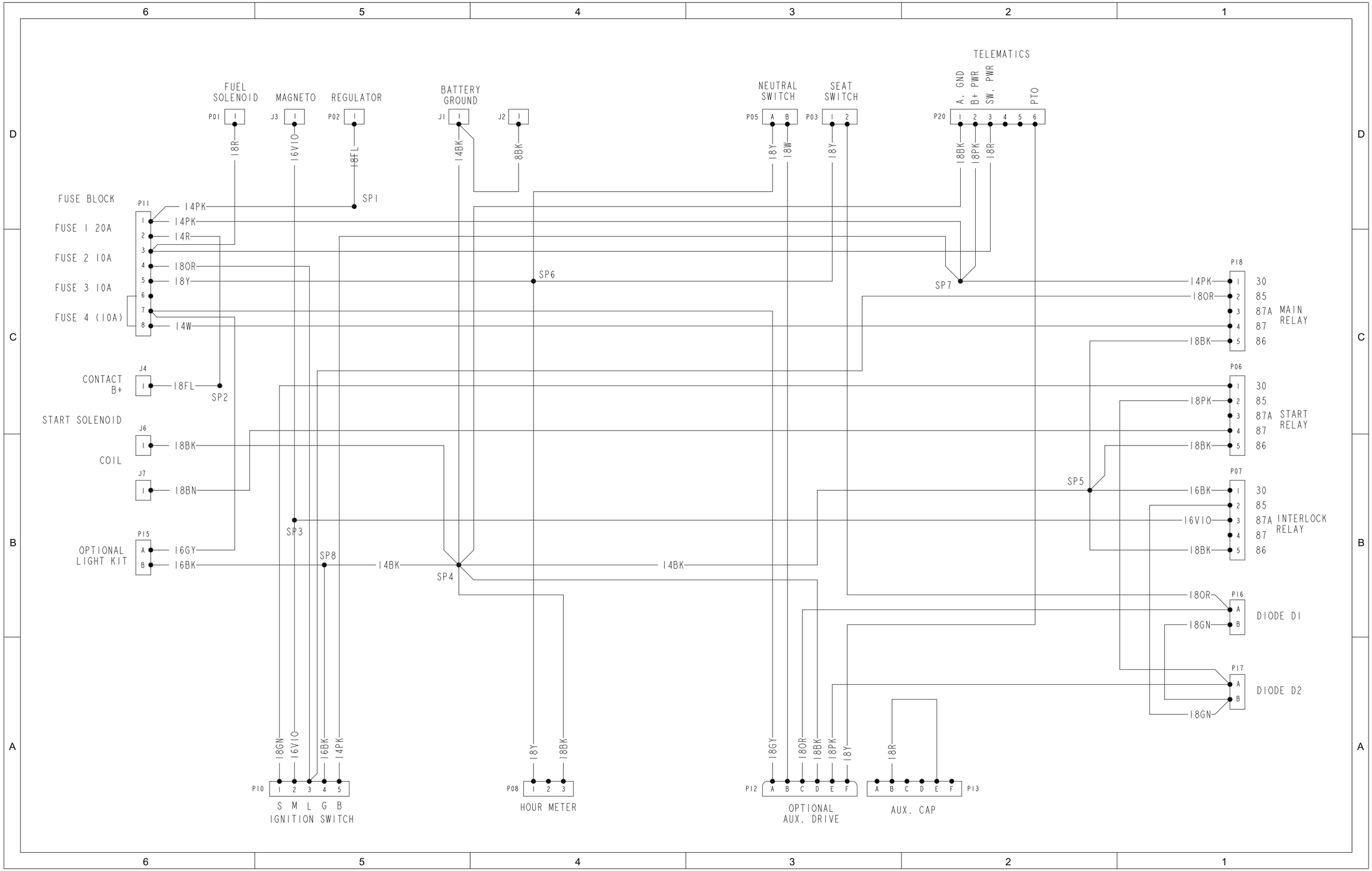
Wire Harness Diagram – Sand Pro 3040/5040



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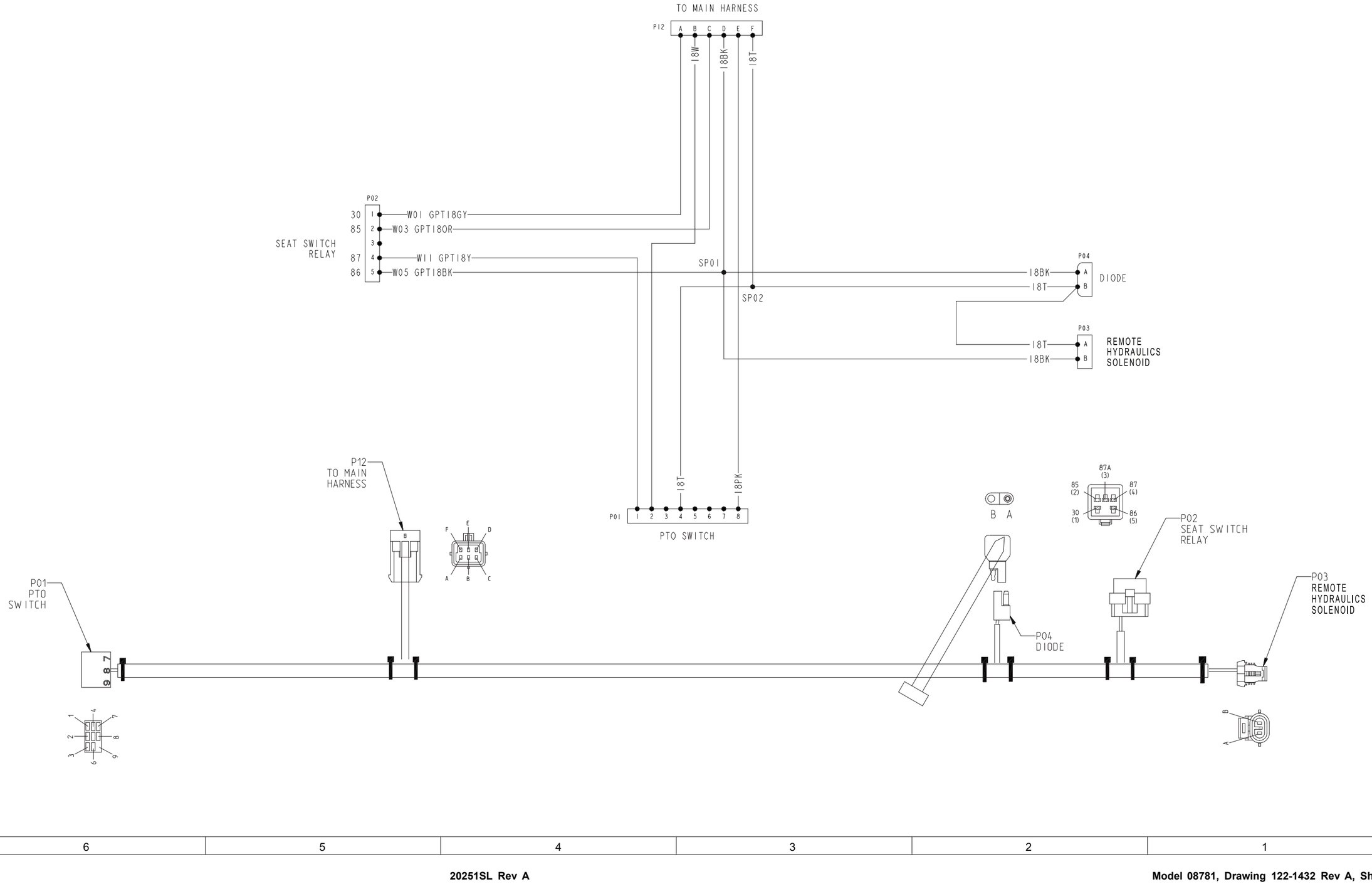
Wire Harness – Rear Remote Hydraulics (Optional)



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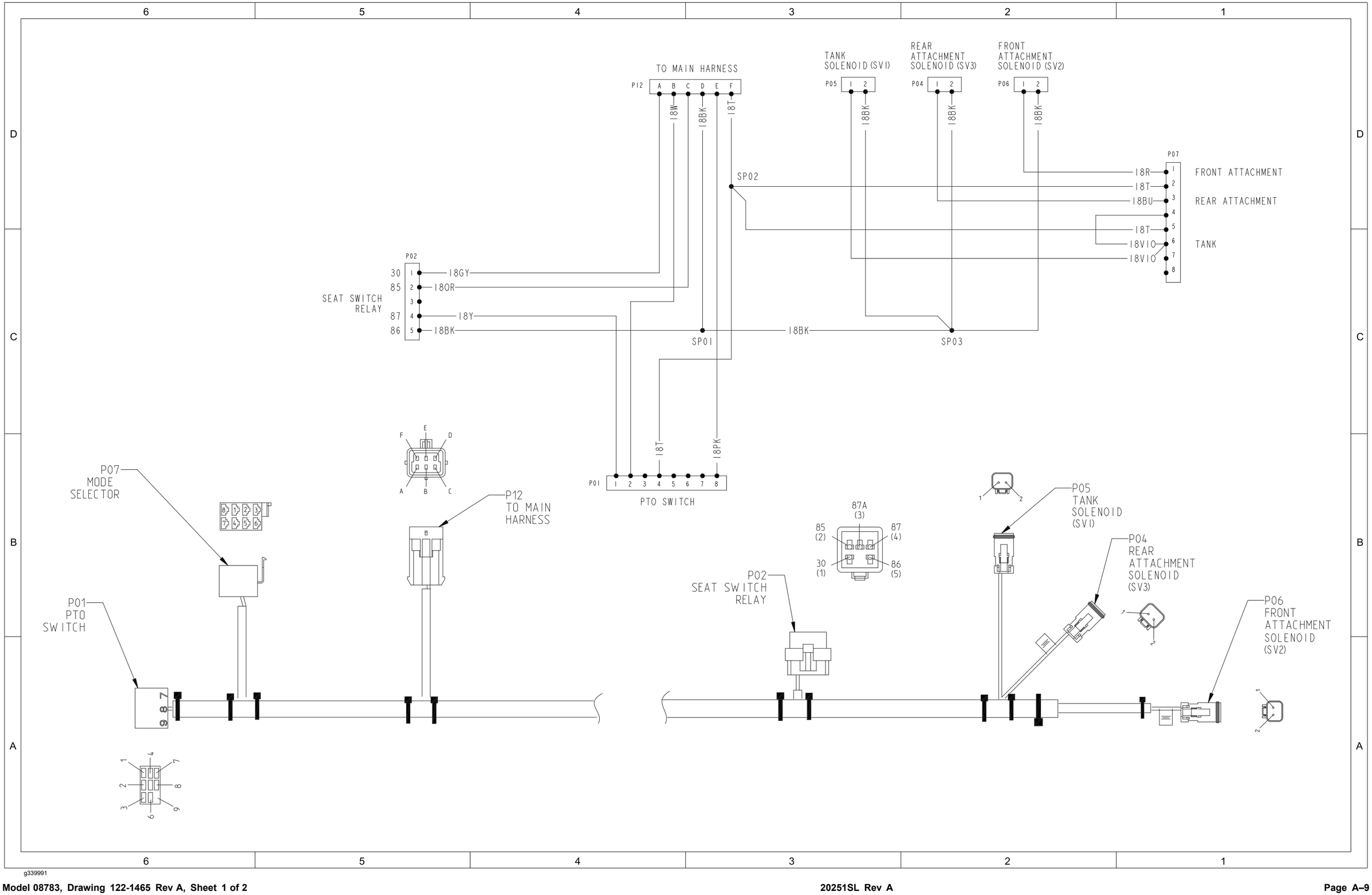
Wire Harness – Switch Kit (Optional)



Count on it.